SIGNALLING EVOLUTION FOR B-ISDN

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Abstract : The provision of the Intelligent Network (IN) and Mobile Services increases significantly the signalling network utilization. The progressive introduction of the ATM technology and the broadband services will restructure, in the near future, the present architecture of the existing SS7 protocols. This paper presents some important issues related to the architecture evolution of the existing Signalling System SS7 in the perspective of the deployment of the B-ISDN and the convergence with the IN signalling requirements.

Keywords : Narrow band Signalling protocols, Broadband Signalling protocols, Call Control, Resource Control and Bearer Control Separation

1 Introduction.

In its first Release, the Broadband Integrated Service Digital Network B-ISDN results from the technological transition to broadband transmission and switching and is adapted to geographically fixed and functionally dedicated terminals. The broadband bearer service control of B-ISDN Release 1 is considered as merely an extension of the Narrow band ISDN N-ISDN signalling. The principles of N-ISDN signalling will then be reviewed in section 2 and its extension to B-ISDN will be examined in section 3. However, a share of 50% or more of all communications with either a terminal or a personal mobility is to be considered in a near future. The generalisation of the Client/Server Architecture, as well as the groupware type of application, will soon transform the network terminals into non committed powerful processing machines . Therefore the future B-ISDN will not be only a broadband bearer service network, it will be also a real teleservice multiplexor (integrator). In these conditions the BISDN ulterior releases aim towards a real integration of long term services using multipoint and multiconnection (multimedia) facilities as well as personal and terminal mobility . The impact of mobile and intelligent services on signalling will be examined in section 4. The requirements that the convergence of the long term facilities of B-ISDN towards intelligent services will be discussed in section 5. ISCP, the solution that ITU-T proposes for this convergence of B-ISDN and Intelligent Networks is examined in section 6 and finally some of the necessary features of the future signalling network will be underlined in section 7.

2 Circuit Associated Signalling in N-ISDN

The ISDN based services take advantage of the multiplexing of a variety of different bearer services and of the enriched outband signalling features provided by the two ISDN signalling interfaces: The User to Network Interface UNI and the Network to Network Interface NNI. See Figure 1.

In the N-ISDN the UNI is done over the D Channel which is controlled by a LAP-D procedure using a D Channel protocol referred as DSS1 or Q931 signalling. Q931 brings three main improvements over previous subscriber signalling systems:

a) It is Out of Band which makes it possible to signal during the call.

b) It allows "En bloc" signalling (complete address in one message) and the out band signalling can be extended to call progress and alerting information. This makes it possible to have a machine initiate and complete an originating call or answer and complete a terminating call.

In the N-ISDN the NNI is done over the Message Transfer Part MTP of the Common Channel Signalling Network CCSN by the ISDN User Part ISUP signalling protocol.

All the services of the N-ISDN are based on the capabilities of the UNI and the NNI signalling. The bearer services offered are switched circuits at 64 kb/s, 384 kb/s, 1536 kb/s and 1920 kb/s. The teleservices offered entail the old telephone service as well as the teletex, the telefax and mixed mode services. ISDN also provides supplementary services, some made possible by the ISUP protocol.

The main supplementary services supported by ISUP are User to User Signalling, Closed User Group CUG, Calling line identification, Call Forwarding.

The CCSN takes no real part in the signalling process except for reliably moving messages between Signalling Points SP. See Figure 2. The CCSN may be viewed as a data network of any kind, except that it has been engineered for the very severe reliability standards associated with telephone operation and some specificities of the signalling messages.

It uses the physical connections provided by time slots of the digital carriers that link the user network switches (MTP1). The link control procedure MTP2 on these physical connections is a "Go Back N" procedure with error and flow control significantly different from HDLC. The differences take place in the error detection, re transmission and flow control mechanism. The Signalling Message Handling function MTP3 routes and distributes the signalling messages to the destination Signalling Points. Its routing is based on the limited addressing scheme of the Signalling Points (telephone exchanges identification), and on a load sharing principle by which the signalling traffic of a Signalling Point is shared evenly by two nodes of the CCSN named Signalling Transfer Points or STPs.

The real signalling function is performed by the ISUP protocol. This protocol is the extension to ISDN of the former Telephone User Part TUP protocol. The TUP was bringing to NNI signalling the same advantages that we have seen with Q931 for UNI: It's Out of Band features make it possible to convey to the originating exchange the call progress and alerting information and make it also possible to signal during the user call.

It must be underlined at this point that common channel signalling does not take any place in the routing of the telephone calls: The choice of the outgoing trunk group is performed by the Translator function of the switch. It is followed by the choice of a given trunk line (also called circuit) within this trunk group. This second choice is performed by the selection function of the switch. The Signalling protocols do not take any part in these choices. Common Channel Signalling is only concerned with the transfer to the distant switch of the call information namely its destination and the trunk that was seized to carry it. Thus, a Common Channel Signalling message always carries a circuit identification code. This type of signalling may then be referred as **Circuit Associated Signalling**

3 B-ISDN Release 1 Signalling with Q2931 and BISUP.

3.1 B-ISDN Signalling Evolution.

. The specification of B-ISDN has been planned in successive Releases also called Capability sets CS. See Figure 3. B-ISDN Release 1 entails:

- Connection oriented bearer service with Constant Bit Rate CBR and end to end timing.
- Connectionless bearer service with Variable Bit Rate VBR and no end to end timing.
- Peak allocation of connection bandwidth.

- Point to point connection topology

. Multiparty connections, Bandwidth negotiation, Distributive services are functions of the B-ISDN left for subsequent releases.

3.2 B-ISDN Release 1 Signalling.

Apart from the multiplexing of the connection oriented and connectionless services B-ISDN Release 1 does not fundamentally departs from the N-ISDN principles : Bandwidth allocation is fixed and connection topology is point to point.

The concepts of N-ISDN signalling therefore carry on to apply. The signalling functions of B-ISDN Release 1 are then specified as an adaptation of N-ISDN signalling functions. See Figure 4.

At the UNI the Q931 D Channel Protocol is extended to the broadband environment under the name of Q2931.

At the NNI the Circuit Associated Signalling of ISUP is modified under the name of BISUP.
New protocols really designed for the full capability B-ISDN will be defined for the following Releases of B-ISDN.

In B-ISDN Release 1 signalling messages defined by Q2931 are exchanged between the signalling points over pre established signalling channels. These signalling channels are initiated by a Metasignalling function . At the UNI, three kinds of Signalling Virtual Channels SVC may be provided:

- Point to point : One SVC connection in each direction is allocated to each signalling endpoint.
- Selective Broadcast.
- General Broadcast is used for Broadcast signalling in the Network to User Direction.

Data transmission on the signalling channels is controlled by the Signalling ATM Adaptation Layer SAAL.

3.3 ATM Addresses

The message types used in the Q2931 UNI are the following:

Call Establishment	Call Clearing	Miscellaneous
SET UP	RELEASE	STATUS ENQUIRY
CALL PROCEEDING	RELEASE COMPLETE	STATUS
CONNECT		
CONNECT ACKNOWLEDGE		

The Set-up message contains the address of the call destination. The length of an ATM address is 20 bytes. It is made of an Initial Domain Part IDP and a Domain Specific Part DSP. See Figure 5.

The IDP specifies a sub domain of the global domain space and identifies the authority responsible for assigning ATM addresses in the specified sub domain. The IDP is further divided into two fields The Authority and Format Identifier AFI and the Initial Domain Identifier IDI. See Figure 6.

The AFI specifies the format of the IDI, The Authority responsible for allocating values of the IDI and the abstract syntax of the DSP. Three specified AFI are : Data Country Code DCC, International Code Designator ICD and E164. The IDI specifies the domain from which DSP values are allocated and the authority responsible for allocating DSP values in that domain.

3.4 Q2931 Messages

The Q2931 messages like Q931 messages include a header followed by Information Elements IE. See Figure 7. The header is made of a Protocol Discriminator, the Call Reference and the Message Type. The Protocol Discriminator is used to distinguish Q2931 UNI messages from other types of UNI protocols.

The IE used in the Q2931 messages are made of an IE type, an IE length and an IE information field. See Figure 8. Many IEs are new to Q2931 :

- An ATM Broadband Bearer Capability IE is introduced to carry the ATM specific parameters defined in ITU-T Recommendation F 811 for the characterisation of an ATM Bearer service : ATM transfer mode, Connection mode (Connection Oriented or Connectionless), Traffic type (CBR or VBR) and end to end timing (required or not required).
- The Channel Identification IE of Q931 is replaced by a Virtual Path Connection and a Virtual Channel Identifier (VPCI). The VPCI does not coincide with the Virtual Path Identifier VPI in the ATM cell header since the VPI value will be changed by the ATM switches.
- The AAL Descriptor IE can be used to convey the ATM Adaptation Layer parameters on an end to end basis.
- ATM user cell rate.
- QOS parameters
- Broadband low layer information.

3.5 BISUP Messages

Most messages for the NNI are common between ISUP and BISUP. The table below give the main common messages in their order of appearance within a call. See Figure 9.

B-ISUP Acronym	**Message Meaning**
IAM	Initial Address Message
ACM	Address Complete
CPG	Call ProGress
FOT	FOrward Transfer
ANM	ANswer Message
USR	User to User Information
SUS	SUSpend
RES	RESume
REL	RELease
RLC	ReLease Complete
RSM	ReSet Message
BLO	BLOcking
BLA	BLocking Acknowledgement
UBL	UnBLocking
UBA	UnBlocking Acknowledgement

However some parameter modifications are required for the B-ISDN. Among those:

- The Circuit Identification Code CIC field is replaced by a VPI/VCI indicator.
- The Cause Indicator which gives the reasons for the release of a call is supplemented with a "QOS non available" cause.
- A QOS parameter is provided.

Some new messages are specific to BISUP

B-ISDN specific messages Acronyms	Message Meaning
IAA	Initial Address message Acknowledge
IAR	Initial Address message Reject
CCR	Consistency Check Request
CCRA	Consistency Check Request Acknowledge
CCE	Consistency Check End
CCEA	Consistency Check End Acknowledge
SGM	SeGMentation
NRM	Network Resource Management
UPA	User Part Available
UPT	User Part Test

The B-ISDN Release 1 signalling application is summarised by the time chart of Figure 9.

3.6 The SAAL architecture

If the B-ISDN Release 1 signalling messages are carried over the ATM links, a Signalling ATM Adaptation Layer SAAL has to be introduced to provide a data link service equivalent to the LAP D Q921 procedure at the UNI and MTP2 at the NNI.

The SAAL makes use of the service provided by the Common Part and the Service Specific Part. See Figure 10.

The Common Part itself is decomposed into the Common Part Convergence Sublayer CPCS and Segmentation and Reassembly SAR Sublayer.

The Service Specific part, structured into the Service Specific Convergence Sublayer SSCS, is performed by a combination of the Service Specific Connection Oriented Protocol SSCOP and one among several Service Specific Coordination Functions SSCF.

The functions of the SAAL components are:

- The SAAL-SAP is the Service Access Point by which all SAAL functions are accessed by the next higher layer. It provides bi-directional flow of information.
- The SCCF-UNI is the Service Specific Coordination Function which maps the particular requirements of the UNI layer 3 protocol (ie Q2931) to the SSCOP services.
- The SCCF-NNI is the Service Specific Coordination Function which maps the particular requirements of the NNI layer 3 protocol (i.e. MTP3) to the SSCOP services.
- The SSCOP is the Service Specific Connection Oriented Protocol function which provides mechanisms for the establishment and release of signalling links and the reliable exchange of information between peer entities. SSCOP comprises core procedures used at the UNI as well as the NNI. They perform data link establishment management, information transfer and an error recovery mechanism (Go Back N). For the NNI more complex procedures are provided to meet the requirements of MTP3. Optional procedures at the UNI may be necessary for specific cases like user access through a satellite which would require an enhanced error recovery mechanism.
- The CPCS is the Common Part Convergence Sublayer which provides the transparent transport of Service Data Units SDUs produced by the next higher layer.
- The SAR is the Segmentation And Reassembly function which splits SAR SDUs to fit into ATM cells while incoming cells are reassembled into SAR SDUs and passed to the CPCS.

4 Non Circuit Associated Signalling for the Mobile and Intelligent Networks IN.

4.1 Mobile Communication

The emergence of mobile telecommunication services creates new signalling needs. Mobile communication requires the call control function of the switches to interrogate remote databases such as the Home Location Register HLR . See Figure 11. Such calls activate in this case a two step translation procedure : A first translation reveals that there is not enough information in the local translator to decide on the routing of the call. An interrogation of the HLR is then performed to get the necessary information. See Figure 12

4.2 Non Circuit Associated Signalling

The interrogations of the HLR are usually considered as a signalling function. However, they have to be viewed as a different type of signalling. The classical meaning of signalling entailed only the exchange of the information required for the set-up, the modification or the release of a connection in the user plane. Here, no such connection is established. This is why this type of signalling may be defined as **Non Circuit Associated Signalling NCAS**. See Figure 13.

The same remarks that we have done for mobile telecommunications are true for the IN services. These services are defined by the requirement of an alternate Call Control or alternate Call Management at the level of the network switches because they cannot be provided by the standard Call Control function imbedded in the switches. Such services do not necessarily need specific Customer Premise Equipment CPE or specific bearer service and do not involve any special signalling system. A typical example of IN based service is the Freephone service (800 number call) which violates the switch Call Control in two ways: Reverse charging and open dialling plan. Such a call therefore requires an alternate Call Control program provided by the IN Architecture.

The IN and the Mobile services make use of Non Circuit Associated Signalling transactions and **Look Ahead** signalling procedures. These features are provided by an other stack of SS7 protocols based on the Signalling Connection Control Part SCCP and the Transaction Capability TC. A typical example is the query of information from the HLR for finding where to route a call to a mobile party in Service Control Point SCP.

4.3 The Non Circuit Associated Protocol Stack

The SCCP supplements the MTP by providing a more complete addressing scheme of associated applications and four classes of connectionless or connection oriented communication services. See Figure 14.

TCAP is made of two sublayers : The Component Sublayer and the Transaction Sublayer. The Component Sublayer encapsulates the application requests and the remote operation answers into protocol data units called "components". The Transaction Sublayer formalises the dialogue between the remote operation and the local application.

Like B-ISDN the definition of IN has been planned in successive capability sets. Today's defined IN services constitute the Capability Set 1 CS1. Most typical CS1 services are Freephone (800), Account Card Calling, Virtual Private Network VPN, Universal Personal Telecommunication UPT. All CS1 services are characterised as **type A services** that is to say as being **single ended**, **single medium** and **single point of control**.

The Services of CS1 implemented today and supported by TCAP and SCCP are :
- Calling card and 800/ freephone.
- CLASS Services: Automatic Call Back

Automatic Recall
Screen List Features and Editing
Calling Number Delivery.

5 Convergence of Broadband and IN Signalling Requirements.

5.1 IN CS2 and B-ISDN Release 2

IN Capability Set 1 is now being implemented. An ATM pilot network corresponding to the Release 1 features is being opened over several European countries. In the meanwhile the specifications for the next Intelligent and BISDN Networks Capability Sets, respectively **IN CS2 and B-ISDN Release 2**, are under study with targeted approval dates by the end of 1996. According to this plan:

The IN CS 2 features include:	The B-ISDN RELEASE 2 features include:
- Personal or Terminal Mobility	- Call/Connection Separation and Look Ahead - Service Negotiation: QOS requirements from User. - Bandwidth Allocation - VP configurations: Cross-connected with standard TMN
- Call Party handling and mid call - Out Channel Call Associated Interworking	- Connection Configuration Multi connection Delayed establishment
- International Services	- Bearer Service: CBR with AAL1 VBR with end to end timing AAL2 VBR with no end to end timing: AAL3/4

B-ISDN Release 2 starts to include IN mechanisms by the Call/Connection Separation and the Look Ahead features. Later on, as the specification work develops, all the new capabilities of IN will be meant for B-ISDN, which will become then a full IN network conforming completely to the IN Architecture.

5.2 IN CS3 and B-ISDN Release 3 Convergence

IN CS3 and B-ISDN Release 3 specifications are not expected before 1998. See Figure 15. The following features have been planned for these Capability Sets :

IN CS 3:	B-ISDN RELEASE 3:
Terminal Mobility IN and Broadband Integration	QOS requirements from User and Network Connection Configuration: Multi connection Multi Party Multi Point Multi Media Bearer Service: VBR without end to end timing AAL5
Service Management and Service Creation.	

5.3 Call Control, Resource Control and Bearer Control

A very important feature of the B-ISDN Release 2 is the Bearer Service Negotiation feature. According to ISDN any communication service is considered as the product of a bearer service and a teleservice, see Figure 16. Multiservice operation is achieved by the multiple combinations of the different bearer services provided by the network and the different teleservices. Furthermore a given teleservice may be provided over a variety of different bearer services or a variety of different attributes of a same type of bearer service. These two last possibilities are called Quality Of Service (QOS) Negotiation.

The QOS Negotiation feature makes it compulsory to split the call processing function in several parts : A teleservice control part referred as **Call Control**, and a bearer service control function referred as **Bearer Control**. It will then be necessary to implement a true separation between Call Control and Bearer Control. Actually more recent studies have shown that this Call/Bearer separation is not enough and that a third layer has to be inserted between the Call and the Bearer Control, called **Resource Control**. See Figure 17. The Resource Control is required, for example, to efficiently route multiparty calls. This splitting of the call processing function raises several questions:

- Does such a structure leave untouched the Call Models as we know them today?
- To which functions is the signalling addressed?

5.4 Call Models

The IN specifications assume a representation of the call processing functions called the **Basic Call Model**. We can summarise this model by the following list of functions:

PRESELECTION:	- Origination detection
	- Originating translation
	- Called Party Address acquisition.
SELECTION:	- Conditional Routing and Path search
	- Signalling
	- Connection
SUPERVISION:	- User events detection (on hook, flashes, messages...)
	- Multimetering Message Accounting (if any).
DISCONNECTION:	- Termination detection
	- Terminating translation
	- Disconnection.

A clean mapping of this Call Processing model into distinct Bearer Control functions and Basic Call Control functions is not possible because this model assumes a precedence of the Bearer Control over the service control : Paths have to be found in the switches and Transmission facilities have to be reserved before service signalling can take place. This is reflected by the Circuit Associated Common Channel Signalling: Signalling messages have to carry a Circuit Identification Code before being sent. This is not compatible with a proper Call Control / Bearer Control separation. An other Call model must be proposed to achieve the precedence of Call Control:

CALL CONTROL	RESOURCE CONTROL	BEARER CONTROL
Set up, Originating Translation		
Call Signalling		
Call Negotiation		
Acceptance of Call	Search for Resources and Efficient Routing	
		Negotiation of QOS
		Acceptance of Negotiation
		Conditional Selection of Bearer Facilities satisfying QOS
		Bearer Signalling
		Connection,
		Supervision
		Usage Parameter Control
Terminating Translation		Disconnection
Release		

In this model the Call Control has an end to end significance, while the Bearer Control has a link by link significance. Three different types of signalling appear:
1) The Call Signalling done end to end in a Look Ahead Non Circuit Associated manner,
2) The Resource Signalling done in a Non Circuit Associated manner,
3) The Bearer Signalling also done Out of Band, but link by link.

5.5 Signalling Separation and Call Agents

The signalling separation that we just underlined applies to the UNI as well as the NNI. There are then three signalling entities in the User Terminal Equipment : A Call Control Agent CCA, A Resource Control Agent RCA and a Bearer Control Agent BCA, each of them being associated with the respective Call Control, Resource Control and Bearer Control Signalling Entities of the Local Exchanges. Figure 19 shows that Resource Control takes place between Terminating Equipment and some Exchanges, Local or Transit usually, referred as SSPs Service Switching Points in the IN terminology.

6 ISCP: A Tool For Call Control, Resource Control and Bearer Control Separation.

6.1 ISCP Concept

From the preceding considerations on the requirements of QOS negotiation, Look Ahead procedures, and Separation of Call, Resource and Bearer Control we derive that more modular and flexible signalling protocols have to be specified for the new B-ISDN Releases. See Figure 19. These new protocols should include in the signalling the same separations that are required in the control and preferably use an Object Oriented Technique. An architecture for such a protocol, called **ISDN Signalling Control Part ISCP** has been proposed and adopted by ITU-T for B-ISDN Releases 2 and 3. Other proposals have been made called EXPANSE and Generic Signalling Protocol GSP.

6.2 Architecture of the ISCP Signalling Application

The ISCP signalling application has been defined using the Application Layer Service ALS defined in the OSI Reference Model. According to this architecture Application Processes AP communicate with each other by means of an Application Entity Invocation AEI. The Application Entity AE is a model of the aspects of the Application Process that are concerned with its interaction with other APs. The AEI contains all the functionalities required for the communication of the two APs. The AEI makes use of Single Association Objects SAO which control a single association between two AEIs. The SAO is itself made of Application Service Elements ASE controlled by a Control Function CF. The Establishment and the Release of the association is performed in the SAO by the generic ASE named Association Control Service Element ACSE.

Under this architecture the Call Control Signalling, the Resource Control Signalling and the Bearer Control Signalling become respectively specific ASEs within an SAO invoked by the communicating APs. These signalling service elements are then controlled by the CF of the SAO. See Figure 20.

It must be underlined at this point that resource control under ISCP is considered as using the generic ASE called Commitment, Concurrency and Recovery CCR Services to reserve the required network resources.

6.3 The Sequentiality principle of signalling

A very interesting question is raised about the sequencing of the three signalling functions : Should the three signalling take place at the same time or should they take place sequentially ? This question is subject to debate, however it seems that only the sequential mode would permit the neat separation of functions that is looked after. This sequentiality is obtained by duplicating the Control Functions in Single Association Control Functions SACF each controlling one signalling service of one kind, the sequentiality being insured by a Multiple Association Control Function MACF within the SAO.

7 Concluding Remarks on B-ISDN Signalling.

The debate on the sequentiality principle is the opportunity to lay a few remarks as a ground for the design of the future Signalling Network. The Key issue will be the performance. In our opinion it is a fact that the volume of signalling messages will drastically increase. This is imbedded into the very principle of mobility and of service negotiation. It would be of very little effect to preach simultaneous signalling rather than sequential signalling because it would save one or two messages in the normal case. There might be no real normal case in the future when already IN services contribute to an important part of the revenue of operators. The signalling network will have to carry a large number of messages and there will be very little time for switching signalling messages. What is the use of building a network like B-ISDN if we have to wait seconds for a connection set up? Connections should be established in less than 100 milliseconds. This should be an engineering objective for the design of the Signalling Network. Many solutions are possible to reach such a target. One of them is a special ATM network linking HLRs and B-STP (Broadband-Signal Transfer Points).

N-ISDN Circuit Associated Signalling.

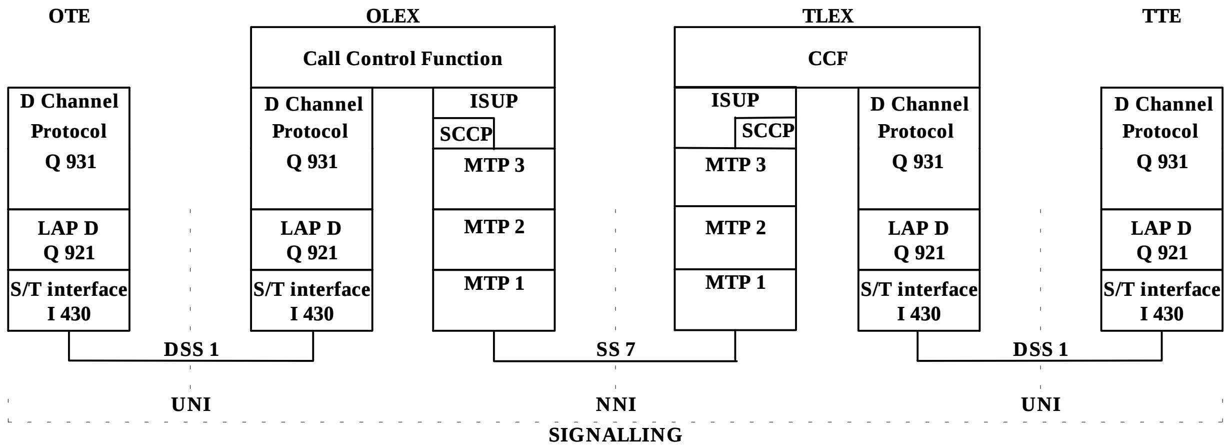

Figure 1

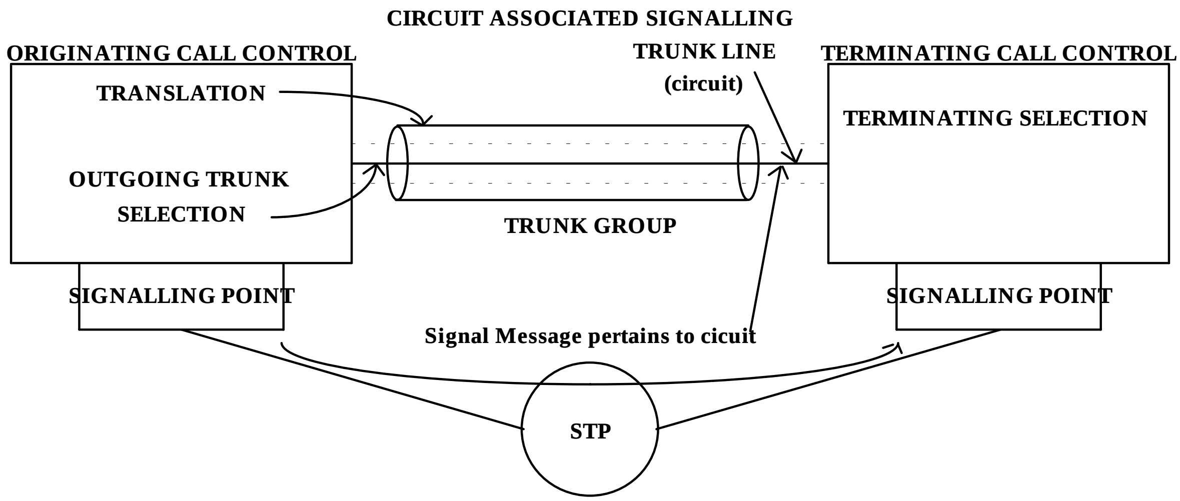

Figure 2

B-ISDN Signalling Evolution.

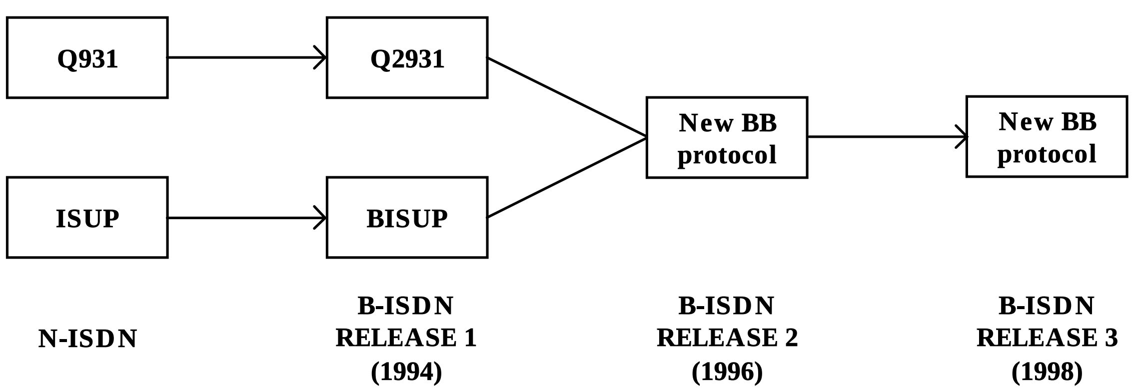

Figure 3

B-ISDN Release 1 Signalling.

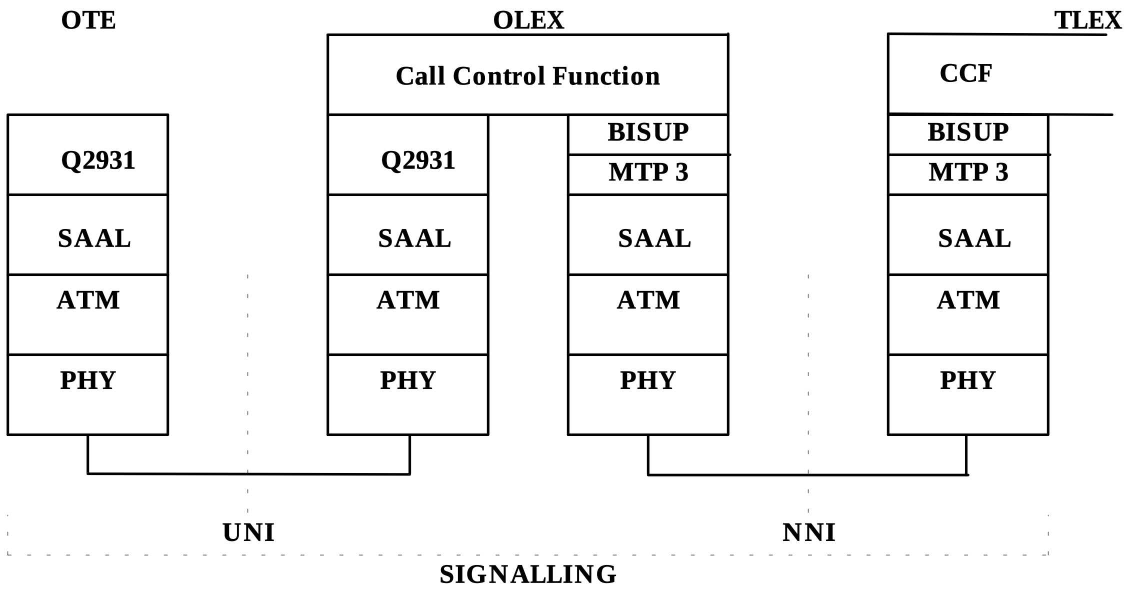

Figure 4

ATM Addresses

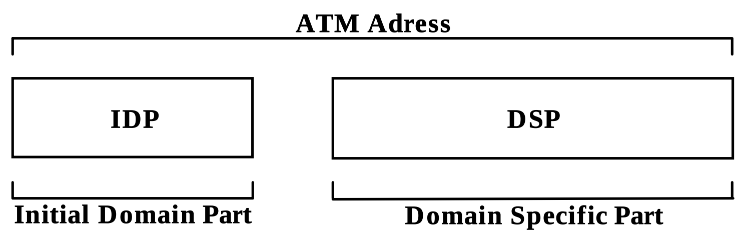

Figure 5

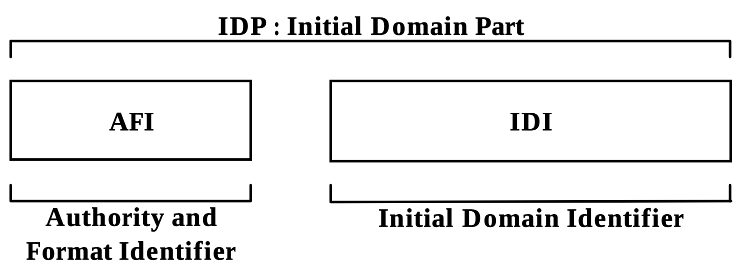

Figure 6

Q2931 Messages

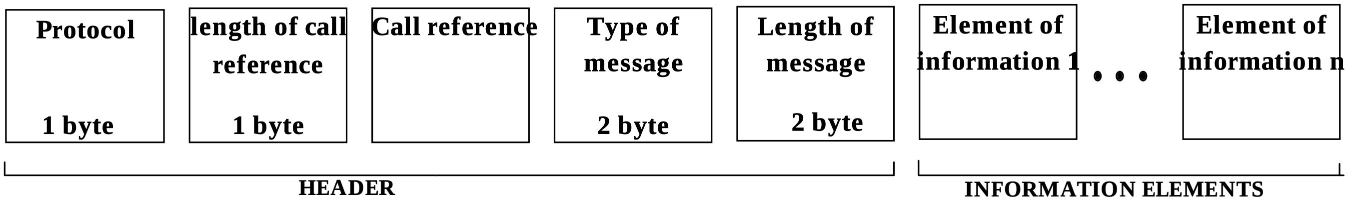

Figure 7

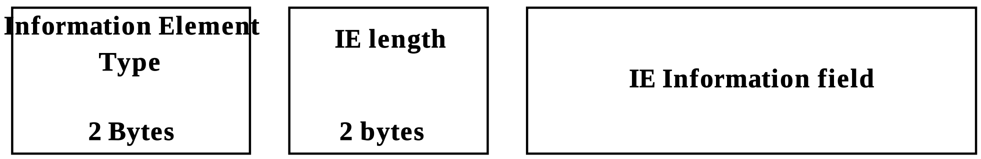

Figure 8

B-ISUP Messages

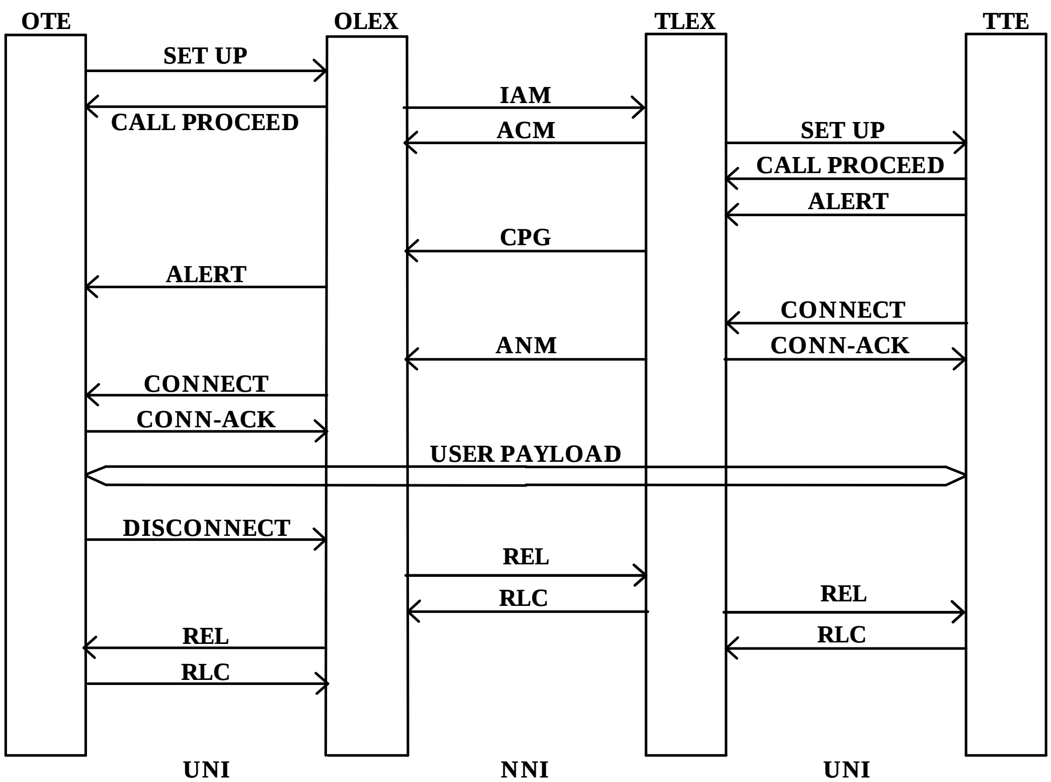

Figure 9

SAAL

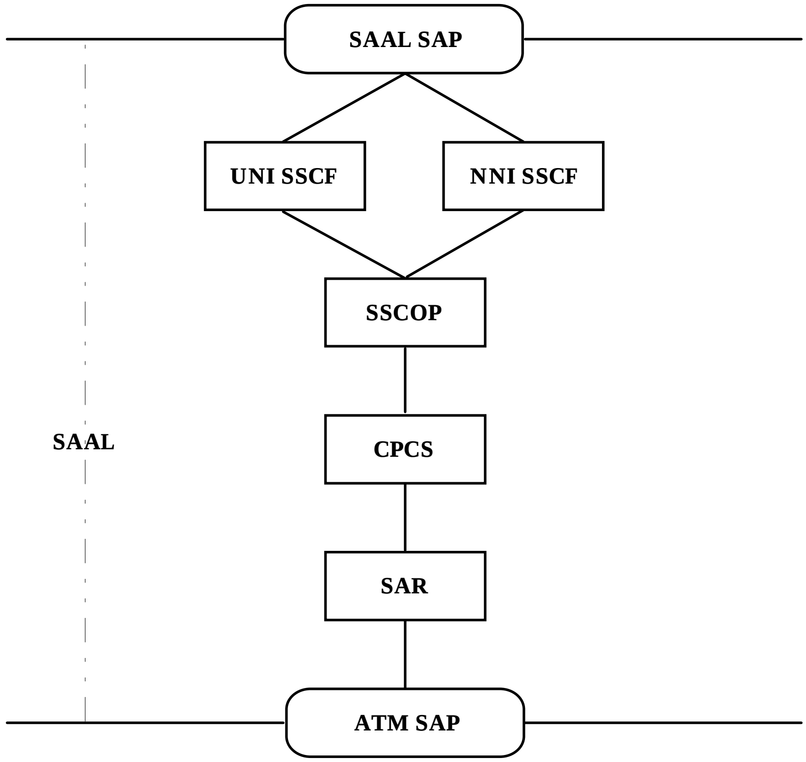

Figure 10

Mobile Communication

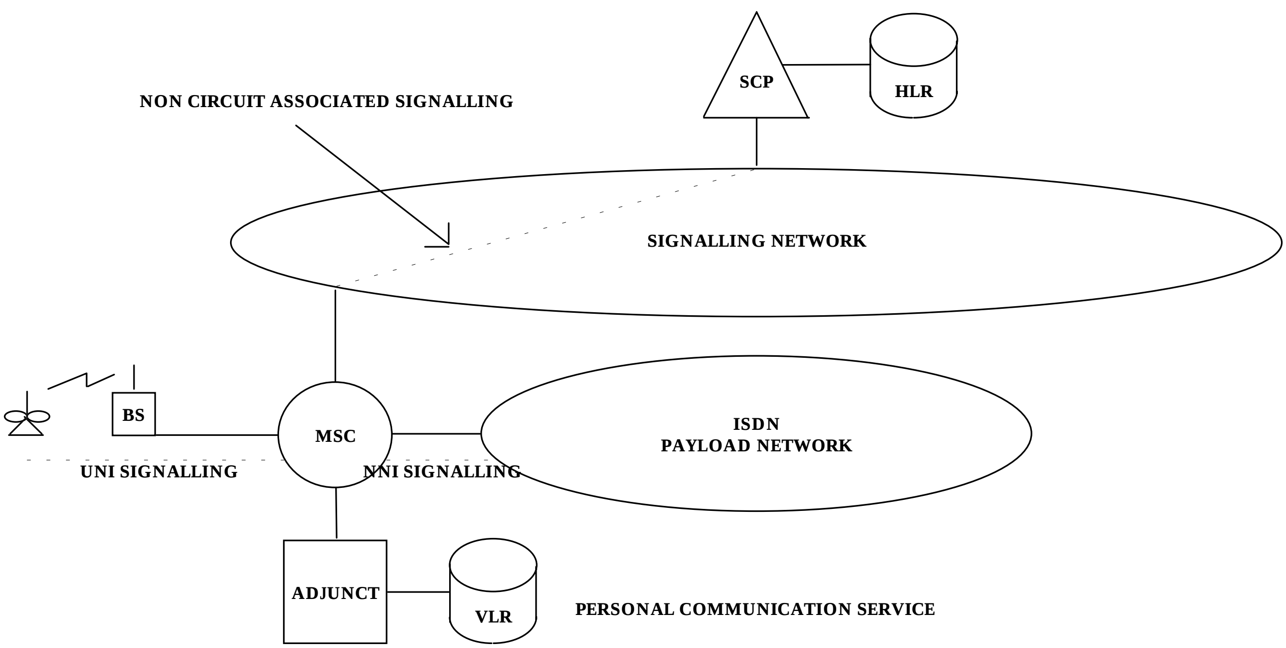

Figure 11

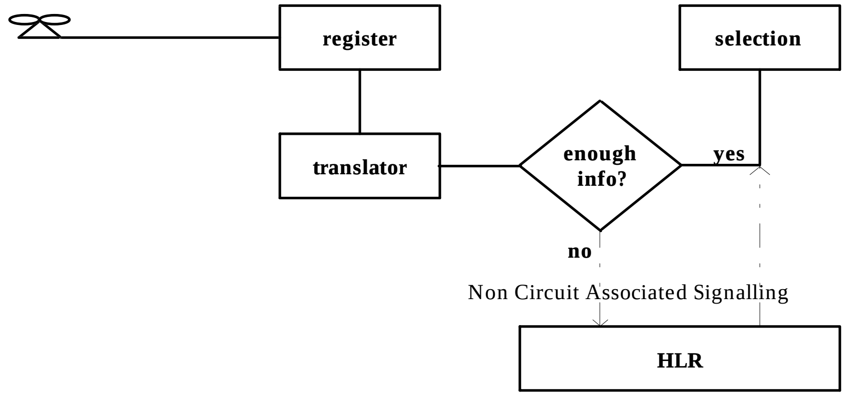

Figure 12

Non Circuit Associated Signalling

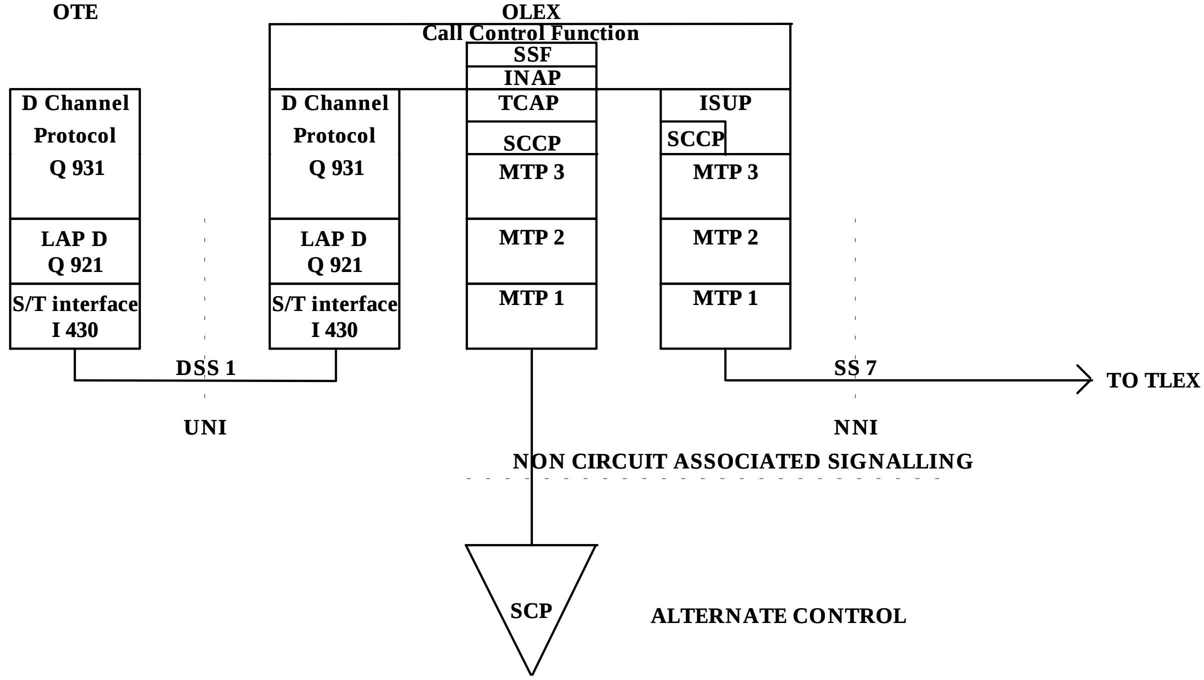

Figure 13

The Non Circuit Associated Protocol Stack.

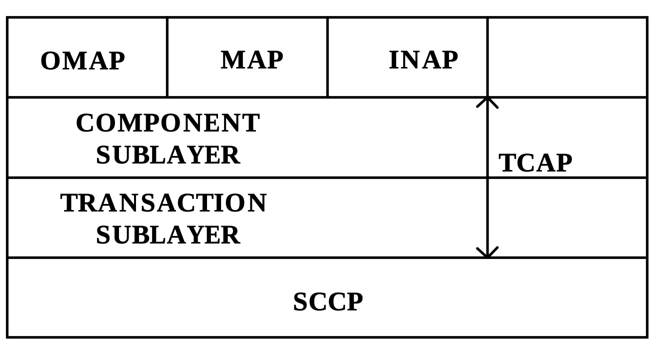

Figure 14

IN CS3 and B-ISDN Release 3 Convergence

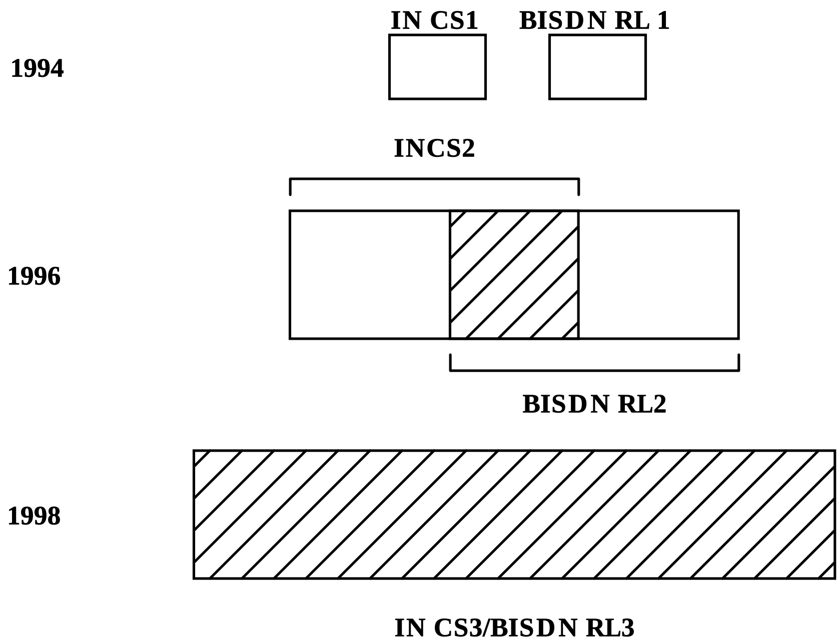

Figure 15

Call Control, Resource Control and Bearer Control

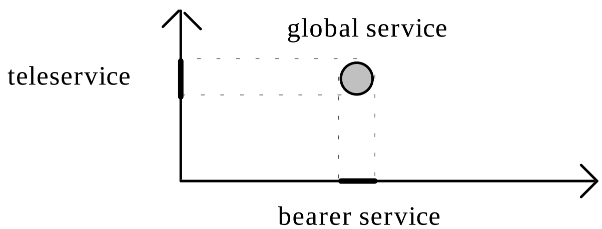

Figure 16

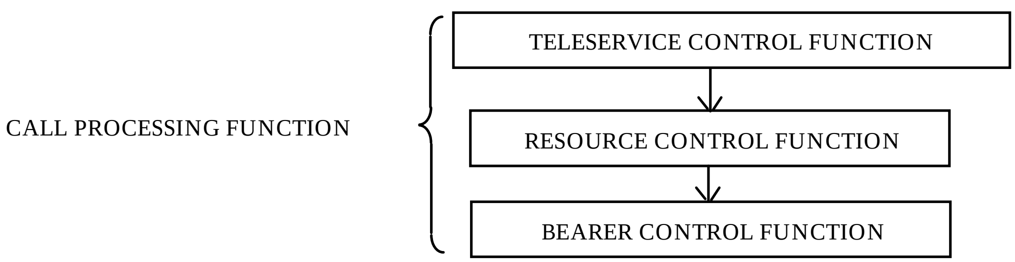

Figure 17

ISCP

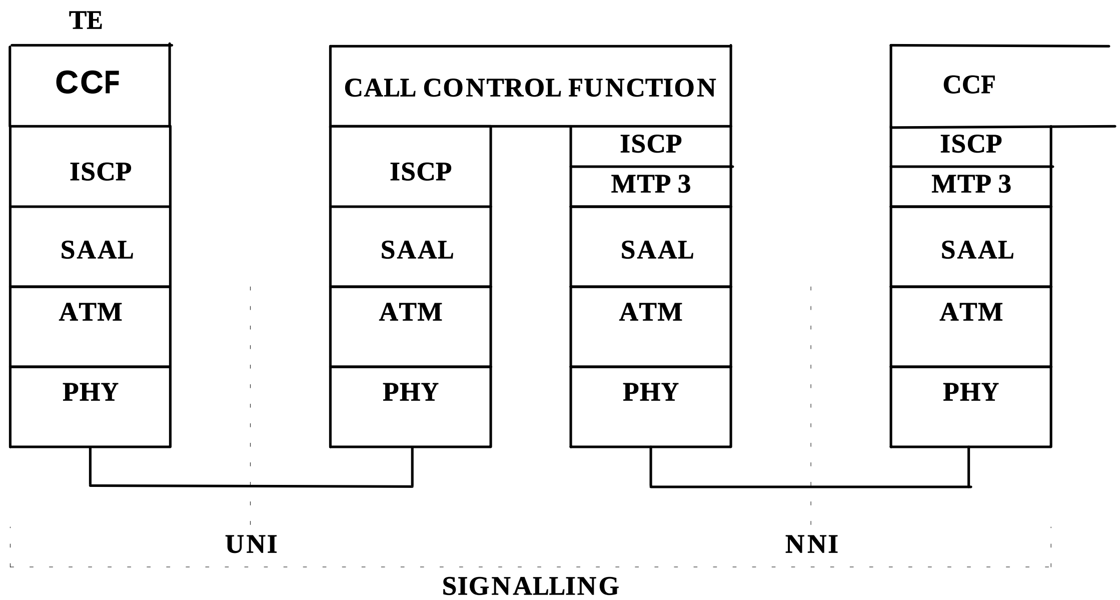

Figure 18

Signalling Separation and Call Agents

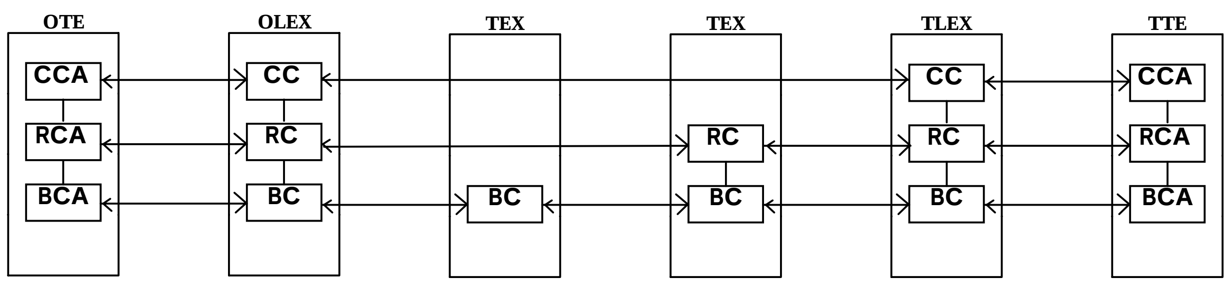

Figure 19

Architecture of the ISCP Signalling Application

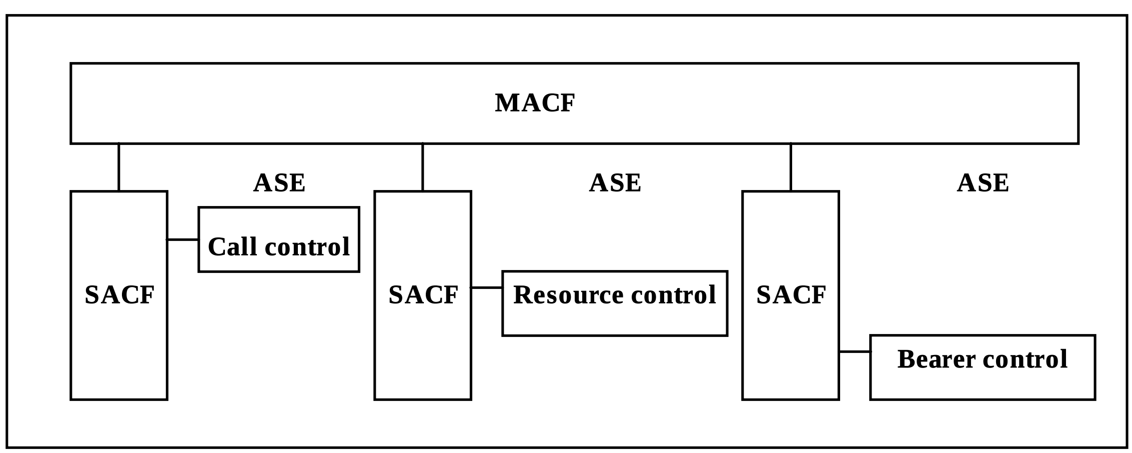

Figure 20

REFERENCES

1- ISDN Architecture, Protocols, Standards. H.J. Helgert. Addison-Wesley 1991.
2- B-ISDN User Part Functional Description. ITU-T Recommendation Q2761.
3- B-ISDN Formats and Codes. ITU-T Recommendation Q2763.
4- B-ISDN Basic Call Procedures. ITU-T Recommendation Q2764.
5- B-ISDN UNI specification. ITU-T Recommendation Q2931.
6- Common Channel Signalling. R. J. Manterfield. Peter Peregrinus Ltd 1991.
7- ISCP: The Best Candidate for the Target B-ISDN Signalling Protocol. A. Paglialunga, M.Siviero. Communication Networks Vol. 4 N°2 (Mar-Apr. 1993)

LIST OF ACRONYMS AND ABBREVIATIONS

AAL	ATM Adaptation Layer
AFI	Authority and Format Identifier
ASE	Application Service Element
ASO	Application Service Object
BCA	Bearer Control Agent
BCF	Bearer Control Function
B-ISDN	Broadband Integrated Service Digital Network
BISUP	Broadband ISDN User Part
CBR	Constant Bit Rate
CCA	Call Control Agent
CCF	Call Control Function
CCSN	Common Channel Signalling Network
CPCS	Common Part Convergence Sublayer
CS	Capability Set
CUG	Closed User Group
DSP	Domain Specific Part
DSS1	Digital Subscriber Signalling System n°1
HLR	Home Location Register
IDI	Initial Domain Identifier
IDP	Initial Domain Part
ISCP	ISDN Signalling Control Part
INAP	Intelligent Network Application Part
ISDN	Integrated Service Digital Network
ISUP	ISDN user Part
LAP D	Link Access Procedure D
MACF	Multiple Association Control Function
MAP	Mobile Application Part
MTP	Message Transfer Part
N-ISDN	Narrowband Integrated Service Digital Network
NNI	Network to Network Interface
OMAP	Operations Maintenance and Administration Part
OTE	Originating Terminal Equipment
OLEX	Originating Local Exchange
RCA	Resource Control Agent
SAAL	Signalling ATM Adaptation Layer
SACF	Single Association Control Function

SAO	Single Association Object
SAR	Segmentation And Reassembly sublayer
SCCP	Signalling Connection Control Part
SP	Signalling Point
SSCF	Service Specific Coordination Function
SSCOP	Service Specific Connection Oriented Protocol
SSCS	Service Specific Convergence Sublayer
SSP	Service Switching Point
STP	Signalling Tranfer Point
TC	Transaction Capability
TCAP	Transaction Capabilities Application Part
TE	Terminal Equipment
TLEX	Terminating Local Exchange
TTE	Terminating Terminal Equipment
UNI	User to Network Interface
VBR	Variable Bit Rate
VPI	Virtual Path Identification
VCI	Virtual Channel Identification