INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.1930

(04/2002)

SERIES Q: SWITCHING AND SIGNALLING

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

BICC access network protocol

ITU-T Recommendation Q.1930

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ITU-T Recommendation Q.1930

BICC access network protocol

Summary

This Recommendation describes the protocol for access networks that support Bearer Independent Call Control (BICC). It describes the signalling for BICC access networks serving analogue loops and trunks, ISDN BRA and PRA, and B-ISDN DSS2.

Three separate signalling associations are included in the BICC access network protocol. They are call control, access network control, and remote media control.

Source

ITU-T Recommendation Q.1930 was prepared by ITU-T Study Group 11 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 April 2002.

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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CONTENTS

ITU-T Recommendation Q.1930

BICC access network protocol

1 Scope

This Recommendation describes the protocol for access networks that support Bearer Independent Call Control (BICC). It defines the access network protocol in terms of formats, codes, and procedures.

The protocol defined by this Recommendation is to be used between "Access Concentration Nodes" and "Interface Serving Nodes" or "Interface Mediation Nodes". This protocol is called the BICC Access Network protocol. It includes three signalling associations:

– Call Control;

– Access Network Control;

– Remote Media Control.

Other protocols, not specified by this Recommendation, are used between Access Concentration Nodes and Serving Nodes for the control of bearers. Other protocols, also not specified in this Recommendation, are used between bearer control functions and other access network functions across the vertical associations.

The scope of this Recommendation is illustrated by the highlighted oval in Figure 1.

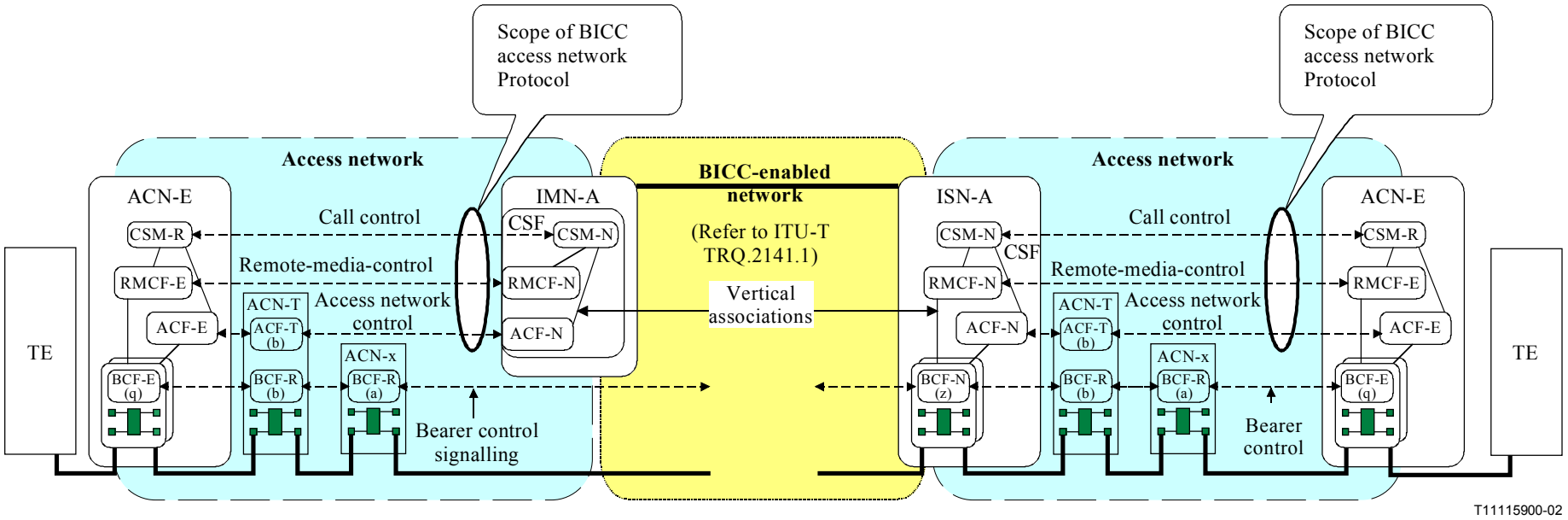


Figure 1/Q.1930 – Scope of this Recommendation – The BICC Access Network Protocol

2 References

The following ITU-T Recommendations and other references contain provision, 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.

NOTE – The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation

[1] ITU-T Recommendation G.964 (2001), *V-Interfaces at the digital local exchange (LE) – V5.1 Interface (based on 2048 kbit/s) for the support of access network (AN)*.

[2] ITU-T Recommendation G.965 (2001), *V-Interfaces at the digital local exchange (LE) – V5.2 interface (based on 2048 kbit/s) for the support of access network (AN)*.

[3] ITU-T Recommendation H.248.1 (2002), *Gateway control protocol: Version 1*.

[4] ITU-T H-series Recommendations – Supplement 2 (2002), *H.248.x sub-series packages guide-Release 2*.

[5] ITU-T Recommendation H.248.2 (2000), *Gateway control protocol: Facsimile, text conversation and call discrimination packages*.

[6] ITU-T Recommendation H.248.3 (2000), *Gateway control protocol: User interface elements and action packages*.

[7] ITU-T Recommendation H.248.6 (2000), *Gateway control protocol: Dynamic tone definition package*.

[8] ITU-T Recommendation H.248.7 (2000), *Gateway control protocol: Generic announcement package*.

[9] ITU-T Recommendation H.248.8 (2000), *Gateway control protocol: Error codes and service change reason description*.

[10] ITU-T Recommendation H.248.10 (2001), *Gateway control protocol: Media gateway resource congestion handling package*.

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

[12] ITU-T Recommendation Q.921 (1997), *ISDN user-network interface – Data link layer specification*.

[13] ITU-T Recommendation Q.931 (1998), *ISDN user-network interface layer 3 specification for basic call control*.

[14] ITU-T Recommendation Q.2931 (1995), *Digital Subscriber Signalling System No. 2 – User-Network Interface (UNI) layer 3 specification for basic call/connection control*.

[15] ITU-T Recommendation Q.1901 (2000), *Bearer Independent Call Control protocol*.

[16] ITU-T Recommendation Q.1902.1 (2001), *Bearer Independent Call Control protocol (Capability Set 2): Functional description*.

[17] ITU-T Recommendation Q.1902.2 (2001), *Bearer Independent Call Control protocol (Capability Set 2) and Signalling System No. 7 ISDN user part: General functions of messages and parameters*.

[18] ITU-T Recommendation Q.1902.3 (2001), *Bearer Independent Call Control protocol (Capability Set 2) and Signalling System No. 7 ISDN user part: Formats and codes*.

[19] ITU-T Recommendation Q.1902.4 (2001), *Bearer Independent Call Control protocol (Capability Set 2): Basic call procedures*.

[20] ITU-T Recommendation Q.1902.5 (2001), *Bearer Independent Call Control protocol (Capability Set 2): Exceptions to the Application transport mechanism in the context of BICC*.

[21] ITU-T Recommendation Q.1902.6 (2001), *Bearer Independent Call Control protocol (Capability Set 2): Generic signalling procedures for the support of the ISDN user part supplementary services and for bearer redirection*.

[22] ITU-T Recommendation Q.1912.1 (2001), *Interworking between Signalling System No. 7 ISDN user part and the Bearer Independent Call Control protocol*.

[23] ITU-T Recommendation Q.1912.2 (2001), *Interworking between selected signalling systems (PSTN access, DSS1, C5, R1, R2, TUP) and the Bearer Independent Call Control protocol*.

[24] ITU-T Recommendation Q.1912.3 (2001), *Interworking between H.323 and the Bearer Independent Call Control protocol*.

[25] ITU-T Recommendation Q.1912.4 (2001), *Interworking between Digital Subscriber Signalling System No. 2 and the Bearer Independent Call Control protocol*.

[26] ITU-T Recommendation Q.1922.2 (2001), *Interaction between the Intelligent Network Application protocol Capability Set 2 and the Bearer Independent Call Control protocol*.

[27] ITU-T Recommendation Q.1950 (2001), *Bearer independent call bearer control protocol*.

[28] ITU-T Recommendation Q.1970 (2001), *BICC IP Bearer control protocol*.

[29] ITU-T Recommendation Q.1990 (2001), *BICC Bearer Control Tunnelling Protocol*.

[30] ITU-T Recommendation Q.2150.0 (2001), *Generic signalling transport service*.

[31] ITU-T Recommendation Q.2150.1 (2001), *AAL type 2 signalling transport converter on MTP3 and MTP3b*.

[32] ITU-T Recommendation Q.2150.2 (2001), *Signalling transport converter on SSCOP and SSCOPMCE*.

3 Definitions

This Recommendation defines the following terms:

3.1 Definitions of signalling associations

The following signalling associations are applied in the reference model.

3.1.1 Call Control Signalling Association (CSM to CSM): Is used to establish, modify, and release calls and services associated with those calls between the ACN-E and the ISN/IMN-A.

3.1.2 Access network control Signalling Association (ACF-E to ACF-N): Is used to insert, modify, and release bearer associations between the ACN-E and the ISN/IMN-A.

3.1.3 Remote Media Control Signalling Association (RMCF-E to RMCF-N): Is used to insert, modify, and remove tones and signals at the user port in ACN-E, and to respond to events detected at the user port in ACN-E that are associated with these tones and signals.

3.1.4 Bearer Control Signalling Association (BCF to BCF): Is used to establish, modify, and release the actual bearer transport connection between BIWFs that is controlled through the BCF in ACN-E and a BCF elsewhere in the BICC network.

3.2 Functional model definitions

Definitions of the items contained in the composite functional model are as follows:

3.2.1 Access Concentration Node (ACN): A functional entity that provides the interface between access facilities, such as analogue loop or ISDN, and the BICC Access Network. This functional entity may contain one or more call state relay models (CSM-R), at least one access control function (ACF), at least one remote media control function (RMCF), and one or more interworking functions (BIWFs) that contain Bearer Control Functions (BCFs). The CSM-R, RMCF, and BIWF interact with the access facilities and with their peers in the BICC Access Network or BICC broadband backbone network. The ACF interacts with its peers in the BICC Access Network. ACNs interact with other ACNs, within their own BICC Access Network domain, as well as with terminal equipment and with ISN/IMNs in the BICC broadband backbone network. Multiple bearer control relay functions BCF-Rs in an ACN's BIWF interact with the BCFs contained in other BIWF entities within the BICC access and BICC broadband backbone networks. The ACN-E is not bounded with respect to its physical location in this Recommendation. It may be located at the customer premises or within the access facilities operated by the network service provider.

3.2.2 Access Control Function (ACF): The ACF is a functional entity which provides a neutral binding of multiple call control protocols to multiple bearer control protocols. It binds the access concentration node to the ISN/IMN across multiple bearer switching nodes. Three types of ACFs are used in the access network functional model: ACF-E, ACF-N, and ACF-T.

- The Access Control Edge Function (ACF-E) mediates between call control and bearer control to provide the requested resources for the call. It interacts with the ACF-N in ISN/IMN-A to obtain the appropriate access network resources under the control of ISN/IMN-A.
- The Access Control Nodal Function (ACF-N) mediates between call control and bearer control to provide the requested resources for the call. It interacts with the ACF-E in ACN-E and ACF-T to assign appropriate access network resources for the call.
- The Access Control Transit Function (ACF-T) allows the ISN/IMN to manage two different types of bearers across the access network. It interacts with the ACF-N in ISN/IMN-A to obtain the appropriate access network resources under the control of ISN/IMN-A. For example, ISN/IMN-A may designate an AAL 2 bearer between ACN-E and ACN-T, while it designates an IP bearer between ACN-T and a distant BIWF.

3.2.3 Backbone Network Connection (BNC): Represents the edge-to-edge transport connection within the backbone network.

3.2.4 Bearer Control Function (BCF): Three types of BCFs are illustrated in the access network functional model: BCF-E, BCF-R and BCF-N.

- The Bearer Control Edge Function (BCF-E) provides the control of the bearer switching function and relays the bearer control signalling requests to next BCF in order to complete the edge-to-edge backbone network connection.
- The Bearer Control Relay Function (BCF-R) provides the control of the bearer switching function and relays the bearer control signalling requests to next BCF in order to complete the edge-to-edge backbone network connection

– The Bearer Control Nodal Function (BCF-N) provides the control of the bearer switching function, the communication capability with its associated call service function (CSF), and the signalling capability necessary to establish and release the backbone network connection to its peer (BCF-N).

3.2.5 Bearer Inter-Working Function (BIWF): A functional entity that provides bearer control and media mapping/switching functions within the scope of a Serving Node (ISN/IMN) or Access Concentration Node (ACN). A BIWF contains one Bearer Control Nodal Function (BCF-N), or one Bearer Control Edge Function (BCF-E) and one or more MCFs and MMSFs, and is functionally equivalent to a Media Gateway that incorporates bearer control. See General Requirements documents for the definitions for MCF and MMSF.

3.2.6 Call Service Function (CSF): The CSF provides the service control nodal actions associated with the access service by inter-working with access call control signalling and Bearer Independent Call Control (BICC) signalling. It signals to its peer (CSF) in the BICC network, or an ACN-E in the BICC Access Network, the characteristics of the call. It invokes, using the Call State Model (CSM), the Access Control Nodal Functions (ACF-N) and Remote Media Control Nodal Functions (RMCF-N) necessary to transport the call control signalling across the BICC broadband access network. It also invokes the Bearer Control Nodal Functions (BCF-N) necessary to transport the narrowband bearer service across the BICC broadband access network. (BCF interaction is not applicable to the IMN configuration).

3.2.7 Call State Model (CSM): Note that two types of CSMs are illustrated in the above functional model, CSM-N, CSM-R.

– The Call State Model (CSM-N) provides the service control nodal actions associated with the access service by inter-working with access call control signalling and Bearer Independent Call Control (BICC) signalling. It signals to its peer (CSM-N) the characteristics of the call, and invokes the Access Control Nodal Functions (ACF-N) and Remote Media Control Nodal Functions (RMCF-N) necessary to transport the call control signalling across the broadband backbone network. It also invokes the Bearer Control Nodal Functions (BCF-N) necessary to transport the narrowband bearer service across the broadband backbone network.

– The Call State Relay Model (CSM-R) provides the service transit actions necessary to establish and maintain a backbone network call and its associated bearer by relaying signalling between CSM-N and the terminal equipment.

3.2.8 Interface Mediation Node: (IMN): A functional entity that provides the interface with the access network. This functional entity contains one or more call service nodal functions (CSF-N), the access control nodal function (ACF-N) and the remote media control nodal function (RMCF-N). The IMN has no direct control of an own bearer inter-working function (BIWF) but controls remotely the BIWF in the access network via the RMCF-N and the ACF-N. The BIWF in the access network directly interacts with its peers within the broadband backbone network.

3.2.9 Interface Serving Node (ISN): A functional entity that provides the interface with ISDN, access, and broadband backbone networks. This functional entity contains one or more call service nodal functions (CSF-N), and one or more inter-working functions (BIWF) which interact with the ISDN network and its peers within the BICC access and BICC broadband backbone networks. The ISN also includes the access control nodal function (ACF-N) and the remote media control nodal function (RMCF-N).

3.2.10 Message Multiplex Function: The function that operates at the call control signalling layer to multiplex and demultiplex the separate information flows used for control of the access network.

3.2.11 Remote Media Control Function (RMCF): The RMCF is a functional entity that originates and terminates media gateway control commands. It provides a horizontal linkage between the ISN/IMN and ACN-E for the purpose of conveying media gateway control information

between the CSM in the ISN/IMN and the port dedicated to the terminal on ACN-E. Two types of RMCFs are illustrated in the access network functional model: RMCF-E and RMCF-N.

- The Remote Media Control Edge Function (RMCF-E) conveys media control commands to and from the port dedicated to the terminal in ACN-E. It interacts with the RMCF-N in ISN/IMN-A to convey commands to and from the CSF in ISN/IMN-A.
- The Remote Media Control Nodal Function (RMCF-N) converts call control messages received from the CSM into media control commands. It interacts with the RMCF-E in ACN-E to convey media control commands to and from the port dedicated to the terminal. It also may interact with the BIWF in ISN-A to convey media control commands to and from the access termination in the BIWF.

3.2.12 Serving Node (SN): A generic term referring to ISN or IMN in this Recommendation.

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

3.3 Definition of Signalling Information Elements and Identifiers

The following signalling objects are used in the BICC access network procedures.

3.3.1 ACA-ID: The Access Control Association Identifier is an information object that is unique between two ACF signalling entities.

3.3.2 ACN Address: A unique identifier within the domain of all ACN/ISN/IMNs that references each ACN.

3.3.3 Action ID: Specifies the Access network control action to be performed.

3.3.4 Connection-ID: An indicator of the bearer resource being associated with the user at the "uni" side. The RMCF-E maps this value to the Logical Port Termination being monitored and controlled by the ISN/IMN.

3.3.5 Connection Group Identifier: An indication sent by the ISN/IMN to the BCF that uniquely identifies a group of bearer resources within the BICC network that are dedicated to a specific purpose, e.g. permanent facilities dedicated to a customer.

3.3.6 Destination Address: The address of the ACN-E, ACN-T, or ISN/IMN that is the termination of the information flow. A unique identifier within the domain of all ISN/IMNs and all ACNs that comprise the access network.

3.3.7 ISN/IMN Address: A unique identifier for each ISN/IMN in the BICC access and BICC broadband backbone network.

3.3.8 Logical Port-ID: An indication that designates the group of bearer terminations, and signalling associations contained within a user-network interface.

3.3.9 Requesting Address: The address of the ACN-E, ACN-T, or ISN/IMN that is the source of the information flow. A unique identifier within the domain of all ISN/IMNs and all ACNs that comprise the access network.

3.3.10 User ID: A unique identifier within the domain of all ACNs and all ISN/IMNs of the user of the signalling association.

3.4 General Definitions

3.4.1 B-channel: A 64 kbit/s bearer channel on the ISDN basic access or primary access.

3.4.2 D-channel: A signalling channel on the ISDN basic access or primary access.

3.4.3 permanent line (PL): A permanently established connection provided between two ISDN user network interfaces routed through the transmission network bypassing network nodes of the

switched digital network. The PL reduces the access capability at the user network interface for switched services.

3.4.4 Port Event: The event detected by the termination.

3.4.5 Port Operation: The command sent from the CSF to the RMCF-E to be executed on the termination.

3.4.6 Signalling Message: The out-band signalling message between the ISN/IMN and the CSM-R.

4 Abbreviations

This Recommendation uses the following abbreviations:

AAL	ATM Adaptation Layer
AC	Access Control
ACF	Access Control Function
ACF-E	Access Control Edge Function
ACF-N	Access Control Nodal Function
ACF-T	Access Control Transit Function
ACN-E	Access Concentration Edge Node
ACN-T	Access Concentration Transit Node
AN	Access Network
ani	Access network interface
APM	Application Transport Mechanism
ATM	Asynchronous Transfer Mode
BC	Bearer Control
BCF	Bearer Control Function
BCF-E	Bearer Control Edge Function
BCF-N	Bearer Control Nodal Function
BCF-R	Bearer Control Relay Function
BCU-ID	Bearer Control Unit Identifier
BICC	Bearer Independent Call Control
B-ISDN	Broadband Integrated Services Digital Network
BIWF	Bearer Interworking Function
BNC	Backbone Network Connection
BRA	ISDN Basic Rate Access
CBC	Call Bearer Control
CC	Call Control
CNAM	Calling Name Delivery
CND	Calling Number Delivery
CSF	Call Service Function

CSM	Call State Model
CSM-N	Call State Nodal Model
CSM-R	Call State Relay Model
DDD	Direct Distance Dial
DDI	Direct Dialling In
DSS1	Digital Subscriber System No. 1
DSS2	Digital Subscriber System No. 2
DTMF	Dual Tone Multi-Frequency
FCS	Frame Check Sequence
FE	Functional Entity
FSK	Frequency Shift Keyed
HDLC	High-level Data Link Control
IAM	Initial Address Message
ID	Identifier
IE	Information Element
IMN	Interface Mediation Node
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISN	Interface Serving Node
ITU-T	International Telecommnication Union – Telecommunication Standardization Sector
kbit/s	Kilobits per second
LAPD	Link Access Procedure on the D-channel
LAPV5	Link Access Procedure on the V5 Interface
LAPV5-EF	LAPV5 Enveloping Function sublayer
LSAS	Line Side Answer Supervision
LSB	Least Significant Bit
LSP	Label Switched Path
MF	Multi-Frequency
MG	Media Gateway
MPLS	Multiprotocol Label Switching
MSB	Most Significant Bit
MTP	Message Transfer Part
nni	Network-to-network interface
PABX	Private Automatic Branch eXchange
PCM	Pulse Code modulation
PL	Permanent Line

PRA	ISDN Primary Rate Access
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Connection
RMC	Remote Media Control
RMCF	Remote Media Control Function
RMCF-E	Remote Media Control Edge Function
RMCF-N	Remote Media Control Nodal Function
ROH	Receiver Off Hook
SAPI	Service Access Point Identifier
SCTP	Stream Control Transmission Protocol
SIT	Special Information Tone
SN	Serving Node
SSCF	Service Specific Coordination Function
SSCOP	Service Specific Connection Oriented Protocol
SSCOPMCE	Service Specific Connection Oriented Protocol in a Multi-link and Connectionless Environment
STC	Signalling Transport Converter
SVC	Switched Virtual Connection
SW	Switching Node (at the bearer)
TE	Terminal Equipment
TEI	Terminal Endpoint Identifier
UNI	User to network interface
V5	Access Network (AN) Interface at The Digital Local Exchange
VMWI	Visual Message Waiting Indicator
VPCI	Virtual Path Connection Identifier

5 Conventions

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

   Examples: Application Transport parameter, Setup message.

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

   Example: Layer 3 Address value 1100000 – *"reserved for national use"*.

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

   Example: The "Signal message" is a Signal message in the BICC access protocol, whereas a Signal message in ITU-T Rec. Q.1902.4 is referred to as an "BICC Signal message".

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

6 Architecture

6.1 Service Architecture

The BICC Access Network supports services provided over the following access types. It is however not intended by this Recommendation to restrict any implementation of ACNs, ISNs or IMNs supporting the full set or a subset of the services listed in this Recommendation.

6.1.1 Analogue Loop and Analogue Trunk

a) *Single customer*
   - with DTMF or line state signalling;
   - with or without supplementary services.

b) *PABXs*
   - with or without DDI;
   - with DTMF or line state signalling;
   - with or without supplementary services.

The protocol elements specified in this Recommendation can be combined in a flexible manner to support dedicated PSTN applications. Applications of data over voice are not described, however, they are not precluded in conjunction with the services described.

6.1.2 ISDN Basic Access

There is no restriction for teleservices or bearer services using B-channels as well as supplementary services for the ISDN access. Packet mode services through D-channel and Packet-data in B-channel are also supported.

Bit rates lower than 64 kbit/s are not supported directly. They are seen as user applications within a 64 kbit/s B-channel.

One or both B-channels may be used for the optional Permanent Line (PL) capability or semi-permanent leased line service. This service must be established with management procedures.

6.1.3 ISDN Primary Access

The full capability of primary access is supported.

6.1.4 B-ISDN DSS2 Access

The intention of this Recommendation is support of 64 kbit/s Circuit Mode Services in DSS2, however, there is no restriction on other capabilities in DSS2.

6.2 Architecture Discussion

This clause discusses architectural aspects of the functional entities in the BICC access network.

6.2.1 ACN-E Architecture

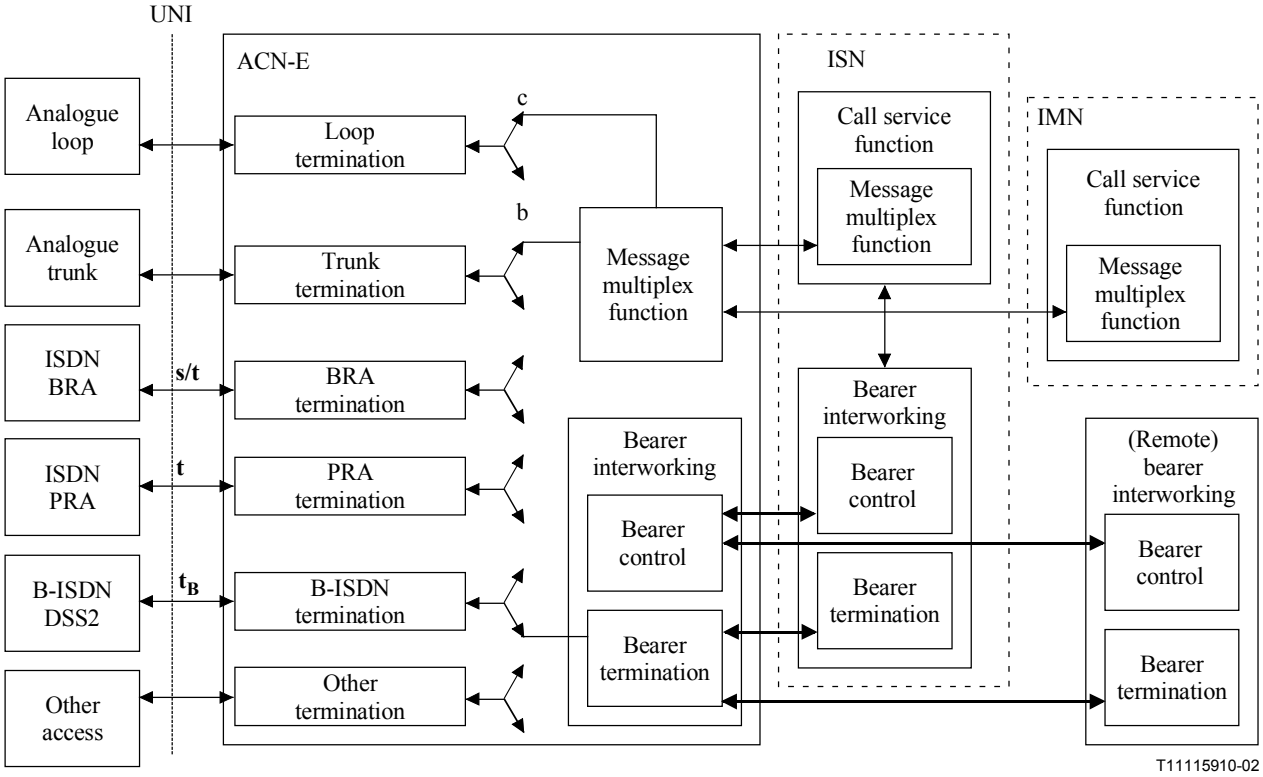
The services listed are present at the respective service terminations on the Access Concentration Edge Node (ACN-E) as illustrated in Figure 2. Control information received on the service termination is multiplexed when passed to the Message Multiplex Function for transport to either an ISN or an IMN. Bearer information received on the service termination is passed to the bearer termination on the ACN-E.

Control information received from the CSF at the Message Multiplex Function in ACN-E is passed to the appropriate service termination. Bearer information received at the bearer termination is distributed to the appropriate service termination.

The ACN-E relays call control information between the terminal and the ISN/IMN and may have no knowledge of the call state.

6.2.2 ISN/IMN Architecture

The Call Service Function in the ISN/IMN has responsibility for call control.



NOTE – The remote Bearer Interworking is outside of the BICC access network. The operation of bearer interworking and bearer control is outside the scope of this Recommendation.

c indicates the transfer of call control, media gateway control, and access network control to/from the Message Multiplex Function.
b indicates the transfer of bearer information to/from the bearer termination.

Figure 2/Q.1930 – BICC Access Network Service Architecture

6.3 Protocol Reference Model

The BICC Access Network protocol includes three signalling associations:

– Call Control;
– Access Network Control;
– Remote Media Control.

The information for call, media, and access is conveyed between the ACN-E and the Call State Entity in the Call Service Function. Generally, the ACN-E is not required to have knowledge of call state, because the call information is passed between the Call State Entity in the CSF and the terminal equipment. The ACN-E also does not initiate bearer establishment, which is invoked by the Call State Entity based on stimuli from call control signalling, or from media control signalling. The ACN-E applies signals and detects events related to media control based on requests from the Call State entity in the CSF.

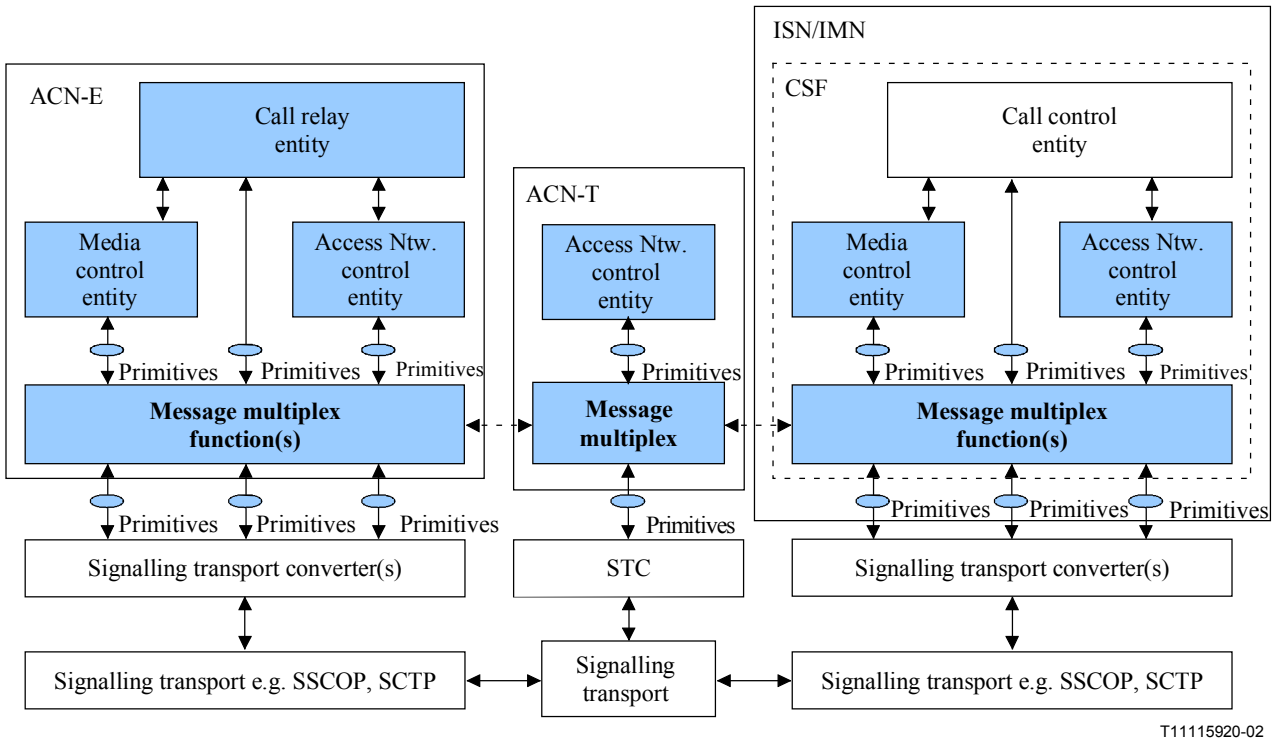


Figure 3/Q.1930 – BICC Access Network Protocol Reference Model

As shown in Figure 3, the Call Control Entity, the RMCF entity, and the ACF entity add the Protocol Type identifier (e.g. call control, remote media control, access network control, and other information) before sending the application data to the Message Multiplex Function. The protocol identifier, described later, signifies the functional entity to which the protocol-specific packet is addressed in the ACN-E, ACN-T, or in the CSF: Call Control Relay, Access network control, Remote Media Control, or Management (which is outside the scope of this Recommendation).

The Access Network Message Multiplex Function in the BICC access network performs multiplexing and message distribution. A given protocol-specific packet may be addressed to any ACN and any ISN/IMNs in the access network.

As shown in Figure 3, the Access Network Message Multiplex Function performs the following functions:

– It adds the Destination and Requesting Address to permit routing of the access network message from multiple ACN-Es to multiple ISN/IMNs, and vice versa. It may also use ACN-T addresses.

– It adds the pointer, which locates the start of the next common header in the stream of messages.

As shown in Figure 3, the Access Network Message Multiplex Function performs the following distribution function:

– It distributes information received from the signalling transport converter to the protocol entities including call control, access network control, and remote media control. These protocol entities are described elsewhere in the BICC Access Network Protocol except for the call control in the ISN/IMN which is described in other Recommendations or protocols, e.g. ITU-T Recs Q.931 and Q.2931, and national PSTN protocols.

6.4 Recommendation structure

This Recommendation describes procedures that are generally relevant to the BICC access network protocol, independent of the bearer technology employed. It first describes the signalling protocol stacks and the format of the multiplex structure for the signalling messages. It then describes the formats, codes, and procedures used for the three BICC access network signalling associations. The operation of each signalling association is described in a separate clause. Interaction between the BICC access network signalling associations is noted in the text. Additionally, interaction with the BICC protocol described in ITU-T Rec. Q.1902-series is also noted in the text.

7 Signalling Identifiers used in the BICC Access Network

Table 1 lists the identifiers that are used for BICC Access Network signalling. Note that many parameters used for the action identifier are derived from ITU-T Rec. Q.765.5 and conveyed across the BICC Access Network. Specific parameters added for the operation of the BICC access network protocol are described in more detail later in this Recommendation.

Table 1/Q.1930 – Identifiers used in the BICC Access Network

Identifiers Used by Protocol-Specific Entities
User Identifier
Logical Port identifier
Access Control Association ID
Connection Identifier
Action Identifier (multiple parameters)
Identifiers used by Message Multiplex
Requesting Address
Destination Address

7.1 Description of Signalling Identifiers

User ID: A unique identifier, within the domain of all ACNs and all ISN/IMNs attached to the access network, of the user of the signalling association.

Connection-ID: An indication of the connection being associated with the user of the user-network interface of of the ACN-E. The RMCF-E maps this value to the Logical Port Termination being monitored and controlled by the ISN/IMN.

Logical Port-ID: An indication that designates the group of bearer terminations, and signalling associations associated with a user-network interface.

Requesting Address: The address of the ACN-E, ACN-T, or ISN/IMN that is the source of the information flow. A unique identifier within the domain of all ISN/IMNs and all ACNs that comprise the access network.

Destination Address: The address of the ACN-E, ACN-T, or ISN/IMN that is the termination of the information flow. A unique identifier within the domain of all ISN/IMNs and all ACNs that comprise the access network.

Action ID: Specifies the Access network control action to be performed.

Access Control Association ID: The Access Control Association Identifier is an information object that is unique between two ACF signalling entities.

7.2 Assignment of User-ID between the ACN-E and CSF

The User-ID is unique within the domain of all ACN-Es that subtend from ISN/IMNs attached to the access network. The recommended assignment of the User ID for selected access protocols is as follows:

Analogue Loop and Analogue Trunk

Each analogue loop or analogue trunk is assigned one User-ID between the ACN-E and the ISN/IMNs.

ISDN Basic Access

Each out-band signalling association represented by an active TEI on the D-channel is assigned one User-ID between the ACN-E and the ISN/IMNs.

ISDN Primary Access

Each out-band signalling association represented by a D-channel is assigned one User-ID between the ACN-E and the ISN/IMNs.

B-ISDN DSS2

Each signalling channel on the B-ISDN has one signalling association represented by a User-ID between the ACN-E and the ISN.

8 Signalling Transport Protocol Stacks

Based on the BICC Access Network protocol reference model, Table 2 provides the BICC Access Network signalling protocol stack for signalling transport networks. The protocol model and an example of the packet format that is transported between the ACN-E, the ACN-T, and the ISN/IMN are shown in Figure 4. The access network Message Multiplex Function relies on the Generic Signalling Transport Service (ITU-T Rec. Q.2150.0) to interface with the Signalling Transport Converter (STC). The access network Message Multiplex Function uses the (STC) to interface to specific signalling transport technologies.

NOTE – Currently, Signalling Transport Converters are defined for the following Signalling Transport Technologies:

- MTP3 and MTP3b (ITU-T Rec. Q.2150.1);
- SSCOP and SSCOPMCE (ITU-T Rec. Q.2150.2); and
- SCTP over IP.

Table 2/Q.1930 – BICC Access Network Signalling Protocol Stack

BICC access signalling protocol	Remote media control	Access network control	Call control
Protocol-specific function	Encapsulated media control messages	Encapsulated access control messages	Encapsulated call control messages
Message multiplex function	Add common header	Add common header	Add common header
Signalling transport	Generic signalling transport		

The BICC Access Network signalling transport model is based on the following criteria:

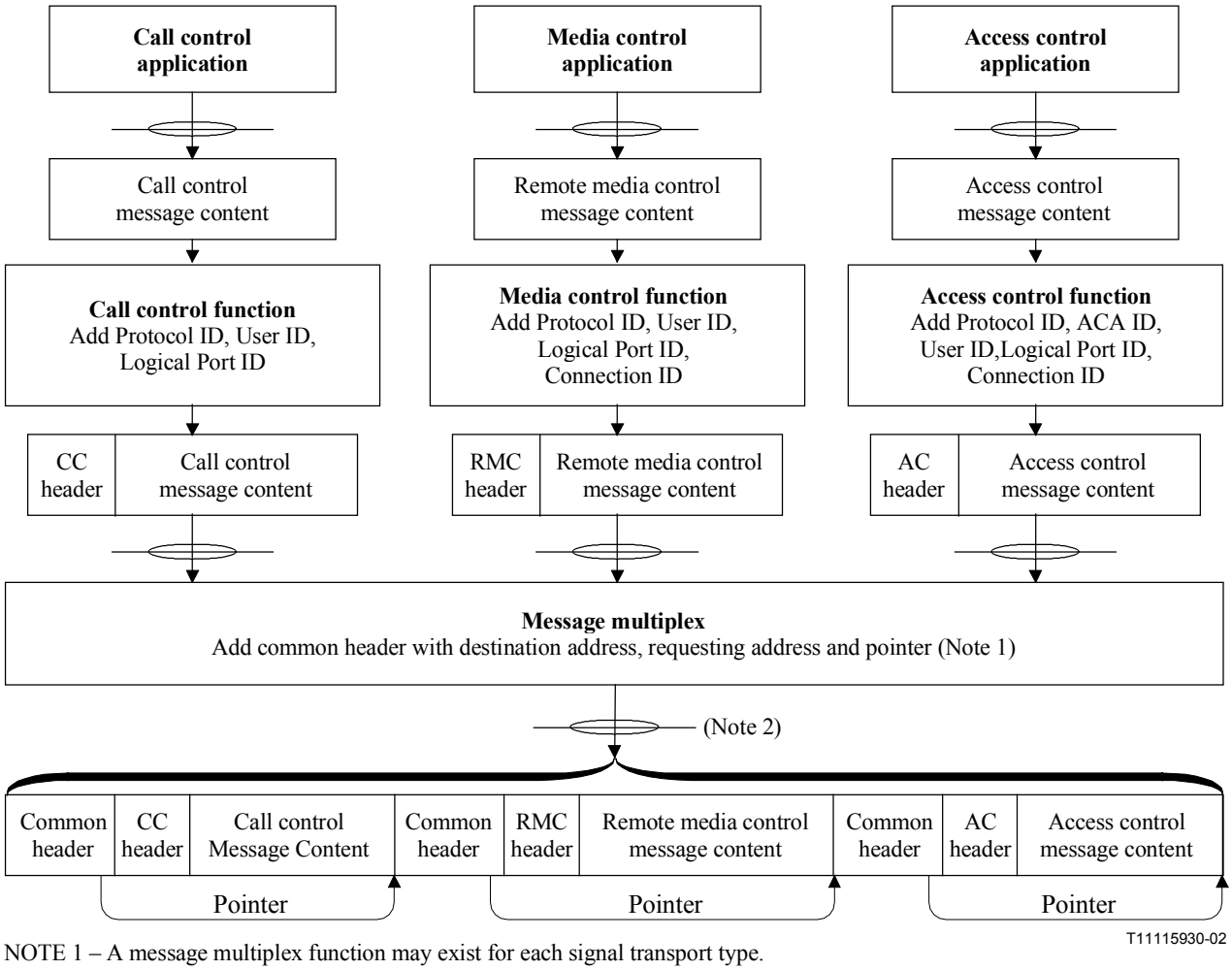
- The access network message multiplex function is defined to be transport independent and, therefore, multiple transport options are possible (e.g., IP or ATM).
- The BICC access network can make use of a common transport network to transport the call control, access network control, and remote media control signalling.
- If a new transport is defined in the future, it is easily adopted for the transport of the BICC access protocol(s).

The protocol model allows multiplexing at a higher layer (i.e., at the access network message multiplex) as opposed to at the lower layers (i.e., at the transport network). Therefore, the need for multiple virtual links or connections between adjacent nodes (i.e., ACN-E and ISN/IMN) is not needed.

8.1 Operation of BICC Access Network Signalling Encapsulation

The procedures for the operation of the BICC access network signalling encapsulation are invariant with respect to the functional entity within the access network in which they are implemented. They apply equally to the Call Service Function (CSF), Access Concentration Transit Node (ACN-T), and Access Concentration Edge Node (ACN-E). The content that is encapsulated within the common header varies with respect to the functional entity that is constructing the protocol-specific header before passing it to the signalling transport function.

The BICC access network operates three applications that are used to establish calls and connections between the ISN/IMN and the Terminal Equipment. These applications, which are defined elsewhere in this Recommendation, are Call Control, Remote Media Control, and Access network control.



NOTE 1 – A message multiplex function may exist for each signal transport type.
NOTE 2 – The destination address is mapped into the appropriate transport association.

Figure 4/Q.1930 – Format of the protocol-specific and message multiplex packet

8.1.1 Actions of the Application-Specific Functions

The content received from the BICC access network applications is passed through an application-specific function that adds the protocol-specific information and protocol-specific header to the encapsulated application information. This protocol-specific information is required for the operation of the BICC access network protocol and includes the following:

For the Call Control application, the protocol-specific information is

– Protocol ID = Call Control;

– User ID = the unique identifier within the BICC Access Network for the signalling association with the terminal equipment;

– Logical Port ID = the unique identifier within the ACN-E for the port that serves the bearer connected to the terminal equipment.

NOTE 1 – The application data that is encapsulated under the call control header is an information element that contains an individual signalling message from another protocol, e.g. DSS1 Q.931 SETUP, DSS1 Q.931 SETUP ACKNOWLEDGE, DSS2 Q.2931 CONNECT, V5 Q.964 ESTABLISH.

For the Remote Media Control application, the protocol-specific information is:

– Protocol ID = Remote Media Control;

– User ID = the unique identifier within the BICC Access Network for the signalling association with the terminal equipment;

– Logical Port ID = the unique identifier within the ACN-E for the port that attaches to the bearer connected to the terminal equipment;

– Connection ID = the unique identifier within the ACN-E for the virtual or physical connection that carries the bearer connected to the terminal equipment.

NOTE 2 – The application data that is encapsulated under the remote media control header is an information element that contains a package defined in H.248 or BICC CBC Q.1950.

For the Access network control application, the protocol-specific information is

– Protocol ID = Remote Media Control;

– ACA-ID = the unique identifier between adjacent functional entities in the access network, i.e. CSF, ACN-T, ACN-E;

– User ID = the unique identifier within the BICC Access Network for the signalling association with the terminal equipment;

– Logical Port ID = the unique identifier within the ACN-E for the port that attaches to the bearer connected to the terminal equipment;

– Connection ID = the unique identifier within the ACN-E for the virtual or physical connection that carries the bearer connected to the terminal equipment.

NOTE 3 – Additional information elements defined in ITU-T Rec. Q.765.5 may be encapsulated under the access network control header.

The content of the protocol-specific packet that is received from the message-multiplex function is used to determine the application instance to which the application content is passed. The UserID identifies the signalling association to which the content applies. The ACA-ID identifies the access control association to which the content of the access network control content applies. The Logical Port ID identifies the port in ACN-E that is connected to the terminal equipment. The Connection ID identifies the bearer between the ACN-E and the terminal equipment.

8.1.2 Actions of the Message-Multiplex Function

The content of the protocol-specific packet that is received from the application-specific function is passed through a message multiplex function that adds the common header. The common header is required for the operation of the BICC access network protocol and includes the following information:

– Destination Address, which is assigned based on UserID (see Note);

– Requesting Address, which is the address of the ISN/IMN or ACN that is sending the protocol-specific packet; and

– Pointer, which points to the start of the next common header.

NOTE – A UserID binds the signalling association used between the ACN-E and the terminal equipment with the serving ISN/IMN.

One protocol-specific packet from any of the applications is encapsulated under one common header. Any number of common headers containing any of the protocol-specific packets can be encapsulated in the signalling transport packet. The Destination Address may be used to map the common headers in succession onto the signalling transport association. Multiple common headers and their content may be mapped into one signalling transport packet. The decision of how many common headers are encapsulated in a transport packet is a network option.

The content received from the transport layer is passed through the multiplex function where the contents of one or more common headers are parsed and forwarded to the protocol-specific functions based on the Protocol ID in the protocol-specific header. The pointer is used to delineate the location of the common headers within the signalling transport packet.

The message-multiplex function supports, at its SAP to the signalling transport layer, the Generic Signalling Transport defined in ITU-T Rec. Q.2150.0.

9 Coding and Procedures for BICC Access Network Common Header

9.1 Coding for BICC Access Network Common Header

This clause specifies the formats and codes of the Bearer Independent Call Control (BICC) access network common header.

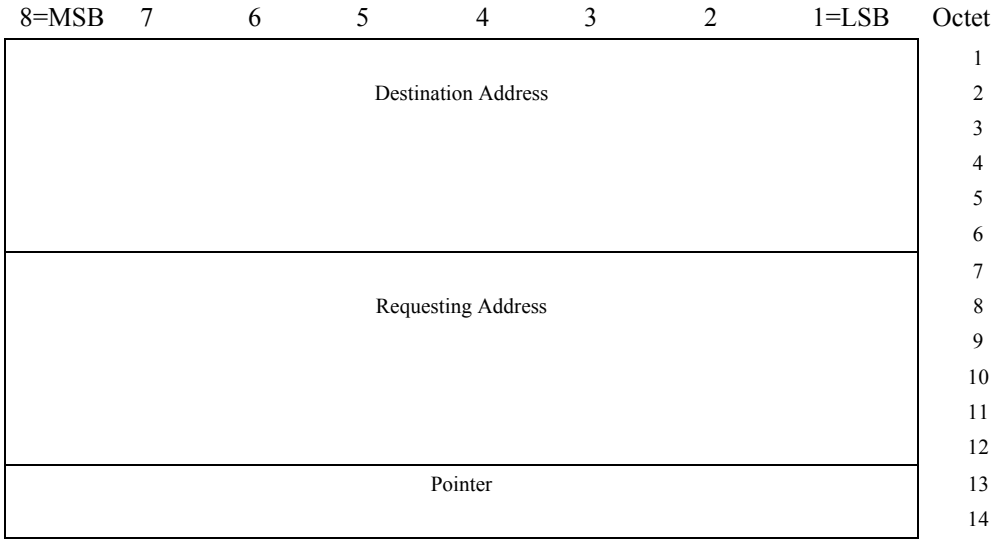


Figure 5/Q.1930 – BICC Access Network Common Header Format

9.1.1 Requesting and Destination Node Address

The format of the Requesting and Destination Node Address is shown in Figure 6.

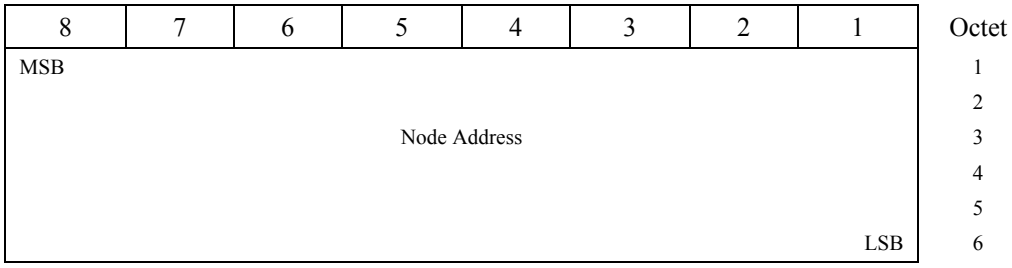


Figure 6/Q.1930 – Destination and Requesting Node Address

The address of an ACN or a SN. The content of the Destination and Requesting Nodes Addresses is a six octet binary value unique within the domain of all SNs that have control relationships with adjacent or subtending access concentration nodes.

9.1.2 Pointer

The format of the Pointer is shown in Figure 7.

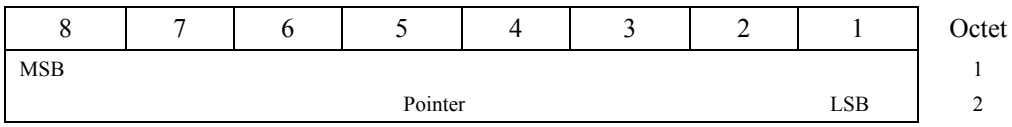


Figure 7/Q.1930 – Pointer

The content of the Pointer is a binary value that indicates the position of the first octet of the common header of the next BICC access message as measured starting from the first position following the pointer. The length of this field is 2 octets.

9.2 Procedures for Addressing using the BICC Access Network Common Header

The diagram in Figure 8 illustrates the signalling associations in the BICC Access Network. There is a signalling association between each ISN/IMN in the BICC Access Network and each ACN-E in the BICC Access Network. If ACN-Ts are present they will subtend from one or more ISN/IMNs via separate signalling associations. They will also have one or more ACN-Es that subtend from them via separate signalling associations.

The signalling associations between the ISN/IMN and the ACN-E may convey all three BICC Access Network Protocols as a multiplexed stream of messages if an ACN-T is not present: Call Control Relay, Remote Media Control, and Access network control. If an ACN-T is present between and ISN/IMN and ACN-E then the signalling association between the ISN/IMN and ACN-E may convey two BICC Access Network Protocols: Call Control Relay and Remote Media Control. The signalling associations between the ISN/IMN through ACN-T, and ACN-T to ACN-E will convey the Access network control messages.

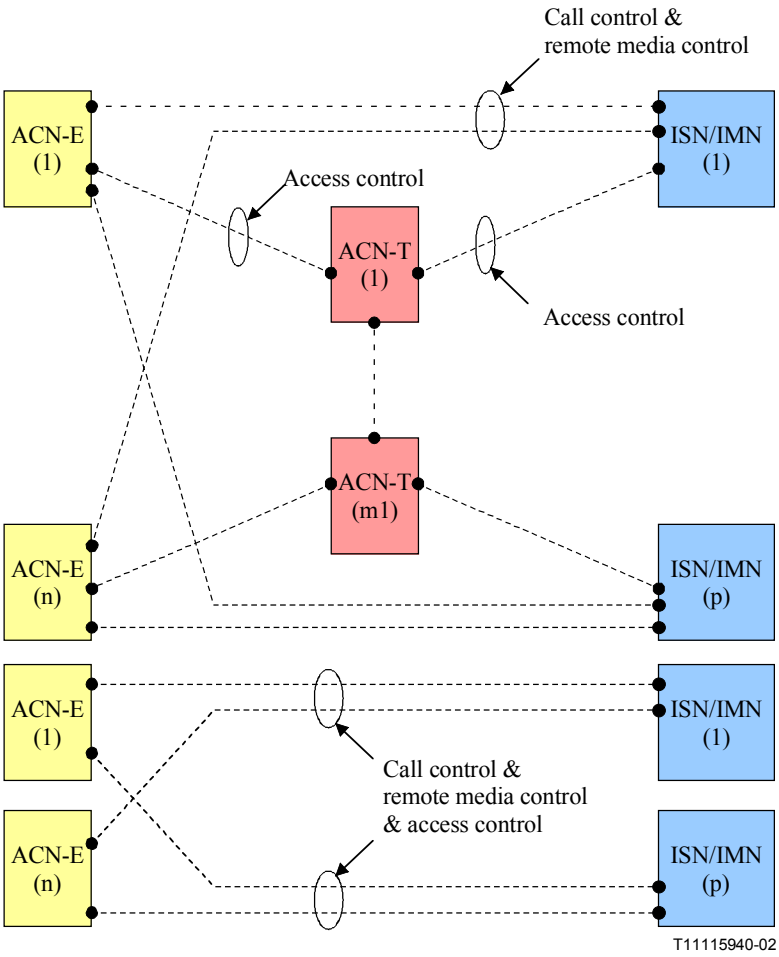


Figure 8/Q.1930 – BICC Access Network Signalling Associations

9.2.1 Operation at the ISN/IMN

The ISN/IMN associates a BICC UserID in any of the protocol-specific messages with the destination ACN-E address. It then addresses the protocol-specific packet, either Call Control Relay, Remote Media Control, or Access network control to the destination ACN-E and places its ISN/IMN address in the requesting address.

The ISN/IMN routes the constructed message with the complete common header on the appropriate signalling association. All messages are sent on the signalling association between the ISN/IMN and the ACN-E, if the ACN-T is not present. The Call Control Relay and Remote Media Control messages will be sent on the signalling association between the ISN/IMN and the ACN-E, if the ACN-T is present. The Access network control messages, containing the destination address of the ACN-E, will be sent on the signalling association between the ISN/IMN and an appropriate ACN-T that has connectivity with the destination ACN-E.

For selected operations on the access network, e.g. bearer redirection and explicit cutthrough, the ISN/IMN may place an ACN-T address of the destination where a specific action is to occur. These Access network control messages, containing the destination address of the ACN-T, will be sent on the signalling association between the ISN/IMN and an appropriate ACN-T that has connectivity with the destination ACN-T.

9.2.2 Operation at the ACN-E

The ACN-E associates a BICC UserID in any of the protocol-specific messages with the address of the ISN/IMN that controls that user. It then addresses the protocol-specific packet, either Call

Control Relay, Remote Media Control, or Access network control to the destination ISN/IMN and places its ACN-E address in the requesting address.

The ACN-E routes the constructed message with the complete common header on the appropriate signalling association. All messages are sent on the signalling association between the ACN-E and the ISN/IMN, if the ACN-T is not present. The Call Control Relay and Remote Media Control messages will be sent on the signalling association between the ACN-E and the ISN/IMN, if the ACN-T is present. The Access network control messages, containing the destination address of the ISN/IMN, will be sent on the signalling association between the ACN-E and the ACN-T that has connectivity with the requesting ACN-E.

9.2.3 Operation at the ACN-T

Each ACN-T in the path between the pair comprised of an ISN/IMN and associated ACN-E receives all Access network control messages regardless of the destination address contained in the Access network control message. Each ACN-T opens and processes the contents of messages destined for the ACN-E or ISN/IMN, before passing the message to the destination. It then follows the procedures of the BICC Access network control protocol in this Recommendation before forwarding the message toward the destination, either ACN-E or ISN/IMN. The destination and requesting addresses in the common header remain unchanged. That is, the destination ACN-E or ISN/IMN sees the requesting address of the originating ISN/IMN or ACN-E, rather than the address of an intermediate ACN-T.

For selected operations on the access network that are to occur at the ACN-T, e.g. bearer redirection and explicit cutthrough, the ISN/IMN may place, in the destination address, the address of the ACN-T where a specific action is to occur. The procedures for the operation at the ACN-T in the previous paragraph apply, however, the ACN-E is replaced with the destination ACN-T.

10 Coding and Procedures for BICC Access Network Messages

This clause specifies the coding for the BICC Access Network information. Figure 9 shows the general layout of the BICC Access Network message format.

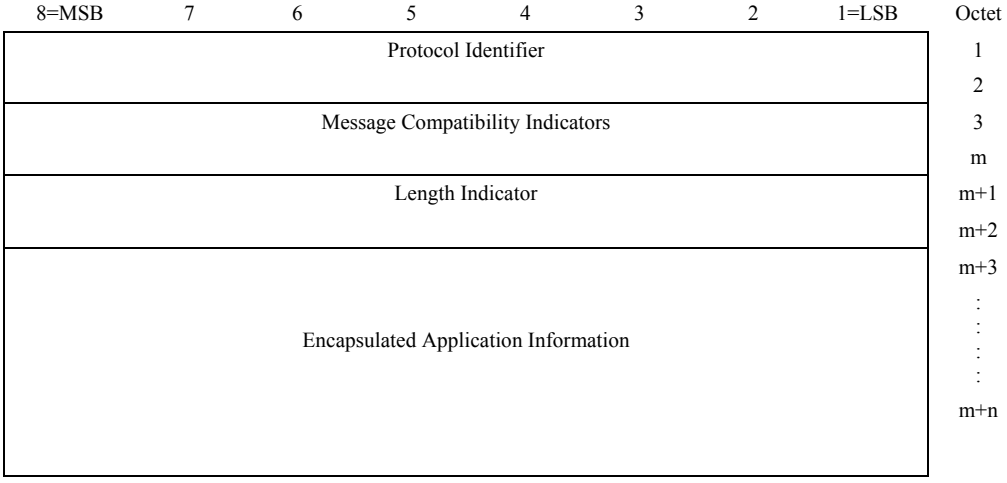


Figure 9/Q.1930 – BICC Access Network Message Format

a) Protocol Identifier

The format of the Protocol identifier is shown in Figure 10.

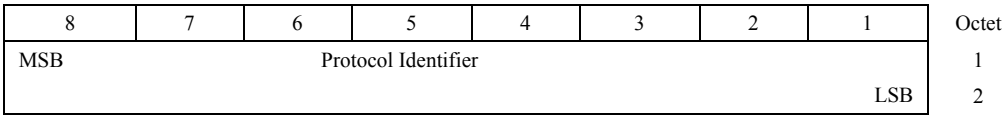


Figure 10/Q.1930 – Protocol Identifier

The content of the Protocol identifier is a two-octet binary value that indicates the protocol entity (e.g., call control, remote media control, or access network control) within the ACN or within the ISN/IMN to which the contents are directed.

The following codes are used in the subfields of the Protocol identifier as shown in Table 3.

Table 3/Q.1930 – BICC Access Network Protocol Identifier Codepoints

Protocol identifier name	Protocol identifier (Octet 1)	Protocol identifier (Octet 2)
Not Assigned	0000 0000	0000 0000
Call Control Relay		
Q.921	0000 0001	0000 0001
Q.931	0000 0001	0000 0010
Q.2931	0000 0001	0000 0011
G.964	0000 0001	0000 0100
Reserved range	0000 0001	All other values
Remote Media Control		
H.248 v1	0000 0010	0000 0001
Reserved range	0000 0010	All other values
Access Network Control		
Q.765.5	0000 0011	0000 0001
Reserved range	0000 0011	All other values
Reserved range	All other values	All Values

b) Message Compatibility Instruction Indicators

The Message Compatibility Indicator is comprised of one or more Message Compatibility Instruction Indicators.

The format of the message compatibility instruction indicators is shown in Figure 11.

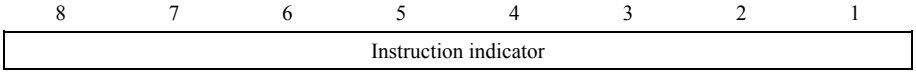


Figure 11/Q.1930 – Message Compatibility Instruction Indicators

The following codes are used in the subfields of the message compatibility instruction indicators:

i) *Instruction indicators*

The format of the Instruction indicators subfield is shown in Figure 12.

8	7	6	5	4	3	2	1	Octet
ext.	G	F	E	D	C	B	A	1
ext.	More instruction indicators if required (reserved)							1a
	:							:
	:							:
1	More instruction indicators if required (reserved)							1n

Figure 12/Q.1930 – Instruction Indicators Subfield

The following codes are used in the Instruction indicators subfield:

Bit
A *End Node/Transit indicator*
0 transit (ACN-T) interpretation
1 end node (ACN-E or ISN/IMN) interpretation

Bit
B *Release connection indicator*
0 do not release connection
1 release connection

Bit
C *Send notification indicator*
0 do not send notification
1 send notification

Bit
D *Discard message indicator*
0 do not discard message (pass on)
1 discard message

Bit
E *Pass on not possible indicator*
0 release connection
1 discard information

Bits
G F *reserved*

ii) *Extension indicator (ext.)*.
0 information continues in the next octet
1 last octet

iii) *More instruction indicators*

The bits will be defined when required.

c) Length Indicator

The format of the Length indicator is shown in Figure 13.

8	7	6	5	4	3	2	1	Octet
MSB	Length Indicator							1
							LSB	2

Figure 13/Q.1930 – Length Indicator

The content of the Length indicator is a two-octet binary value that specifies the number of octets in the Encapsulated application information. The length excludes the access network message header including Protocol identifier, Compatibility, and Length indicator.

d) Encapsulated Application Information

The general layout of the Encapsulated application information field of the BICC Access Network message format is shown in Figure 14.

8=MSB 7 6 5 4 3 2 1=LSB	Octet
Information element Identifier 1	1
Length indicator 1	2
	2a
Compatibility information 1	3
Contents 1	4
Information element Identifier n	m
Length indicator n	
Compatibility information n	
Contents n	p

Figure 14/Q.1930 – Encapsulated Application Information

Each information element within the encapsulated application information has the same structure. An information element consists of four fields, which always appear in the following order: Identifier (1 octet), Length indicator, Compatibility information, and Contents.

The Identifier distinguishes one type from another one and governs the interpretation of the contents. There are two types of identifiers: type "constructor", and type "simple" (refer to ITU-T Rec. Q.765.5). In case of "constructor", the contents field shall again consist of one or more information elements, each of which is structured as described above, i.e., Identifier, Length indicator, Compatibility information, Contents. In case of "simple", the Contents field contains one value only.

When passing on an information element of type "constructor", the order of the information elements within this "constructor" shall be maintained.

The format of the Length indicator is shown in Figure 15. The Length indicator specifies the length (i.e. integral number of octets in pure binary representation) of the Compatibility information and Contents. The length does not include the Identifier, or the Length indicator. Bit 8 is defined as Extension indicator and indicates whether or not the information on the length continues through the next octet. Value "0" of the Extension indicator means "information continues through the next octet", while value "1" means "last octet". The Length indicator itself has a maximum length of 2 octets, i.e. if octet 1a is needed, the Extension indicator of octet 1a is always set to value "1".

8	7	6	5	4	3	2	1	Octet
Ext.							LSB	1
Ext.=1	0	0	0	MSB				1a

Figure 15/Q.1930 – Length Indicator

The format of this field is shown in Figure 16. The Compatibility information contains corresponding instructions for the case that the received information element is unrecognised.

8	7	6	5	4	3	2	1	Octet
	pass-on not possible				general action			1
Ext=1	send notification indicator	instruction indicator		reserved	send notification indicator	instruction indicator		

Figure 16/Q.1930 – Compatibility Information

The following codes are used in the subfields of the Compatibility information field.

i) Bits

21	*Instruction indicator for general action*
00	Pass on information element
01	Discard information element
10	Discard BICC access data
11	Release call

ii) Bit

3	*Send notification indicator for general action*
0	Do not send notification
1	Send notification

iii) Bit

4	*reserved*

iv) Bits

65	*Instruction indicator for pass-on not possible*
00	Release call
01	Discard information element
10	Discard BICC access data
11	reserved (interpreted as 00)

v) Bit

7	*Send notification indicator for pass-on not possible*
0	Do not send notification
1	Send notification

vi) Bit

8	*Extension indicator*
0	Information continues through the next octet
1	Last octet

The Contents field is the substance of the element and contains the information the element is intended to convey.

10.1 List of Identifiers

In addition to the identifiers listed in ITU-T Rec. Q.765.5 that may be used on the BICC Access Network Control signalling association, Table 4 contains the list of identifiers reserved for the BICC Access Network. All other values are not in use in this Recommendation.

Table 4/Q.1930 – List of Identifiers for the BICC Access Network

Coding				Applicability on Access Network Signalling Association		
Value	**Information Element Name**	**Type**	**Reference**	**Call Relay**	**Media Control**	**Access Network Control**
1101 0000 to 1101 1001	Reserved	–	–	–	–	–
1101 1010	User ID	simple	10.2	M	M	M
1101 1011	Logical Port ID	simple	10.3	M	M	M
1101 1100	Connection-ID	simple	10.4	–	M	M
1101 1101	Connection Group ID	simple	10.5	–	O	O
1101 1110	Access Control Association ID	simple	10.6	–	–	M
1101 1111	Application Data	simple	10.7	M	M	–
M Mandatory Identifier O Optional Identifier "–" indicates not in use on the indicated signalling association						

Mandatory indicates that an identifier is required, and must be always present in each message on the indicated access network signalling association for operation of the BICC Access Network protocol. Optional indicates that an identifier may be required, and may be present in a message for operation of procedures in the BICC Access Network protocol. "–" indicates that an identifier is not used on the indicated signalling association.

10.2 User Identifier

The format of the User identifier is shown in Figure 17.

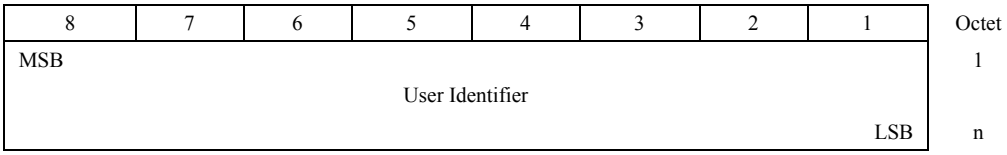


Figure 17/Q.1930 – User Identifier

The content of the User identifier is a unique value, within the domain of all ACNs and ISN/IMNs attached to the access network, that identifies the layer 2 signalling association at the user side of the ACN-E in the case of ISDN, or to a signalling channel associated with a UNI in the case of B-ISDN. The User identifier identifies the physical port in the case of an analogue loop or analogue trunk. The coding of the User identifier is implementation specific.

10.3 Logical Port Identifier

The format of the Logical port identifier is shown in Figure 18.

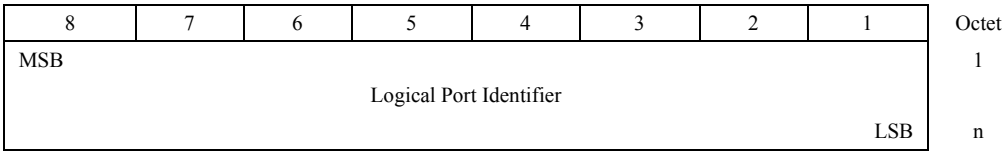


Figure 18/Q.1930 Logical Port Identifier

The content of the Logical Port identifier is a value that designates the group of bearer terminations, and signalling associations on the user-network interface of ACN-E. The coding of the Logical Port identifier is implementation specific.

10.4 Connection Identifier

The format of the Connection identifier is shown in Figure 19.

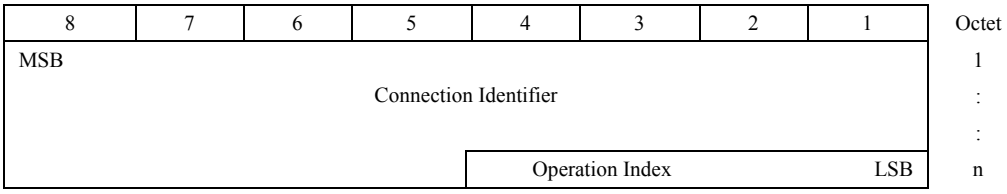


Figure 19/Q.1930 – Connection Identifier

The content of the Connection identifier is an indicator of the connection being associated with the user at the user-network interface of the ACN-E. The ACN-E maps the Connection identifier to the termination on the logical port being monitored and controlled by the CSF. The Operation index occupies the four lowest order bits of the Connection identifier. The operation index is always zero unless otherwise indicated by procedures at the CSF. The Operation index is used to eliminate ambiguity when multiple operations are performed with respect to the termination on the logical port of ACN-E. An example is a two-way call, bridged at the ACN-E, where each leg must be cut-through individually. The CSF will index all the messages related to the second leg with the next value in sequence, i.e. the value binary "one", and so on to add more legs or to perform other operations that would be ambiguous at the ACN-E. The coding of the Connection identifier is implementation specific.

10.5 Connection Group Identifier

The format of the Connection group identifier is shown in Figure 20.

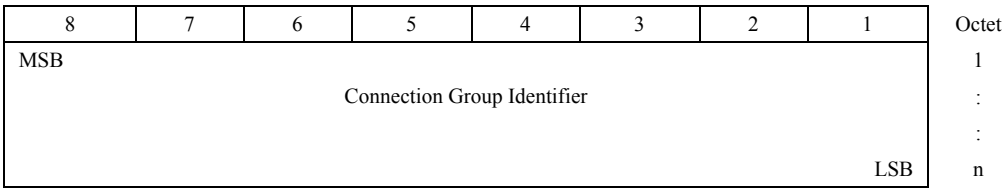


Figure 20/Q.1930 – Connection Group Identifier

The content of the Connection group identifier is an indicator of a permanent virtual facility to which the requested bearer connection is to be assigned on the BICC-side of the ACN-E or at an ACN-T. It may be mapped to a dedicated value of a bearer path identifier, e.g., VPCI for ATM, or AAL Type 2 Path for AAL 2, explicit LSP for MPLS. The coding of the Connection group identifier is implementation specific.

10.6 Access Control Association Identifier

The format of the Access control association identifier is shown in Figure 21.

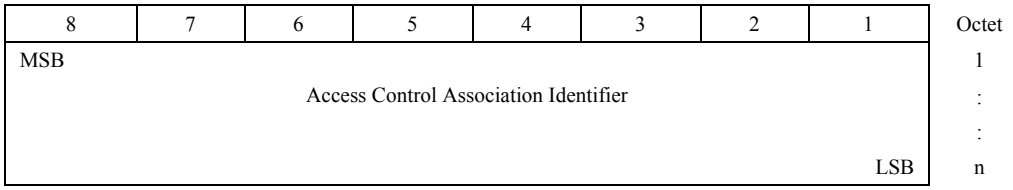


Figure 21/Q.1930 – Access Control Association Identifier

The content of the Access control association identifier is unique within the access control relationship between any two access concentration nodes, or between an access concentration node and an ISN/IMN. The Access control association identifier is always the first information element after the header of an access control message.

10.7 Application Data

The format of the Application data is shown in Figure 22.

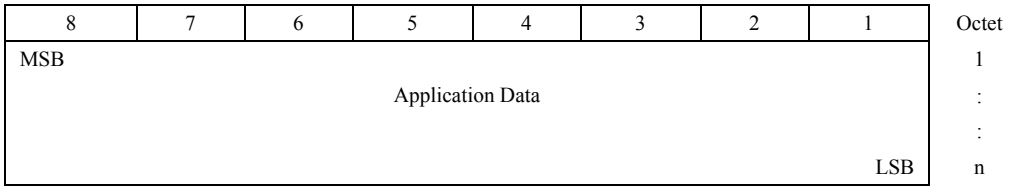


Figure 22/Q.1930 – Application Data

The Application data information element contains messages defined in other protocols, e.g., ITU-T Recs Q.931, Q.2931, G.964, and H.248.

11 Coding and Procedures for BICC Access Network Call Control

This clause specifies the coding and procedures for the BICC access network call control. Figure 23 shows the BICC access network call control message format used in the access network. The BICC access network identifiers for User-ID and Logical Port ID are placed ahead of Application Data in the contents of the Call Control message. The Application Data contains a message defined in another protocol, e.g. ITU-T Recs. Q.931, Q.2931, and G.964, and appears last in the call control message.

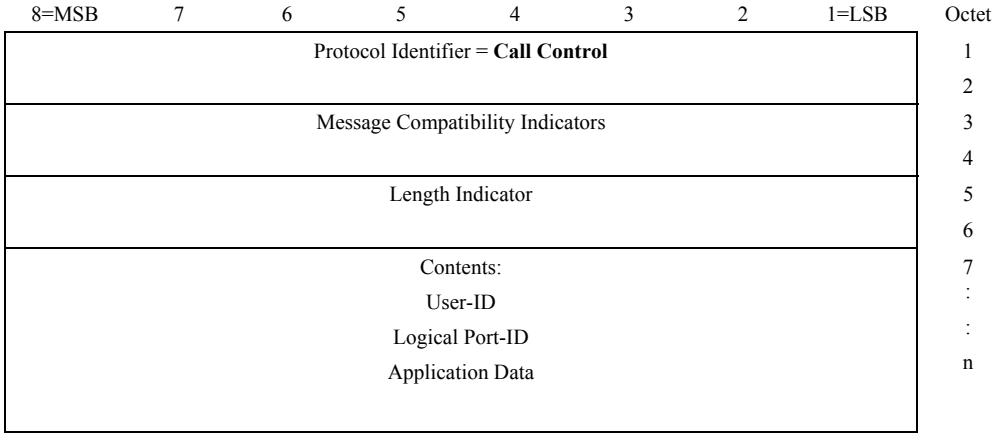


Figure 23/Q.1930 – BICC Access Network Call Control Message Format

11.1 Procedures for Call Control

This clause contains the procedures of the BICC access network call control protocol for the support of services described in clause 6. Support of these services is independently of the bearer technology in the access network, of the signalling message transport technology in the access network, and of the access signalling protocol. These procedures are applicable to function-based protocols such as DSS1, DSS2 , and V5.

Call procedures related to the appropriate Recommendation either Q.931 DSS1, Q.2932 DSS2, or G.964 V5 apply to the BICC Access Network. These procedures are extended in the BICC access network call control protocol to include capabilities that relay signalling messages between the CSF and the terminal equipment with minimal interaction of the ACN-E. The ACN-E is required to relay signalling messages between the CSF and the terminal equipment without interpreting the content of the messages.

For the BICC Access Network, call set-up is divided into three phases:

– Call Admission;

– Bearer Establishment; and

– Call Establishment.

BICC access network call control is engaged during Call Admission and Call Establishment phases of call set-up.

11.1.1 Successful Call Admission

Call admission starts when the CSF receives a service request from the terminal or from the network. It terminates when the CSF authenticates the service request and prepares to ask for resources within the BICC access network.

Origination from Network side of the CSF

This procedure assumes the conditions described in 7.2.8/Q.1902.4, Actions required at the destination SN for progressing the call are satisfied.

The CSF, on receipt of a call request from the network, authenticates the request and prepares to establish the bearer connections within the access network for the terminating half of ISN-A and toward the preceding SN on the network side in case of the IMN configuration. It maintains the status of the DSS1 or DSS2 terminal and other attributes of the requested connection:

1) serving ACN Address (determined from BICC User ID);

2) BICC User ID (determined from called address information),;

3) BICC Logical Port ID (determined from BICC User ID);

4) preferred Connection ID (determined from BICC UserID);

5) service options including preferred connection group (determined from service options); and

6) preferred setup option, either Forward or Backward Bearer Connection.

On completion of the call admission phase, i.e. when the CSF at the ISN/IMN has received the complete selection information from the network and has authenticated the service request, the CSF determines if a bearer is to be established between an ACN-E and the ISN, or between an ACN-E and the preceding SN on the network side in the case of the IMN configuration.

1) The CSF initiates the BICC Access Network Control protocol in 12.2 to initiate bearer establishment and to request the bearer resources needed within the BICC access network to connect the call, if a bearer is to be established.

2) The CSF proceeds to process the service request, if a bearer is not required by the requested service.

If the call is to be routed to the terminal equipment, the outgoing signalling procedure is initiated after the bearer establishment procedures is complete if a bearer is to be established.

Origination from the Terminal Equipment

The ACN-E, on receipt of a call request (e.g. V5 seizure) from a function-based terminal, e.g. DSS1 terminal, notifies the CSF of the request. It includes the complete signalling information received from the terminal in a BICC access network call control message to notify the CSF, as well as the following information:

1) serving ISN/IMN Address related to the BICC User ID (determined from internal data bases),
2) BICC User ID for the terminal originating the call (determined from internal data bases),
3) BICC Logical Port ID (determined from internal data bases).

The CSF, on receipt of the call request, initiates the signalling protocol appropriate for call processing. The exact sequence of call processing operations is determined by the protocol, e.g. Q.931 DSS1, Q.2931 DSS2, or G.964 V5.

On completion of the call admission phase, i.e. when the CSF at the ISN/IMN has received the complete selection information from the calling party and has authenticated the service request, the CSF determines if a bearer is to be established between an ACN-E and the ISN, or between an ACN-E and the preceding SN on the network side in the case of the IMN configuration.

1) The CSF initiates the BICC Access Network Control protocol in 12.2 to initiate bearer establishment and to request the bearer resources needed with the BICC access network to connect the call, if a bearer is to be established.
2) The CSF proceeds to process the service request, if a bearer is not required by the requested service.

If the call is to be routed to another SN, the outgoing signalling procedure is initiated after the bearer establishment procedures is complete, if a bearer is to be established. In some situations, such as overlap sending, the outgoing signalling procedures may be initiated before complete address information is received.

11.1.2 Successful Call Establishment

This clause describes the minimal set of CSF and ACN procedures used for successful call establishment for function-based terminals, e.g. DSS1 Q.931, Q.2931 DSS2, or G.964 V5.

A common set of procedures is provided to support call establishment between the ISN/IMN and the ACN-E. These procedures support call establishment across the BICC access network using the BICC access network call control protocol supplemented by the coding and procedures in the BICC remote media control protocol and the BICC access network control protocol. These are described in later clauses of this Recommendation.

A prerequisite to initiation of Call Establishment is the completion of Bearer Establishment, as determined by the CSF in ISN/IMN-A. This occurs after notification is received from Bearer Control, according to the procedures in the BICC Access network control protocol in clause 12:

"The CSF receives confirmation that the bearer is available between all ACNs involved with the bearer establishment, out to and including the ACN-E. Confirmation is accomplished by returning a BICC access control message containing an action indicator "BNC established" from the ACN-E to the CSF. This indication is cascaded hop-by-hop backward from the ACN-E to the CSF. When received at the CSF, in conjunction with receipt of a primitive from the BCF indicating *"BNC set-up*

success" (BCF indication not applicable to the IMN), the "BNC established" primitive indicates bearer continuity across the BICC access network."

Procedures at the CSF

When the CSF receives confirmation that the bearer is available between all ACNs involved with the bearer establishment, out to and including the ACN-E, it proceeds to establish the call across the BICC access network. It uses call procedures of the appropriate protocol, e.g. Q.931 DSS1, Q.2931 DSS2, or G.964 V5. In some cases these procedures are dependent on the type of service provided to the terminal equipment.

Origination from Network side of the CSF

The CSF, on confirmation of bearer path availability, initiates the signalling protocol appropriate to complete the establishment of the call. The exact sequence of call processing operations is determined by the signalling protocol; e.g. Q.931 DSS1, Q.2931 DSS2, or G.964 V5. It includes information in a BICC access network call control message in addition to the alerting message coded according to the appropriate Recommendation:

1) serving ACN-E Address related to the BICC User ID (determined from internal data bases),
2) BICC User ID for the destination of the call (determined from internal data bases),
3) BICC Logical Port ID (determined from internal data bases).

The CSF continues to send signalling messages to, and receive messages from the ACN-E, using the BICC access network call control protocol. The exact signalling sequence is determined by the signalling protocol and the service associated with the particular type of terminal equipment.

The CSF, after indication of ANSWER in a Call Control message received from the ACN-E, may initiate bearer cut-through in both directions, or as appropriate to the national protocol, if it has not already done so. The BICC Access Network Protocol allows for cut-through in three ways, one of which shall be provisioned in the CSF:

1) At a BIWF in the domain of the controlling CSF using the BICC CBC protocol in ITU-T Rec. Q.1950 and the contents coded according to 7.1.7/H.248.1 v1, LocalControl Descriptor with mode property set to send-only, receive-only, send/receive, inactive. Cuththrough at the BIWF is not applicable to the IMN.
2) At one or more ACN-Ts in the domain of the controlling CSF using BICC Access network control procedures in this Recommendation.
3) At the ACN-E using BICC Remote Media Control with contents coded according to 7.1.7/H.248.1 v1, LocalControl Descriptor with mode property set to send-only, receive-only, send/receive, inactive, or loop-back. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the Context within the ACN-E.

The call establishment phase, in the destination SN, ends with cut-through on ANSWER indication.

Origination from the Terminal Equipment

The CSF, on confirmation of bearer path availability, initiates the appropriate signalling protocol to complete the establishment of the call. The exact sequence of call processing operations is determined by the protocol, and in some cases by the service associated with the particular type of terminal.

The CSF continues to send signalling messages to, and receive messages from the ACN-E, using the BICC access network call control protocol. The exact signalling sequence is determined by the signalling protocol, e.g. Q.931 DSS1 , Q.2931 DSS2, or G.964 V5, and the service associated with the particular type of terminal.

The CSF may initiate bearer cut-through as described in 7.2.1.2.2/Q.1902.4, Internal through Connection of the Bearer Path, or as appropriate to the signalling protocol, if it has not already done so. The BICC Access Network Protocol allows for cut-through in three ways, one of which shall be provisioned in the CSF:

1) At a BIWF in the domain of the controlling CSF using the BICC CBC protocol in ITU-T Rec. Q.1950 and the contents coded according to 7.1.7/H.248.1 v1, LocalControl Descriptor, with mode property set to send-only, receive-only, send/receive, inactive. Cuththrough at the BIWF is not applicable to the IMN.

2) At one or more ACN-Ts in the domain of the controlling CSF using BICC Access network control procedures in this recommendation.

3) At the ACN-E using BICC Remote Media Control with contents coded according to 7.1.7/H.248.1 v1, LocalControl Descriptor, with mode property set to send-only, receive-only, send/receive, inactive, or loop-back. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the context within the ACN-E.

The call establishment phase, in the originating SN, ends with cut-through on ANSWER indication.

11.1.3 Normal call release

The CSF follows the release procedures in clause 11/Q.1902.4, Normal Call Release, which first request the BCF to disconnect the internal through-connection of the bearer path. In addition, the CSF:

1) uses BICC Remote Media Control protocol and follows the procedures specified in appropriate signalling protocols to release the call between the ISN/IMN and the terminal equipment;

2) uses the BICC Access network control protocol to initiate release of the bearer hop-by-hop across the BICC access network, after ensuring that the terminal is released and no other actions require services of the bearer; and

3) issues an indication of call release to the BCF within the domain of the CSF, not the domain of ACNs (not applicable to the IMN).

NOTE – At an ISN/IMN an indication of call release is issued to the ACN, but the subsequent decision to initiate bearer release protocol is the responsibility of BCF logic within each ACN.

Release from Network side of the CSF

The CSF, on receipt of release indication from the network, initiates the appropriate signalling protocol, and any procedures specific to the terminal, to release the connection between the ISN/IMN and the terminal equipment. The exact sequence of call processing operations is determined by the signalling protocol, and in some cases by the service associated with the particular type of terminal.

The CSF may issue a BICC acess network call control disconnect/release message to the ACN-E that serves the function-based terminal. It includes information in the BICC access network call control message, in addition to the signalling in either Q.931, Q.2931, or G.964:

1) serving ACN-E Address related to the BICC User ID (determined from internal data bases),

2) BICC User ID (determined from internal data bases),

3) BICC Logical Port ID (determined from internal data bases).

When the CSF receives confirmation that the terminal has disconnected, e.g. receives release/release complete, it proceeds to request bearer release.

Release from the Terminal Equipment

The ACN-E, on receipt of a disconnect/release indication from the terminal equipment issues a BICC access network call control message to the CSF containing the following:

1) serving CSF address related to the BICC User ID (determined from internal data bases),
2) BICC User ID (determined from internal data bases),
3) BICC Logical Port ID (determined from internal data bases).

The CSF, on receipt of disconnect/release from the terminal equipment, initiates the appropriate signalling protocol, and any procedures specific to the terminal, to confirm release of the connection between the ISN/IMN and the terminal equipment. The exact sequence of call processing operations is determined by the signalling protocol, and, in some cases, by the service associated with the particular type of terminal.

The CSF proceeds to request bearer release.

11.2 Abnormal conditions

In general, the abnormal procedures defined for the signalling protocol that is conveyed in the BICC access network call control message is used to handle abnormal conditions between the terminal equipment and the CSF. The ACN-E is treated as a portion of the signalling transport network.

11.2.1 Receipt of unreasonable signalling information

The message transport service provided by the STC and its lower layers avoids missequencing, or double delivery, of messages with a high reliability (e.g. see ITU-T Rec. Q.706). However, undetected errors at the lower message transport layers and CSF or ACN malfunctions may produce signalling information messages that are either ambiguous or inappropriate.

Unreasonable or unexpected signalling information may also be received at a CSF or ACN due to differing levels of signalling protocol enhancements at different CSFs and ACNs within a network. A CSF using a more enhanced version of the protocol may send information to an ACN using a less enhanced version of the protocol and which is outside the protocol definition supported at that ACN.

To account for the occurrences listed above, the formats and codes for message and information element compatibility are supported in the BICC access network. The full adaptation of these codes to the BICC access network is for further study.

11.2.2 Handling of message format errors

The following are considered message format errors:

a) The message length is less than the number of octets required to contain the mandatory variables.

b) An information element's length indicator causes the overall message length to be exceeded.

When a message format error is detected the message shall be discarded.

11.2.3 Handling of unexpected messages

An unexpected message is one which contains a message type code that is within the set supported at the CSF or ACN, but is not expected to be received at the time that it is received.

When an unexpected message is detected the message shall be discarded.

11.2.4 Compatibility for the BICC Access Network Call Control

Message Compatibility

The Message Compatibility procedures of ITU-T Rec. Q.1902.4 apply to the BICC Access Network message compatibility with the following exceptions:

- Use of the Confusion message is not applicable;
- Use of the Facility Reject message is not applicable;
- Use of the Broadband/narrow-band interworking indicator is not applicable.

Compatibility for the BICC Access Network Identifiers

The BICC access network identifiers include the User ID, Logical Port ID, ACA-ID, Connection ID, Connection Group ID, Application Data IE, and other identifiers defined in ITU-T Rec. Q.765.5. The compatibility mechanisms of 13.4.8/Q.1902.4, are applied to these identifiers and information elements.

Compatibility for the BICC Access Network Call Control Application Data

The application data is comprised of messages from other protocols, e.g. Q.931, Q.2931. G.964.

The error handling and reporting procedures of the appropriate Recommendation, either ITU-T Recs. Q.931, Q.2931, or G.964, apply to the application content conveyed by the BICC access network call control protocol. These procedures are applied at the terminal equipment or the CSF. They do not apply at the ACN-E, because the application content is not visible.

12 Coding and Procedures for Access Network Control

The coding and procedures for the access network control information are based on the coding in ITU-T Rec. Q.765.5 and the procedures in ITU-T Rec. Q.1902.4. The coding and procedures in clause 11/Q.765.5 and the procedures in ITU-T Recs. Q.1902.4 and Q.1902.6 are included by reference in the BICC Access Network protocol in this Recommendation. The Association ID is the first information element in the contents of the Access network control message followed by other identifiers defined in this Recommendation and in ITU-T Rec. Q.765.5.

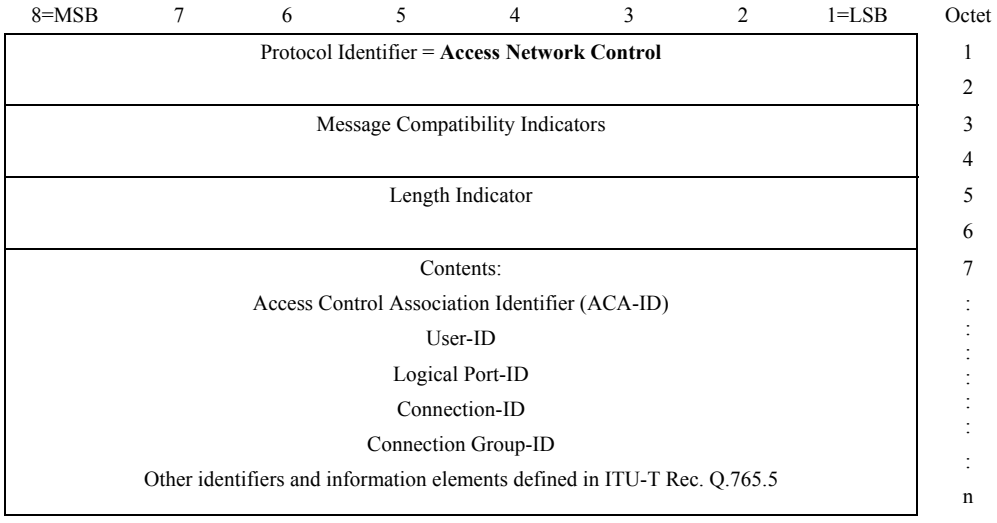


Figure 24/Q.1930 – BICC Access Network Control Message Format

12.1 Formats and Codes for BICC Access Network Control

This clause contains the formats and codes of the application data for the Bearer Independent Call Control (BICC) access network control protocol for the support of services described in clause 6. These services are supported independently of the bearer technology in the access network, of the signalling message transport technology in the access network and of the access signalling protocol used.

The formats and codes including general layout described in clause 11/Q.765.5, BICC Transport – Formats and codes of application data, are used as the contents of the BICC Access Network Control Message. Several additional application data identifiers are included specifically for BICC access network control. The additional identifiers are listed in Table 4.

New codes are also added to the action indicator in ITU-T Rec. Q.765.5 for use in the BICC access network: BNC established, Cut-through Backward, Cut-through Forward, Cut BNC Backward, Cut BNC Forward, Release BNC, and Release BNC Confirm.

12.1.1 Coding of Action Indicators Unique to the BICC Access Network

The following codes are reserved in the Action Indicator field for the BICC access network. All other values are not in use in this Recommendation.

Code	Action Indicator
1100 0000 to 11011000	reserved
1101 1001	BNC established
1101 1010	cut-through backward
1101 1011	cut-through forward
1101 1100	cut BNC backward
1101 1101	cut BNC forward
1101 1110	release BNC
1101 1111	release BNC confirm

The meaning of the "connect forward" and "connect backward" action indicators defined in ITU-T Rec. Q.765.5 differs in the context of the BICC access network. Whereas the BICC indicators are relative to the direction of call establishment, the BICC access network indicators are relative to the direction to or from the ACN-E.

– Forward set-up is the direction from SN toward ACN-E.

– Backward set-up is the direction from ACN-E toward SN.

Some of the codes specified in ITU-T Rec. Q.765.5 may not be used in the access network based on the distribution of functions between the functional elements: call control, remote media control, and access network control. A discussion of these codes is provided in the following paragraph.

The signal, signal type, and duration information elements are used to apply signals to the bearer path in the BICC network. These signals are applied in the access network to the forward or reverse path either at the user-side of ACN-E, or at the user side of an ACN-T, or at a BIWF controlled by an ISN. They, therefore, may be conveyed across the access network control signalling association if capabilities to provide these functions are placed in the ACN-Ts.

12.2 Procedures for BICC Access Network Control

This clause contains the procedures of the Bearer Independent Call Control (BICC) access network control protocol for the support of narrow-band ISDN services independent of the bearer technology, of the signalling message transport technology, and of the access signalling protocol.

The procedures related to the Application Transport Mechanism of Bearer Independent Call Control (BICC) in ITU-T Rec. Q.1902.4, Bearer independent call control protocol, basic call procedures (2001) apply to the BICC access network. Several additional procedures are included specifically for BICC access network control.

To apply the procedures of ITU-T Rec. Q.1902.4 in the BICC access network, the terminology relating to the nodal functions must be changed to recognise that rather than SNs, the procedures refer to ACNs and to ISN/IMNs. Additionally, the nodal functions and BICC primitives in ITU-T Rec. Q.1902.4 may not be visible in the procedures for the ACNs. They, however, may be assumed to be present within the access network functional entities. The Q.1902.4 procedures for the CSF apply to the ACF in the BICC access network. The IAM and APM in ITU-T Recs. Q.1902.4 and Q.1902.6 are replaced by the Access network control Protocol message in the BICC access network.

12.2.1 Successful Bearer Establishment

This clause describes the minimal set of CSF and ACN procedures used for the set up of a bearer. Additional procedures may also be used. These are described in later clauses of this Recommendation.

A common set of procedures is provided to support the set up of bearers between the ISN/IMN, the ACN-T and the ACN-E. These procedures support successive hop-by-hop bearer establishment across the BICC access network between the ISN/IMN and ACN-E.

The same options supported in ITU-T Rec. Q.1902.4 are included for the handling of bearers:

1) A bearer is established and released for each call set-up and release. The bearer set-up is initiated in the forward direction.
2) A bearer is established and released for each call set-up and release. The bearer set-up is initiated in the backward direction.
3) The bearer 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/Q.1902.4).

Procedures at the CSF for the ISN Configuration

The CSF is the initiator of bearer set-up requests on the BICC access network. Only outgoing bearer set-up procedures apply, therefore, at the access network side of the CSF. The applicable procedures are described in the following clauses.

When the CSF at the ISN has received the complete selection information from the calling party or from the network, and has determined that a bearer is to be established between the ISN and an ACN-E, the bearer establishment procedure is initiated. (The ACN-E to be associated with the call is known at this point. An outgoing BIWF may be selected, or the BIWF may also have been pre-determined, depending on the characteristics of the incoming access type.)

If the call is to be routed to another CSF, or to the terminal equipment, the outgoing signalling procedure is initiated. In some situations, such as overlap sending, the outgoing signalling procedures may be initiated before complete address information is received.

The CSF determines the direction of bearer establishment: forward or backward. Five bearer establishment options in ITU-T Rec. Q.1902.4 are supported with additional identifiers and additional procedures related to the BICC access network. The procedures in ITU-T Rec. Q.1904.2 are modified such that, rather than conveying information in both the BICC IAM and BICC APM, information is conveyed between the CSF and the succeeding ACN in BICC Access Network Control messages.

1) If the bearer is to be established in the forward direction, i.e. from the CSF toward ACN-E, then the procedures of 7.4.1/Q.1902.4, Per-call bearer set-up in forward direction, apply at the CSF.

   Timer T1 and timer T2 are set when a BNC_Request is sent containing the "connect forward" action indicator.

2) If the bearer is to be established in the backward direction, i.e. from the ACN toward the CSF, then the procedures of 7.4.2/Q.1902.4, Per-call bearer set-up in backward direction, apply at the CSF.

   Timer T2 is set when a BNC_Establish is sent containing the "connect backward" action indicator.

3) For fast bearer establishment using bearer control tunnelling, the procedures of 6.2/Q.1902.4, and 7.4.3/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – fast set-up, apply at the CSF.

   Timer T1 and timer T2 are set when a BNC_Request is sent containing the "connect forward" action indicator. Timer T2 is set when a BNC_Establish is sent containing the "connect backward" action indicator.

4) For delayed bearer establishment using bearer control tunnelling, the procedures of 6.2/Q.1902.4, and 7.4.4/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – delayed forward, apply at the CSF.

   Timer T1 and timer T2 are set when a BNC_Request is sent containing the "connect forward" action indicator.

5) For delayed bearer establishment using bearer control tunnelling, the procedures of 6.2/Q.1902.4, and 7.4.5/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – delayed backward, apply at the CSF.

   Timer T2 is set when a BNC_Establish is sent containing the "connect backward" action indicator.

The procedures in ITU-T Rec. Q.1902.4 are modified such that, rather than conveying information in both the BICC IAM and BICC APM, information is conveyed between the CSF and the succeeding ACN, either ACN-T or ACN-E, in BICC Access Network Control messages.

Additional identifiers related to the BICC access network are conveyed along with the "connect" Action indicator:

1) ACA-ID – Regardless of the source of the call, the CSF assigns a new Access Control Association ID for each new bearer that is to be established.

2) User-ID – For a call incoming from the network, the CSF determines the User-ID for which the bearer is to be established by analysis of the called party address. For a call incoming from the terminal equipment, the CSF receives the User-ID for which the bearer is to be established from the incoming call control message for digital terminals, or remote media control message for analogue terminals.

3) Logical Port ID – For a call incoming from the network, the CSF determines the Logical Port ID for which the bearer is to be established by analysis of the called party address. For a call incoming from the terminal equipment, the CSF receives the Logical Port ID for which the bearer is to be established from the incoming call control message for digital terminals, or remote media control message for analogue terminals.

4) Connection ID – The CSF obtains the Connection ID for which the bearer is to be established from the channel negotiation procedures used by ISDN and B-ISDN terminals. The Connection ID for analogue terminals is provisioned.

5) Connection Group ID – The CSF obtains the Connection Group ID from service logic.

Additional procedures are included for confirmation of bearer establishment (continuity) across the BICC access network. The CSF receives confirmation that the bearer is available between all ACNs involved with the bearer establishment, out to and including the ACN-E. Confirmation is accomplished by returning a BICC access network control message containing an action indicator "BNC established" from the ACN-E to the CSF. This indication is cascaded hop-by-hop backward from the ACN-E to the CSF. When received at the CSF, in conjunction with receipt of a primitive from the BCF indicating *"BNC set-up success"* (BCF indication not applicable to the IMN configuration), the "BNC established" primitive indicates bearer continuity across the BICC access network.

Procedures at the CSF for the IMN Configuration

The procedures for the IMN configuration are the same as those for the ISN configuration with several differences. The differences account for the fact that the IMN does not have vertical signalling associations with bearer control. Instead, the IMN passes bearer information between the access network and adjacent SNs through interaction with adjacent ACNs and the adjacent SNs.

The outgoing signalling procedure described in 7.4/Q.1902.4, toward the succeeding SN, and the incoming signalling procedures described in 7.5/Q.1902.4, from the preceding SN, are initiated before bearer establishment in the IMN configuration.

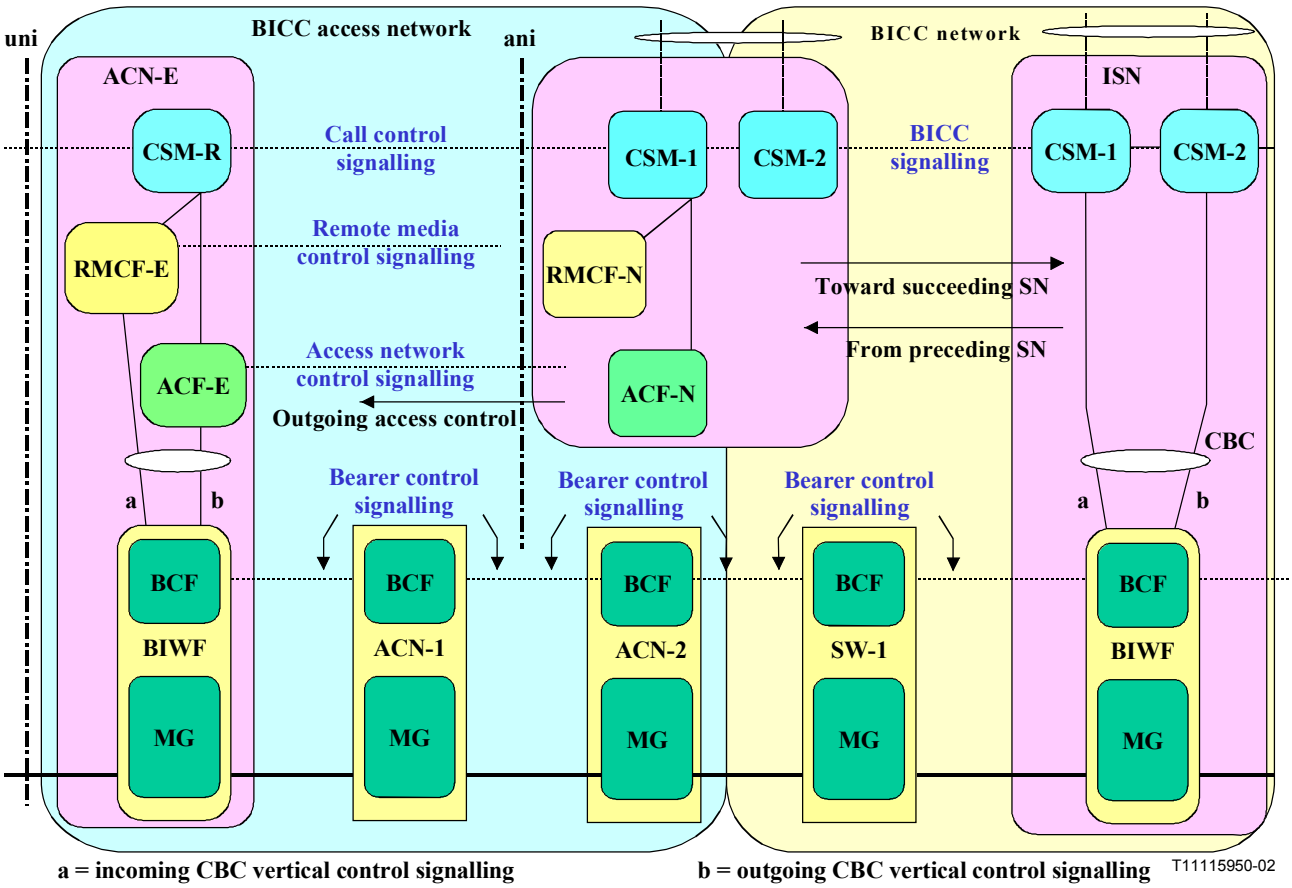


Figure 25/Q.1930 – BICC Access Network Reference Model for IMN Configuration

The outgoing signalling procedures described in 7.4/Q.1902.4, toward the succeeding SN are initiated before bearer establishment in the IMN configuration. The outgoing signalling procedure is started on terminal-originated calls in the following cases:

1) For bearer set-up toward the succeeding SN, to retrieve the address of the BIWF on the network side. This action is taken before sending the access network control message toward the ACN.

2) For bearer setup toward the ACN, to indicate the address of the BIWF of the ACN. This action is taken after the access network control protocol is invoked to obtain the BIWF address of the ACN.

The incoming signalling procedure for sending the APM described in 7.5/Q.1902.4, toward the preceding SN is continued after the access network control procedures are initiated. The signalling procedure toward the preceding SN is interrupted on calls terminating toward the access network in the following cases:

1) For bearer setup toward the ACN, to indicate the address of the BIWF of the ACN. This action is taken after the access network control protocol is invoked to obtain the BIWF address of the ACN.

2) For bearer set-up toward the preceding SN, to establish the bearer from the ACN. The access network control and bearer establishment procedures are completed before the optional APM "*connected*" is sent to the preceding SN.

Detailed Description of Exceptions to ISN Procedures at the CSF for the IMN Configuration

The CSF determines the direction of bearer establishment: forward or backward. Five bearer establishment options in ITU-T Rec. Q.1902.4 are supported with additional identifiers and

additional procedures related to the BICC access network. The procedures in ITU-T Rec. Q.1904.2 are modified such that, rather than conveying information in both the BICC IAM and BICC APM, information is conveyed between the CSF and the succeeding ACN in BICC Access Network Control messages.

1) If the bearer is to be established in the forward direction, i.e. from the CSF toward ACN-E, then the procedures of 7.4.1/Q.1902.4, Per-call bearer set-up in forward direction, apply at the CSF.

   Following are exceptions to the procedures in 7.4.1/Q.1902.4, for the access network configured with an IMN rather than an ISN:

   The CSF serving the access network determines that the bearer is to be established in the forward direction across the access network. This can occur either:

   i) for a call originated from the terminal, where the CSF determines that backward bearer setup is requested for connection to the succeeding SN; or

   ii) for a call terminating from the network, where the CSF determines that forward bearer setup is requested from the preceding SN.

   For the case of the terminal originated call with backward bearer setup from the succeeding SN the following procedures apply:

   i) The CSF does not select a BIWF and procedures start at 1.3), 7.4.1/Q.1902.4, with the sending of a BICC_Data Request primitive (corresponding to a BICC Access Network Control Message) to the selected ACN.

   ii) A BIWF is not selected in 2.3) 7.4.1/Q.1902.4, and the procedures continue toward the succeeding SN following 1.1), 7.4.2/Q.1902.4. The information forwarded in the IAM with BICC_Data Request primitive is the information received from the ACN in 2), 7.4.1/Q.1902.4.

   iii) The Bearer Set-up indication in 2), 7.4.2/Q.1902.4. is received at the ACN, indicating the outgoing setup procedure is successfully completed.

   For the case of the call terminating from the network with forward bearer setup from the preceding SN the following procedures apply:

   i) The CSF does not select a BIWF, however, it may be received in a BICC_Data indication primitive (corresponding to the IAM received from the preceding SN). Procedures start at 1.3), 7.4.1/Q.1902.4, with the sending of a BICC Access Network Control Message to the selected ACN. The information forwarded in the ACM with BICC_Data Request primitive is the information received from the preceding SN.

   ii) A BIWF is not selected in 2.3), 7.4.1/Q.1902.4, and the procedures continue toward the preceding SN following 1.3), 7.4.1/Q.1902.4. The information forwarded in the APM with BICC_Data Request primitive is the information received from the ACN in 2), 7.4.1/Q.1902.4.

   iii) The Bearer Set-up indication in 3), 7.4.1/Q.1902.4, is received at the ACN, indicating the incoming setup procedure is successfully completed.

2) If the bearer is to be established in the backward direction, i.e. from the ACN toward the CSF, then the procedures of 7.4.2/Q.1902.4, Per-call bearer set-up in backward direction, apply at the CSF.

   Following are exceptions to the procedures in 7.4.2/Q.1902.4 for the access network configured with an IMN rather than an ISN:

The CSF serving the access network determines that the bearer is to be established in the backward direction across the access network. This can occur either:

i) for a call originated from the terminal, where the CSF determines that forward bearer setup is requested for connection to the succeeding SN; or

ii) for a call terminating from the network, where the CSF determines that backward bearer setup is requested from the preceding SN.

For the case of the terminal originated call with forward bearer setup to the succeeding SN the following procedures apply:

i) The CSF first initiates the procedures in 7.4.1/Q.1902.4, toward the succeeding SN, however, the CSF will not select the BIWF using the BNC Information request primitive.

ii) On receipt of the BICC_Data Indication primitive in 2), 7.4.1/Q.1902.4, a BIWF is not selected by the CSF, however, the procedures continue following 1.1), 7.4.2/Q.1902.4 with the sending of a BICC Access Network Control Message to the ACN. The information forwarded in the ACM with the BICC_Data Request primitive is the information received from the succeeding SN in accordance with 2), 7.4.1/Q.1902.4.

iii) The Bearer Set-up Connect indication in 3), 7.4.1/Q.1902.4. is received at the ACN, indicating the outgoing setup procedure is successfully completed.

For the case of the call terminating from the network with backward bearer setup toward the preceding SN the following procedures apply:

i) The CSF does not select a BIWF, however, it may be received in a BICC_Data indication primitive (corresponding to the IAM received from the preceding SN). Procedures start at 1.1), 7.4.2/Q.1902.4, with the sending of a BICC Access Network Control Message to the selected ACN. The information forwarded in the ACM with BICC_Data Request primitive is the information received from the preceding SN.

ii) The Bearer Set-up Connect indication in 3), 7.4.1/Q.1902.4 is received at the ACN, indicating the incoming setup procedure is successfully completed.

3) For fast bearer establishment using bearer control tunnelling, then the procedures of 6.2 and 7.4.3/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – fast set-up, apply at the CSF.

Following are exceptions to the procedures in 7.4.3/Q.1902.4, for the access network configured with an IMN rather than an ISN:

The CSF serving the access network determines that the bearer is to be established in the backward direction across the access network. This can occur either:

i) for a call originated from the terminal, where the CSF determines that forward/backward bearer setup is requested for connection to the succeeding SN; or

ii) for a call terminating from the network, where the CSF determines that backward/forward bearer setup is requested from the preceding SN.

For the case of the terminal originated call with forward/backward bearer setup to the succeeding SN the following procedures apply:

i) The CSF issues a BICC_Data Request primitive (corresponding to an ACM) toward the ACN following the procedures of 1.1), 7.4.2/Q.1902.4. The CSF subsequently receives a BICC_Data indication primitive (corresponding to an ACM) from the ACN that indicates "*tunnelling to be used*" which includes BNC characteristics and bearer control PDU.

ii) The CSF follows the procedures in 7.4.3/Q.1902.4.

iii) The CSF proceeds to relay bearer control PDUs in BICC_Data request primitives between the ACN and the succeeding SN,

iv) The "*BNC set-up success*" indication in 3), 7.4.3/Q.1902.4 is received at the ACN, indicating the outgoing setup procedure is successfully completed.

For the case of the call terminating from the network with backward/forward bearer setup toward the preceding SN the following procedures apply:

i) The CSF receives a BICC_Data indication primitive (corresponding to an IAM) from the preceding SN that indicates "*tunnelling to be used*" which includes BNC characteristics and bearer control PDU. The CSF relays the contents of the BICC_Data indication in a BICC_Data Request primitive (corresponding to an ACM) to the ACN.

ii) The CSF proceeds to relay bearer control PDUs in BICC_Data request primitives between the ACN and the preceding SN.

iii) The CSF follows the procedures in 7.4.3/Q.1902.4.

iv) The "*BNC set-up success*" indication 3), 7.4.3/Q.1902.4 is received at the ACN, indicating the incoming setup procedure is successfully completed.

4) For delayed bearer establishment using bearer control tunnelling, then the procedures of 6.2 and 7.4.4/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – delayed forward, apply at the CSF.

Following are exceptions to the procedures in 7.4.4/Q.1902.4, for the access network configured with an IMN rather than an ISN:

The CSF serving the access network determines that the bearer is to be established in the forward direction across the access network. This can occur either:

i) for a call originated from the terminal, where the CSF determines that backward bearer setup is requested for connection to the succeeding SN; or

ii) for a call terminating from the network, where the CSF determines that forward bearer setup is requested from the preceding SN.

For the case of the terminal originated call with backward bearer setup from the succeeding SN the following procedures apply:

i) The CSF does not select a BIWF and procedures start at 1.3), 7.4.4/Q.1902.4, with the sending of a BICC_Data Request primitive (corresponding to a BICC Access Network Control Message) to the selected ACN.

ii) A BIWF is not selected and a Bearer Set-up request is not issued in 2.2), 7.4.4/Q.1902.4. Procedures continue toward the succeeding SN following 1.1), 7.4.5/Q.1902.4. The information forwarded in the APM with BICC_Data Request primitive is the information received from the ACN in 2), 7.4.4/Q.1902.4.

iii) The CSF proceeds to relay bearer control PDUs in BICC_Data request primitives between the ACN and the succeeding SN.

iv) The "*BNC set-up success*" indication in 4), 7.4.4/Q.1902.4 is received at the ACN, indicating the outgoing setup procedure is successfully completed.

For the case of the call terminating from the network with forward bearer setup from the preceding SN the following procedures apply:

i) The CSF does not select a BIWF, however, it may be received in a BICC_Data indication primitive (corresponding to the IAM received from the preceding SN). Procedures start at 1.3), 7.4.4/Q.1902.4 with the sending of a BICC Access Network Control Message to the selected ACN. The information forwarded in the ACM with BICC_Data Request primitive is the information received from the preceding SN.

ii) A BIWF is not selected and a Bearer Set-up request is not issued in 2.2), 7.4.4/Q.1902.4. Procedures continue toward the preceding SN following 2), 7.4.5/Q.1902.4.

iii) The "*BNC set-up success*" indication in 4), 7.4.4/Q.1902.4 is received at the ACN, indicating the incoming setup procedure is successfully completed.

5) For delayed bearer establishment using bearer control tunnelling, then the procedures of 6.2 and 7.4.5/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – Delayed Backward, apply at the CSF.

Following are exceptions to the procedures in 7.4.5/Q.1902.4 for the access network configured with an IMN rather than an ISN:

The CSF serving the access network determines that the bearer is to be established in the backward direction across the access network. This can occur either:

i) for a call originated from the terminal, where the CSF determines that forward bearer setup is requested for connection to the succeeding SN; or

ii) for a call terminating from the network, where the CSF determines that backward bearer setup is requested from the preceding SN.

For the case of the terminal originated call with forward bearer setup to the succeeding SN the following procedures apply:

i) The CSF first initiates the procedures in 7.4.5/Q.1902.4 toward the succeeding SN, however, the CSF will not select the BIWF using the BNC Information request primitive.

ii) The CSF proceeds to relay bearer control PDUs in BICC_Data request primitives between the ACN and the succeeding SN.

iii) The "*BNC set-up success*" indication in 3), 7.4.5/Q.1902.4 is received at the ACN, indicating the outgoing setup procedure is successfully completed.

For the case of the call terminating from the network with backward bearer setup toward the preceding SN the following procedures apply:

i) The CSF does not select a BIWF, however, it may be received in a BICC_Data indication primitive (corresponding to the IAM received from the preceding SN). Procedures start at 1.1), 7.4.5/Q.1902.4 with the sending of a BICC_Data Request primitive (corresponding to a BICC Access Network Control Message) to the selected ACN. The information forwarded in the ACM with BICC_Data Request primitive is the information received from the preceding SN.

ii) The CSF proceeds to relay bearer control PDUs in BICC_Data request primitives between the ACN and the succeeding SN.

iii) The "*BNC set-up success*" indication in 3), 7.4.5/Q.1902.4 is received at the ACN, indicating the incoming setup procedure is successfully completed.

Procedures at the ACN-T

The ACN-T, if present, is both a recipient and an initiator of bearer set-up requests. Both incoming and outgoing bearer set-up procedures apply, therefore, at the ACN-T and at any other intermediate ACNs between the CSF and the ACN-E.

Incoming bearer set-up procedure

The procedures of 7.5/Q.1902.4, Incoming bearer set-up procedure, apply. The procedures are modified such that, rather than conveying information in both the BICC IAM and BICC APM, information is conveyed between the CSF and the succeeding ACN-T in BICC Access Network

Control messages. There are also additional identifiers and additional procedures related to the BICC access network.

1) If the bearer is to be established in the forward direction, i.e. from the CSF toward the ACN, then the procedures of 7.5.1/Q.1902.4, Per-call bearer set-up in forward direction, apply at the ACN-T.
2) If the bearer is to be established in the backward direction, i.e. from the ACN toward the CSF, then the procedures of 7.5.2/Q.1902.4, Per-call bearer set-up in backward direction, apply at the ACN-T.
3) For fast bearer establishment using bearer control tunnelling, then the procedures of 6.2 and 7.5.3/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – fast set-up, apply at the ACN-T.
4) For delayed bearer establishment using bearer control tunnelling, then the procedures of 6.2 and 7.5.4/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – delayed forward, apply at the ACN-T.
5) For delayed bearer establishment using bearer control tunnelling, then the procedures of 6.2 and 7.5.5/Q.1902.4, Per-call bearer set-up using bearer control tunnelling – delayed backward, apply at the ACN-T.

The ACN-T will forward the "BNC established" indication toward the CSF in a BICC access network control message when the following three conditions are true:

1) The "BNC established" indication is received from the subtending ACN, either ACN-T or ACN-E.
2) The outgoing bearer set-up procedure is complete according to 7.4/Q.1902.4 Outgoing Bearer Set-Up Procedure.
3) The incoming bearer set-up procedure is complete according to 7.5/Q.1902.4 Incoming Bearer Set-Up Procedure.

Outgoing bearer set-up procedure

The procedures of 7.4/Q.1902.4, Outgoing bearer set-up procedure, apply at the ACN-T. The procedures are modified such that, rather than conveying information in both the BICC IAM and BICC APM, information is conveyed between the ACN-T and the succeeding ACN, either ACN-T or ACN-E, in BICC Access Network Control messages.

The ACN-T assigns a new Access Control Association ID for each new bearer that is to be established between itself and the succeeding ACN-T or ACN-E. It determines the direction of bearer establishment: forward or backward. The five bearer establishment options in ITU-T Rec. Q.1902.4 are supported with additional identifiers and procedures for the BICC access network including timers as outlined in this Recommendation under Procedures at the CSF.

Additional identifiers related to the BICC access network are conveyed along with the "connect" Action indicator:

1) ACA-ID – Regardless of the source of the call, the ACN-T assigns a new Access Control Association ID for each new bearer that is to be established.
2) User-ID – The User-ID obtained from the CSF is passed forward to the succeeding ACN, either ACN-T or ACN-E.
3) Logical Port ID – The Logical Port ID obtained from the CSF or preceding ACN-T is passed forward to the succeeding ACN, either ACN-T or ACN-E.
4) Connection ID – The Connection ID obtained from the CSF or preceding ACN-T is passed forward to the succeeding ACN, either ACN-T or ACN-E.

5) Connection Group ID – The Connection Group ID obtained from the CSF or preceding ACN-T is passed forward to the succeeding ACN, either ACN-T or ACN-E.

Procedures at the ACN-E

The ACN-E is always the recipient of the bearer set-up request, rather than the initiator. Only incoming bearer set-up procedures, therefore, apply to the ACN-E.

The procedures of 7.5/Q.1902.4, Incoming bearer set-up procedure, apply. The procedures are modified such that, rather than conveying information in both the BICC IAM and BICC APM, information is conveyed between the ACN-T and the succeeding ACN-E in BICC Access Network Control messages. There are additional indicators and procedures related to the BICC access network.

The ACN-E will send the "BNC established" indication toward the CSF in a BICC access network control message when the following condition is true:

1) The incoming bearer set-up procedure is complete according to 7.5/Q.1902.4 Incoming bearer set-up procedure.

12.3 Additional set-up procedures

12.3.1 Introduction

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

12.3.2 Codec Negotiation

The support of the codec negotiation procedure is optional. When codec negotiation is required, the negotiation has to be performed edge-to-edge (across the BICC network(s) and BICC Access Network(s) that support this procedure).

Codec negotiation is not applicable in case of reuse of idle bearers, refer to Annex B/Q.1902.4.

If codec negotiation is to be supported across the BICC access network, the CSF is the node that initiates codec negotiation, regardless of the direction of call establishment. The ACN-T may perform the functions of either transiting or terminating node. The ACN-E may perform the functions of the terminating node.

The procedures of 8.3.4, 8.3.5 and 8.3.6/Q.1902.4 apply, however, codec information is conveyed in the BICC access network control message rather than the BICC APM.

12.3.3 Bearer Control Unit Identifier (BCU-ID)

The procedures of 8.19/Q.1902.4 apply, however, the BCU-ID is conveyed in the BICC access network control message rather than the BICC APM. The procedures apply at the CSF, ACN-T, and ACN-E.

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

The outband transport of tones across the access network may be implemented in the access network control protocol rather than in the remote media control protocol, if required by the access network configuration. The procedures for outband transport of tones are implemented in the CSF and the ACN-T if it is present in the access network, rather than in the ACN-E.

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 that insertion of signals into the bearer at the ACN-T is to be performed, a BICC access network control message may be forwarded to the ACF-T following the procedures of 8.20.2.1/Q.1902.4.

If a BICC access network control message indicating that a Signal is switched on/off is received by the ACN-T and insertion of signals in the bearer is required, the BCF is requested to insert or disconnect the signal following the procedures of 8.20.2.2/Q.1902.4.

The procedures of 8.20/Q.1902.4 apply, however, the tone information is conveyed in the BICC access network control message rather than the BICC APM.

12.3.5 Codec modification/mid-call codec negotiation procedures

If codec modification/mid-call codec negotiation is supported across the BICC access network, either the CSF, ACN-T or ACN-E may act as initiating or terminating nodes. The ACN-T may also perform the function of transiting node.

The procedures of 10.4/Q.1902.4 Codec modification/mid-call codec negotiation procedures apply. However, codec modification information is conveyed in the BICC access network control message rather than the BICC APM.

12.3.6 Connection Group Identifier

The connection group identifier is used to connect a bearer on the user-network interface of the ACN-E to a virtual private facility within the BICC access network. The logic used to determine that a request is to be connected to the virtual permanent facility is beyond the scope of this recommendation. The procedures for connecting to a virtual permanent facility are provided in this clause.

When the logic that controls the CSF determines that a call request is to be provided over a permanent virtual facility, the normal bearer establishment and bearer release procedures in this Recommendation are followed. In addition to the information required in the BICC access network control message, the Connection Group Identifier is included in the request to establish the bearer.

Two options are possible within the BICC access network:

1) The virtual permanent facility is provisioned in the ACN-E;

2) The virtual permanent facility is provisioned in the ACN-T.

The ACN in which the permanent virtual facility is provisioned recognises the Connection Group Identifier and passes the request to its Bearer Control Function. The bearer control function uses the virtual permanent facility for connection of the bearer.

12.3.7 Interaction with services invoking bearer redirection

The CSF may have capabilities of a Bearer Control Anchor (BC-Anchor) or a Redirecting-to node for the purposes of bearer redirection as described in clause 6/Q.1902.6, Bearer Redirection. As a result, an ACN-E or an ACN-T may be involved with the bearer redirection procedures.

Redirection of Bearer at ACN-E

The CSF shall follow the procedures in clause 6/Q.1902.6 for the BC-Anchor or for the Redirecting-to node when interacting with other CSFs.

The CSF shall follow the successful bearer establishment, bearer cut-through, and normal bearer release procedures of this Recommendation for redirecting the bearer between the BC-Anchor and the Redirecting-to node when interacting with ACNs.

Bearer cut-through will occur in ACN-E with implicit association of the BNC-ID of the new bearer and the common Connection ID at the user-network interface of both old and new bearers. If late cut-through is requested then four options provisioned in the CSF may be available depending on the BICC access network capabilities:

If the BICC access network supports only implicit cut-through at all ACNs:

1) The CSF invokes cut-through in a BIWF within the domain of the CSF (not applicable to the IMN).

2) The CSF delays establishment of the new bearer until receipt of a BICC_Data indication primitive (corresponding to any message) with action indicator set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect cut-through request*".

If the BICC access network supports explicit cut-through:

3) The CSF invokes explicit cut-through at the ACN-E using remote media control procedures. It may also apply "cut BNC" to the old bearer at ACN-E. The Operation Index in the Connection Identifier is set to a new value in the BICC access network control and remote media control messages related to the new bearer.

4) The CSF invokes explicit cut-through at all ACN-Ts using procedures in "Bearer cut-through (optional procedures at ACN-T)" in this Recommendation. The Operation Index in the Connection Identifier is set to a new value in the BICC access network control and remote media control messages related to the new bearer.

The ability of the ACN-E to bridge the old and new bearer in a three-way connection must be provisioned in the CSF. If bridge capability is not provided at the ACN-E, then the CSF must remove the old bearer before establishment of the new bearer, for implicit cut-through operation, or before cut-through of the new bearer, for explicit cut-through operation.

Redirection of Bearer at ACN-T (optional procedures at ACN-T)

The BICC access network configuration may be such that redirection of the bearer is best executed at the ACN-T, rather than at the ACN-E. The procedures in this clause are included to support execution of bearer redirection at the ACN-T.

This is a network option that requires enhanced capabilities in the ACN-T and that must be provisioned in the CSF and the ACN-T. How this is provisioned is beyond the scope of this Recommendation.

The CSF shall follow the procedures in clause 6/Q.1902.6 for the BC-Anchor or for the Redirecting-to node when interacting with other CSFs.

On receipt of a redirection request in an APM from the CC-Anchor, the CSF shall behave as follows:

– BAT ASE information received from the CC-Anchor is passed in a BICC access network control message to the ACN-T where redirection will occur. The address of the ACN-T may be determined from the User-ID of the call to be redirected. The existing ACA-ID is used with the Bearer Redirection Indicator "*New connection identifier*" included in the request for a new bearer.

– BICC access network control information received from the ACN-T related to the redirection is passed on to the CC-Anchor in a BAT ASE with Bearer Redirection Indicator "*new connection identifier*" included.

– BICC access network control information that is related to the existing bearer is passed between the CSF, ACN-T, and ACN-E following normal procedures.

The ACN-T will become the BC-Anchor, and respond appropriately to the CC-Anchor through the CSF.

If late cut-through is requested, then four options provisioned in the CSF may be available depending on the BICC access network capabilities:

If the BICC access network supports only implicit cut-through at all ACNs:

1) The CSF invokes cut-through in a BIWF within the domain of the CSF (not applicable to the IMN);

2) The CSF delays establishment of the new bearer until receipt of a BICC_Data indication primitive (corresponding to any message) with action indicator set to "Bearer Redirect" and including Bearer Redirection Indicator "redirect cut-through request".

If the BICC access network supports explicit cut-through:

3) The CSF invokes explicit cut-through at the ACN-E using remote media control procedures. It may also apply "cut BNC" to the old bearer at ACN-E. The Operation Index in the Connection Identifier is set to a new value in the BICC access network control and remote media control messages related to the new bearer.

4) The CSF invokes explicit cut-through at an ACN-T using procedures in "Bearer cut-through (optional procedures at ACN-T)" in this Recommendation, except that all BICC access network control messages are addressed to the ACN-T that is serving as the BC-Anchor.

The ability of the ACN-T to bridge the old and new bearer in a three-way connection must be provisioned in the CSF. If bridge capability is not provided at the ACN-T, then the old bearer must be removed before establishment of the new bearer, for implicit cut-through operation, or before cut-through of the new bearer, for explicit cut-through operation.

Release of the old bearer connection at the ACN-T, or BC-Anchor, follows the procedures of 6.5.2.2.3/Q.1902.6, Release of old bearer connection. All BICC access network control messages are addressed to the ACN-T that is serving as the BC-Anchor.

12.3.8 Procedures for reuse of idle bearers

The procedures of Annex B/Q.1902.4, Procedures for reuse of idle bearers, apply. However, information is conveyed in the BICC access network control message rather than the BICC APM.

12.3.9 Procedures for use of Structured AAL 1 bearers

The procedures of Annex E/Q.1902.4, Procedures for use of Structured AAL1 bearers, apply. However, information is conveyed in the BICC access network control message rather than the BICC APM.

12.4 Normal bearer release

The CSF follows the release procedures in clause 11/Q.1902.4, Normal call release. In addition, the CSF initiates release of the bearer hop-by-hop across the BICC access network.

NOTE – At an ISN/IMN an indication of call release is issued to the ACN, but the subsequent decision to initiate bearer release protocol is the responsibility of BCF logic within each ACN.

12.4.1 Procedures at the CSF

The CSF initiates bearer release by issuing a BICC access network control message containing the following information:

1) ACA-ID for the bearer association being released. (Assigned by the CSF at bearer establishment);

2) Action ID set to Release BNC;

3) BNC-ID of the bearer being released, if known;

4) Connection ID related to the bearer being released;

5) Logical Port ID of the bearer being released;

6) User ID related to the bearer being released.

Timer T5 is set and a confirmation of bearer release request is awaited from the succeeding ACN, either ACN-T or ACN-E. Timer T6 is set at the first instance of timer T5.

12.4.2 Procedures at the ACN-T

The ACN-T, if present, is both a recipient and an initiator of bearer release requests. Both incoming and outgoing bearer release procedures apply, therefore, at the ACN-T at and any other intermediate ACNs between the CSF and the ACN-E.

Incoming bearer release procedure

On receipt of a BICC access network control message containing an Action ID set to release BNC, the ACN-T will perform two functions:

1) Notify its BCF logic of the release request.
2) Return a BICC access network control message to the preceding ACN or CSF containing the following information:
   - ACA-ID for the bearer association being released;
   - Action ID set to Release BNC Confirm;
   - BNC-ID of the bearer being released, if known;
   - User ID related to the bearer being released.

Outgoing bearer release procedure

ACN-T will issue a BICC access network control message to the succeeding ACN, either ACN-T or ACN-E, containing the following information:

1) ACA-ID for the bearer association being released. (Assigned by the ACN-T at bearer establishment);
2) Action ID set to Release BNC;
3) BNC-ID of the bearer being released, if known;
4) Connection ID related to the bearer being released;
5) Logical Port ID of the bearer being released;
6) User ID related to the bearer being released.

Timer T5 is set and a confirmation of bearer release request is awaited from the succeeding ACN, either ACN-T or ACN-E. Timer T6 is set at the first instance of timer T5.

12.4.3 Procedures at the ACN-E

The ACN-E is always the recipient of the bearer release request, rather than the initiator. Only incoming bearer release procedures, therefore, apply to the ACN-E.

On receipt of a BICC access network control message containing an Action ID set to release BNC, the ACN-E will perform two functions:

1) Notify its BCF logic of the release request.
2) Issue a BICC access network control message to the preceding ACN or CSF containing the following information:
   - ACA-ID for the bearer association being released;
   - Action ID set to Release BNC Confirm;
   - BNC-ID of the bearer being released, if known;
   - User ID related to the bearer being released.

The ACN-E may also perform other functions including the dissociation of resources related to the bearer in the BICC access network from the Connection ID.

12.5 Bearer cut-through (optional procedures at ACN-T)

The BICC access network configuration may be such that the end-to-end cut-through of the bearer is best executed at the ACN-T. The procedures in this clause are included to support execution of bearer cut-through. This is a network option that must be provisioned in the CSF and the ACN-T.

The ACN-T may be provisioned in one of two ways:

1) Cut-through of the bearer path in the forward and backward directions is immediate upon satisfaction of the following two conditions (implicit operation):
   - The outgoing bearer set-up procedure is complete according to 7.4/Q.1902.4, Outgoing bearer set-up procedure.
   - The incoming bearer set-up procedure is complete according to 7.5/Q.1902.4, Incoming bearer set-up procedure.
2) Cut-through of the bearer path in the forward and backward directions is executed under the control of the CSF (explicit operation). Explicit operation is used when the control of cut-through cannot be executed at another node, e.g. a BIWF in the domain of the ISN, or ACN-E in the BICC access network.

Implicit cut-through requires no specific procedures.

Explicit cut-through uses the "cut-through forward" and "cut-through backward" Action indicators in the BICC access network control message to instruct the ACN-T to execute the cut-through.

In the ACN-T, and consistent with the definition of forward and backward in the access network, the forward direction is defined from the "incoming side" to the "outgoing side". The backward direction is defined from the "outgoing side" to the "incoming side", keeping in mind that the "incoming side" for the purpose of access network control messaging is always toward the CSF. Conversely, the "outgoing side" for the purpose of access network control messaging is always toward the ACN-E.

The CSF on receipt of an indication that the call is connected, e.g. ANSWER message, constructs a BICC access network control message containing the following indicators.

NOTE 1 – The CSF need not wait for an ANSWER indication to cut-through the bearer. Cut-through indicators may be sent at any time based on call procedures:

1) User-ID related to the bearer that is to be cut-through.

NOTE 2 – There may be multiple bearers per User-ID.

2) ACA-ID related to the bearer that is to be cut-through. (The ACA-ID changes hop-by-hop across the network).
3) BNC-ID of the bearer that is to be cut-through, if known. (The BNC-ID changes hop-by-hop across the network).
4) Action indicators set to either "cut-through forward", "cut-through backward", or both.

Timer T3 is set when an access network control message is sent containing the "*Cut-through*" action indicator.

The BICC access network control message is routed to the ACN-E address associated with the User-ID, following the normal procedures for message routing. Each ACN-T in the path between the CSF and ACN-E, which is provisioned for explicit cut-through, will execute the actions as indicated. Each ACN-T that is provisioned for implicit cut-through will forward the message and disregard the contents, i.e. pass on and do not send notification.

The ACN-E will return a response following the normal procedures for message routing, i.e. based on the User-ID, it will determine the destination address of the ISN/IMN and include its address as the Requesting Node. The message shall contain the following indicators:

1) User-ID related to the bearer that is to be cut-through.

NOTE 3 – There may be multiple bearers per User-ID.

2) ACA-ID related to the bearer that is to be cut-through. (The ACA-ID changes hop-by-hop across the network).

3) BNC-ID of the bearer that is to be cut-through, if known. (The BNC-ID changes hop-by-hop across the network).

4) Action indicators set to either "cut-through forward", "cut-through backward", or both.

Each successive ACN-T will forward the "cut-through" indication toward the CSF in a BICC access network control message when one of the following conditions is true:

1) The ACN-T is provisioned for implicit cut-through, i.e. pass on and do not send notification.

2) The ACN-T is provisioned for explicit cut-through, and cut-through is complete.

12.6 Cut BNC (optional procedures at ACN-T)

The BICC access network configuration may be such that the end-to-end cut-through of the bearer is best executed at the ACN-T. In order to provide selected services, it may be advantageous to sever the BNC connection at the ACN-T without releasing the BNC. This is a network option that must be provisioned in the CSF and the ACN-T in conjunction with Bearer Cut-through optional procedures.

The procedures for Cut BNC are the same as the procedures for Bearer Cut-through with the exception that the Action Indicator "Cut-through Forward" and "Cut-through Backward" are replaced with "Cut BNC Forward" and "Cut BNC Backward".

Timer T4 is set when an access network control message is sent containing the "*Cut-BNC*" action indicator.

12.7 Abnormal conditions

12.7.1 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 Rec. Q.706). However, undetected errors at the lower message transport layers and CSF or ACN malfunctions may produce signalling information messages that are either ambiguous or inappropriate.

Unreasonable or unexpected signalling information may also be received at a CSF or ACN due to differing levels of signalling protocol enhancements at different CSFs and ACNs within a network. A CSF using a more enhanced version of the protocol may send information to an ACN using a less enhanced version of the protocol and which is outside the protocol definition supported at that ACN.

To account for the occurrences listed above, the formats and codes for message and information element compatibility are supported in the BICC access network. The full adaptation of these codes to the BICC access network is for further study.

12.7.2 Handling of message format errors

The following are considered message format errors:

a) The message length is less than the number of octets required to contain the mandatory variables.

b) An information element's length indicator causes the overall message length to be exceeded.

When a message format error is detected, the message shall be discarded.

12.7.3 Handling of unexpected messages

An unexpected message is one which contains a message type code that is within the set supported at the CSF or ACN, but is not expected to be received at the time that it is received.

When an unexpected message is detected the message shall be discarded.

12.7.4 Compatibility for BICC Access Network Control

Message Compatibility

The Message Compatibility procedures of ITU-T Rec. Q.1902.4 apply to the BICC Access Network message compatibility with the following exceptions:

- Use of the Confusion message is not applicable;
- Use of the Facility Reject message is not applicable;
- Use of the Broadband/narrow-band interworking indicator is not applicable.

Compatibility for the BICC Access Network Identifiers

The BICC access network identifiers include the User ID, Logical Port ID, ACA-ID, Connection ID, Connection Group ID, Application Data IE, and other identifiers defined in ITU-T Rec. Q.765.5.

The compatibility mechanisms of 13.4.8/Q.1902.4 are applied to these identifiers and information elements, however, information is conveyed in the BICC access network control message rather than the BICC IAM or BICC APM. The procedures apply at the CSF and ACNs.

12.8 Timers for the BICC Access Network Control Protocol

The BICC Access Network protocol conveys information specific to multiple signalling protocols, e.g. Q.931, G.964, in addition to BICC access network information. As a result, multiple Recommendations contain the values for timers that are used for protocols such a Q.931 that extend between the BICC CSF and the terminal equipment, or for protocols such as H.248 that extend between the BICC CSF and the ACN-E. The BICC access network is expected to operate within the limits of timers defined in these other signalling Recommendations. In addition, several new timers are recommended for the operation of the BICC Access Network protocol.

The timers listed in this recommendation are unique to the BICC access network, and to the BICC access network control protocol. Table 5 contains the present list of timers unique to BICC Access Network Control. Additional timers specified in ITU-T Rec. Q.1902.4, such as T40 through T43 for DTMF and codec operations, also apply to the BICC access network when such functions are implemented. Some of these timers are referenced in Table 5.

Table 5/Q.1930 – Timers in the BICC Access Network Protocol

Symbol	Time-out value	Cause for initiation	Normal termination	At expiry	Clause reference
T1	1/2 to10 seconds	When a BNC_Request is sent containing the "connect forward" action indicator	At receipt of complete BNC-ID/ BIWF information	Resend *"BNC_Request*" and start timer T1	12.2.1
T2	1/2 to10 seconds	When a BNC_Request is sent containing the "connect forward" action indicator or when a BNC_Establish is sent containing the "connect backward" action indicator.	At receipt of "*BNC Established*" response	Resend *"BNC Request*" or resend "*BNC_Establish*" and start timer T2	12.2.1
T3	1/2 to10 seconds	When *"Cut-through*" action indictator is sent	At receipt of "*Cut-through*" response	Resend *"Cut-through*" and start timer T3	12.5
T4	1/2 to10 seconds	When *"Cut-BNC*" action indicator is sent	At receipt of "*Cut-BNC*" response	Resend *"Cut-BNC*" and start timer T4	12.6
T5	15-60 seconds	When BNC Release action indicator is sent	At receipt of Release Confirm	Retransmit BNC Release and start timer T5	12.4
T6	5-15 minutes	When initial BNC Release action indicator is sent	At receipt of Release Confirm	Alert maintenance personnel and remove the ACA-ID from service, stop T5. Procedure continues until maintenance intervention occurs.	12.4
T40	Reference Q.1902.4	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/ Q.1902.4
T41	Reference Q.1902.4	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/ Q.1902.4
T42	Reference Q.1902.4	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/Q.1902.4
T43	Reference Q.1902.4	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/Q.1902.4

13 Coding and Procedures for Remote Media Control

The coding and procedures for the remote media control information are an extension to the coding and procedures in ITU-T Rec. H.248.1. They are based on the BICC protocol requirements in the

BICC Access and Access Network Requirements. Procedures that fall within national protocols are outside of the scope of this Recommendation.

The BICC access network identifiers are placed ahead of Application Data in the contents of the Remote Media Control message. The Application Data contains a message defined in another protocol, e.g. H.248 series of Recommendations, and appears last in the remote media control message.

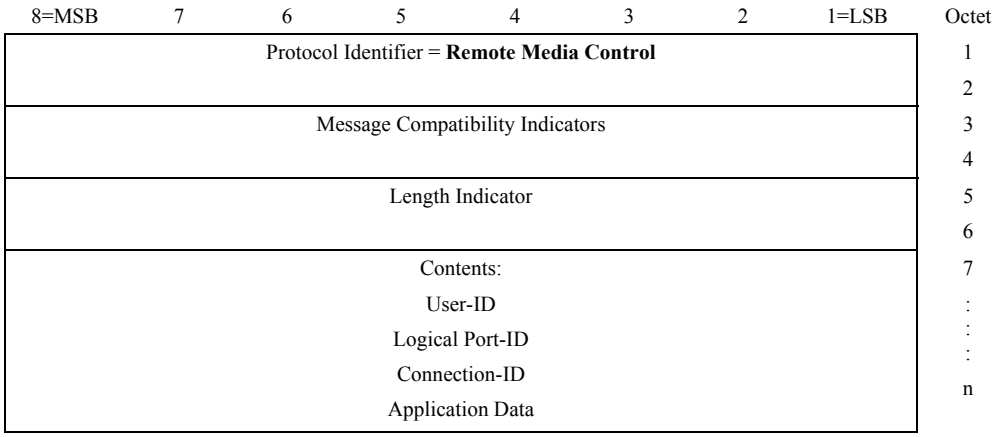


Figure 26/Q.1930 – BICC Remote Media Control Message Format

13.1 H.248 Functions Applicable to Remote Media Control

Basic BICC functionality from H.248.1 (Mandatory):

– H.248.1 v1, Annex E, clause E.1 Generic;

– H.248.1 v1, Annex E, clause E.2 Base Root Package.

Optional BICC functionality from H.248 series Recommendations (depending upon the network services deployed in the network):

– H.248.1 v1, Annex E, clause E.3 Tone Generator Package;

– H.248.1 v1, Annex E, clause E.4 Tone Detection Package;

– H.248.1 v1, Annex E, clause E.5 Basic DTMF Generator Package;

– H.248.1 v1, Annex E, clause E.6 DTMF Detection Package;

– H.248.1 v1, Annex E, clause E.7 Call Progress Tones Generator Package;

– H.248.1 v1, Annex E, clause E.8 Call Progress Tones Detection Package;

– H.248.1 v1, Annex E, clause E.9 Analog Line Supervision Package;

– H.248.1 v1, Annex E, clause E.10 Basic Continuity Package;

– H.248.1 v1, Annex E, clause E.13 TDM Circuit Package;

– H.248.2, Facsimile, text conversation and call discrimination packages;

– H.248.3, User interface elements and action packages;

– H.248.6, Dynamic tone definition package;

– H.248.7, Generic announcement package;

– H.248.10, Media gateway resource congestion handling package.

Basic BICC Functionality (Mandatory):

– Bearer Network Connection Cut Through Package, A.4/Q.1950;

– Generic Bearer Connection Package, A.6/Q.1950.

Optional BICC functionality (depending upon the network services deployed in the network):

– Reuse Idle Package, A.5/Q.1950;
– Bearer Control Tunnelling Package, A.7/Q.1950;
– Basic Call Progress Tones Generator with Directionality, A.8/Q.1950;
– Expanded Call Progress tones Generator Package, A.9/Q.1950;
– Basic Services Tones Generation Package, A.10/Q.1950;
– Expanded Services Tones Generation Package, A.11/Q.1950;
– Intrusion Tones Generation Package, A.12/Q.1950;
– Business Tones Generation Package, A.13/Q.1950.

13.2 Procedures for Remote Media Control

This clause contains the procedures of the Bearer Independent Call Control (BICC) remote media protocol for the support of services described in clause 6. These services are supported independently of the bearer technology in the access network, of the signalling message transport technology in the access network, and of the access signalling protocol. These procedures are applicable to stimulus-based protocols such as analogue loop or analogue trunk signalling.

Call procedures related to the appropriate national or international administration apply to the BICC Access Network. These procedures are extended in the BICC Remote Media Control protocol to include capabilities recommended in ITU-T Rec. H.248.1. Several additional procedures are included specifically for BICC remote media control.

The BICC Remote Media Control protocol performs three major functions:

– It provides call control messaging for stimulus-based terminals, such as analogue loops, using the remote media control protocol.
– It provides control of information conveyed in-band, such as audible ringing, for stimulus-based terminals and for functional terminals such as those operating on ISDN Basic Rate Interfaces and Primary Rate Interfaces.
– It executes bearer cut-through instructions received from the CSF when explicit cut-through is supported in the ACN-E.

The physical attributes of the analogue line, including the type of line, reside in the ACN-E. Call admission and call establishment procedures, therefore, are intended to be independent of the type of analogue line. They are dependent on the specific telecommunications service requested over the line, e.g. Direct Dial In (DDI), Direct Distance Dial (DDD), or Operator Assisted.

The ACN-E performs functions, unique to the type of analogue line, that are required to satisfy call processing in the terminal, e.g. battery reversal, leads attached to ground. It also provides functions required for analogue line signalling in general, such as battery, ringing, and line supervision. Such functions, therefore, are excluded from the BICC Remote Media Control protocol in favour of universal functions related to call control in general, e.g. call origination, call disconnect.

Analogue lines are provisioned in the idle state. This reduces media control messaging related to the unique attributes of each type of line. Additionally, lines are initialized to recognize call processing initiating events such as seizure, using remote media control commands.

For the BICC Access Network, call set-up is divided into three phases:

– Call Admission;
– Bearer Establishment; and
– Call Establishment.

BICC Remote Media Control is engaged during Call Admission and Call Establishment phases of call set-up.

13.2.1 Successful Call Admission

Call admission starts when the CSF receives a service request from the terminal or from the network. It terminates when the CSF authenticates the service request and prepares to ask for resources within the BICC access network.

Origination from Network side of the CSF

This procedure assumes the conditions described in 7.2.8/Q.1902.4, Actions required at the destination SN, for progressing the call, are satisfied.

The CSF, on receipt of a call request from the network that will terminate on an analogue line, authenticates the request and prepares to establish the bearer connections within the access network for the terminating half of ISN-A, and toward the preceding SN on the network side in case of the IMN configuration. It maintains the status of the analogue line and other attributes of the requested connection:

1) serving ACN Address (determined from internal data bases and BICC User ID);
2) BICC User ID (determined from called address information);
3) BICC Logical Port ID (determined from internal data bases and BICC User ID);
4) service options including preferred connection group (determined from internal data bases); and
5) preferred setup option, either Forward or Backward Bearer Connection.

On completion of the call admission phase, i.e. when the CSF at the ISN/IMN has received the complete selection information from the network and has authenticated the service request, the CSF determines if a bearer is to be established between an ACN and a SN.

1) The CSF initiates the BICC Access Network Control protocol in 12.2 to initiate bearer establishment and to request the bearer resources needed within the BICC access network to connect the call, if a bearer is to be established.
2) The CSF proceeds to process the service request, if a bearer is not required by the requested service.

If the call is to be routed to the terminal equipment, the outgoing signalling procedure is initiated after the bearer establishment procedures is complete if a bearer is to be established.

Origination from the Terminal Equipment

The ACN-E, on receipt of a call request (seizure) from a stimulus-based terminal, e.g. analogue line, notifies the CSF of the request. It includes information in a BICC remote media control message to notify the CSF:

1) serving ISN/IMN Address related to the BICC User ID (determined from internal data bases);
2) BICC User ID for the terminal originating the call (determined from internal data bases);
3) BICC Logical Port ID (determined from internal data bases);
4) Connection ID for the analogue line set to its initial value (determined from provisioned information); and
5) Event descriptor for the seizure within an event notification coded according to ITU-T Rec. H.248.1.

The CSF, on receipt of the call request, initiates the national protocol appropriate for call processing. The exact sequence of call processing operations is determined by the national protocol,

and in some cases by the service associated with the particular type of analogue line. In many cases, the CSF will use remote media control commands to request that the ACN-E provide dial tone to the terminal. After which, the terminal will respond with digits representing the destination address for the call. The digits are relayed to the CSF using remote media control protocol. Dial Tone may be removed by the ACN-E based on provisioned digit handling instructions:

1) after receipt of the first digit by the ACN-E; or

2) after a remote media control command is received from the CSF requesting removal of Dial Tone at a later point in the sequence of digits; or

3) by other local arrangement.

The CSF authenticates the call request and processes the digits.

On completion of the call admission phase, i.e. when the CSF at the ISN/IMN has received the complete selection information from the calling party and has authenticated the service request, the CSF determines if a bearer is to be established between an ACN and a SN.

1) The CSF initiates the BICC Access Network Control protocol in 12.2 to initiate bearer establishment and to request the bearer resources needed with the BICC access network to connect the call, if a bearer is to be established.

2) The CSF proceeds to process the service request, if a bearer is not required by the requested service.

If the call is to be routed to another SN, the outgoing signalling procedure is initiated after the bearer establishment procedures is complete if a bearer is to be established. In some situations, such as overlap sending, the outgoing signalling procedures may be initiated before complete address information is received.

13.2.2 Successful Call Establishment

This clause describes the minimal set of CSF and ACN procedures used for successful call establishment for stimulus-based terminals, e.g. analogue lines.

A common set of procedures is provided to support call establishment between the ISN/IMN and the ACN-E. These procedures support call establishment across the BICC access network using the BICC Remote Media Control protocol supplemented by the coding and procedures in ITU-T Rec. H.248.1 for analogue lines. Additional procedures may also be used. These are described in later clauses of this Recommendation.

A prerequisite to initiation of Call Establishment is the completion of Bearer Establishment, as determined by the CSF in ISN/IMN-A. This occurs after notification is received from Bearer Control, according to the procedures in the BICC Access Network Control protocol in clause 12:

"The CSF receives confirmation that the bearer is available between all ACNs involved with the bearer establishment, out to and including the ACN-E. Confirmation is accomplished by returning a BICC access network control message containing an action indicator "BNC established" from the ACN-E to the CSF. This indication is cascaded hop-by-hop backward from the ACN-E to the CSF. When received at the CSF, in conjunction with receipt of a primitive from the BCF indicating *"BNC set-up success"* (BCF indication not applicable to the IMN), the "BNC established" primitive indicates bearer continuity across the BICC access network."

Procedures at the CSF

When the CSF receives confirmation that the bearer is available between all ACNs involved with the bearer establishment, out to and including the ACN-E, it proceeds to establish the call across the BICC access network using call procedures of the appropriate national or international administration. In some cases, these procedures are dependent on the type of service provided to the terminal equipment by the analogue loop.

Origination from Network side of the CSF

The CSF, on confirmation of bearer path availability, initiates the national protocol appropriate to complete the establishment of the call. The exact sequence of call processing operations is determined by the national protocol, and in some cases, by the service associated with the particular type of analogue line. The CSF may alert the terminal equipment to the incoming call request. It may issue a BICC Remote Media Control message to the ACN-E that serves the stimulus-based terminal. It includes information in a BICC remote media control message in addition to the alerting (e.g. ringing, or seizure) signal coded according to ITU-T Rec. H.248.1:

1) serving ACN-E Address related to the BICC User ID (determined from internal data bases);
2) BICC User ID for the destination of the call (determined from internal data bases);
3) BICC Logical Port ID (determined from internal data bases);
4) Connection ID for the analogue line set to its initial value (determined from provisioned information); and
5) Signal descriptor to apply ringing or to seize the analogue line coded according to ITU-T Rec. H.248.1.

The ACN-E, on receipt of a call request (e.g. ringing or seizure) from the CSF, applies a signal appropriate to the type of terminal on the analogue line. If ringing is applied, the ACN-E may perform autonomous actions depending on the BICC access network capabilities:

If the BICC access network supports only implicit cut-through at all ACNs:

1) The ACN-E disconnects the bearer path between the ringing generator and the BICC access network during the ringing cycle. On receipt of seizure or answer from the terminal (e.g. Trip Ring), the bearer path is reconnected.

If the BICC access network supports explicit cut-through at any ACNs:

1) The ACN-E may remain passive and the CSF invokes bearer path cut-through by sending BICC Remote Media Control messages to the ACN-Ts, on receipt of seizure or answer from the terminal (e.g. Trip Ring). The Operation Index in the Connection Identifier is set to its initial value in the BICC access network control related to the bearer.
2) The CSF invokes bearer path cut-through by sending BICC Remote Media Control messages to the ACN-E on receipt of seizure or answer from the terminal (e.g. Trip Ring). The Operation Index in the Connection Identifier is set to its initial value in the BICC access network control and remote media control messages related to the bearer.

The CSF continues to send signals to, and receive event notifications from, the ACN-E, using the BICC Remote Media Control protocol. The exact signalling sequence is determined by the national protocol and the service associated with the particular type of analogue line. Some of the services that may apply during and after alerting are listed here:

1) Generation and detection of digits (refer to E.5/H.248.1, v1 Basic DTMF Generator Package and E.6/H248.1, v1 DTMF detection Package.)
2) Generation and detection of tones (refer to ITU-T Rec. H.248.1 v1 and Annex A/Q.1950).

The CSF, after indication of ANSWER in a Remote Media Control message received from the ACN-E, may initiate bearer cut-through in both directions, or, as appropriate, to the national protocol, if it has not already done so. The BICC Access Network Protocol allows for cut-through in three ways, one of which shall be provisioned in the CSF:

1) At a BIWF in the domain of the controlling CSF using the BICC CBC protocol in ITU-T Rec. Q.1950 and the contents coded according to 7.1.7/H.248.1 v1, LocalControl Descriptor, with mode property set to send-only, receive-only, send/receive, inactive. This option is not applicable to the IMN configuration.

2) At one or more ACN-Ts in the domain of the controlling CSF using BICC Access Network Control procedures in this Recommendation.

3) At the ACN-E using BICC Remote Media Control with contents coded according to 7.1.7/H.248.1 v1, LocalControl Descriptor, with mode property set to send-only, receive-only, send/receive, inactive, or loop-back. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the Context within the ACN-E.

The call establishment phase, in the destination SN, ends with cut-through on ANSWER indication.

Origination from the Terminal Equipment

The CSF, on confirmation of bearer path availability, initiates the national protocol to complete the establishment of the call. The exact sequence of call processing operations is determined by the national protocol, and, in some cases, by the service associated with the particular type of analogue line.

The CSF continues to send signals to, and receive event notifications from, the ACN-E, using the BICC Remote Media Control protocol. The exact signalling sequence is determined by the national protocol and the service associated with the particular type of analogue line. Some of the services that may apply during and after alerting are listed here:

1) Generation and detection of digits (refer to E.5/H.248.1 v1, Basic DTMF Generator Package, and E.6/H.248.1, v1, DTMF detection Package.)

2) Generation and detection of tones (refer to ITU-T Recs H.248.1 v1, and Annex A of Q.1950).

The CSF may initiate bearer cut-through as described in 7.2.1.2.2/Q.1902.4, Internal through Connection of the Bearer Path, or, as appropriate, to the national protocol, if it has not already done so. The BICC Access Network Protocol allows for cut-through in three ways, one of which shall be provisioned in the CSF:

1) At a BIWF in the domain of the controlling CSF using the BICC CBC protocol in ITU-T Rec. Q.1950 and the contents coded according to 7.1.7/H.248.1 v1, LocalControl descriptor, with mode property set to send-only, receive-only, send/receive, inactive. This option is not applicable to the IMN configuration.

2) At one or more ACN-Ts in the domain of the controlling CSF using BICC Access Network Control procedures in this Recommendation.

3) At the ACN-E using BICC Remote Media Control with contents coded according to 7.1.7/H.248.1 v1, LocalControl descriptor, with mode property set to send-only, receive-only, send/receive, inactive, or loop-back. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the context within the ACN-E.

The call establishment phase, in the originating SN, ends with cut-through on ANSWER indication.

13.3 Additional set-up procedures

13.3.1 Introduction

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

13.3.2 Echo Control

The procedures of 8.4/Q.1902.4, Echo Control, apply at the Originating and Destination ISN/IMN. Additionally, the CSFs in the Originating and Destination ISN/IMNs use BICC Remote Media Control and coding specified in C.9/H.248.1, v1 to enable echo cancellation at the ACN-E.

1) Incoming Echo Canceller shall refer to the side of the ACN-E facing the BICC access network.

2) Outgoing Echo Canceller shall refer to the side of the ACN-E facing the terminal equipment.

NOTE – In the case of the Originating ISN/IMN, the meaning or incoming and outgoing in the BICC Remote Media Control message is reversed from the definition in 8.4/Q.1902.4, Echo Control.

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

The outband transport of tones across the access network may be implemented in either the remote media control protocol or the access network control protocol. The decision is dependent on the access network configuration. The procedures for outband transport of tones are implemented in the CSF and the ACN-E if the remote media control protocol is used.

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, the procedures of 8.20.2.1/Q.1902.4 are followed.

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 CSF has three options for inserting or disconnecting the signal. These options are dependent on the BICC access network configuration:

1) The CSF follows the procedures of ITU-T Rec. Q.1902.4 and requests that a BCF within its domain insert or disconnect the signal (not applicable to the IMN).

2) The CSF uses BICC Remote Media Control and coding of ITU-T Rec. H.248.1 v1, to request that an ACN-E within its domain insert or disconnect the signal.

3) The CSF uses BICC Access Network Control and the procedures of 8.20.2.1/Q.1902.4 to request that an ACN-T within its domain insert or disconnect the signal.

Signal Detection in Bearer at ACN-E

If information is received from the ACN-E and the CSF determines that DTMF and tone information must be detected and transported in the BICC access network call control signalling, the BICC remote Media Control protocol may be used. The CSF will request that the ACN-E detect the DTMF or tone information using the coding and procedures in ITU-T Rec. H.248.1 v1. The DTMF or tone information will be handled according the procedures in ITU-T Rec. Q.1902.4 and the procedures in this Recommendation.

13.3.4 Interaction with services invoking bearer redirection

The CSF may have capabilities of a Bearer Control Anchor (BC-Anchor) or a Redirecting-to node for the purposes of bearer redirection as described in clause 6/Q.1902.6, Bearer Redirection. As a result, an ACN-T or an ACN-E may be involved with the bearer redirection procedures.

The CSF shall follow the procedures in clause 6/Q.1902.6 for the BC-Anchor or for the Redirecting-to node when interacting with other SNs.

The CSF shall follow normal cut-through procedures of this Recommendation at the ACN-E when redirecting the bearer between the BC-Anchor and the Redirecting-to node. Any operation, such as cut-though, requested of the ACN-E related to each new or redirected bearer, will be identified by a new Operation Index function within the Connection Identifier. This allows the ACN-E to distinguish operations related to new or redirected bearers from those related to old bearers.

Two possibilities are provided for the cut-through of the new bearer connection at the BC-Anchor node as invoked through the ACN-E:

1) Immediate Cut-Through, where the new bearer connection is cut-through immediately when it is established, following the procedures for standard bearer set-up.
2) Late Cut-Through, where the new bearer connection is under control of the CC_Anchor node which sends an explicit cut-through request to the BC-Anchor to trigger cut-through.

Additionally, two possibilities for bearer cut-through in general are provided at the ACN-E:

1) Implicit cut-through, where the bearer is immediately connected across the ACN-E when both incoming and outgoing paths are established
2) Explicit cut-through, where the stream mode in the H.248.1 Local Control Descriptor is used to connect the incoming and outgoing bearer paths in the ACN-E.

The BC-Anchor may trigger Late Cut-through at the ACN-E only if Explicit cut-through is supported at the ACN-E. Other options for explicit cut-through are contained in this Recommendation under BICC Remote Media Control protocol and BICC Access Network Control protocol.

13.4 Normal call release

The CSF follows the release procedures in clause 11/Q.1902.4, Normal call release, which first request the BCF to disconnect the internal through-connection of the bearer path. In addition, the CSF:

1) uses BICC Remote Media Control protocol and follows the procedures specified in appropriate national protocols to release the connection between the ACN-E and the terminal equipment;
2) uses the BICC Access Network Control protocol to initiate release of the bearer hop-by-hop across the BICC access network, after ensuring that the terminal is released and no other actions require services of the bearer; and
3) issues an indication of call release to the BCF within the domain of the CSF, not the domain of ACNs (not applicable to the IMN).

NOTE 1 – At an ISN/IMN an indication of call release is issued to the ACN, but the subsequent decision to initiate bearer release protocol is the responsibility of BCF logic within each ACN.

NOTE 2 – In the situation where there is no BCF in the domain of the CSF, the application of ROH at the ACN-E may be the viable option in the BICC Access Network.

Release from Network side of the CSF

The CSF, on receipt of release indication from the network, initiates the appropriate national protocol, and any procedures specific to the terminal, to release the connection between the ACN-E and the terminal equipment. The exact sequence of call processing operations is determined by the national protocol, and, in some cases, by the service associated with the particular type of analogue line.

The CSF may issue a BICC Remote Media Control message to the ACN-E that serves the stimulus-based terminal. It includes information in a BICC remote media control message, in addition to the "clear" signal coded according to ITU-T Rec. H.248.1:

1) serving ACN-E Address related to the BICC User ID (determined from internal data bases);

2) BICC User ID (determined from internal data bases);

3) BICC Logical Port ID (determined from internal data bases);

4) Connection ID for the analogue line set to its initial value (determined from provisioned information); and

5) Signal descriptor coded according to ITU-T Rec. H.248.1 and set to "clear back" for a release from the network side of the CSF.

The ACN-E, on receipt of the "clear back" request from the CSF, applies a signal appropriate to the type of terminal on the analogue line. If the ACN-E does not receive confirmation from the terminal that the terminal is disconnected, e.g. loop open or on hook, it may notify the CSF using the BICC Remote Media Control protocol. The CSF may then apply Receiver Off Hook (ROH) in one of two ways:

1) at the ACN-E using BICC Remote Media Control protocol coded according to Annex A/Q.1950 and ITU-T Rec. H.248.1 v1; or

2) at a BIWF in the domain of the CSF using BICC CBC protocol in ITU-T Rec. Q.1950.

When the CSF receives confirmation that the terminal has disconnected, e.g. applied loop open or on-hook, it proceeds to request bearer release. It may also use the BICC Remote Media Control protocol to request that the ACN-E detect seizure on the idle connection to the terminal equipment.

NOTE 3 – The analogue line attached to the ACN-E is returned to its idle state by actions within the ACN-E. That is, there is no explicit signalling to control the state of various types of analogue lines.

Release from the Terminal Equipment

The ACN-E, on receipt of a clear indication from the terminal equipment issues a BICC Remote Media Control message to the CSF containing the following:

1) serving CSF address related to the BICC User ID (determined from internal data bases);

2) BICC User ID (determined from internal data bases);

3) BICC Logical Port ID (determined from internal data bases);

4) Connection ID for the analogue line set to its initial value (determined from provisioned information); and

5) Event descriptor coded according to ITU-T Rec. H.248.1 and set to "clear forward" for a release from the terminal equipment.

The CSF, on receipt of "clear forward" event from the terminal equipment, initiates the appropriate national protocol, and any procedures specific to the terminal, to confirm release of the connection between the ACN-E and the terminal equipment. The exact sequence of call processing operations is determined by the national protocol, and, in some cases, by the service associated with the particular type of analogue line.

The CSF proceeds to request bearer release. It may also use the BICC Remote Media Control protocol to request that the ACN-E detect seizure on the idle connection to the terminal equipment.

NOTE 4 – The analogue line attached to the ACN-E is returned to its idle state by actions within the ACN-E. That is, there is no explicit signalling to control the state of various types of analogue lines.

13.5 Bearer cut-through procedures

The CSF may initiate bearer cut-through as described in 7.2.1.2.2/Q.1902.4, Internal through connection of the bearer path, or, as appropriate, to the national protocol. The BICC Access Network Protocol allows for cut-through in three ways, one of which shall be provisioned in the CSF:

1) At a BIWF in the domain of the controlling CSF using the BICC CBC protocol in ITU-T Rec. Q.1950 and the contents coded according to 7.1.7/H.248.1 v1, LocalControl

descriptor, with mode property set to send-only, receive-only, send/receive, inactive. This option is not applicable to the IMN configuration.

2) At one or more ACN-Ts in the domain of the controlling CSF using BICC Access Network Control procedures in this Recommendation.

3) At the ACN-E using BICC Remote Media Control with contents coded according to 7.1.7/H.248.1 v1, LocalControl descriptor, with mode property set to send-only, receive-only, send/receive, inactive, or loop-back. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the context within the ACN-E.

The BICC access network configuration may be such that the end-to-end cut-through of the bearer is best executed at the ACN-E. The procedures in this clause are included to support execution of bearer cut-through. This is a network option that must be provisioned in the CSF and the ACN-E.

The ACN-E may be provisioned in one of two ways:

1) Cut-through of the bearer path in the forward and backward directions is immediate upon satisfaction of the following two conditions (implicit operation)
   - The outgoing bearer set-up procedure to the terminal equipment is complete according to the procedures of the BICC Remote Media Control protocol in this Recommendation.
   - The incoming bearer set-up procedure is complete according to 7.5/Q.1902.4, Incoming bearer set-up procedure.

2) Cut-through of the bearer path in the forward and backward directions is executed under the control of the CSF (explicit operation). Explicit operation is used when the control of cut-through cannot be executed at another node, e.g. a BIWF in the domain of the ISN, or at an ACN-T in the BICC access network.

Implicit cut-through requires no specific procedures.

Explicit cut-through uses BICC Remote Media Control protocol. Contents are coded according to 7.1.7/H.248.1 v1, LocalControl descriptor, with mode property set to send-only, receive-only, send/receive, inactive, or loop-back. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the context within the ACN-E. That is, cut-through is controlled at the side of the ACN-E that has adjacency to the terminal equipment.

13.6 Cut BNC procedures

Cut BNC operation uses Explicit cut-through procedures of the BICC Remote Media Control protocol. Contents are coded according to 7.1.7/H.248.1 v1, LocalControl descriptor, with mode property set to send-only, receive-only, send/receive, inactive. The TerminationID for the descriptor will reference the relationship between the BICC Connection ID and the context within the ACN-E. That is, cut-through is controlled at the side of the ACN-E that has adjacency to the terminal equipment.

13.7 Abnormal conditions

13.7.1 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 Rec. Q.706). However, undetected errors at the lower message transport layers and CSF or ACN malfunctions may produce signalling information messages that are either ambiguous or inappropriate.

Unreasonable or unexpected signalling information may also be received at a CSF or ACN due to differing levels of signalling protocol enhancements at different CSFs and ACNs within a network.

A CSF using a more enhanced version of the protocol may send information to an ACN using a less enhanced version of the protocol and which is outside the protocol definition supported at that ACN.

To account for the occurrences listed above, the formats and codes for message and information element compatibility are supported in the BICC access network. The full adaptation of these codes to the BICC access network is for further study.

13.7.2 Handling of message format errors

The following are considered message format errors:

a) The message length is less than the number of octets required to contain the mandatory variables.

b) An information element's length indicator causes the overall message length to be exceeded.

When a message format error is detected, the message shall be discarded.

13.7.3 Handling of unexpected messages

An unexpected message is one which contains a message type code that is within the set supported at the CSF or ACN, but is not expected to be received at the time that it is received.

When an unexpected message is detected the message shall be discarded.

13.7.4 Compatibility for the BICC Remote Media Control

Message Compatibility

The Message Compatibility procedures of ITU-T Rec. Q.1902.4 apply to the BICC Access Network message compatibility with the following exceptions:

- Use of the Confusion message is not applicable;
- Use of the Facility Reject message is not applicable;
- Use of the Broadband/narrow-band interworking indicator is not applicable.

Compatibility for the BICC Access Network Identifiers

The BICC access network identifiers include the User ID, Logical Port ID, ACA-ID, Connection ID, Connection Group ID, Application Data IE, and other identifiers defined in ITU-T Rec. Q.765.5.

The compatibility mechanisms of 13.4.8/Q.1902.4, are applied to these identifiers and information elements.

Compatibility for the BICC Remote Media Control Application Data

The application data is comprised of content from other protocols, e.g. H.248.1.

The error handling and reporting procedures of ITU-T Rec. H.248.1 v1, apply to the content conveyed by the BICC Remote Media Control protocol. Such procedures include 7.3/H.248.1, v1, Command Error Codes, as well as error procedures embedded in ITU-T Rec. H.248.

Appendix I

BICC Access Network Q.921 Relay

This appendix provides an example of protocol stacks for support, over the Generic Signalling Transport in ITU-T Rec. Q.2150.0, of the same functionality, layer services, and primitives that are provided in ITU-T Rec. Q.921 for the signalling layer defined in ITU-T Rec. Q.931. This description is provided to support the legacy service access point between the signalling defined in ITU-T Rec. Q.931 and the data link layer defined in ITU-T Rec. Q.921.

The approach taken is similar to ITU-T Rec. G.964. That is, the entire LAPD frame on SAPI 0 is transported across call control signalling association in the BICC access network after first being encapsulated with a protocol-specific header and a common header. The TEI assignment procedures of ITU-T Rec. Q.921 that are associated with SAPI 63, are implemented in the ACN-E, as they are in the body of this Recommendation in support of ISDN.

I.1 Description of Changes to the BICC Access Network Protocol

This clause describes the changes to the formats, codes, and procedures in the body of this Recommendation to accommodate service access according to ITU-T Rec. Q.921 at the Q.931 signalling layer.

This implementation may result in specification of redundant protocol elements. For example, a BICC UserID is assigned per TEI. The BICC UserID and the Q.921 TEI conveyed in the LAPD frame are synonymous, although coded with different values and used by different protocol entities within the ACN-E and the CSF.

I.2 Protocol Stacks

The protocol stacks are modified as illustrated in Figure I.1.

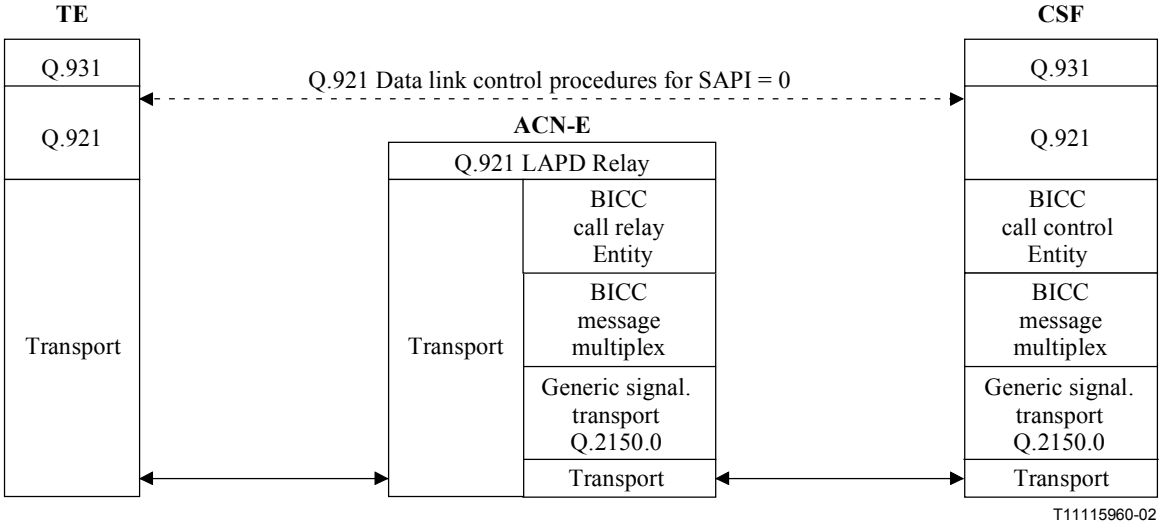


Figure I.1/Q.1930 – Protocol Stacks for Q.921 Interface to Q.931

I.3 Service Access Point to the Q.931 Signalling Layer at the CSF

The primitives supported at the boundary between the signalling layer for ITU-T Rec. Q.931 and the data link layer are defined in ITU-T Rec. Q.921. The BICC access network call control entity will remove all flags before passing the Q.921 LAPD frame to signalling transport, and add flags when passing frames from signalling transport to the Q.921 LAPD layer.

I.4 Service Access Point to the Q.2150.0 Signalling Transport Layer at the CSF

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

The application-specific data passed from the BICC access network call control entity to signalling transport are the entire LAPD frame starting at the beginning of the first address field and including the FCS octets, and excluding the HDLC bit stuffing.

I.5 Service Access Point to the Q.2150.0 Signalling Transport Layer at the ACN-E

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

I.6 Service Access Point to the Q.921 LAPD Relay at the ACN-E

The primitives supported at the boundary between the Q.921 LAPD Relay and the transport layer are defined in ITU-T Rec. Q.921.

The application-specific data passed between LAPD relay and the BICC call relay entity is the LAPD frame including flags as defined in ITU-T Rec. Q.921. The BICC call relay entity will remove all flags before passing the LAPD frame to signalling transport, and add flags when passing frames from signalling transport to Q.921 LAPD Relay.

Appendix II

BICC Access Network Q.931 Relay

This appendix provides an example of protocol stacks for support, over the Generic Signalling Transport in ITU-T Rec. Q.2150.0, of the signalling layer defined in ITU-T Rec. Q.931.

The approach taken is to pass the entire signalling message defined in ITU-T Rec. Q.931, augmented with mandatory and optional BICC access network identifiers, to the Generic Signalling Transport defined in ITU-T Rec. Q.2150.0. That is, the signalling messages, normally conveyed on SAPI 0, are transported across the call control signalling association in the BICC access network after first being encapsulated with a protocol-specific header and a common header defined in this Recommendation. The data link layer defined in ITU-T Rec. Q.921 is terminated on the BICC Access Network at the ACN-E. The TEI assignment procedures of ITU-T Rec. Q.921 that are associated with SAPI 63 are implemented in the ACN-E. Any teleservice or data service conveyed in the D channel is interworked at the data-link layer or the bearer layer in the ACN-E.

II.1 Protocol Stacks

The protocol stacks are illustrated in Figure II.1.

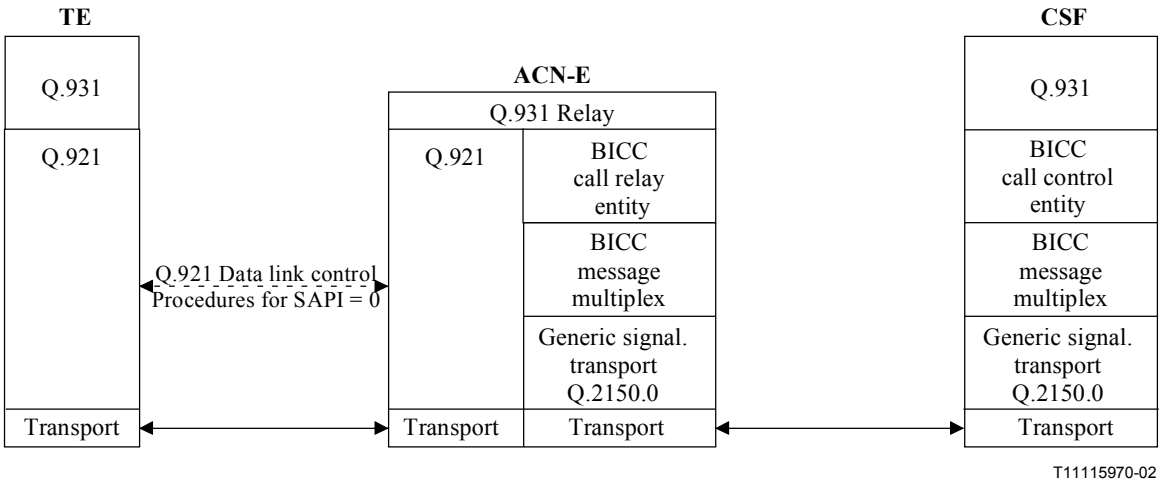


Figure II.1/Q.1930 – Protocol Stacks for Q.931 Relay

II.2 Service Access Point to the Q.931 Signalling Layer at the CSF

The application-specific data passed between the Q.931 signalling layer and the BICC access network call control entity is the entire message defined in ITU-T Rec. Q.931.

II.3 Service Access Point to the Q.2150.0 Signalling Transport Layer at the CSF

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

II.4 Service Access Point to the Q.931 Signalling Layer at the ACN-E

The primitives supported at the boundary between the signalling layer for Q.931 and the Q.921 Data link layer are defined in ITU-T Rec. Q.921.

The application-specific data passed between the Q.931 signalling layer and the BICC call relay entity is the entire message defined in ITU-T Rec. Q.931.

II.5 Service Access Point to the Q.2150.0 Signalling Transport Layer at the ACN-E

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

Appendix III

BICC Access Network Q.2931 Relay

This appendix provides an example of protocol stacks for support, over the Generic Signalling Transport in ITU-T Rec. Q.2150.0, of the signalling layer defined in ITU-T Rec. Q.2931.

The approach taken is to pass the entire signalling message defined in ITU-T Rec. Q.2931, augmented with mandatory and optional BICC access network identifiers, to the Generic Signalling Transport defined in ITU-T Rec. Q.2150.0. That is, the signalling messages are transported across the call control signalling association in the BICC access network after first being encapsulated with a protocol-specific header and a common header defined in this Recommendation. The Service Specific Coordination Function (SSCF) defined in ITU-T Rec. Q.2130 and the Service Specific

Connection Oriented Protocol (SSCOP) defined in ITU-T Rec. Q.2110, are terminated on the BICC Access Network at the ACN-E.

III.1 Protocol Stacks

The protocol stacks are illustrated in Figure III.1. There is no implication of equivalency between the two stacks in the ACN-E. That is, the BICC layers are added on the right side with no intention to be equivalent to the SSCF and SSCOP functions on the left side. In fact, the Q.2150 functions are equivalent to Q.2130 and Q.2110.

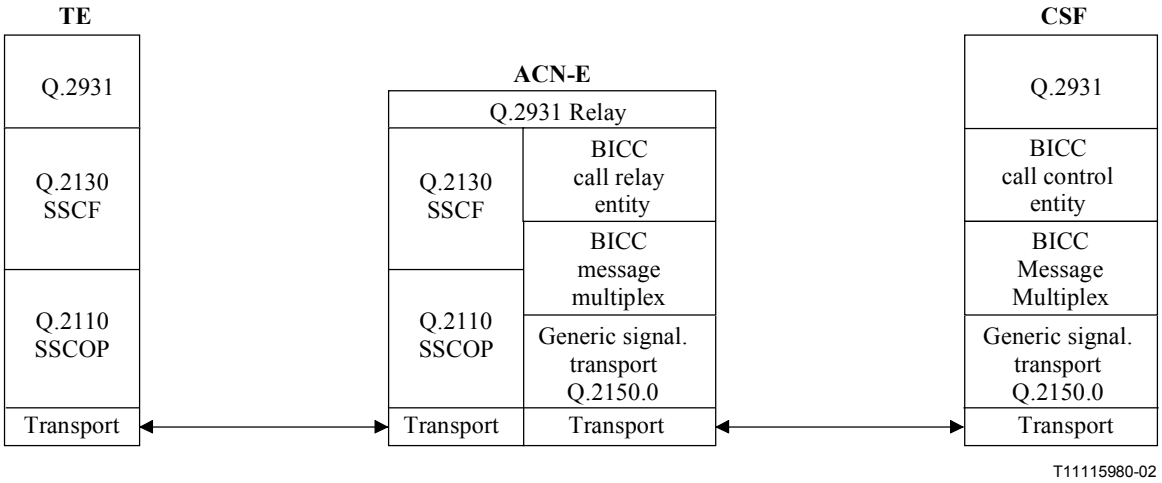


Figure III.1/Q.1930 – Protocol Stacks for Q.2931 Relay

III.2 Service Access Point to the Q.2931 Signalling Layer at the CSF

The application-specific data passed between the Q.2931 signalling layer and the BICC access network call control entity is the entire message defined in ITU-T Rec. Q.2931.

III.3 Service Access Point to the Q.2150.0 Signalling Transport Layer at the CSF

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

III.4 Service Access Point to the Q.2931 Signalling Layer at the ACN-E

The primitives supported at the boundary between the signalling layer for ITU-T Rec. Q.2931 and the SSCF are defined in ITU-T Rec. Q.2130.

The application-specific data passed between the Q.2931 signalling layer and the BICC call relay entity is the entire message defined in ITU-T Rec. Q.2931.

III.5 Service Access Point to the Q.2150.0 Signalling Transport Layer at the ACN-E

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

Appendix IV

BICC Access Network G.964 Relay

This appendix provides an example of protocol stacks for support, over the Generic Signalling Transport in ITU-T Rec. Q.2150.0, of the same functionality, layer services, and primitives that are provided in ITU-T Rec. G.964 for the V5 protocol. This description is provided to support the legacy service access point between the signalling defined in ITU-T Rec. G.964 and the data link layer defined in the same Recommendation. Although this annex is written with reference to ITU-T Rec. G.964, there is no prohibition against extension to ITU-T Rec. G.965.

The entire LAPV5-FE frame is transported across call control signalling association in the BICC access network, after first being encapsulated with a BICC protocol-specific header and a BICC common header. The functions of the V5 access network (AN) are performed in the BICC ACN-E.

IV.1 Description of Changes to the BICC Access Network Protocol

This clause describes the changes to the formats, codes, and procedures in the body of this Recommendation to accommodate service access according to ITU-T Rec. G.964 between the signalling layer and the BICC layer.

This implementation may result in specification of redundant protocol elements. For example, a BICC UserID is assigned per "user port" defined in V5. The BICC UserID and the G.964 envelope function address for ISDN are synonymous, although coded with different values and used by different protocol entities within the ACN-E and the CSF.

IV.2 Protocol Stacks

The protocol stacks are illustrated in Figure IV.1.

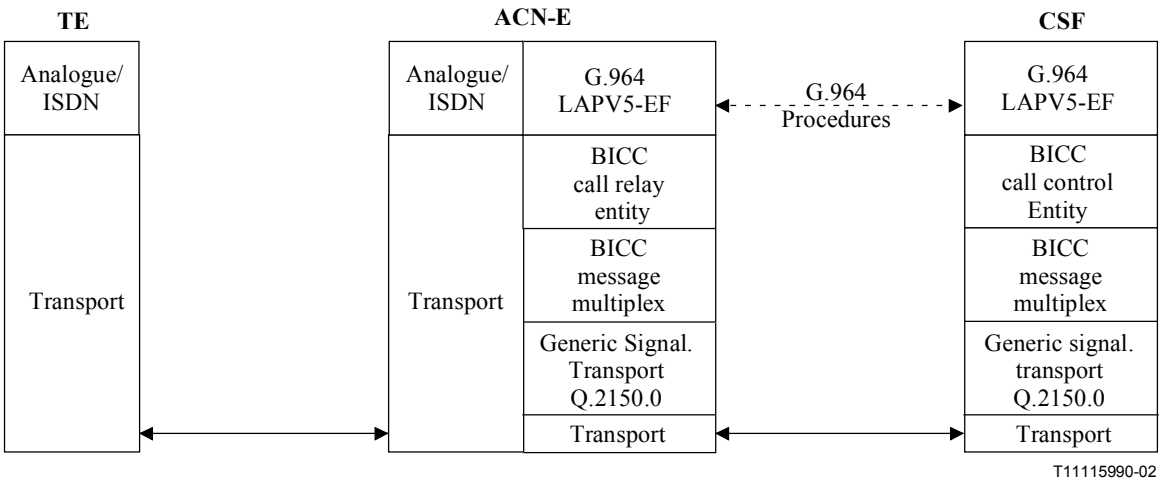


Figure IV.1/Q.1930 – Protocol Stacks for G.964 Relay

IV.3 Service Access Point to the G.964 Signalling Layer at the CSF

The primitives supported at the boundary between the signalling layer for G.964 and the data link layer are defined in ITU-T Rec. G.964. The LAPV5-EF frame is passed to the BICC access network call control entity including flags. The BICC access network call control entity will remove all flags before passing the LAPV5-EF frame to signalling transport, and add flags when passing frames from signalling transport to the LAPV5-EF.

IV.4 Service Access Point to the Q.2150.0 Signalling Transport Layer at the CSF

The primitives supported at the boundary between the BICC Message Multiplex and the signalling transport layer are defined in ITU-T Rec. Q.2150.0.

IV.5 Service Access Point to the LAPV5-EF Relay at the ACN-E

The primitives supported at the boundary between the LAPV5-EF Relay and the transport layer are defined in ITU-T Rec. G.964.

The application-specific data passed between LAPV5-EF relay and the BICC call relay entity is the LAPV5-EF frame including flags as defined in ITU-T Rec. G.964. The BICC call relay entity will remove all flags before passing the LAPV5-EF frame to signalling transport, and add flags when passing frames from signalling transport to the LAPV5-EF.

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[2] ITU-T Q-series Recommendations – Supplement 31 (2000), Technical Report TRQ.2141.0: *Signalling requirement for the support of narrowband services via broadband transport technologies – Capability set 2 (CS-2)*.

[3] ITU-T Q-series Recommendations – Supplement 32 (2000), Technical Report TRQ.2141.1: *Signalling requirement for the support of narrowband services via broadband transport technologies – CS-2 signalling flows*.

[4] ITU-T Q-series Recommendations – Supplement ? (Draft), Technical Report TRQ.2142.1: *Signalling requirements for the support of narrowband services via broadband transport technologies – CS-3 signalling flows*.

[5] ITU-T Q-series Recommendations – Supplement 39 (2002), Technical Report TRQ.2700: *Requirements for signalling in access networks that support BICC*.

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Geneva, 2002