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SERIES Q: SWITCHING AND SIGNALLING

Technical report TRQ.2001: General aspects for the development of unified signalling requirements

ITU-T Q-series Recommendations – Supplement 7

(Previously CCITT Recommendations)

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SUPPLEMENT 7 TO ITU-T Q-SERIES RECOMMENDATIONS

TECHNICAL REPORT TRQ.2001: GENERAL ASPECTS FOR THE DEVELOPMENT OF UNIFIED SIGNALLING REQUIREMENTS

Summary

This supplement specifies the general aspects for the development of unified signalling requirements. The general aspects are defined in terms of business models, information object models, functional entity models and engineering models.

This supplement is intended to specify the essential features and models required to develop functional entity actions for session control, resource control, call control, bearer control and transport control.

Source

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FOREWORD

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Supplement 7 to Q-series Recommendations

TECHNICAL REPORT TRQ.2001: GENERAL ASPECTS FOR THE DEVELOPMENT OF UNIFIED SIGNALLING REQUIREMENTS

(Geneva, 1999)

1 Scope

This supplement (Technical Report) provides an overall framework for the development of ITU-T unified signalling requirements. This supplement is a guideline document for the other technical reports to be developed. Specifically, this supplement provides:

1) a business model;
2) an information object model;
3) a computational object model;
4) several engineering views;
5) a description of management-related functionalities.

2 References

– ITU-T Recommendation H.221 (1997), *Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices*.

– ITU-T Recommendation H.245 (1998), *Control protocol for multimedia communication*.

– CCITT Recommendation I.130 (1988), *Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN*.

– ITU-T Recommendation Q.65 (1997), *The unified functional methodology for the characterization of services and network capabilities.*

– ITU-T Recommendation Q.1224 (1997), *Distributed functional plane for intelligent network capability set 2*.

– ITU-T Recommendation X.901 (1997) | ISO/IEC 10746-1:1998, *Information technology – Open Distributed Processing – Reference model*: *Overview*.

– ITU-T Recommendation X.902 (1995) | ISO/IEC 10746-2:1996, *Information technology – Open Distributed Processing – Reference model*: *Foundations*.

– ITU-T Recommendation X.903 (1995) | ISO/IEC 10746-3:1996, *Information technology – Open Distributed Processing – Reference model*: *Architecture*.

– ITU-T Recommendation X.904 (1997) | ISO/IEC 10746-4:1998, *Information technology – Open Distributed Processing – Reference model*: *Architectural Semantics*.

– Unified modelling language (1997), Version 1.1.

3 Definitions

This supplement defines the following terms:

3.1 access session: An access session is established when two business domains are bound together in a secure relationship. The early stage of the access session is the agreement of terms between domains to continue interaction and authentication of the domains. Security protection may be delegated to subsequent service sessions. Domains that offer services will enforce certain policies in the access session which are derived from the commercial and technical aspects of the contract.

3.2 add: A signalling capability which allows the addition of a new party, or a new communication capability to a session, call, or bearer connection.

3.3 attach: A signalling capability which allows the attachment of an existing party to an existing communication capability.

3.4 bearer connection: A communication capability provided by the network connectivity provider typically between two or more parties. A bearer connection may be used to support one or more communication resources.

3.5 bearer branch owner: Typically, a party who adds a bearer branch to a bearer connection is the owner of that bearer branch. There may be several bearer branch owners per network bearer connection. A bearer branch owner may be associated with the root, a leaf or a party not attached to the network connection.

3.6 broker: Provides location information that the business domains use to locate other entities for the purpose of establishing communications.

3.7 call: An end-to-end communications call control instance between two or more call party end points or between one call party end point and its serving node.

3.8 call owner: Typically a party who initiates a call control instance is the call owner. There is only one call owner per call.

3.9 communication capability: An information transfer capability between two or more party end points. Between session control end points, the communication capability is a stream connection, between resource control end points, the communication capability is a resource connection, between bearer control end points the communication capability is a bearer connection.

3.10 computational object: A functional entity that provides a unique function by receiving, using and generating informational objects contained or to be contained in the information flows between computational objects.

3.11 consumer: Enrolls for and consumes services. A consumer may be an individual, a household with multiple end users or a small or large business with multiple end users.

3.12 detach: A signalling capability which allows the removal of a party from a communication capability.

3.13 join: A signalling capability which allows the combining of two or more control instances or two or more communication capabilities into one entity.

3.14 federation: The concept of federation is used here to allow entities covering limited service areas to agree to interact with peer entities to enable a larger, often global, communication area.

3.15 informational object: Information exchanged between computational objects which for example describe the characteristics of bearers, party addresses, etc.

3.16 logical reference point: A logical reference point refers to an interface between two entities through which a set of logical messages is defined. The physical embodiment and carriage of these messages may pass through additional entities and are not included in the logical reference point definition.

3.17 network connection: A bearer connection of topology types 1 to 6 as defined in Table A.1.

3.18 network connection owner: Typically, a party who initiates a network connection is the network connection owner. There is only one network connection owner per network connection. There may be several network connection owners per call. A network connection owner may be associated with the root, a leaf or a party not attached to the network connection.

3.19 party: A generic term used to denote a user of a given signalling capability.

3.20 party end point: An end point of a control association.

3.21 party owner: Typically, a party who adds a party to a call is the owner of that party. There may be several party owners within a call.

3.22 retailer: Provides the contact point for the consumer to arrange for, and the contact point for the service provider to offer, services which employ communication services as the delivery mechanism.

3.23 release: A signalling capability which allows the clearing of a control instance or a communication capability.

3.24 relay node: Network equipment, such as a transit bearer exchange, which contains a bearer control functional entity but no call control functional entity.

3.25 resource: An end-to-end communications stream that may be carried on a network bearer connection or other communication transport facilities.

3.26 serving node: Network equipment, such as a local exchange (LEX) or PBX, which contains call control and bearer control functional entities.

3.27 service provider: Provides any of a variety of services which employ communication services as the delivery mechanism.

3.28 service session: A service session is an instance of a service type and includes information necessary to negotiate QoS, security context, use of service and communication resources and to control relationships among participating members of the service session.

3.29 session: The temporary relationship among a group of objects that are assigned to collectively fulfil a task for a period of time. A session has a state that may change during its lifetime. The session represents an abstract, simplified view of the management and usage of the objects and their shared information. Sessions can span multiple business administrative domains.

3.30 stream: An abstraction of a sequence of interactions, resulting in conveyance of information from a producer object to a consumer object.

3.31 user access session: A user access session represents the capabilities and configuration that an end user employs to contact either a retailer, another user or server. Once an access session has been established, it maintains permanent information about a user domain, including identification and the associate user's capabilities in this domain.

3.32 server access session: A server access session represents the capability and configuration that a server employs to contact either a retailer, user or another server. Once a server session has been established, it maintains permanent information about a server domain, including identification and the associate server's capabilities in this domain.

4 Abbreviations

This supplement uses the following abbreviations:

AAL	ATM Adaptation Layer
ACF	Authentication Control Function
ADF	Authentication Data Function
AN	Access Network
ATM	Asynchronous Transfer Mode
BC	Bearer Control
BC-N	Bearer Control (Network)
BC-R	Bearer Control (Relay)
BC-S	Bearer Control (Specialized)
BC-T	Bearer Control (Terminal)
B-ISDN	Broadband Integrated Services Digital Network
CC	Call Control
CC-N	Call Control (Network)
CC-S	Call Control (Specialized)
CC-T	Call Control (Terminal)
FE	Functional Entity
FM	Fabric Management
FNA	IMT-2000 Functional Network Architecture
ID	Identifier
IN	Intelligent Network
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LEX	Local Exchange
LRCF	Location Registration Control Function
LRDF	Location Registration Data Function
M	Merge function
MCF	Mobile Communication Function
MSC	Message Sequence Chart
NA	Not Applicable
NC	Network Connection
N-ISDN	Narrow-band ISDN
NNI	Network-Network Interface
NT	Network Termination
OAM&P	Operations, Administration, Maintenance and Provisioning
ODP	Open Distributed Processing
PC	Presentation Control
PCA	Presentation Control Agent
PEP	Party End Point
PSTN	Public Switched Telephone Network

QoS	Quality of Service
R	Replication function
RC	Resource Control
RC-S	Resource Control (Specialized)
RC-T	Resource Control (Terminal)
RLS	Release
RM-ODP	Open Distributed Processing Reference Model
RN	Relay Node
SACF	Service Access Control Function
SAP	Service Access Point
SAR	Segmentation and Reassembly
SC	Service Control
SC-N	Service Control (Network)
SC-T	Service Control (Terminal)
SeC	Session Control
SeC-N	Session Control (Network)
SeC-T	Session Control (Terminal)
SCF	Service Control Function
SDF	Service Data Function
SDL	Specification and Description Language
SDU	Service Data Unit
SG	Study Group
SN	Serving Node
TC	Transport Control
TC-N	Transport Control (Network)
TC-S	Transport Control (Specialized)
TC-T	Transport Control (Terminal)
TE	Terminal Equipment
TEI	Terminal Equipment Identifier
TMN	Telecommunication Management Network
UAC	User Application Control
UAC-T	User Application Control (Terminal)
UFM	Unified Functional Model
UIMF	User Information Module Function
UML	Unified Modelling Language
UNI	User-Network Interface
VBR	Variable Bit Rate
VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier

VP Virtual Path

VPC Virtual Path Connection

VPI Virtual Path Identifier

5 General aspects

5.1 Overview

The general aspects for the development of signalling requirements covered within the scope of this supplement will be limited to assist the development of signalling flows between signalling entities that are typically defined as control plane computational objects (functional entities). Table 5-1 illustrates that there are many communication relationships that support an end-user-to-end-user application. These communications can be categorized through the use of service levels and planes as illustrated in the table. Note that service levels should not be confused with ISO layers. Within a plane and at a particular service level, computational objects communicate on a peer-to-peer basis. A different subset of ISO layers may be used to support these peer-to-peer computational object communications at a particular service level. Communication between computational objects residing in the same plane but at different service levels communicate on an interservice level basis. Communication between computational objects residing in the same service level but in different planes communicate on an interplanar basis. The scope of signalling requirements contained in this supplement will be limited to open interface communications between computational objects residing in the control plane. This will include peer-to-peer and interservice level communications.

Table 5-1 – Service levels and planes

	User plane (user stream)	**Control plane (operational stream)**	**Management plane (management stream)**
F. Principle (application) service level	User application (selection and modification of "files" within an application) (e.g. MPEG-2 content)	User application (binding between applications) (e.g. VCR-like control)	User application OAM&P computational objects
E. Application support service level	Application information transfer services (e.g. binary file and still image protocols)	User-to-service control computational objects (e.g. brokerage and directory services)	Application service OAM&P computational objects
D. Session and transport service level	Multiparty communication transport services	Transport session and service session control computational objects (e.g. multiclient, multiserver, multinetwork service)	Session and transport OAM&P computational objects
C. Resource service level	Resource-connection adaptation mapping services computational objects	Resource control computational objects (e.g. H.245-type services)	Resource service OAM&P computational objects

Table 5-1 – Service levels and planes *(concluded)*

	User plane (user stream)	Control plane (operational stream)	Management plane (management stream)
B. Network service level	User data transfer and adaptation protocol computational objects	Call, bearer and transport control computational objects	OAM&P network level computational objects
A. Physical service level	Transmission associated computational objects	Fabric control computational objects	OAM&P physical level computational objects

The signalling requirements specifying signalling relationships will be covered by the TRQ.2000 series of technical reports. This supplement will only identify the signalling relationships and specify the general aspects for the development of signalling requirements for these signalling relationships. For more detail on these signalling relationships, see clause 8.

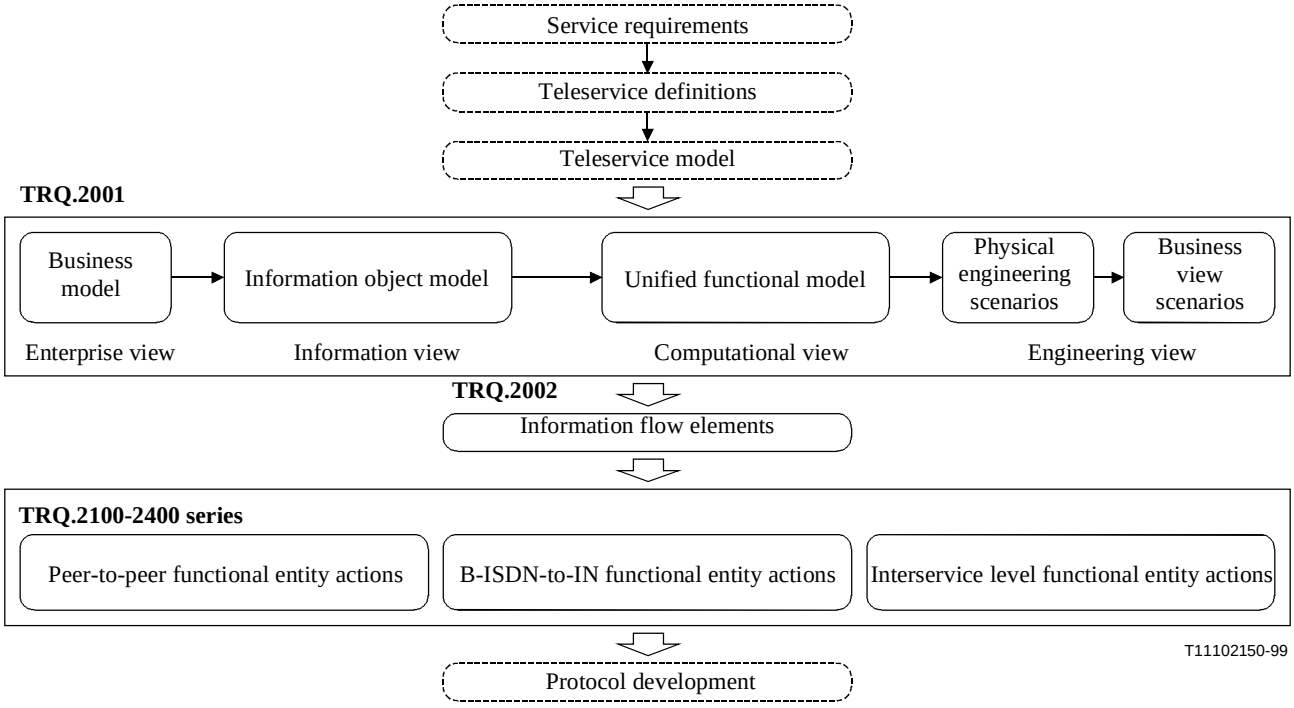
5.2 Unified signalling requirements methodology

The use of the Recommendation I.130 method and the open distributed process reference model has assisted in providing a coordinated framework to develop unified signalling requirements. Figure 5-1 illustrates how both concepts, together with object-oriented techniques, have been adapted to produce a process suitable to develop unified Recommendations. This process includes the following activities:

- **Service requirements**: Identification of the services to be supported.
- **Teleservice definitions**: Derivation of the underlying telecommunication services. This equates to step 1.1 in Recommendation I.130.
- **Teleservice model**: Derivation of a service model (production of service attributes and dynamic behaviour). This equates to steps 1.2 and 1.3 in Recommendation I.130.
- **Enterprise view**: Captures business model requirements that justify and orient the system design. This equates to the enterprise view in ODP but has no equivalent in Recommendation I.130.
- **Information view**: Analysis is performed in order to derive an object model. Precise definitions describing each object class is created at this point. This equates to the information view in ODP but has no equivalent in Recommendation I.130.
- **Computational object model**: Analysis is carried out based on teleservice definitions and models, resulting in the unified functional model. This involves the derivation of a unified functional model. This equates to the computational view in ODP and is used instead of step 2.1 in Recommendation I.130.
- **Engineering view**: Gives scenarios showing how functional entities could be allocated onto physical entities to identify physical interfaces. This equates to the engineering view in ODP and is used instead of step 2.5 in Recommendation I.130. Physical distributions against the business model requirements could also be investigated.
- **Information flow elements**: Information flow elements are described. This has no equivalent in ODP or Recommendation I.130.
- **Functional entity actions**: Information flows for the physical interfaces identified in the engineering view are illustrated via high-level overviews. This has no direct equivalent in ODP and is used instead of step 2.2 in Recommendation I.130.

- **Protocol development**: Develop protocols for each signalling interface. This equates to stage 3 in Recommendation I.130.

NOTE – In ODP terms, the technology view is not within the scope of this supplement.



This figure shows the relationships between the TRQ.2000 series of Technical Reports and the work on service requirements, teleservice definitions, teleservice models and protocol development done elsewhere.

NOTE – The dotted boxes show activities external to those covered within the TRQ.2000 series of Technical Reports.

Figure 5-1 – Framework to develop unified signalling requirements

6 Business model

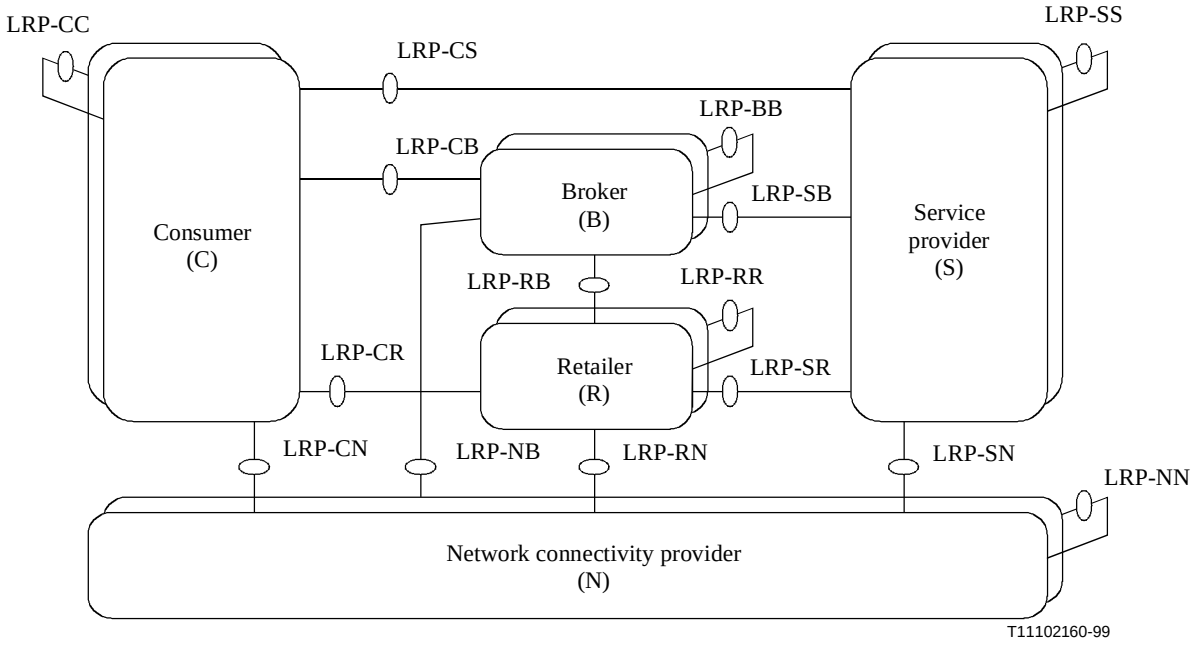
The business model supports the Open Distributed Processing (ODP) enterprise view. The business model is developed to partition particular business functions into business domains so that logical reference points can be defined between the domains. The specification work for underlying capabilities of the structure will focus on the definition of information flows across the interdomain logical reference points; see Appendix I.

6.1 Overview of the business model domain structure

The proposed business model is composed of five domains. Note that nothing in this model precludes any combination of these five domains in single physical entity within a specific engineering view. Figure 6-1 illustrates the business model, showing the following domains:

- Consumer – Enrolls for and consumes services. A consumer may be an individual, a household with multiple end users, or a small or large business with multiple end users.
- Broker – Provides location information that the business domains use to locate other entities for the purpose of establishing communications.

- Retailer – Provides the contact point for the consumer to arrange for, and the contact point for the service provider to offer, services which employ communication services as the delivery mechanism.
- Service provider – Provides any of a variety of services which employ communication services as the delivery mechanism. A service provider providing management can manage one or more domains in whole or in part, and provides functions needed for administrative and off-line billing capabilities. Note that a content provider is a subclass of a service provider which supplies information content to another service provider.
- Network connectivity provider – Provides the communication services that transport information that may either be control plane information or user plane information. The service control information can be transported by either means depending on the business application.



LRP–XY Logical reference point between domain "X" and "Y"

Figure 6-1 – Business model domains

6.2 Description of the domains in the business model

The business model domains are described in more detail below.

6.2.1 Consumer

The consumer business domain has many possible missions with a common need for services which employ communication services as the delivery mechanism. All other business domains described below operate for the benefit of the consumer.

6.2.1.1 Major functions

The consumer is an intelligent end point, capable of storing and executing software. Major functions of the consumer business domain include:

1) Obtaining location of retailers, service providers and other consumers.

2) Creating service relationships that include service providers and other consumers.

3) Enrolling with retailers.

4) Indicating availability to retailers (log-on function).

NOTE 1 – Mobility is supported by allowing a consumer to log on to retailers covering other than the consumer's home area; as will be discussed, these retailers must be "federated" with the home area retailer in order to obtain necessary service information.

5) Accepting download from retailers to upgrade the interaction capability with the retailer.

NOTE 2 – The downloading function involves user plane, not control information.

6.2.1.2 Control information

The consumer will initiate control information for the following purposes to the indicated business domains:

1) For the purpose of locating retailers: communication to the broker.

NOTE 1 – If necessary, the network connectivity provider may be used to establish communication with the broker or the retailer. This note applies to all examples of control information involving the broker and the retailer from other business domains as well.

2) For the purpose of locating services or other consumers: communication to the retailer (which in turn initiates control information with the broker) or the broker (directly).

3) For the purpose of accessing services: communication to the retailer (which in turn initiates control information with other parties) or to the network connectivity provider (to establish communication service with a service provider directly).

NOTE 2 – In this case, the service provider must allow direct control information to the consumer.

4) For the purpose of accessing other consumers: communication to the retailer (which in turn initiates control information with other parties) or to the network connectivity provider (to establish communication service with another consumer directly).

The consumer will accept control information for the following purposes from the indicated business domains:

1) For the purpose of receiving an invitation to join a session: communication from the retailer.

2) For the purpose of accepting communication service: communication from the network connectivity provider.

6.2.2 Broker

The broker business domain has the mission of providing all business domains with the means to locate other individual entities.

6.2.2.1 Major functions

Major functions of the broker business domain include:

1) In response to an identifier, provision of a unique end point address or a set of addresses.

NOTE – A set of addresses could be given if different connectivity networks are able to be used for the communication (e.g. the telecommunication network, the Internet and a WAN); the address must at least indirectly identify the associated communication network type.

2) In response to a service category, provision of a list of identifiers associated with that service category.

Examples of function 1 are:

- In response to a name, provision of the network address (e.g. the E.164 number).
- In response to a name with a request for retailer, provision of the network address (e.g. the E.164 number) of the associated retailer.

- In response to a network address (e.g. an IP address), provision of an associated address from a different network (e.g. the E.164 number) (address resolution function).
- In response to a network address (e.g. Freephone number) with a request for routing address, provision of a routing address (e.g. the E.164 number).

Examples of function 2 are:

- In response to a service category (e.g. video-on-demand), provision of the identifiers of service providers that provide that service.
- In response to a service category (e.g. video-on-demand) with a request for retailer, provision of the identifiers of retailers that provide that service.

6.2.2.2 Control information

The broker will initiate control information for the following purposes to the indicated business domains:

– For the purpose of locating entities not in its own knowledge base: communication to the broker.

NOTE – The other brokers contacted must be federated as discussed later.

The broker will accept control information for the following purposes from the indicated business domains:

1) For the purpose of receiving a request for location information: communication from the consumer, broker, retailer, service provider and network connectivity provider.
2) For the purpose of updating its knowledge base: communication from the consumer, broker, retailer, service provider and network connectivity provider.
3) For the purpose of accepting communication service: communication from the network connectivity provider.

6.2.2.3 Federation

The broker may federate with other brokers to increase the broker's coverage as viewed by the other business domains.

6.2.3 Retailer

The retailer business domain has the mission of providing other business domains (consumers, service providers) with a point of contact for services which employ communication services as the delivery mechanism.

6.2.3.1 Major functions

Major functions of the retailer business domain include:

1) Management of enrolment to obtain various services (including person-to-person communication, if desired) by consumers.
2) Management of enrolment to provide various services by service providers.
3) Authorization prior to service usage.
4) Maintenance of session-level user service profiles and treatment policies.
5) Session management and communication, that is, establishing and maintaining the association list of parties and resources that partake in a session with session owner, and communicating session policy information for the purpose of establishing access to the session.

6) Initiating downloads to consumers and service providers to upgrade the interaction capability with them.

NOTE 1 – The downloading function involves user plane, not control information.

7) (Optional) Establishment of network connectivity (i.e. calls and connections) associated with a session (e.g. via signalling to a network connectivity provider), including coding, rate and QoS negotiations.

NOTE 2 – Third-party call control is required for this function.

8) (Optional) Collecting accounting information for the purpose of off-line billing, in the general case, for each invoked service (including network connectivity) as well as for the services of the retailer.

NOTE 3 – For this function, network connectivity billing must be associated with the retailer for the associated services.

6.2.3.2 Control information

The retailer will initiate control information for the following purposes to the indicated business domains:

1) For the purpose of locating other entities and services not in its knowledge base: communication to the broker.

2) For the purpose of accessing services: communication to the service provider or, when outside its realm, to the retailer (which in turn initiates control information with other parties).

NOTE – The other retailers contacted must be federated as discussed later for access to outside service providers and to outside consumers.

3) For the purpose of accessing consumers: communication to the consumer or, when outside its realm, to the retailer (which in turn initiates control information with other parties).

4) For the purpose of establishing business domain-to-business domain communication service: communication to the network connectivity provider.

The retailer will accept control information for the following purposes from the indicated business domains:

1) For the purpose of receiving a request for location information from an enrolee: communication from the consumer.

2) For the purpose of providing access to services: communication from the consumer.

3) For the purpose of updating its knowledge base: communication from the consumer and the service provider.

4) For the purpose of accepting communication service: communication from the network connectivity provider.

6.2.3.3 Federation

The retailer may federate with other retailers to increase the retailer's coverage as viewed by the consumer and the service provider domains.

6.2.4 Service provider

The service provider business domain has the mission of providing services which employ communication services as the delivery mechanism. The nature of the services can be content (e.g. video source), information manipulation (e.g. translation, audio bridge, video bridge), replication (multicasting and data bridging), management (provisioning, maintenance and billing) or

a combination of these types. Commercial and regulatory constraints may affect the completeness of service provided by a single service provider.

6.2.4.1 Major functions

The service provider is an intelligent end point, capable of storing and executing software. Major functions of the service provider business domain include:

1) Obtaining location of retailers.

2) Enrolling with retailers.

3) Indicating availability to retailers (log-on function).

4) Accepting download from retailers to upgrade the interaction capability with the retailer.

NOTE – The downloading function involves user plane, not control information.

5) Collecting accounting information for the purpose of off-line billing for service usage. The party requesting this service is associated with this information.

6) Initiating of operation, administration, fault reporting, fault recovery, diagnostic requests and initialization of the components of the business domain entities.

6.2.4.2 Control information

The service provider will initiate control information for the following purposes to the indicated business domains:

1) For the purpose of locating retailers: communication to the broker.

2) For the purpose of registering services: communication to the retailer.

3) For the purpose of accessing non-resident services: communication to the retailer (which in turn initiates control information with other parties) or to the network connectivity provider (to establish communication to a service provider directly).

The service provider will accept control information for the following purposes from the indicated business domains:

1) For the purpose of receiving an invitation to join a session: communication from the retailer.

2) For the purpose of providing access to services: communication from the retailer.

3) For the purpose of accepting communication service: communication from the network connectivity provider.

6.2.5 Network connectivity provider

The network connectivity provider business domain has the mission of providing at least the equivalent of a wire or wires that are needed for desired services (including person-to-person communication).

6.2.5.1 Major functions

The major functions of the network connectivity provider depend on the type of network, but for the example of switched telecommunication networks the major functions include:

1) Setting up calls with or without connections.

2) Adding and modifying connections.

3) Collecting accounting information for the purpose of off-line billing for network connectivity; the billing point is associated with this information.

6.2.5.2 Control information

The network connectivity provider will initiate control information for the following purposes to the indicated business domains:

1) For the purpose of locating end points: communication to the broker.

2) For the purpose of establishing communication service: communication to the consumer, broker, retailer, service provider and network connectivity provider.

NOTE – The other network connectivity providers contacted must be federated as discussed to increase the serving area.

The network connectivity provider will accept control information for the following purposes from the indicated business domains:

– For the purpose of establishing communication service: communication from the consumer, broker, retailer, service provider and network connectivity provider.

6.2.5.3 Federation

The network connectivity provider may federate with other network connectivity providers to increase the service area.

7 Information object model

7.1 General

The manipulation of information by distributed functions is best described using objects. The use of object-oriented philosophy will help structure the relationships between unified objects, assist in deriving the information flows and show the behaviour and data associated within the unified system. This clause addresses object modelling aspects of the unified system. It introduces the class types and clarifies the way that these classes are related in an advanced telecommunication system.

The unified object model is generated using the UML (unified modelling language) notation.

7.1.1 Object modelling and signalling requirements

Signalling requirements must guide the specification of protocol and procedures associated with the interoperation of independently designed systems to provide telecommunication services. Information flows and SDL have been used effectively in the past to define the requirements of relatively simple services. Traditional signalling requirements enhanced these components with descriptions of the parameters to be included within the information flows. The complexity and multiplicity of advanced services make it difficult, if not impossible, to provide an exhaustive collection of information flows for each possible service. Not only is it difficult to provide, it is difficult to use the results in stage 3 specification of signalling protocol and procedures because the design of an efficient protocol first necessitates the reverse engineering of the flows to gain an understanding of the fundamental relationships of the information which is being exchanged, and a conceptualization of the entities about which signalling is concerned.

Object modelling provides an opportunity to adjust the traditional methods to be responsive to the pressures to rapidly specify improved signalling protocols. This approach is useful because many advanced capabilities can be modelled with a small number of objects. Furthermore, object modelling partitions the complexity of the stage 2 specification, which simplifies the stage 2 specification without reducing the feature content of these advanced capabilities. Lastly, many of the stage 2 information flows for components specified in this supplement result in functional entity actions that can be modelled on creation and deletion of objects. By defining the creation and

deletion actions (information flows and SDLs) for a small number of object classes, insight into a large number of capabilities has been achieved.

Objects are defined by their behaviour, their relationships to other objects and their attributes (referred to as parameters within signalling). Signalling protocols define the actions and attributes across an interface needed to provide a service. Defining the details of the call model objects will result in the definition of signalling protocol information element exchanges and of actions needed to support the interactions between call control functional entities.

The information flows contain parameters needed to specify the objects in call and bearer interactions. Information flows cause objects to be created, modified or deleted. The specific objects to be affected, and what operations are to be performed, are determined from the actions and parameters specified in the information flows.

All objects have a state field which reflects transient and stable states. The possible states are creation-pending, modification-pending and stable. A deleted object (e.g. after a release or detach) does not exist; therefore, there is no "deleted" state.

7.1.2 Views of sessions, resources, calls and connections

The classes in the object model are used as generic building blocks to form telecommunication services and to represent sessions, resources, calls and connections. The object model is described from the *local* perspective. The *local view* is the picture of a telecommunication service as perceived by the signalling end points associated with the telecommunication service. The other end points in this view may be considered from the *remote* perspective.

7.2 Local view of the information object model

Figure 7-1 shows the session inheritance hierarchy, Figure 7-2 shows the party end point inheritance hierarchy, and Figure 7-3 shows the information object model in which classes representing sessions request resources to invoke one or more calls representing a multimedia service with multiple parties and using multiple multimedia connections. For a brief description of the notation used in these figures, see Annex C.

A session can be an access session or a service session. An access session can be a user access session or a server access session. A consumer, broker or retailer may be associated with a user access session; a retailer, broker or service provider may be associated with a server access session.

A party end point can be a consumer party end point, a retailer party end point, a broker party end point or a service provider party end point. Each of these party end points may, in turn, be remote party end points or local party end points containing zero or more session party end points, resource group party end points, resource party end points, call party end points, network connection party end points or transport end points.

The information object model of Figure 7-3 encompasses local and remote objects for session, resource, call and network connection service level associations.

The information object model of Figure 7-4 encompasses local and remote objects for call, network connection and transport service level associations.

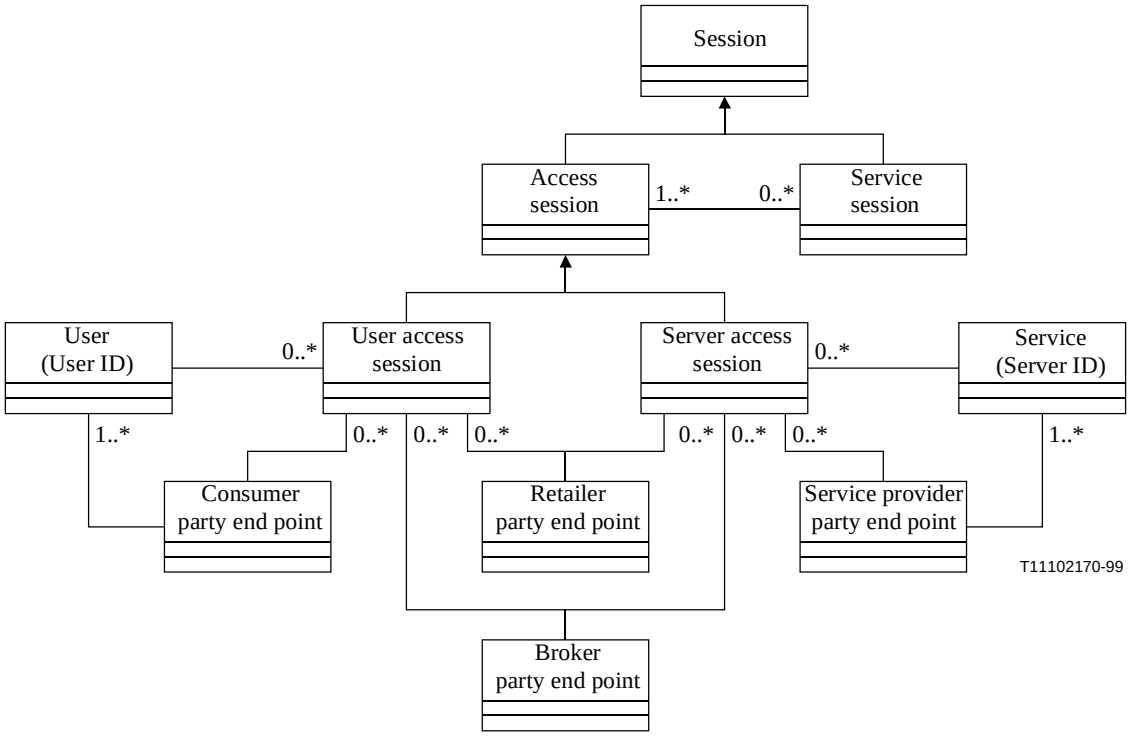


Figure 7-1 – Session inheritance hierarchy

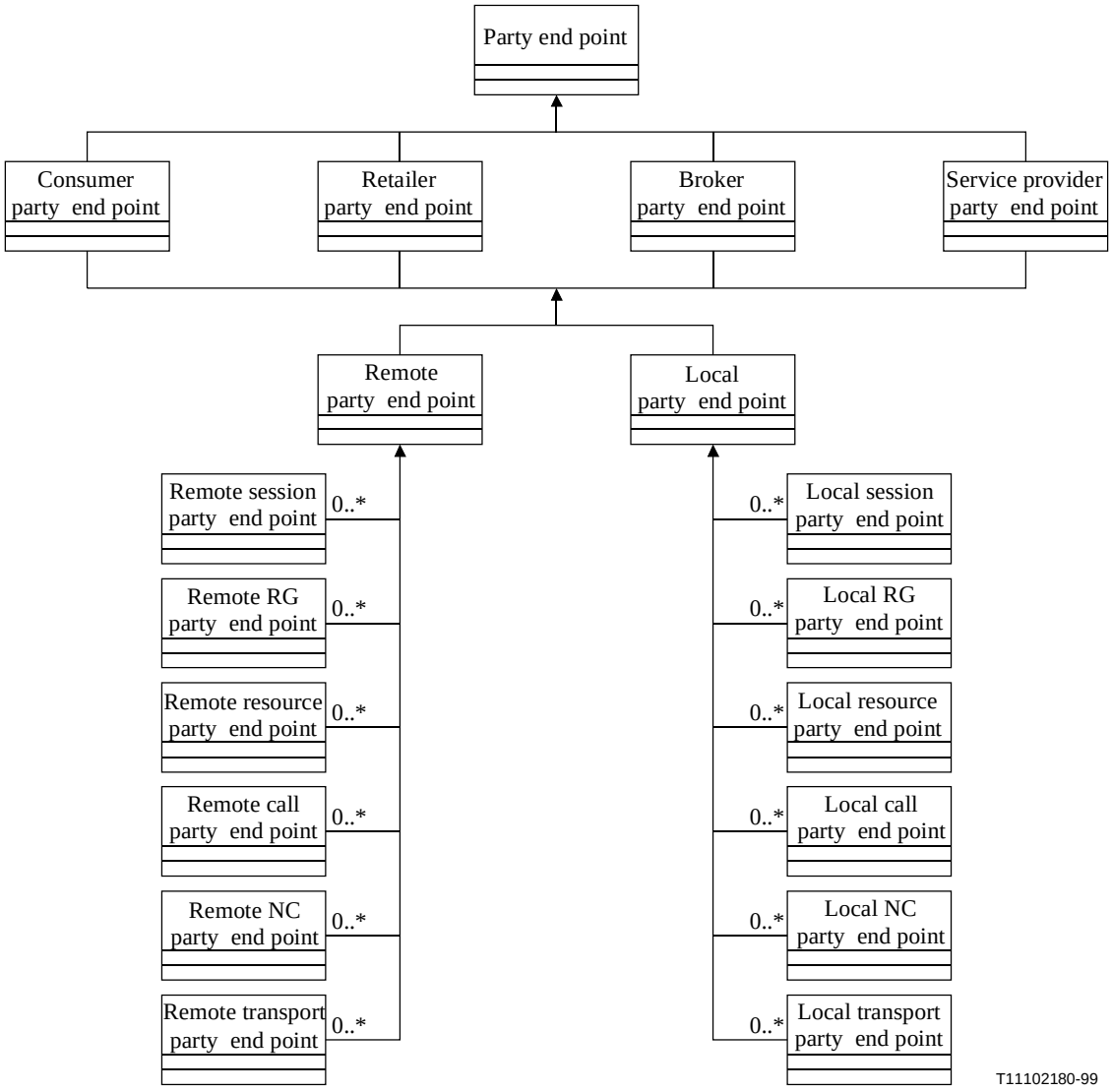
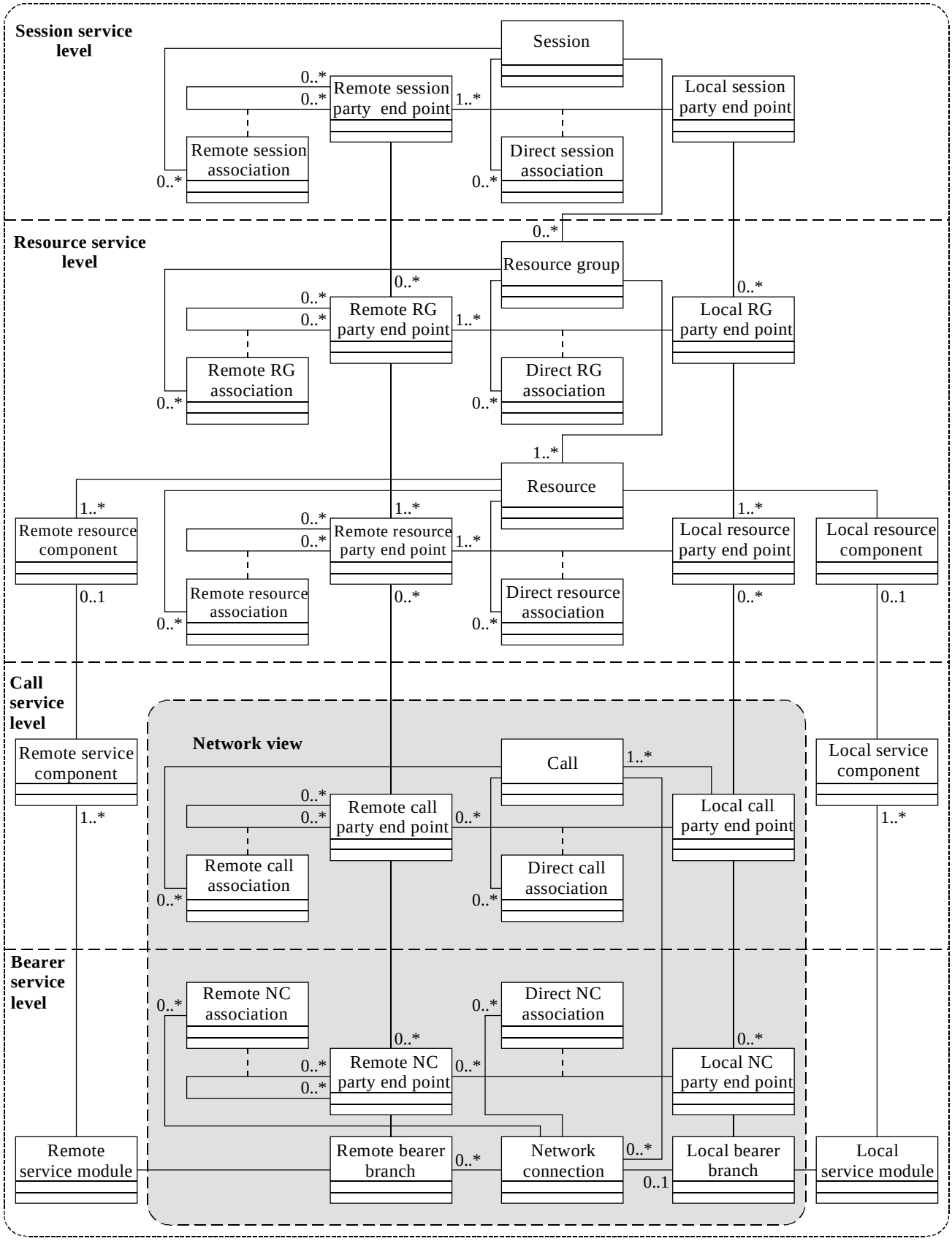


Figure 7-2 – Party end point inheritance hierarchy



NOTE – The relationships between service modules and other object types reflect ITU-T service requirements that allow AAL multiplexing (e.g. through the MID field of AAL type 3/4, or via AAL type 2) and media multiplexing (e.g. in accordance with Recommendation H.221).

Figure 7-3 – Information object model (excluding the transport service level)

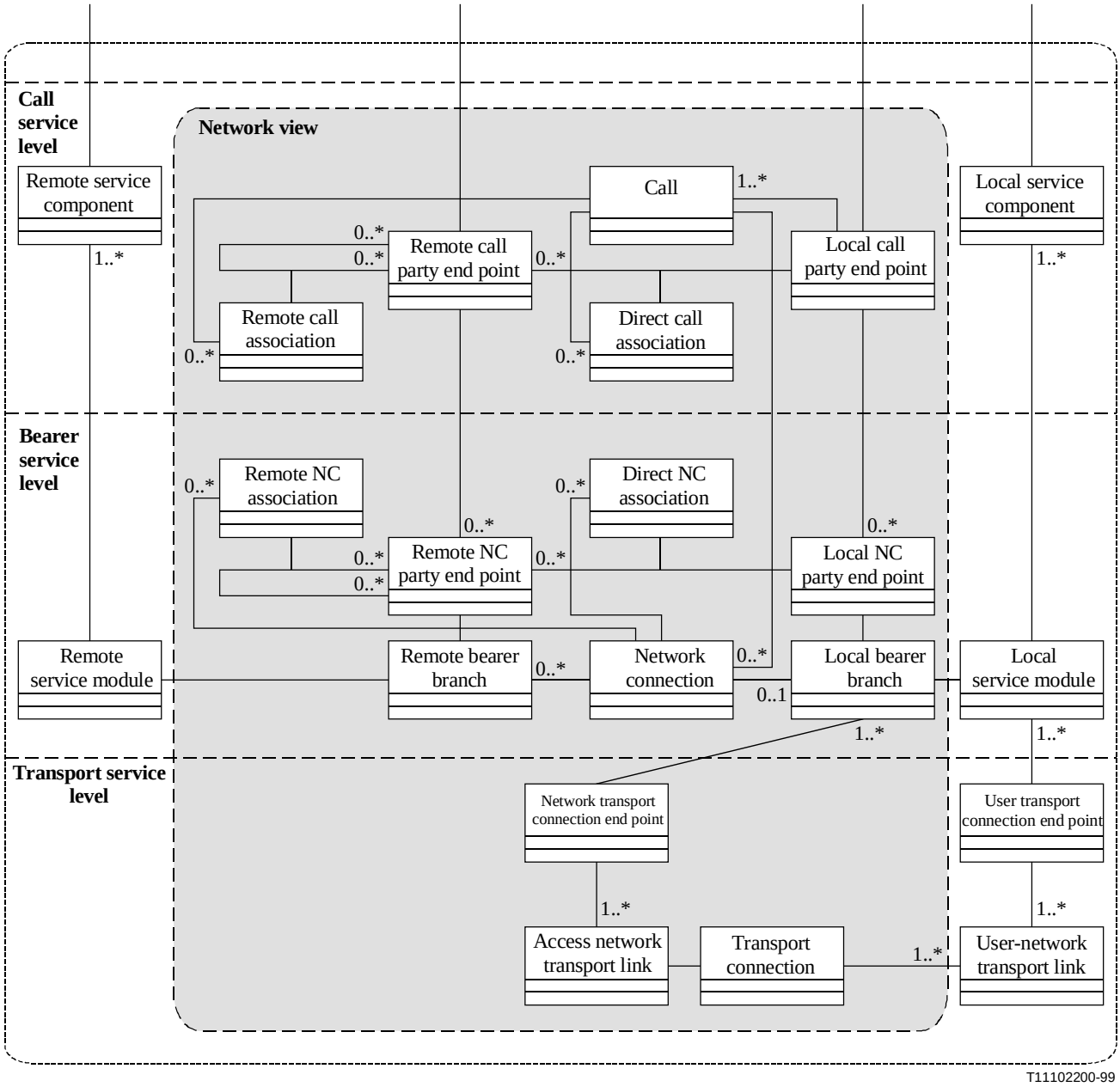


Figure 7-4 – Information object model (excluding the session and resource service levels)

Tables 7-1 to 7-5 list the attributes and operations of the classes contained in the information object model.

NOTE – Class attributes shown in bold font identify attributes belonging to a class regardless of the class associations with other classes. Class attributes shown in normal font identify attributes belonging to a class due to the class association with other classes.

Table 7-1 – General classes

Class name	Class attributes
Service Session	**Service Session ID** List of associated Access Session IDs
Access Session	**Access Session ID** Service Session associated with this Access Session
User Access Session	**Access Session ID** Consumer PEP ID associated with this User Access Session Retailer PEP ID associated with this User Access Session Broker PEP ID associated with this User Access Session
Server Access Session	**Access Session ID** Service Provider PEP ID associated with this Server Access Session Retailer PEP ID associated with this Server Access Session Broker PEP ID associated with this Server Access Session
User	**User ID**
Service	**Server ID**
Party End Point	**Party End Point ID** **Party End Point "Network Address"** **Party End Point Business**
Consumer Party End Point	**Party End Point ID** **Party End Point "Network Address"** List of User Access Session IDs associated with this PEP
Retailer Party End Point	**Party End Point ID** **Party End Point "Network Address"** List of User Access Session IDs associated with this PEP List of Server Access Session IDs associated with this PEP
Broker Party End Point	**Party End Point ID** **Party End Point "Network Address"** List of User Access Session IDs associated with this PEP List of Server Access Session IDs associated with this PEP
Service Provider Party End Point	**Party End Point ID** **Party End Point "Network Address"** List of Server Access Session IDs associated with this PEP
Local Party End Point	**Party End Point ID** **Party End Point "Network Address"** **Party End Point Business** List of Local Session Party End Point IDs
Remote Party End Point	**Party End Point ID** **Party End Point "Network Address"** **Party End Point Business** List of Remote Session Party End Point IDs

Table 7-2 – Session service level classes

Class name	Class attributes
Session	**Session ID** **PEP ID of Session Owner** List of Direct Session Association IDs List of Remote Session Association IDs List of associated Resource Group IDs
Direct Session Association	**Direct Session Association ID** Session ID associated with this Association Local Session PEP associated with this Association Remote Session PEP associated with this Association
Remote Session Association	**Remote Session Association ID** Session ID associated with this Association First Remote Session PEP associated with this Association Second Remote Session PEP associated with this Association
Local Session Party End Point	**Session Party End Point ID** Local PEP ID associated with this PEP List of associated Remote Session PEP IDs List of associated Local Resource Group Party End Point IDs
Remote Session Party End Point	**Session Party End point ID** Remote PEP ID associated with this PEP Associated Local Session PEP ID List of associated Remote Session PEP IDs List of associated Remote Resource Group Party End Point IDs

Table 7-3 – Resource service level classes

Class name	Class attributes
Resource Group	**Resource Group ID** **PEP ID of Resource Group owner** Associated Session ID List of associated Direct Resource Group Associations List of associated Remote Resource Group Associations
Direct Resource Group Association	**Direct Resource Group Association ID** Associated Resource Group ID Associated Local Resource Group PEP ID Associated Remote Resource Group PEP ID
Remote Resource Group Association	**Remote Resource Group Association ID** Associated Resource Group ID First associated Remote Group Resource PEP ID Second associated Remote Group Resource PEP ID
Local Resource Group Party End Point	**Resource Group Party End Point ID** Associated Local Session PEP ID List of associated Remote Resource Group PEP IDs List of associated Local Resource PEP IDs
Remote Resource Group Party End Point	**Resource Group Party End Point ID** Associated Remote Session PEP ID Associated Local Resource Group PEP ID List of associated Remote Resource Group PEP IDs List of associated Remote Resource PEP IDs

Table 7-3 – Resource service level classes *(concluded)*

Class name	Class attributes
Resource	**Resource ID** **PEP ID of Resource owner** Resource Group ID associated with this Resource List of associated Direct Resource Associations List of associated Remote Resource Associations Associated Local Resource Component List of associated Remote Resource Components
Local/Remote Resource Component	**Resource Component ID** **Resource Component Characteristics (inc. ISO protocol stack above layer 3)** Associated Resource Associated Service Component
Direct Resource Association	**Direct Resource Association ID** Resource ID associated with this Association Local Resource PEP associated with this Association Remote Resource PEP associated with this Association
Remote Resource Association	**Remote Resource Association ID** Resource ID associated with this Association First Remote Resource PEP associated with this Association Second Remote Resource PEP associated with this Association
Local Resource Party End Point	**Resource Party End Point ID** Local Resource Group PEP associated with this PEP List of associated Remote Resource PEPs Associated Local PEP
Remote Resource Party End Point	**Resource Party End Point ID** Remote Resource Group PEP associated with this PEP Associated Local Resource PEP List of associated Remote Resource PEPs Associated Remote PEP

Table 7-4 – Call service level classes

Class name	Class attributes
Call	**Call Control Segment ID** **PEP ID of Call owner** List of Direct Call Association IDs List of Remote Call Association IDs List of associated Network Connection IDs
Local/Remote Service Component	**Service Component ID** **Service Component Characteristics (inc. High_Layer Information)** **Communication Configuration (Source, Sink, Bidirectional)** **Service Component Traffic descriptor requirements** **Service Component QoS descriptor requirements** Associated Resource Component ID Associated Service Module ID
Direct Call Association	**Direct Call Association ID** Call associated with this Association Local PEP associated with this Association Remote PEP associated with this Association
Remote Call Association	**Remote Call Association ID** Call associated with this Association First Remote PEP associated with this Association Second Remote PEP associated with this Association
Local Party End Point	**Party End Point ID** **PEP ID of Party owner** List of associated Local Resource Party End Point IDs List of associated Remote Party End Point IDs List of associated Local Network Connection Party End Point IDs
Remote Party End Point	**Party End Point ID** **PEP ID of Party owner** List of associated Remote Resource Party End Point IDs Associated Local Party End Point ID List of associated Remote Party End Point IDs List of associated Remote Network Connection Party End Point IDs

Table 7-5 – Bearer service level classes

Class name	Class attributes
Network Connection	**Network Connection ID** **PEP ID of Network Connection owner** **Network Connection Topology Type** Associated Call ID List of associated Direct Network Connection Association IDs List of associated Remote Network Connection Association IDs Associated Local Bearer Branch ID List of associated Remote Bearer Branch IDs
Direct Network Connection Association	**Direct Network Connection Association ID** **Transit Network Selection ID** Network Connection ID associated with this Association Local Network Connection PEP associated with this Association Remote Network Connection PEP associated with this Association
Remote Network Connection Association	**Remote Network Connection Association ID** **Transit Network Selection ID** Network Connection ID associated with this Association First Remote Network Connection PEP associated with this Association Second Remote Network Connection PEP associated with this Association
Local Network Connection Party End Point	**Network Connection Party End Point ID** Local Party End Point associated with this PEP List of associated Remote Network Connection Party End Point IDs Associated Local Bearer Branch ID
Remote Network Connection Party End Point	**Network Connection Party End Point ID** Remote Party End Point associated with this PEP List of associated Remote Network Connection Party End Point IDs Associated Local Network Connection Party End Point ID Associated Remote Bearer Branch ID
Local/Remote Bearer Branch	**Bearer Branch ID** **PEP ID of Branch owner** **Network Connection Party End Point ID associated with this Bearer Branch** **Network-Oriented Low Layer Information** **Communication Configuration (Source, Sink, bidirectional)** Service Module ID associated with this Bearer Branch Attached Network Connection ID
Local/Remote Service Module	**Service Module ID** **Communication Configuration (Source, Sink, bidirectional)** **Multiplexing Method** Bearer Branch associated with this Service Module List of associated Service Component IDs

Table 7-6 – Transport level classes

Class name	Class attributes
Transport Connection	**Transport ID** **PEP ID of Transport Owner** **Transport Connection Topology Type** Associated Access Network Transport Link ID List of associated User Network Transport Link ID
Access Network Transport Link	**Access Network Transport Link ID** **PEP ID of Transport Owner** Network Transport Connection End Point ID Transport Link Characteristics Attached Transport Connection ID
User Network Transport Link	**User Network Transport Link ID** **PEP ID of Transport Owner** User Transport Connection End Point ID Transport Link Characteristics Attached Transport Connection ID
User Transport Connection End Point	**User Transport Connection Party End Point ID** **PEP ID of Transport End Point** List of Local Service Module IDs List of User Network Transport Link IDs Multiplexing Method
Network Transport Connection End Point	**Network Transport Connection End Point ID** **PEP ID of Transport End Point** List of Local Bearer Branch IDs List of Access Network Transport Link IDs Multiplexing Method

7.3 Description of session control classes

7.3.1 Session

This object is a single instance of service use with global significance. It may be requested by a user or by a service provider and it may be referenced by any participating party.

The session concept is for an overall global object that specifies a complete dynamic multiclient, multiserver and multinetwork service.

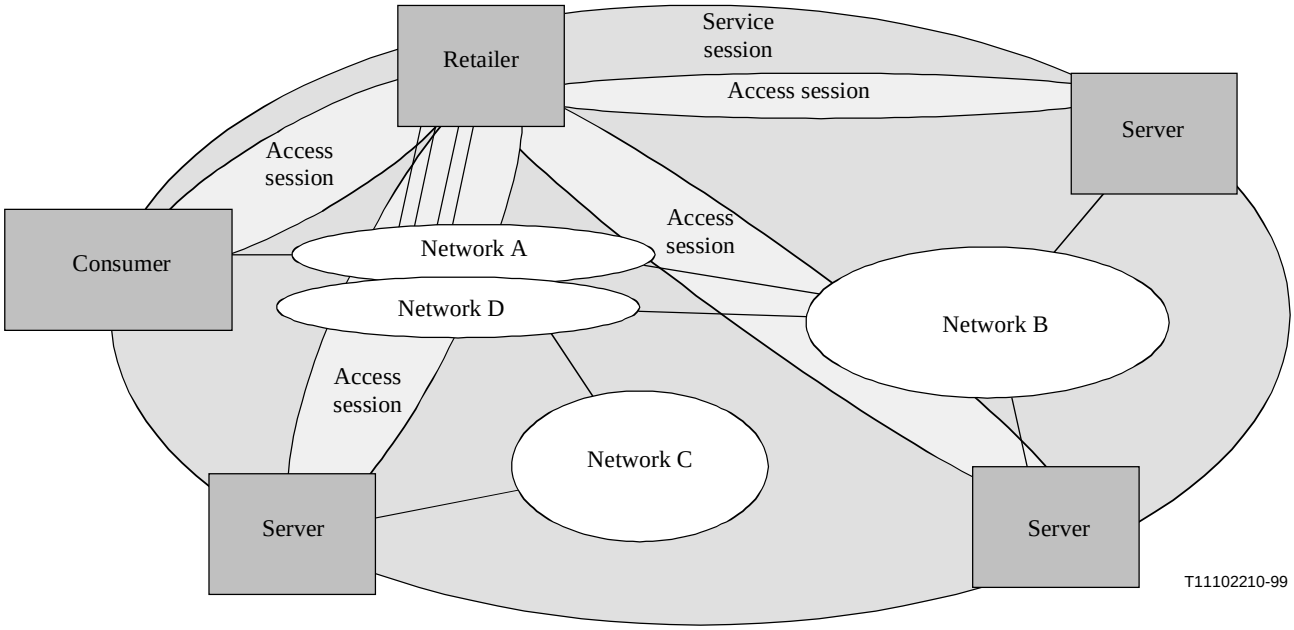


Figure 7-5 – Session (illustrates the two types of session: service and access)

NOTE 1 – The session manager may reside on an IN platform, may be provided by a third party outside the network or may be distributed in the network.

NOTE 2 – In particular the session allows a client to receive service from multiple networks through multiple independent accesses.

The session identifier is global in significance, but is not necessarily used (in a given instance of a telecommunication service) by some (or any) networks. Those entities with visibility of the session can be considered "session aware".

It can be tempting to make other identifiers global by making them dependent on the session, but this implies that such identifiers can, themselves, only be inspected at "session aware" entities.

Issues of security and potential confusion arise in those cases where the session identifier is allocated outside the network.

The remote session party class inherits from the session class.

7.3.2 Direct/remote session association

This object is the end-to-end association between end users of one or more networks, as perceived by the serving network(s) as a transparent end-to-end relationship. Figure 7-6 illustrates a session association between the consumer and one of the servers associated with the telecommunication service. In an actual telecommunication service there could be a session association among each set of parties that are directly associated with the session.

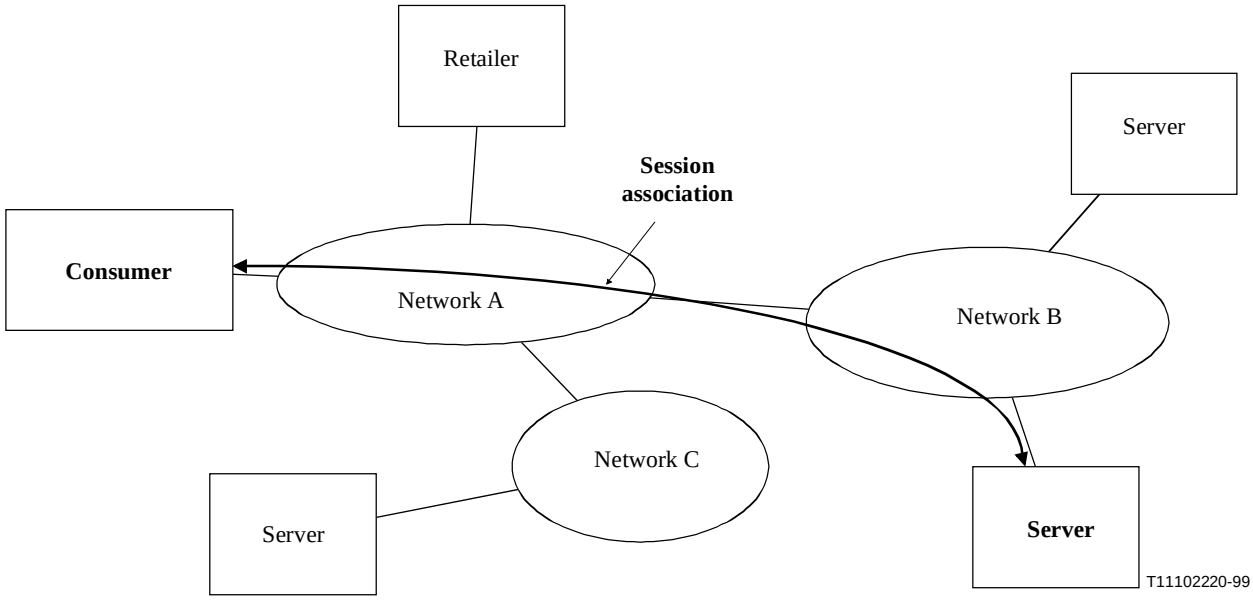


Figure 7-6 – Session association

7.4 Description of resource control classes

7.4.1 Resource group (RG)

This object represents a set of resources that have a common routing or control characteristic, such as a common route resource group, or a life and death resource group. This resource group may be carried on one or more network connections. Figure 7-7 illustrates the relationship between a resource group and network connections. Note that for each resource group there are one or more related network connections. A resource may map one-to-one or many-to-one to a network connection. The service module provides the necessary multiplexing/demultiplexing of the resource to the network connection.

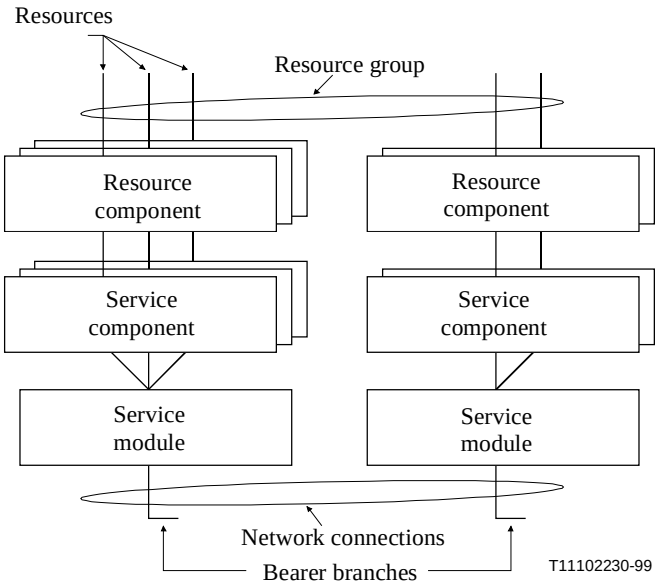


Figure 7-7 – Resource group and network connection illustration

7.4.2 Direct/remote resource group association

This object is the end-to-end association between end users of one or more networks, as perceived by the serving network(s) as a transparent end-to-end relationship. This association represents a set of resources that may be multiplexed on a single network connection. Figure 7-8 illustrates a resource group association between the consumer and one of the servers associated with the telecommunication service. In an actual telecommunication service there could be a resource group association among each set of parties that are directly associated with the resource group.

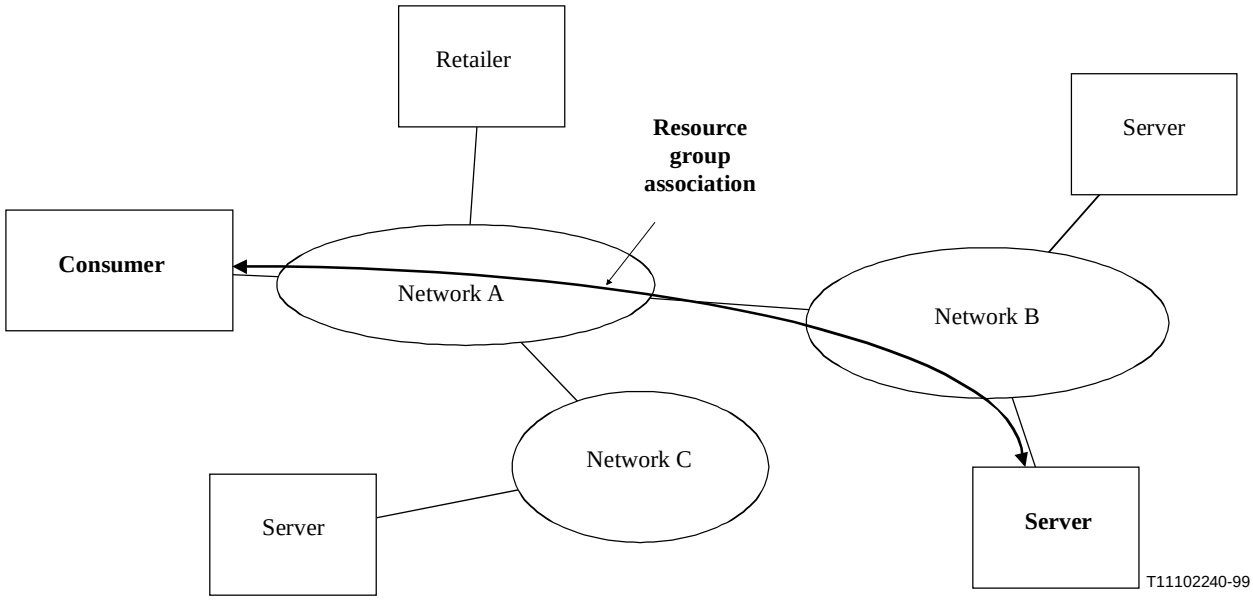


Figure 7-8 – Resource group association

7.4.3 Resource

This object identifies a resource control level peer-to-peer communication stream, which may be carried by one network connection or other communication transport facilities (e.g. user-to-user information within the signalling transport). The resource identifier is global in significance when tied into the session, but is not necessarily used (in a given instance of a telecommunication service) by some (or any) networks. The resource identifier has a single end-to-end value. Figure 7-9 shows three example resources between consumer and server. Two resources are transported over ATM and the other resource is transported using DVB over, say, Ethernet.

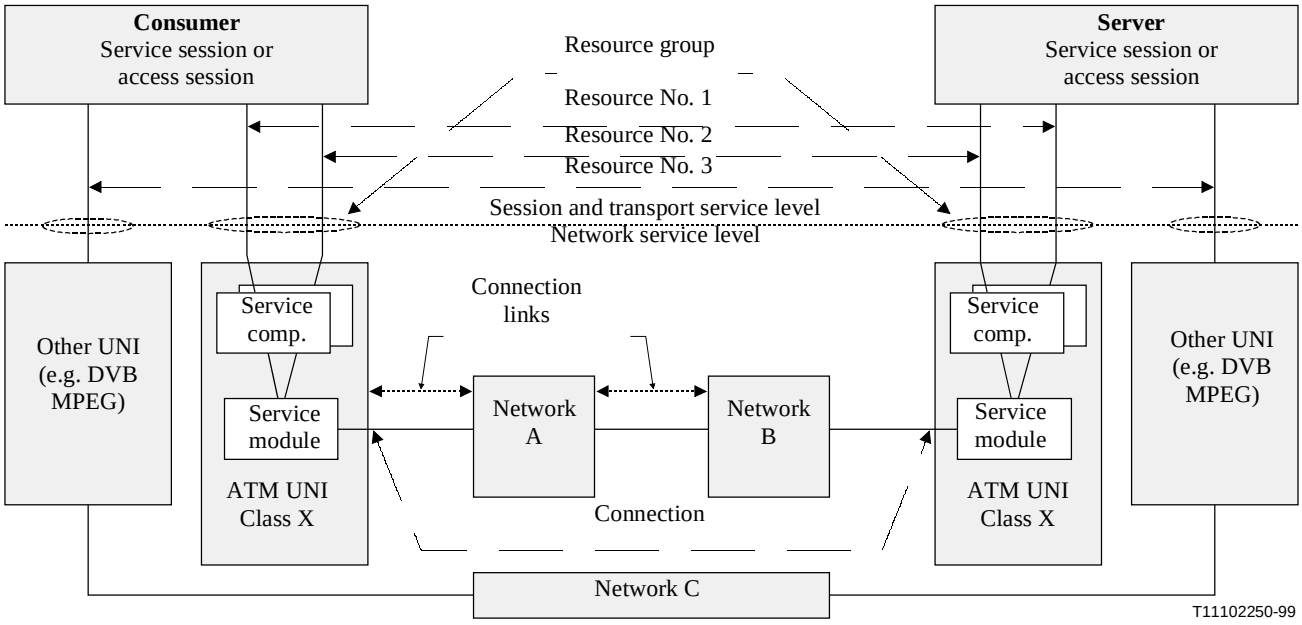


Figure 7-9 – Resource, connection and connection link

Notice that the resource identifier may apply across multiple network technologies and therefore it is allocated outside these network technologies.

The network connection will need to carry a related resource identifier so that the terminal knows what to do with the new stream.

7.4.4 Direct/remote resource association

This object is the end-to-end association between end users of one or more networks, as perceived by the serving network(s) as a transparent end-to-end relationship. This association carries user-to-user information between the associated service components. Figure 7-10 illustrates a resource association between the consumer and one of the servers associated with the telecommunication service. In a telecommunication service there could be a resource association among each set of parties that are directly associated with the individual resource.

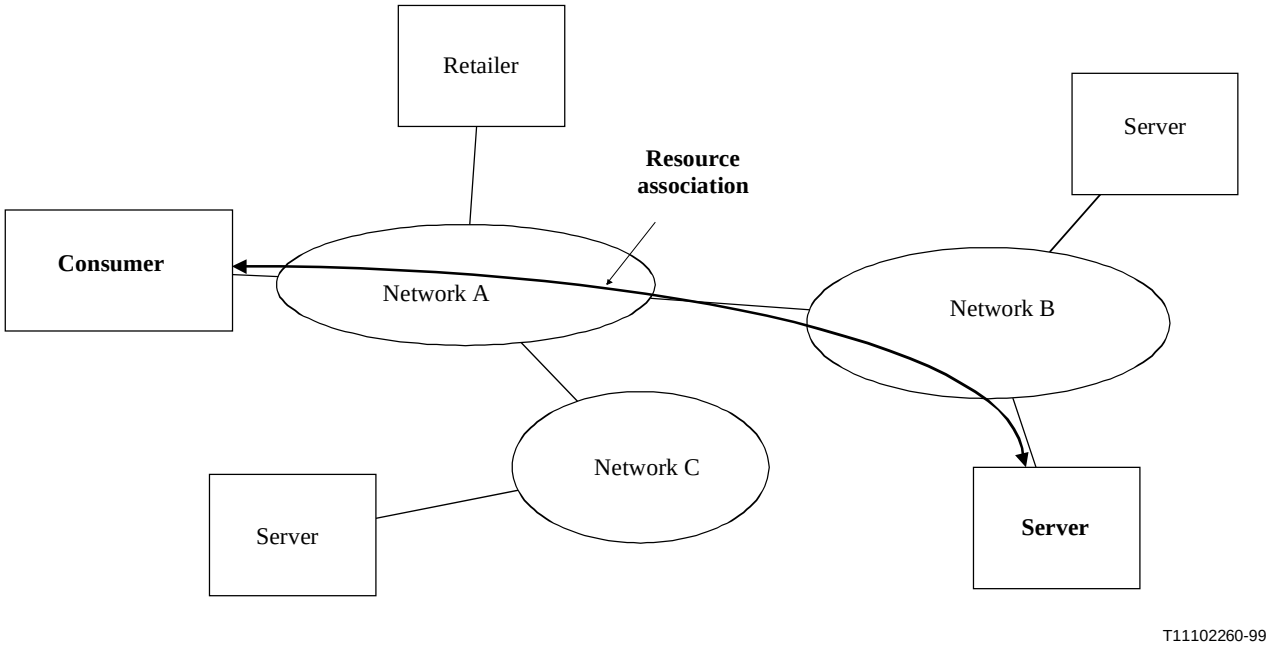


Figure 7-10 – Resource association

7.4.5 Resource component

A resource component (see Figure 7-11) is defined as a single medium end point within an end system that is associated with a session telecommunication service related to a single medium such as voice, data, video, etc.

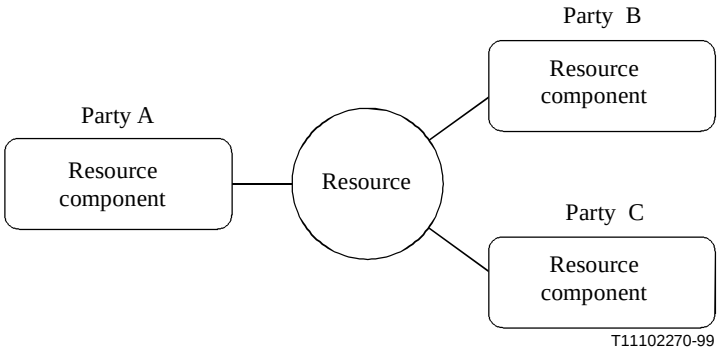


Figure 7-11 – Resource component

7.5 Description of call control classes

7.5.1 Service component

A service component (see Figure 7-12) is defined as a single medium end point within an end system that is associated with a telecommunication service related to a single medium such as voice, data, video, etc. Service components associated with different party end points attached to the same network connection may be different. For example, on a point-to-multipoint connection where party A is the root and parties B and C are leaves, the service components associated with party A may be audio, video and subtitle. Party B may have the same service components as party A while party C may only have the audio and video service components.

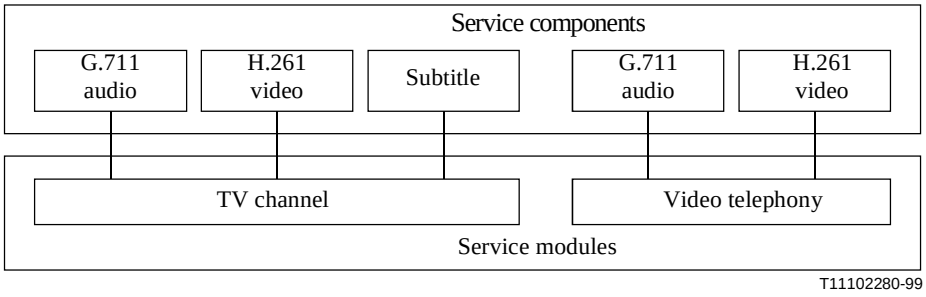


Figure 7-12 – Service component and service module illustration

7.5.2 Call

This object (see Figure 7-13) is defined as the end-to-end network view of an association of two or more call party end points using a telecommunication service to communicate through the network(s).

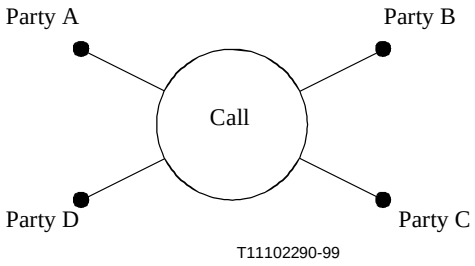


Figure 7-13 – Call graph

7.5.3 Direct/remote call association

A call association object is the end-to-end association between two end users of one or more networks, as perceived by the serving network(s) as a transparent end-to-end relationship. This association carries signalling information that allows the service component to be attached to or detached from its associated service module. Figure 7-14 illustrates a call party association between the consumer and one of the servers associated with the telecommunication service. In an actual telecommunication service there would be a call party association among each set of parties that are directly associated with the call.

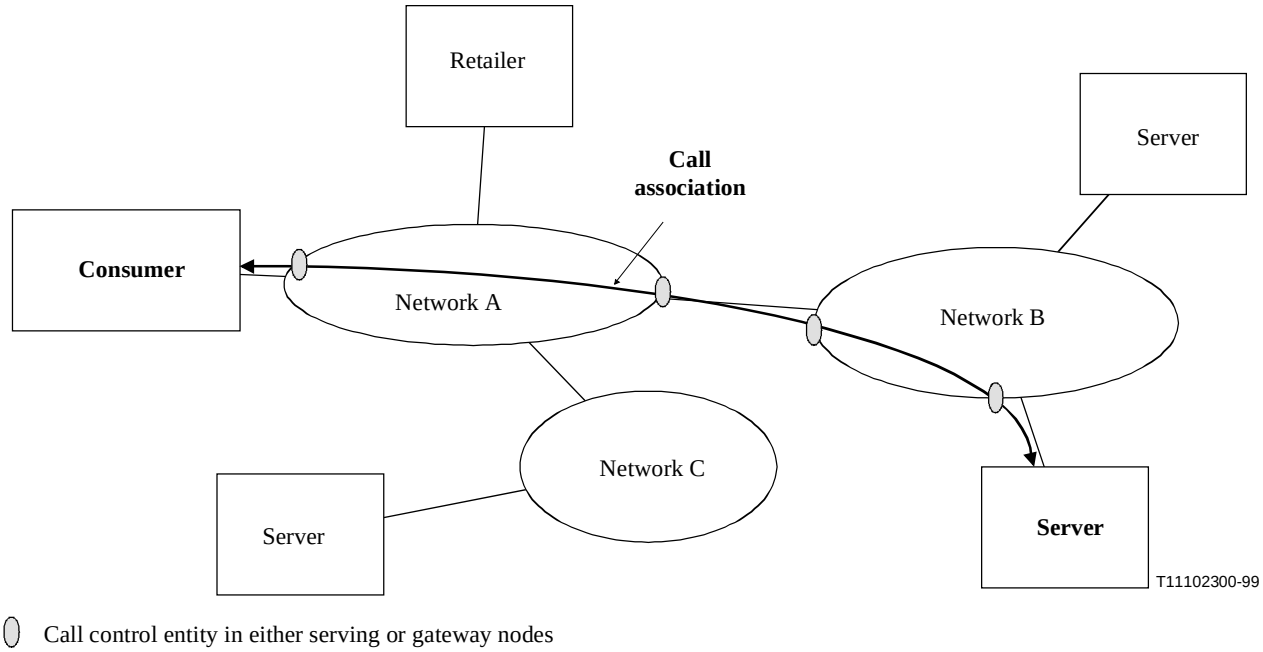
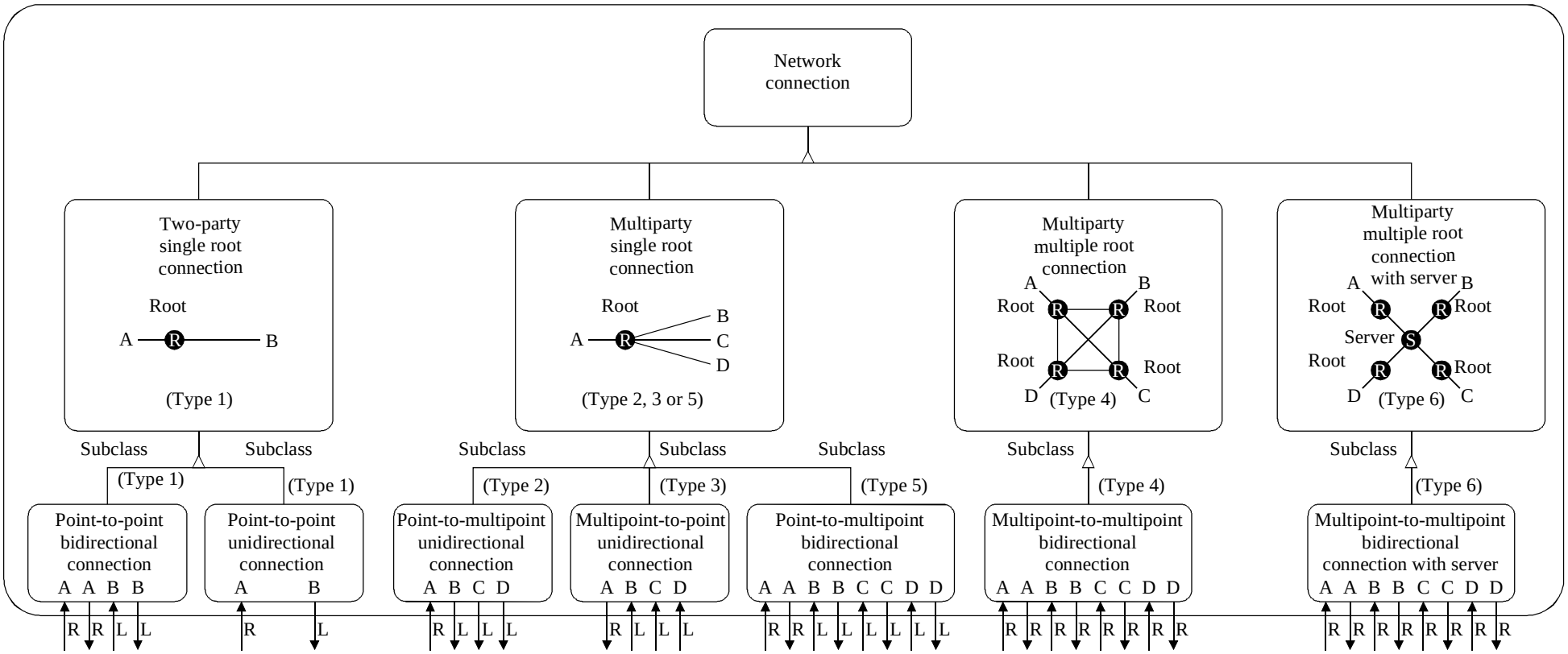


Figure 7-14 – Call association

7.6 Description of bearer control classes

7.6.1 Network connection

This object represents a network connection, which could be a type 1 to type 6 connection topology as defined in Table A.1. Figure 7-15 illustrates the object graph for the four types of network connection configurations. Note that a network connection configuration could contain various network connection types (i.e. multiparty Single Root could be a type 1 unidirectional/bidirectional, type 2, type 3 or type 5 connection).



R Root
L Leaf

NOTE – Root is a replication and multiplexing point of control.

Figure 7-15 – Network connection graph

7.6.2 Network connection association

This object is the end-to-end signalling association between end users of one or more networks carrying signalling information that allows the end points to establish, to be attached to, to be detached from, or to release their associated network connection. Figure 7-16 illustrates a network connection association between the consumer and one of the servers associated with the telecommunication service. In an actual telecommunication service there would be a network connection association among each set of parties that are directly associated with the network connection.

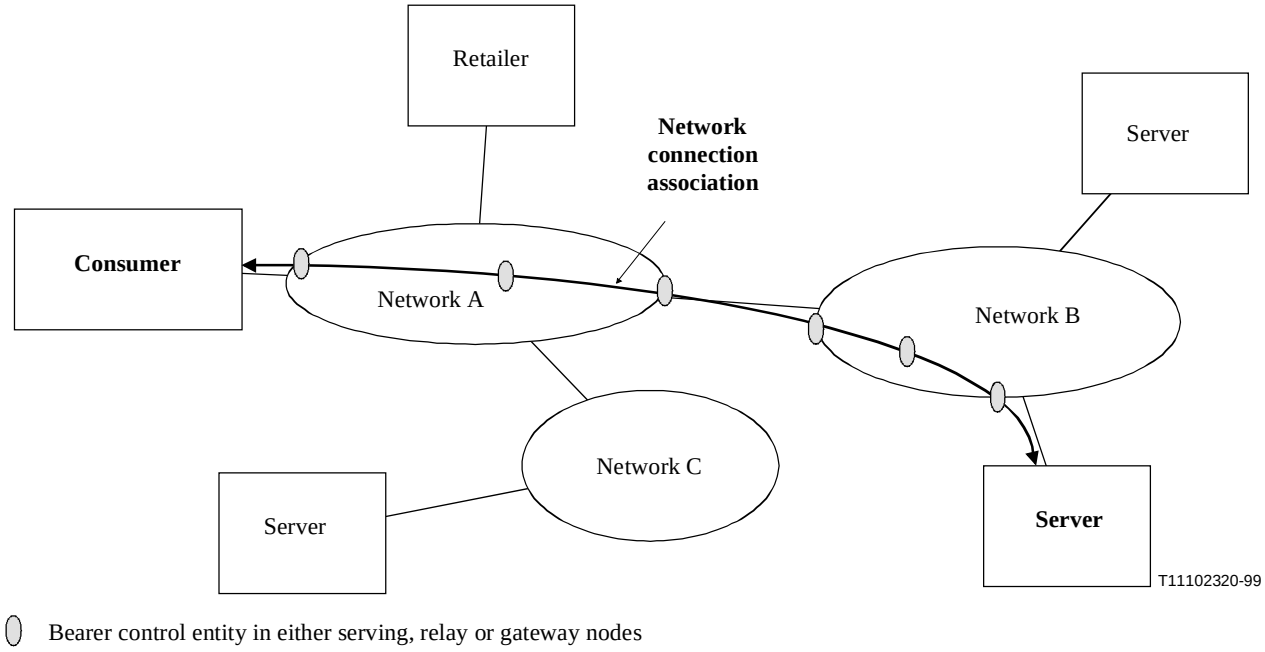


Figure 7-16 – Network connection association

7.6.3 Bearer branch

The bearer branch (see Figure 7-17) links the service module to the network connection. The bearer branch represents the network characteristics associated with a particular party end point.

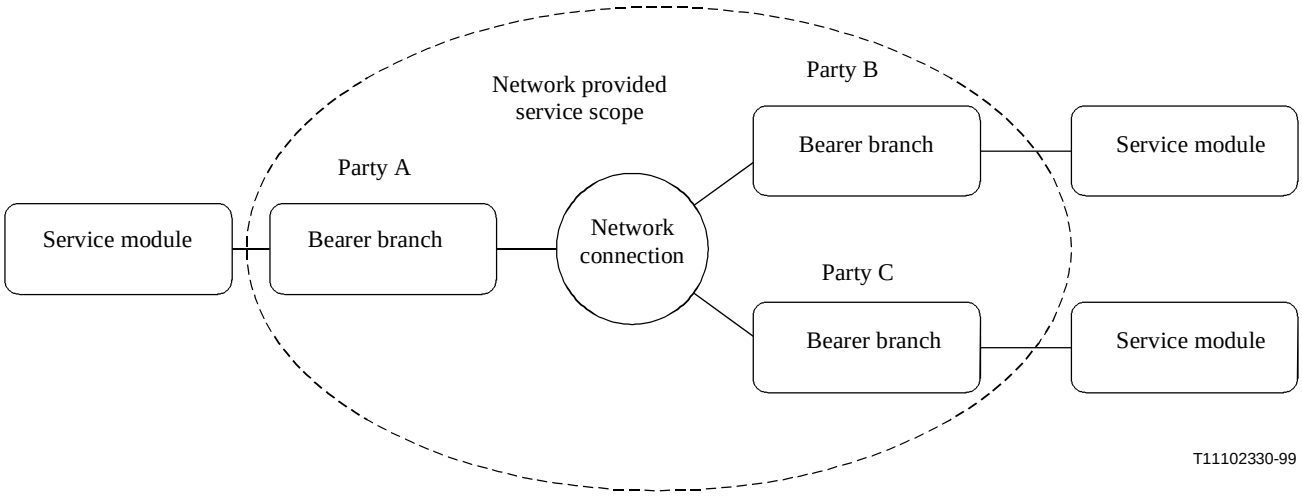


Figure 7-17 – Bearer branch

7.6.4 Service module

A service module (see Figure 7-18) multiplexes one or more service components (one medium specified in a service component), and it specifies a multiplexing method for all service components within the service module. Service modules associated with different party end points attached to the same network connection may be different. For example, on a point-to-point connection where parties A and B are end points, the service module associated with party A may be transmit only and the service module associated with party B may be receive only.

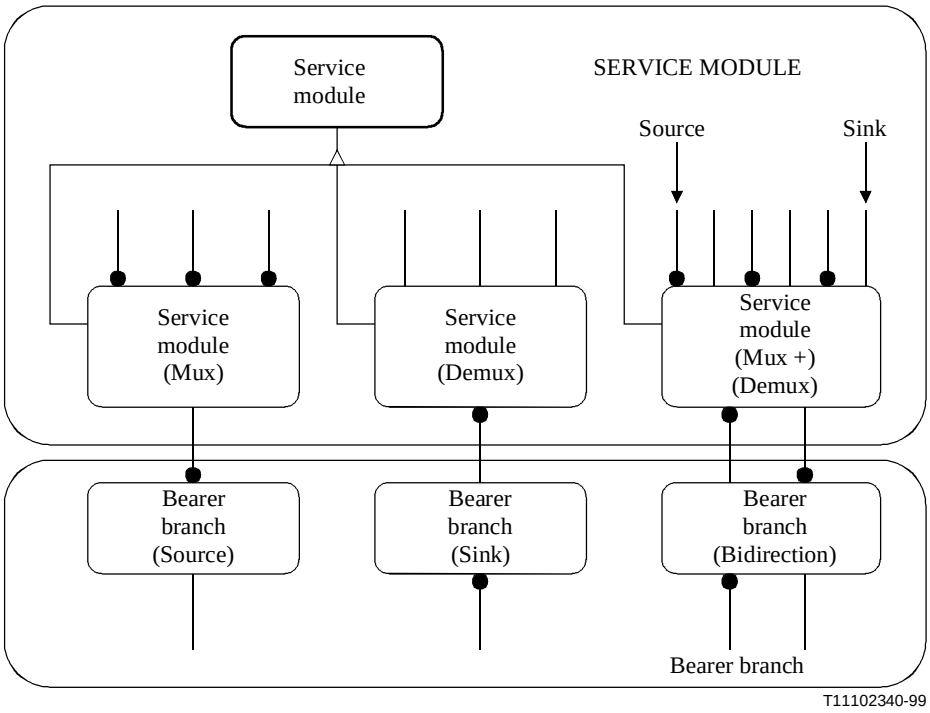


Figure 7-18 – Service module graph

7.7 Description of transport control classes

7.7.1 Transport connection

This object (see Figure 7-19) represents a transport connection, which would be limited to a type 1 and type 2 connection topology as defined in Table A.1. A transport connection is made up of a concatenation of transport links. Between two end points, multiple, parallel transport connections may exist that carry the same information.

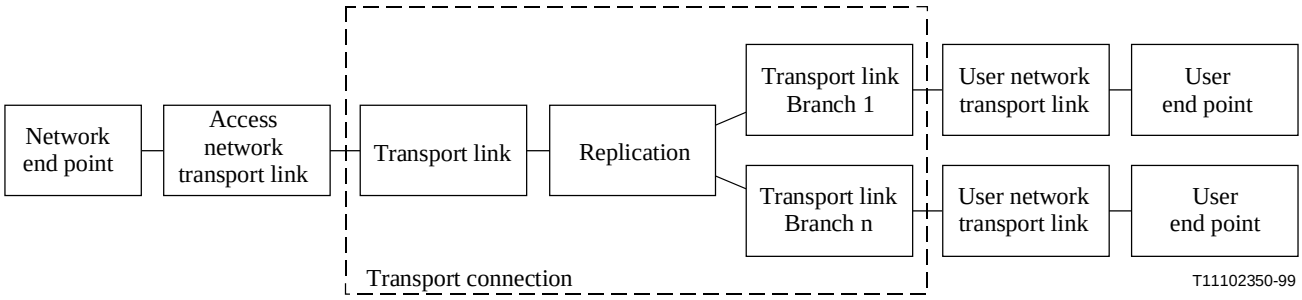


Figure 7-19 – Support for type 2 connections in an access network

7.7.2 Transport link

This object consists of two types: a user network transport link and an access transport link. In any particular transport connections there may exist one or more access network transport links, but only one user to network transport link. Figure 7-20 illustrates the possibility of more than one parallel transport connections between the two end points made up of the types of transport links. For type 1 connections there will only be one user-network transport link, but for type 2 connections there will be more than one user-network transport link and user end point. Note that a User Transport Connection end point may have the ability to multiplex several service modules on to a Transport Connection which will be demultiplexed at the Network transport connection end point and be represented as a set of Local bearer branches to the network.

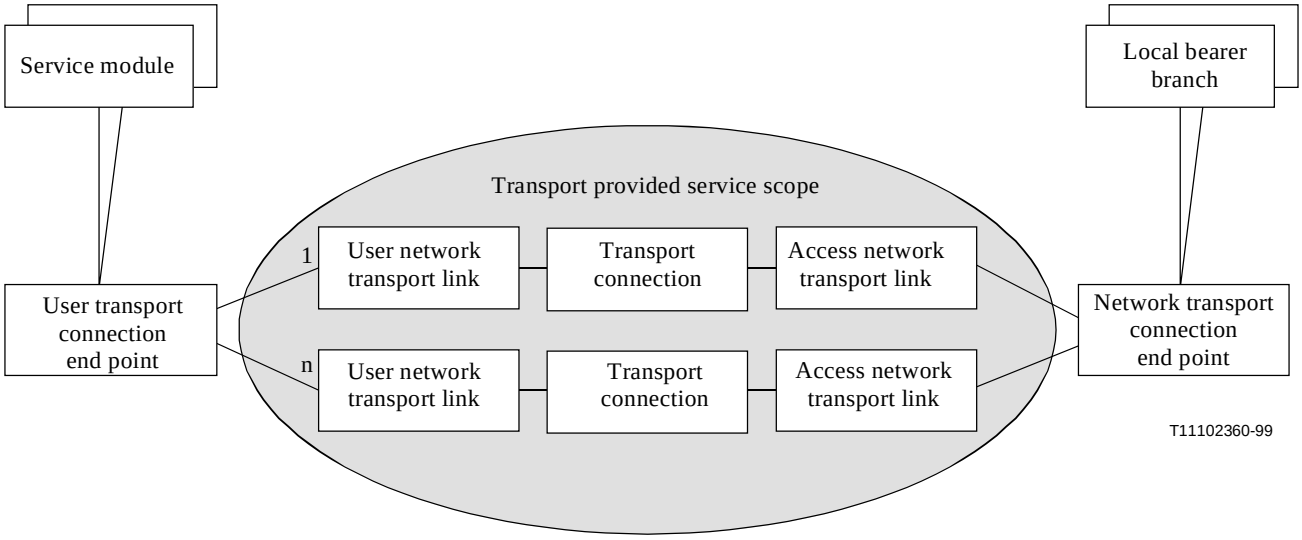


Figure 7-20 – Transport link

7.8 Description of common class attributes

7.8.1 Party end point network address

The party end point network address is to specify the directory number of the party. This can consist of the party end point number and the party end point subaddress. Alternative ways to store the number would be using network service access points (NSAPs) or ATM end system addresses (AESAs).

7.8.2 Communication configuration

This attribute indicates the communication configuration (i.e. source, sink or bidirectional).

7.9 Description of session control class attributes

7.9.1 Session party end point ID

This attribute is defined as the end points of a session. Note that the state of each session party end point illustrates the status of the end point with respect to the session.

The definition of the local session end point status illustrated in Figure 7-21 is as follows:

- Null: Session branch non-existent. No party association with session point.
- Pending: Session branch awaiting indication from party associated with the remote branch.
- Joined: Session branch is joined to the session point. Communication stream between session point and the remote party associated with the branch is possible.
- Shared: Session branch being shared between two separated sessions. This session branch is on "hold".
- Third: Session branch non-existent. Used to associate a third party with a session it has established.
- Surrogate: Session branch which provides a temporary association between the session point and a local party during a session forwarding operation or session transfer operation.

The remote session end point status is limited to the null, pending and joined states.

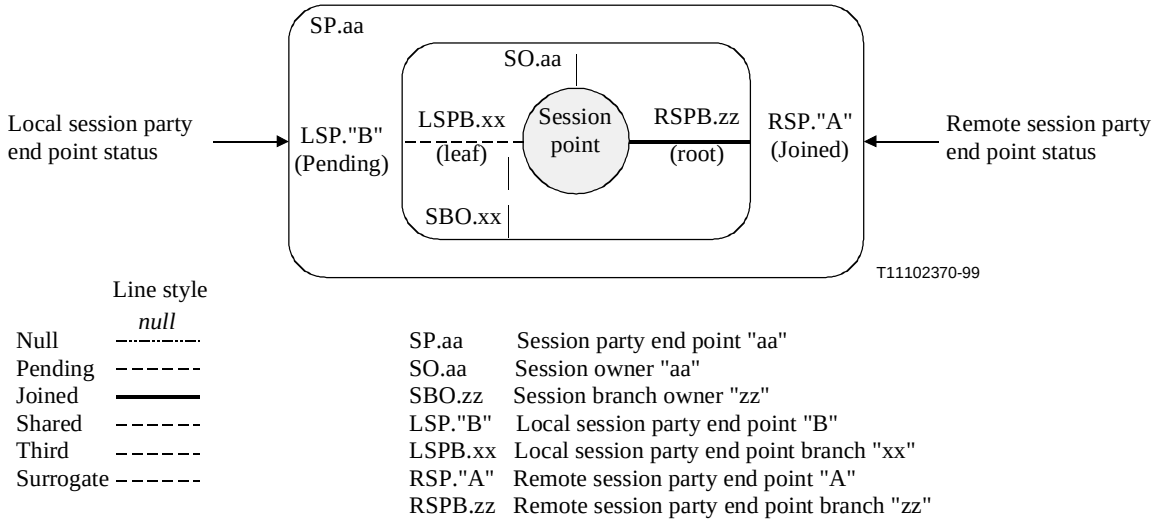


Figure 7-21 – Session party end point local view

7.9.2 Party end point business type

A party end point may be associated with a consumer, a broker, a retailer or a service provider or may be associated with a combination of these business domains.

7.9.3 Session ID

This attribute is used to uniquely identify the session. The session ID is global in significance.

7.9.4 Session owner

This attribute is used to uniquely identify the session owner.

7.9.5 Session association ID

This element identifies the first and second session party end point identifiers in this association.

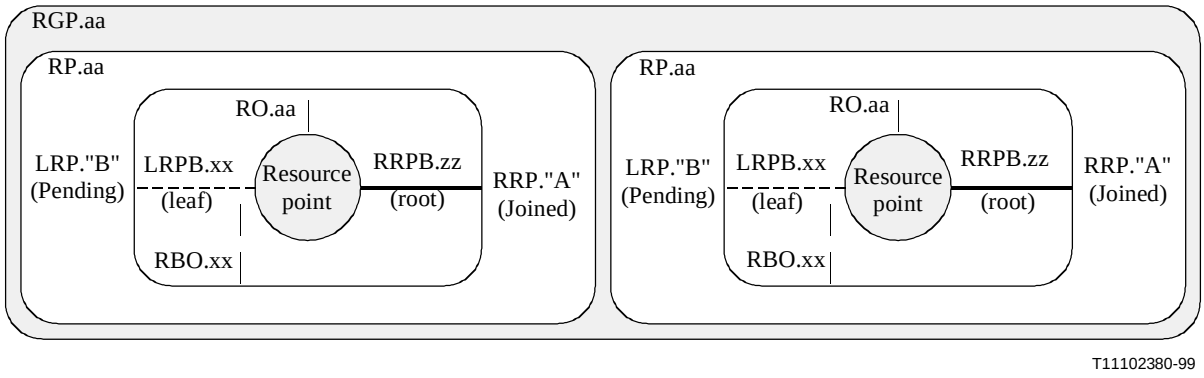
7.9.6 Session type

This attribute is used to identify the type of session relationship (i.e. access session or service session) between the first and second party end points.

7.10 Description of resource control class attributes

7.10.1 Resource group party end point ID

This attribute defines the end points of a resource group (see Figure 7-22). Note that the state of each resource group party end point illustrates the status of the end point with respect to the resource group.



Line style	
Null	*null*
Pending	– – – – – –
Joined	———
Shared	– – – – – –
Third	– – – – – –
Surrogate	– – – – – –

RP.aa	Resource party end point "aa"
RO.aa	Resource owner "aa"
RBO.zz	Resource branch owner "zz"
LRP."B"	Local resource party end point "B"
LRPB.xx	Local resource party end point branch "xx"
RRP."A"	Remote resource party end point "A"
RRPB.zz	Remote resource party end point branch "zz"

Figure 7-22 – Resource group party end point local view

7.10.2 Resource group ID

This attribute identifies a resource group. All resources in a resource group will be routed together or have common control characteristics such as life-and-death procedures.

7.10.3 Resource group owner

This attribute is used to uniquely identify the resource group owner.

7.10.4 Resource group association ID

This element identifies the first and second resource group party end point identifiers in this association.

7.10.5 Resource party end point ID

This attribute is defined as the end points of a resource. Note that the state of each resource party end point illustrates the status of the end point with respect to the resource.

The definition of the local resource end point status illustrated in Figure 7-23 is as follows:

- Null: Resource branch non-existent. No party association with resource point.
- Pending: Resource branch awaiting indication from party associated with the remote branch.
- Joined: Resource branch is joined to the resource point. Communication stream between resource point and the remote party associated with the branch is possible.
- Shared: Resource branch being shared between two separated resources. This resource branch is on "hold".
- Third: Resource branch non-existent. Used to associate a third party with a resource it has established.
- Surrogate: Resource branch which provides a temporary association between the resource point and a local party during a resource forwarding operation or resource transfer operation.

The remote resource end point status is limited to the null, pending and joined states.

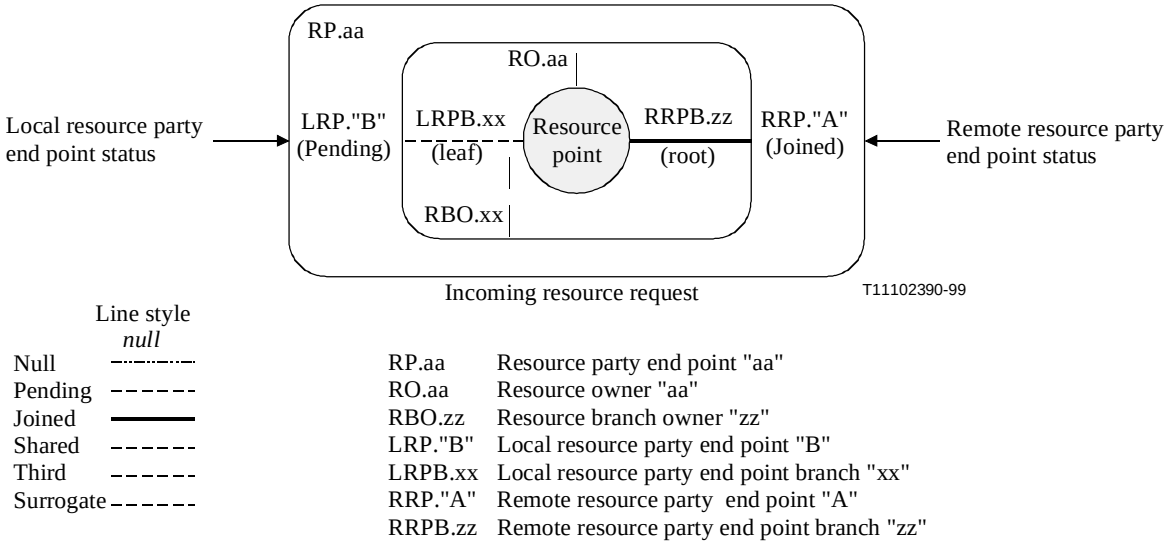


Figure 7-23 – Resource party end point local view

7.10.6 Resource ID

This attribute is used to identify the resources within the session. The resource identifier is global in significance but not necessarily used by any of the networks.

7.10.7 Resource owner

This attribute is used to uniquely identify the resource owner.

7.10.8 Resource association ID

This element identifies the first and second resource party end point identifiers in this association.

7.10.9 Resource component ID

The resource component identifier is used to identify a resource component associated with a resource.

7.10.10 Resource component characteristics

The resource component characteristics indicate the complete resource "stack" of protocols.

7.11 Description of call control class attributes

7.11.1 Call party end point ID

This attribute defines the end points of a call. In the information model, two classifications are illustrated, local call party end point and remote call party end point. In both cases, these end points are a subclass of the party end point object. Figure 7-24 illustrates the relationships of these objects. Note that each call party end point's states illustrate the status of the end point with respect to the call.

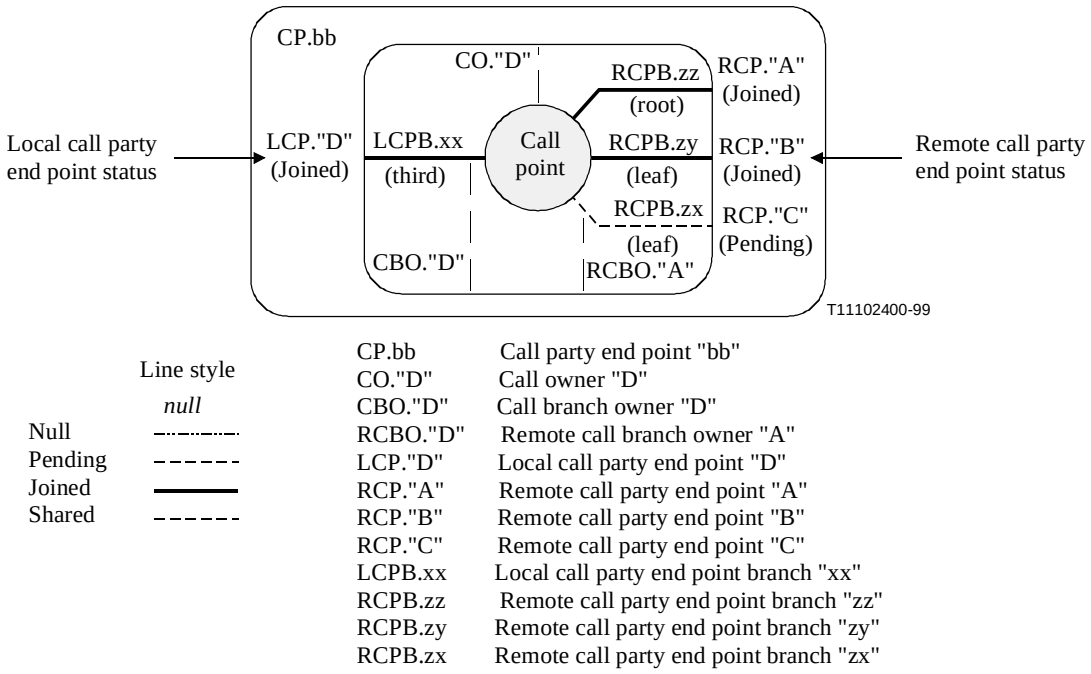


Figure 7-24 – Call party end point local view

The definition of the call party end point status illustrated in Figure 7-24 is as follows:

- Null: Designated party has no association with the call relationship.
- Pending: Call relationship awaiting answer indication from designated party.
- Joined: Designated party is joined to the call object.

- Shared: Designated party is being shared between two call relationships. This party association is on "hold".

7.11.2 Call ID

The call identifier is used by all signalling entities to reference the instance of call service to which this signalling control information flow pertains.

7.11.3 Call owner

This attribute is used to uniquely identify the call owner.

7.11.4 Party owner

This attribute is used to uniquely identify the party owner.

7.11.5 Call association ID

This element identifies the first and second call party end point identifiers in this association.

7.11.6 Service component ID

The service component identifier is used to identify a service component associated with a resource.

7.11.7 Service component characteristics

The service component characteristics indicate type of media (e.g. voice, video, data, etc.), information transfer rate, symmetry and media characteristics. This information allows end control entities to determine if sufficient bandwidth and facilities exist to accept the service component. These characteristics include high-layer information. High-layer information provides the characteristics of the layers above the "network layer" information associated with the media characteristics. Examples of such information are telephony, group 4 facsimile, documentation profiles (Recommendations T.501, T.502, T.503 and T.504), teletex, telex, message handling systems (X.400-series Recommendations), OSI applications (X.200-series Recommendations), video broadcast, video telephony, etc. This attribute could be used by the requesting party for compatibility checking.

7.11.8 Service component traffic descriptor requirements

This attribute describes the service traffic requirements such as bandwidth, and provides a mechanism for connection negotiation.

7.11.9 Service component QoS descriptor requirements

This attribute describes the quality of service (QoS) requirements of the service.

7.12 Description of bearer control class attributes

7.12.1 Transit network ID

The transit network identifier is used by bearer control entities to reference the transit network to be used in the execution of the bearer control action. This attribute may be repeated within the information flow. This attribute is referenced in the Q.2931 protocol by the network identification field within the transit network selection information element.

7.12.2 Network connection party end point ID

This attribute defines the end points of a network connection. In the information model, two classifications are illustrated: local connection end point and remote connection end point. In both cases, these end points are a subclass of the party end point object. Figure 7-25 illustrates the

relationships of these objects. Note that the connection end points states illustrate the status of that end point with respect to the overall connection.

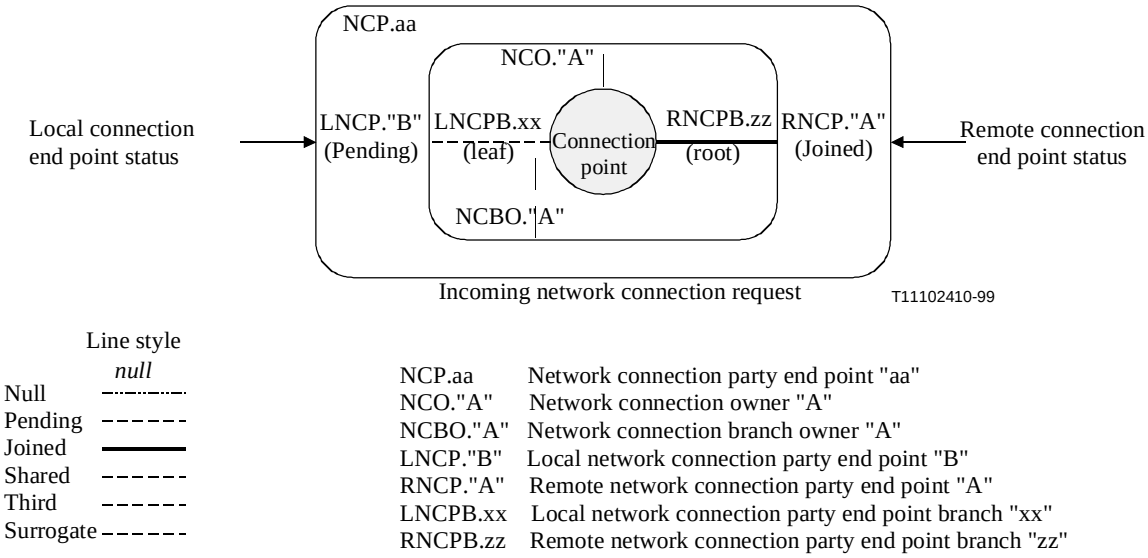


Figure 7-25 – Network connection party end point local view

The definition of the local connection end point status illustrated in Figure 7-25 is as follows:

- Null: Connection branch non-existent. No party association with connector object.
- Pending: Connection branch awaiting Answer indication from party associated with the branch.
- Joined: Connection branch is joined to the connector object. Communication stream between connector object and the party associated with the branch is possible.
- Shared: Connection branch being shared between two separated connections. This connection branch is on "hold".
- Third: Connection branch non-existent. Used to associate a third party with a connector it has established.
- Surrogate: Connection branch which provides a temporary association between the connector object and a local party during a connection forwarding operation or connection transfer operation.

The remote connection end point status is limited to the null, pending and joined states.

7.12.3 Network-oriented low layer information

This set of information specifies protocols and characteristics for the network of the AAL layer and below for a network connection to support particular services/applications.

7.12.4 Network connection topology type

This attribute defines the network connection topology types for a network connection that is associated with the bearer service. The connection topology type would be one of those defined in Table A.1, such as point-to-point, unidirectional point-to-multipoint, unidirectional multipoint-to-point, multipoint-to-multipoint without a server, bidirectional point-to-multipoint and multipoint-to-multipoint with a server.

7.12.5 Network connection ID

This attribute is used to identify the network connection uniquely within the call. A network connection is mapped into one network connection.

7.12.6 Network connection owner

This attribute is used to uniquely identify the network connection owner.

7.12.7 Bearer branch owner

This attribute is used to uniquely identify the bearer branch owner.

7.12.8 Network connection association ID

This element identifies the first and second network connection party end point identifiers in this association.

7.12.9 Service module ID

The service module identifier is used by edge-to-edge or end-to-end control entities to reference a virtual user service module connection between the requesting and requested parties. A service module will be mapped into a single network connection in a call.

7.12.10 Multiplexing method

A multiplexing method may be specified to be used to multiplex all service components in the service module. Examples of multiplexing methods are defined in Recommendations H.221 and H.223.

7.13 Call, bearer and transport control segment relationships

7.13.1 Call control segment

The call control segment object represents the instance of a zero, single or multiconnection telecommunication service between an end user and its serving network, between two network nodes or between two network gateways. It is of local significance, understood by the two functional entities across the physical interface separating the two functional entities and identifies a collection of zero or more connections within a single telecommunication service. Each call control segment will be treated independently by the serving network even though all are associated with the same session identifier. Figure 7-26 represents a single telecommunication service consisting of several associated/related call control segments. Each applicable functional entity provides the incoming call control segment to outgoing call control segment associations necessary to provide the portion of the telecommunication service passing through it.

NOTE – Call control segments in this Supplement should not be confused with IN call segments. While call control segments relate to the communication associations between certain functional entities, IN call segments relate to connection state machines.

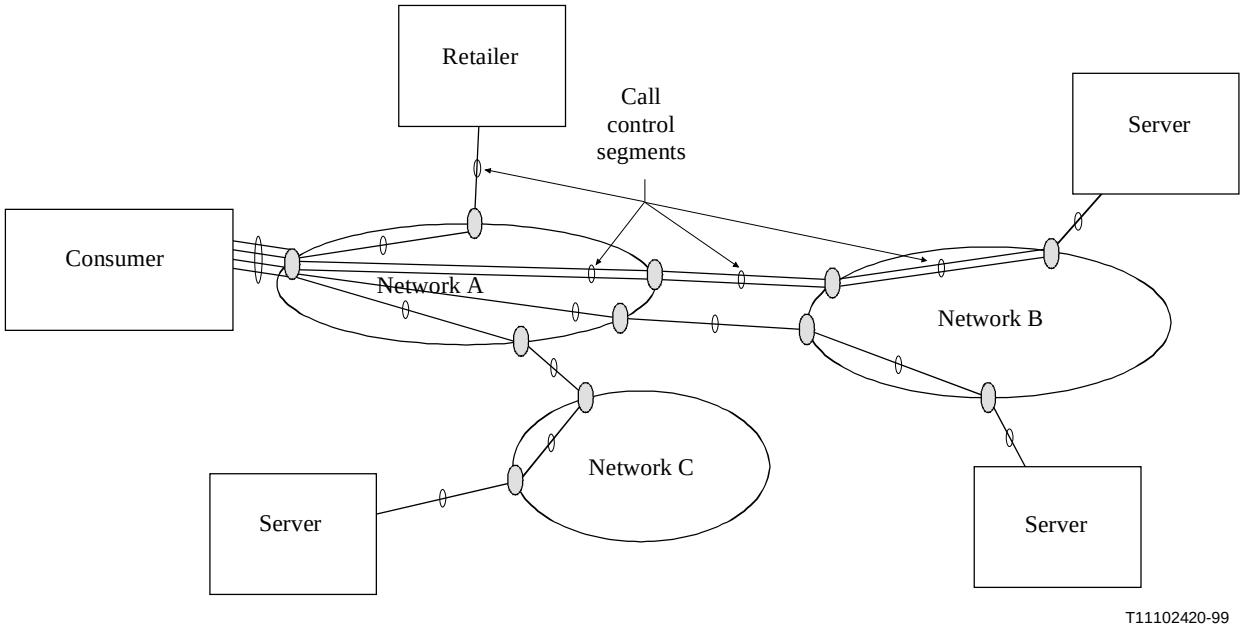


Figure 7-26 – Call control segment relationship diagram

In Figure 7-26, two call control segments are shown between network A and network B containing a different number of connections. This represents the case where two points of attachment exist between two networks (i.e. two sets of gateways).

Figure 7-27 shows the relationship between the call ID attribute and the call control segments. It is the call ID that provides the mapping function between in ingress and egress call control segments.

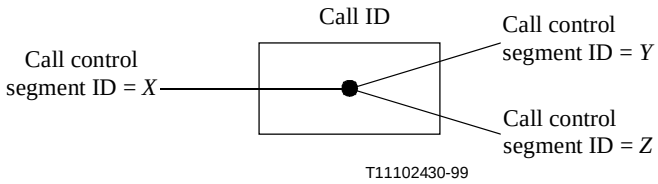


Figure 7-27 – Call ID, call control segment ID relationship diagram

7.13.2 Bearer control segment

The bearer control segment object represents the instance of a single telecommunication service between an end user and its serving network, between two network nodes, between two transit nodes or between two network gateways. It is of local significance, understood by the two functional entities across the physical interface separating the two functional entities and identifies a single connection within a single telecommunication service. Each bearer control segment will be treated independently by the serving network even though all are associated with the same session identifier. Figure 7-28 represents a single telecommunication service consisting of several associated/related bearer control segments. Each applicable functional entity provides the incoming bearer control segment to outgoing bearer control segment associations necessary to provide the portion of the telecommunication service passing through it.

NOTE – Bearer control segments in this supplement should not be confused with IN call segments. While bearer control segments relate to the communication associations between certain functional entities, IN call segments relate to connection state machines.

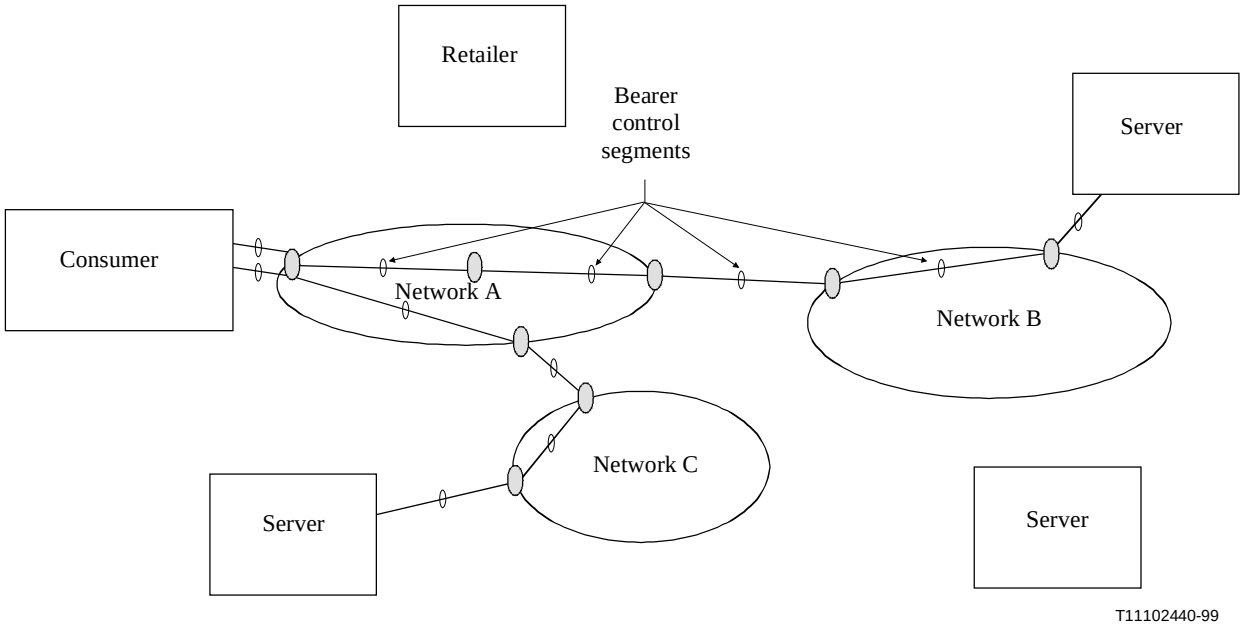


Figure 7-28 – Bearer control segment relationship diagram

Figure 7-29 shows the relationship between the network connection ID attribute and the bearer control segments. It is the network connection ID that provides the mapping function between in ingress and egress bearer control segments.

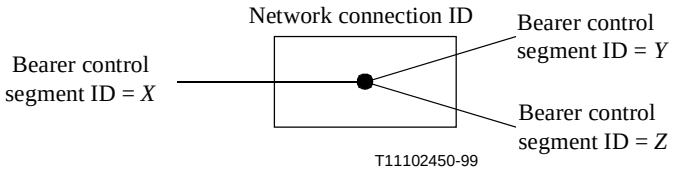


Figure 7-29 – Network connection ID, bearer control segment ID relationship diagram

7.13.3 Transport control segment

The transport control segment object represents the instance of a single transport signalling service between an end user and its serving network. It is of local significance, understood by the two functional entities across the physical interface separating the two functional entities and identifies a single transport connection within a single transport signalling service. Each transport control segment will be treated independently by the serving transport network. Figure 7-30 represents a single transport service consisting of several associated/related transport control segments. Each applicable functional entity provides the incoming transport control segment to outgoing transport control segment associations necessary to provide the portion of the transport service passing through it.

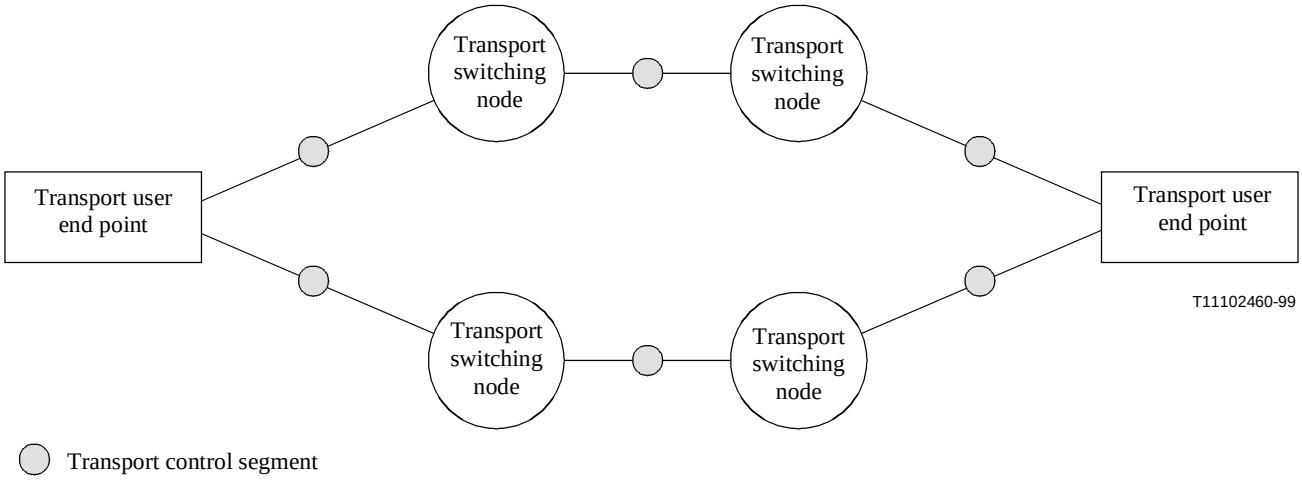


Figure 7-30 – Transport control segment relationship diagram

7.13.4 Relationships between call, bearer and transport control segments

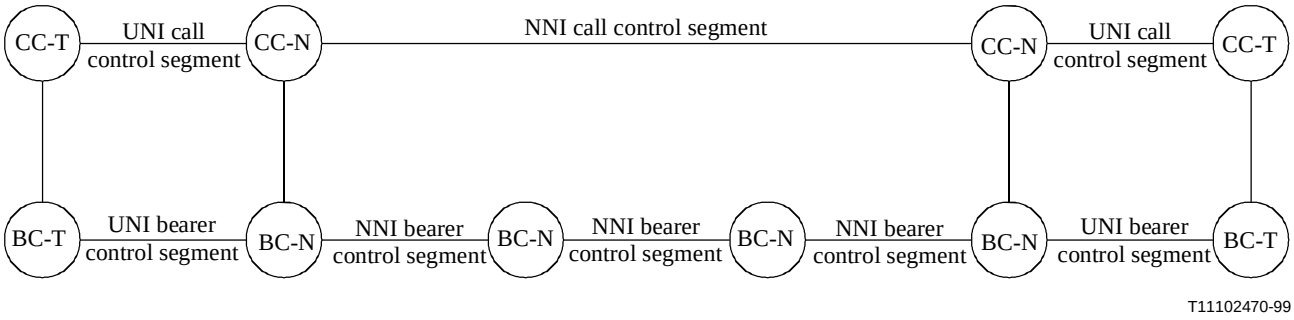
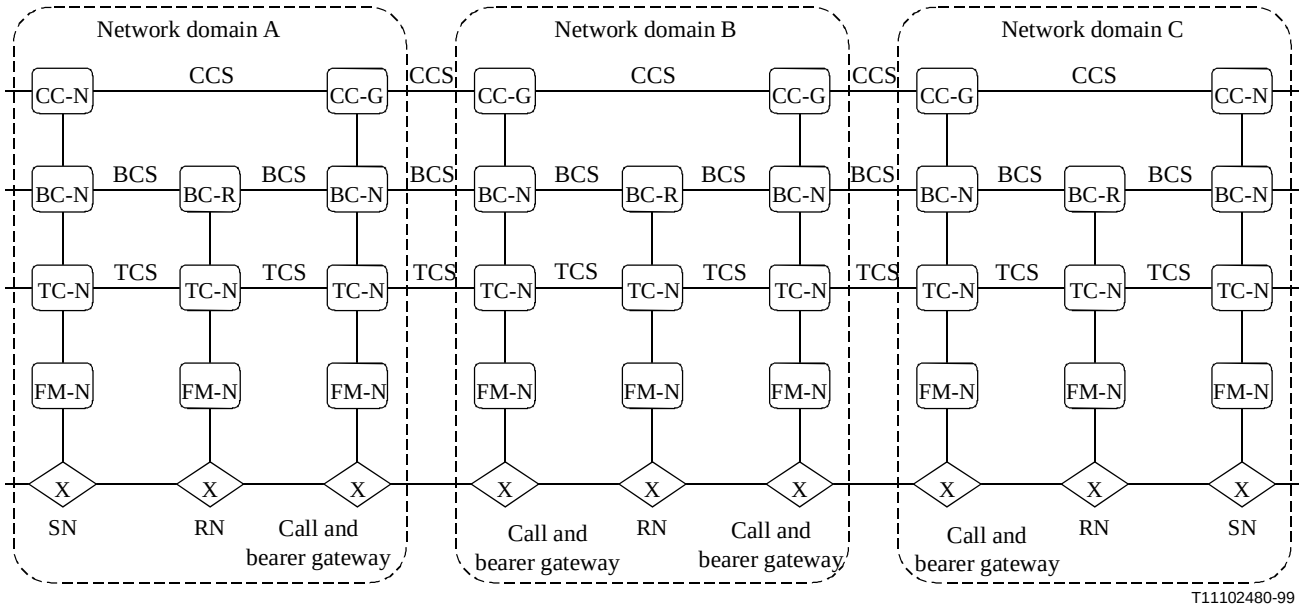


Figure 7-31 – Call and bearer control segments in B-ISDN CS-2.2/3

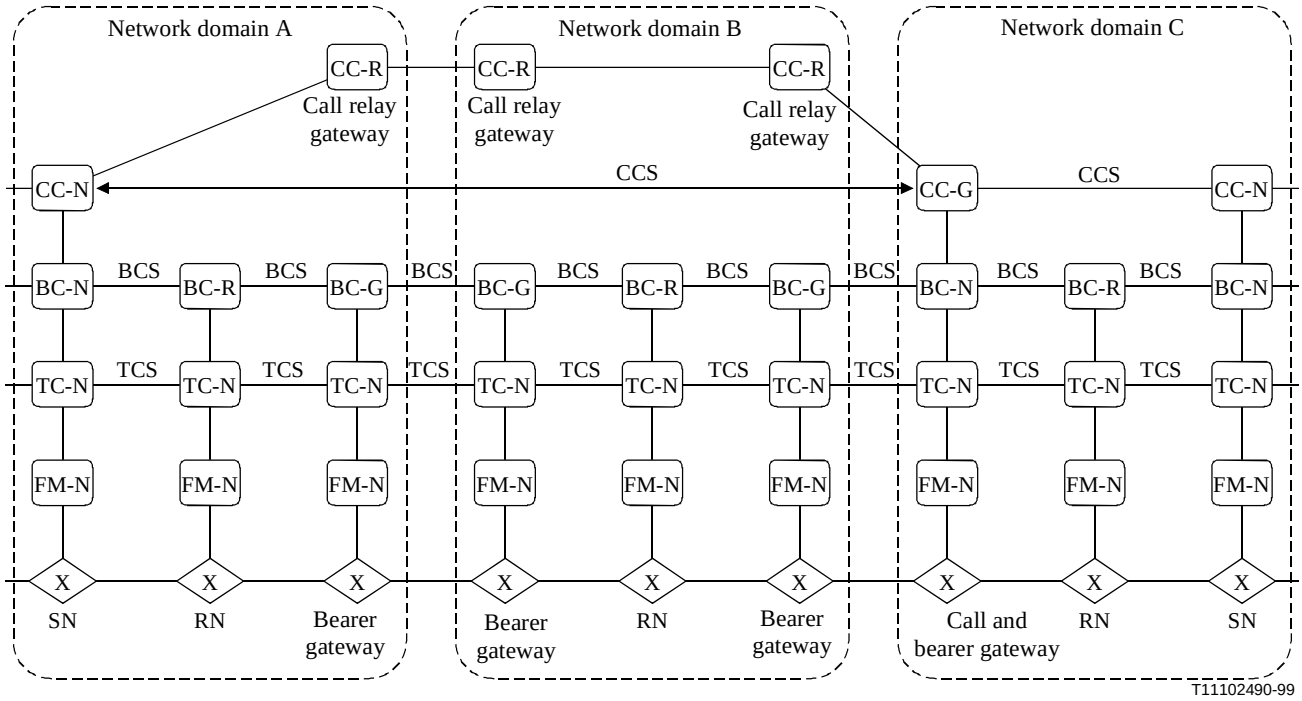
It should be noted that a call may consist of zero or more network connections. Hence, a call control segment may consist of zero or more bearer control segments.

Figures 7-32 to 7-34 show call control segment, bearer control segment and transport control segment relationships involving the gateway functions.



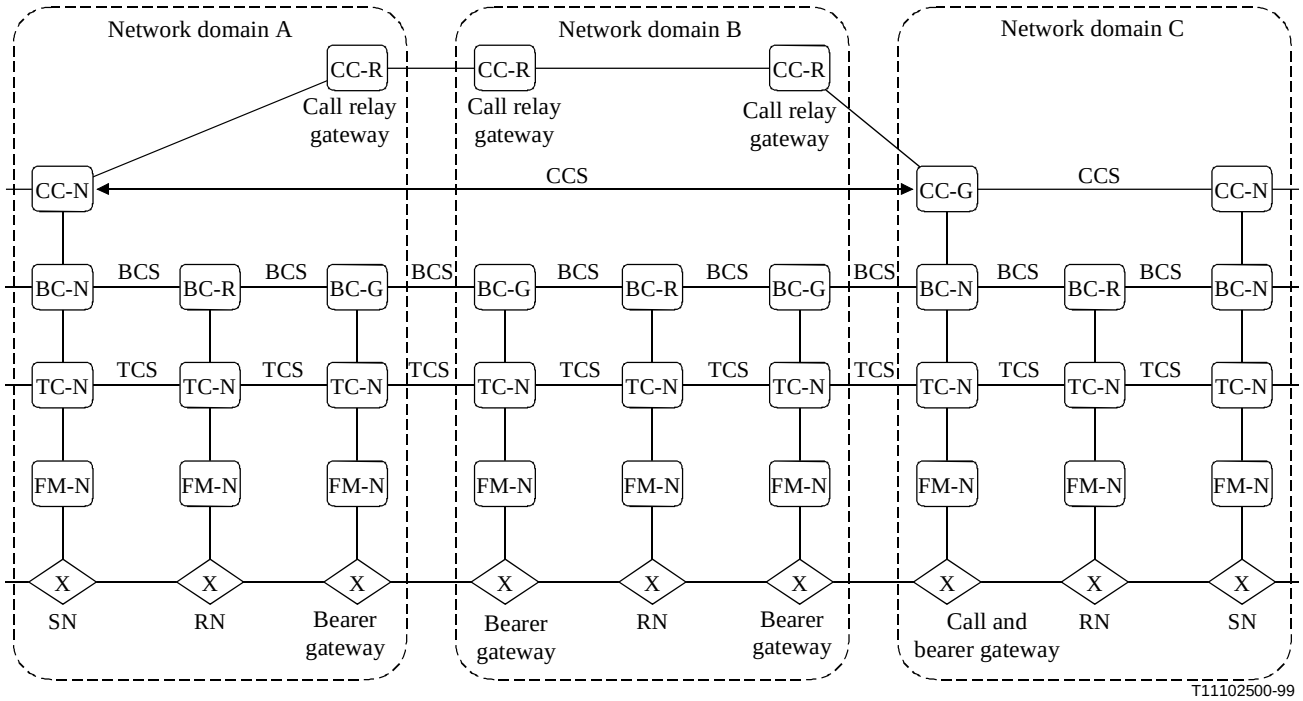
Bearer control segment
Call control segment
Transport control segment

Figure 7-32 – Call and bearer control segments involving call and bearer gateways



BCS Bearer control segment
CCS Call control segment
TCS Transport control segment

Figure 7-33 – Call and bearer control segments involving call relay and bearer relay gateways (single call and bearer transit network)



BCS Bearer control segment
CCS Call control segment
TCS Transport control segment

Figure 7-34 – Call and bearer control segments involving call relay and bearer relay gateways (separated call and bearer transit networks)

8 Computational object model

The computational model has been derived through detailed analysis based on teleservice definitions and models, resulting in the unified functional model. This involves the derivation of a unified functional model.

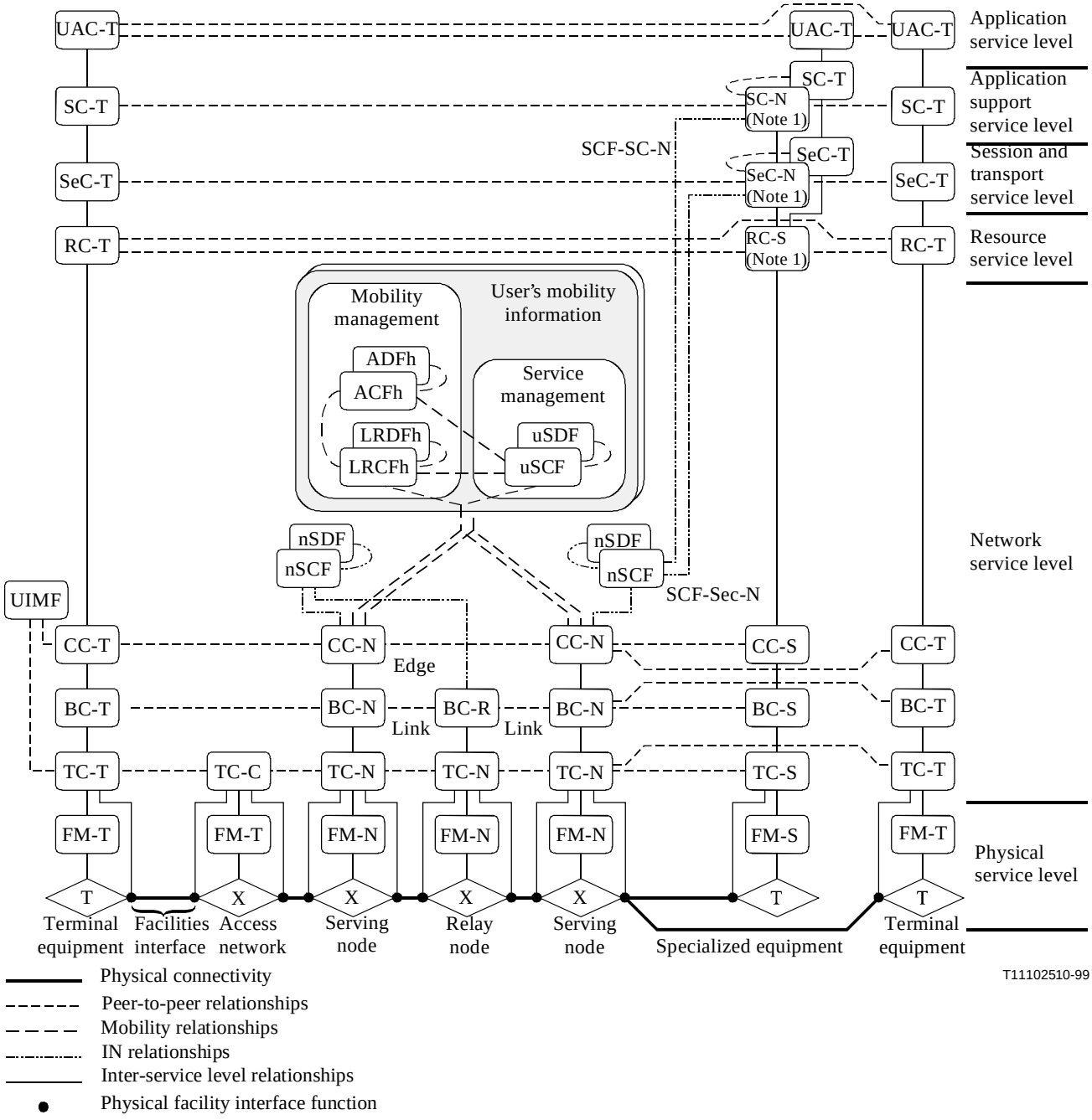
Unified telecommunication services will involve sophisticated service-related processing by the network. The proposed unified functional model provides separation and grouping of functions required for unified telecommunications that will be conducive to flexibility in support of new services and in deployment of service processing in the network. This functional model combines and integrates aspects of intelligent network distributed functional plane architecture and modelling of control and signalling.

The functional model is described in terms of FEs and FE relationships. The FE concept is taken from existing work in intelligent networks and ISDN. In this functional model, an FE is defined as a unique grouping of functions that is typically a subset of the functionality required to support a service. A physical entity may contain more than one FE, but one FE cannot be split between multiple physical entities; instead, interaction between multiple FEs may be required to provide the service.

The use of FEs in modelling allows a separation of concerns resulting in modular design and flexibility to support a large variety of services and facilitate the evolution of the network. The FEs are independent of physical deployment and implementation, providing the flexibility for multiple physical network configurations. The FE relationship defined in the functional model should help to identify the requirements for signalling protocols, although explicit interfaces are only necessary between FEs deployed in separate physical nodes.

8.1 Description of the unified functional model

The Unified Functional Model is the name given to this computational object model in ITU-T and is illustrated in Figure 8-1; that aids in the description of the target unified signalling requirements is based on the separation of the control plane into several levels of signalling functional entities. The unified functional model has been incorporated into Recommendation Q.65, the unified functional methodology, and is being used to develop unified information flows and functional entity actions.



This diagram presents a functional entity model without reference to any physical realization or architecture.

UAC level control may be carried by user SVC.
SC, SeC and RC level control may be carried by signalling SVC or user SVC.
CC, BC and TC level signalling carried by signalling SVC.

Specialized equipment may be attached to a serving node or a gateway node (not shown).

NOTE 1 – These functions could be emulated by the SCF; in such cases, the relationships towards these functions would lead to the SCF.
NOTE 2 – SC-N to SC-N relationships exist between different specialized equipment.
NOTE 3 – SeC-N to SeC-N relationships exist between different specialized equipment.
NOTE 4 – CC-N contains the FNA computational objects associated with SACF, LRCFv, LRDFv, ACFv and ADFv. CC-T contains the FNA MCF computational object.

Figure 8-1 – Unified functional model

Figure 8-1 illustrates the functional entities that comprise a serving node, relay node, access network, specialized equipment and terminal equipment entities. The reason for grouping these functional entities into groups is to allow easy transformation of the model into network application oriented network topologies. It does not imply that these functional entities contained within a group are required to be implemented in a single physical entity. It should be noted at this point that the unified functional model also includes gateway node functional groupings. To maintain clarity, these are not illustrated in Figure 8-1. Figure 8-2 illustrates the three types of gateway functional models.

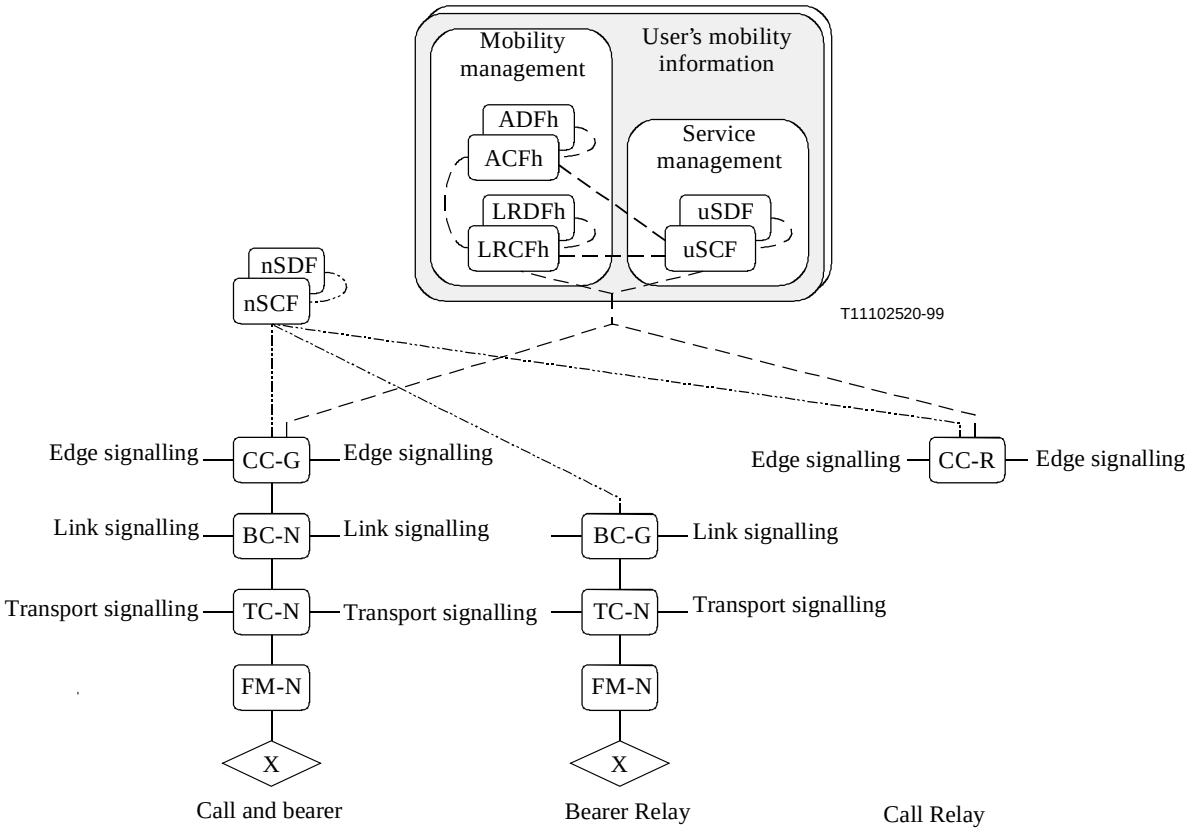


Figure 8-2 – Gateway node functional models

The Call and Bearer gateway terminates both link signalling and edge signalling associations. The Call Control portion of this gateway type is aware of the bearers passing through it. It provides the call and bearer coordination functions associated with these bearers and call control screening functionality.

The Bearer Relay gateway is similar to a relay node but provides additional bearer associated network gateway functionality.

The Call Relay gateway provides call control screening functions and provides a method of call control signalling relay functionality.

8.2 Definition of functional entities

8.2.1 Network switching element (X)

Although not strictly an FE, the network switching element represents an aggregation of network elements under control of a single functional entity. It may be defined based on geographical concerns, administrative partitioning, network technology or other bases. Network elements within this entity may be included in lower layer functions of systems such as switches, cross-connects,

transmission systems, bridges, video storage devices and other specialized resources. In the simplest case, this entity may represent a single switching fabric.

8.2.2 Fabric management (FM)

FM controls the network resources contained within a particular network switching element. FM supports requests for establishment of transport connections between access points of the switching element, decomposing these into lower level actions within elements of the switching element, such as switching fabrics. It also supports the control of specialized resources such as bridges or video devices within the network switching elements.

8.2.3 Transport control (TC)

TC supports the control of the transport channel between the serving node and an end point through one or more access networks, or between SNs and other nodes within the network containing network switching elements (X). This transport channel is a logical relationship consisting of one or more signalling network connections and zero or more user information network connections. It provides coordination of the actions of one or multiple FM FEs in order to link together access network connections into an end-point to-serving node transport channel connection across one or more networks. Examples of TC functions are:

- Attachment of terminal-network signalling association.
- Mobility handover of transport channel between base station type access network elements.
- Control of transport channel through a remote concentrator access network element.
- Control of transport channel through cross-connect network elements between the user and the serving node and between serving nodes, relay nodes and gateway nodes within the network.

8.2.4 Bearer control (BC)

BC supports the control of network resources on a network link-by-network link scale to support end-to-end carriage of information. It provides coordination of the actions of one or multiple FM FEs in order to link together switching element connections into an end-to-end connection across a network. BC can allocate network resources in order to optimize overall connection cost or performance. BC FEs may need to cooperate in order to control connections, e.g. when crossing multiple administrative domains, using peer-to-peer interaction (i.e. signalling).

Separation of FM and BC allows for control of aggregations of network elements by a single controller, where applicable, transparent-to-service-related processing. In a centrally controlled system, for example, the BC FE may be deployed in a single node, with responsibility for reconfiguring the entire network. For a distributed implementation, multiple FEs may be used, where each FE has a smaller range of control and cooperation is necessary to manage an end-to-end connection.

8.2.5 Call control (CC)

CC supports the control of calls on a network-wide scale. This includes those functions that are technology specific but do not require functional entity action in all intermediate nodes. Examples of CC functions are:

- Pre-negotiation.
- Party control.
- Closed user group.
- Multiconnection identifier establishment.
- Most supplementary services.

CC is technology aware, in that, a specific relationship between two CC FEs will employ flows appropriate to the underlying technology of the network being used (e.g. AAL parameters in ATM). CC is not technology dependent and can be used over a number of different transport technologies to coordinate a call. For simple calls, the user application may employ the CC FE directly, without the presence of an SM FE. Although a call can exist without any connections, CC typically provides coordination of the actions of multiple CM FEs in order to link together switching element connections into an end-to-end connection across a network. Separation of CC from CM allows for the separation of call control and connection control. CC-T could be provided by customer premises equipment or by a network function.

CC-T manages end-user access to service control functions within the network. In the IN terminology this function is called the CCAF, additional information of which can be found in Recommendation Q.1224.

Note that the CC-N contains the FNA computational objects associated with SACF, LRCFv, LRDFv, ACFv and ADFv. The CC-T contains the FNA MCF computational object.

8.2.6 Resource control (RC)

RC uses an appropriate network infrastructure to provide the capabilities required by SeC. This may be an ATM network, the Internet, a radio network, etc.

8.2.7 Session control (SeC-N and SeC-T)

SeC FEs support the control of communications sessions between user applications, including end-user, network and third-party-based applications. A communication session is defined as a single instance of a telecommunication service.

NOTE – The telecommunication service does not need to be run by a single operator and may be offered by multiple operators.

It may involve any number of end users, any number of calls and any number of connections transporting information between end users. The communications session defines only the association among end users within the context of the service. End users involved in a session need not be involved in the transport of information. Examples of SeC functions are:

- Establishment, maintenance and release of communications sessions.
- Searching for or listing available pre-existing sessions.
- Maintaining a roster of participating node (including end users/applications) involved in each session.
- Authorizing and/or inviting user applications to participate in a session.
- Recording usage of session resources by participants (e.g. for billing, statistics).
- Allowing new users to join pre-existing sessions.
- Identifying the participants in a session to one another.
- Negotiating the set and type of resources required to support the session.
- Controlling the allocation of participating users to resources.
- Arbitration on contention for specific session resources (e.g. "meeting chair" functions).
- Control of the "ownership" of sessions and session resources.

One or more SeC-Ns could cooperate to handle requests for sessions from users, through the SeC-T FE. SeC utilizes the services provided by transport of information between the end users of the communications session. SeC functions are generic in that they may be reused as part of a number of specific end-user services. The SeC functions are technology independent and may be located anywhere within or outside the public network. While the services it provides are technology

independent, an SeC FE may be located at an interworking point between multiple network technologies (e.g. at a conference bridge with POTS, ISDN and ATM ports), using appropriate technology specific services provided by RC FEs.

The SeC provides the service-related functions required to control a specialized network resource (such as a menu display, hypertext server, video gateway, or multimedia resource). The SeC makes use of call and bearer control functions provided via an associated RM entity, for control of any associated element layer switching element, and for participation in link-by-link bearer associations.

SeC-T controls end-user access to communications session control functions within the network. It provides access to SeC functions for control of session services, maintaining local session and/or service state information for the end user. It may provide access to RM functions for determination of local resources to be used for a particular session.

Grouping of end-user support functions into the SeC-T FE models the ability for the user to access functions at the generic level provided by session control.

8.2.8 Network's service control function (nSCF)

The network's service control function (nSCF) is located within the network domain of the SN visited by the mobile user. This functional entity provides generic network-based services to all mobile customers. These services have been referred to as default IN services which may be different in each network domain. The nSCF and the CCF associated with the visited SN are always in the same network domain; therefore, the one-to-one signalling association between these two functional entities is never supported by an Inter-domain NNI signalling capability. The network SCF performs processing and provides access to data that is specialized for a particular service application. SCF extends the generic negotiation and control capabilities provided by SeC to support specific end-user services. Within IN terminology this function is also called the SCF, additional information of which can be found in Recommendation Q.1224.

8.2.9 Network's service data function (nSDF)

The network's service data function (nSDF) encapsulates and provides real-time access to generic customer and network (corporate) data. This data is used by nSCF in processing service logic. Instances of nSDF may interact with other instances of nSDF if necessary to process a request for access to or management of data. These interactions are transparent to other FEs. Within IN terminology this function is also called the SDF, additional information of which can be found in Recommendation Q.1224. The nSCF and the nSDF are always in the same network domain; therefore, the one-to-one signalling association between these two functional entities is never supported by an Inter-domain NNI signalling capability.

8.2.10 User's service control function (uSCF)

The user's service control function (uSCF) is located in the network domain designated as the home network region of the mobile customer. The SN visited by the mobile customer may be in the home network domain of the visiting mobile customer, or in a different network domain. The uSCF and the CCF associated with the SN serving the visiting mobile user have a one-to-one signalling association. If the uSCF and the CCF are in the same network domain, this signalling association is supported by an Intra-domain NNI signalling capability. If the uSCF and the CCF are in different network domains, the signalling association is supported by an Inter-domain NNI signalling capability.

8.2.11 User's service data function (uSDF)

The user's service data function (uSDF) encapsulates and provides real-time access to user-specific data. This data is used by uSCF in processing service logic. Within IN terminology this function is also called the SDF, additional information of which can be found in Recommendation Q.1224. The uSCF and the uSDF are always in the same network domain; therefore, the one-to-one signalling association between these two functional entities is never supported by an Inter-domain NNI signalling capability.

8.2.12 Location registration control function (LRCFh)

The location registration control function (LRCFh) is located in the network domain designated as the home network region of the mobile customer. The SN visited by the mobile customer may be in the home network domain of the visiting mobile customer or in a different network domain. The LRCFh and the CCF associated with the visited SN have a one-to-one signalling association. If the LRCFh and the CCF associated with the visited SN are in the same network domain, this signalling association is supported by an Intra-domain NNI signalling capability. If the LRCFh and the CCF associated with the visited SN are in different network domains, the signalling association is supported by an Inter-domain NNI signalling capability.

8.2.13 Location registration data function (LRDFh)

The location registration data function (LRDFh) is located in the network domain designated as the home network region of the mobile customer. This functional entity contains the mobile customer's service profile, registration information (e.g. logged on/logged off status, etc.), and present location information (e.g. network domain and SN within the domain last associated with the mobile customer). The LRDFh and the LRCFh are always in the same network domain; therefore, the one-to-one signalling association between these two functional entities is never supported by an Inter-domain NNI signalling capability.

8.2.14 Authentication control function (ACFh)

The authentication control function (ACFh) is located in the network domain designated as the home network region of the mobile customer. The SN visited by the mobile customer may be in the home network domain of the visiting mobile customer or in a different network domain. The ACFh and the CCF associated with the visited SN have a one-to-one signalling association. If the ACFh and the CCF associated with the visited SN are in the same network domain, this signalling association is supported by an Intra-domain NNI signalling capability. If the ACFh and the CCF associated with the visited SN are in different network domains, the signalling association is supported by an Inter-domain NNI signalling capability.

8.2.15 Authentication data function (ADFh)

The authentication data function (ADFh) is located in the network domain designated as the home network region of the mobile customer. This functional entity contains the mobile customer's complete authentication information. The ADFh and the ACFh are always in the same network domain; therefore, the one-to-one signalling association between these two functional entities is never supported by an Inter-domain NNI signalling capability.

8.2.16 Service control (SC-T and SC-N)

SC-T provides end-to-end brokerage type functions between terminals. SC-N. Example brokerage services are:

- Yellow page searches and selection.
- Name-to-end point address resolution.

- End point address-to-network address resolution.

8.2.17 User application control (UAC)

UAC provides the control of the application itself. Examples would be pause, rewind, bookmarking, application protocol selection and content selection. Application examples are:

- Video-on-demand.
- Joint documentation editing.
- Electronic mail.
- Selective videoconferencing.
- Web-based telephony.

9 Engineering views

This clause describes the potential engineering scenarios that can be realized based on the unified functional model described in clause 8.

The unified functional model provides separation and grouping of functions required for telecommunications that will be conducive to flexibility in support of new services and in deployment of service processing in the network. This unified functional model combines and integrates aspects of the intelligent network distributed functional plane architecture, modelling of control and signalling, and modelling of IMT-2000 control and signalling. For the relationship between the unified functional model and the layering concepts for telecommunication management networks, refer to clause 10.

There are many possible engineering scenarios that can be obtained by various groupings of the functional entities (FEs) defined in the unified functional model, and this clause describes those considered important enough for development of signalling Recommendations.

In addition, this clause highlights how the business domains can be related to the various groupings of the functional entities defined in the unified functional model.

9.1 Physical engineering scenarios

9.1.1 Physical engineering scenario showing the call control and bearer control service-independent portions

The discussion below concentrates on the portion of the physical architecture related to service-independent functionality (i.e. related to the control of calls and connections); however, the relationship between this service-independent scenario and a service-dependent scenario, based on IN concepts, is also illustrated. To maintain clarity, the higher-layer service-independent functionality (i.e. user application control, service control, session control and resource control) are omitted from the preceding discussion.

This proposed scenario entails grouping the FEs of the unified functional model into three physical systems as follows:

- **Call controller** – The call controller contains the CC FE and is responsible for call level signalling and processing.
- **Connection controller –** The connection controller contains the BC FE and is responsible for connection level signalling and processing.
- **Switching element** – The switching element contains both the TC and FM FEs and is responsible for the creation and destruction of cross-connections between physical facilities (e.g. it performs ATM layer and physical layer processing and switching).

Because there are three physical systems proposed, there are two exposed, control interfaces or application programming interfaces (APIs) that interconnect the proposed physical systems. The connection controller application programming interface (CCAPI) connects a call controller and a connection controller. The switching element application programming interface (SCAPI) connects a connection controller and a switching element. These two APIs would be in addition to the user-network interfaces (UNIs), the network node interfaces (NNIs) and the interfaces to the service-dependent portion of the scenario.

9.1.1.1 Definition of components and interfaces

Figure 9-1 depicts the scenario consisting of call controllers, connection controllers, switching elements, CCAPIs and SCAPIs. It also shows an example of a service-dependent system by illustrating an service control point (SCP) and its interface to the service-independent network. Other physical systems that can be used to provide services, such as an intelligent peripheral (IP), could conceptually be included but are not illustrated.

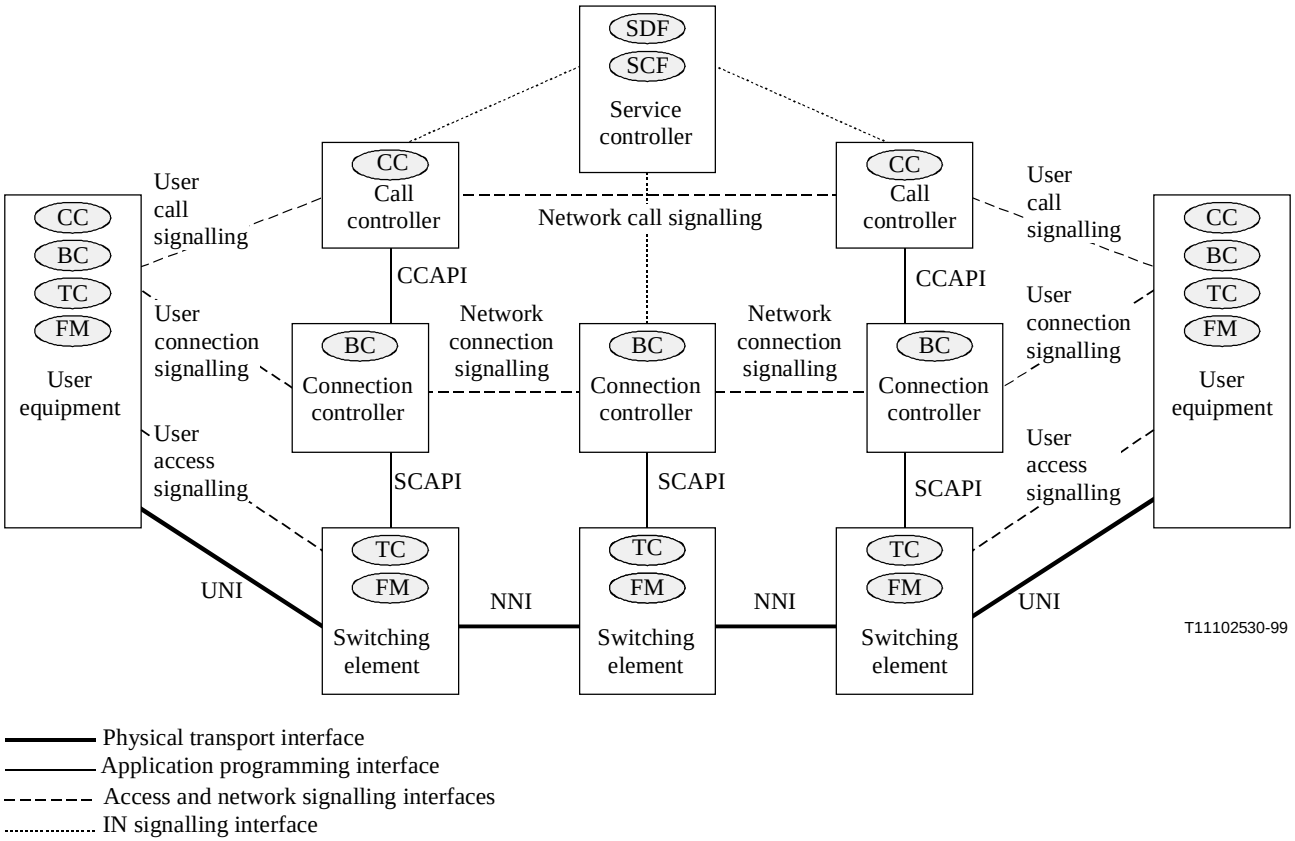


Figure 9-1 – Modular ATM components and interfaces

The proposed modular ATM components and the application programming interfaces that interconnect them relate to the Unified functional model as follows:

- **Call controller** – The call controller includes the CC FE. Call controllers reside at the edge of the network. An end user interacts with the serving call controller to negotiate the parameters of a communications arrangement (such as bandwidth, quality of service, etc.). If an acceptable set of parameters can be negotiated, the call controller uses the services provided by the connection controller to establish, maintain and disconnect the network resources necessary to provide the negotiated arrangement.

- **Connection controller** – The connection controller includes the BC FE. Connection controllers reside throughout the network. After one or more call controllers negotiate the parameters of a communications arrangement with the end user, the connection controllers are responsible for establishing, maintaining and disconnecting the network resources necessary to provide the negotiated arrangement. One connection controller interacts with a peer connection controller to establish and disconnect network facilities on a link-by-link basis. Connection controller components provide a generic and flexible connection model that encompasses multimedia and multiparty call requirements.
- **Switching element** – The switching element includes the TC and FM FEs. Switching elements cross-connect a virtual connection at one port with a virtual connection at another port. Via one or more cross-connects at various switching elements located between users, a virtual connection is created between the users. The characteristics of this virtual connection are based on the call parameters negotiated at the call controller level and the route is determined by the connection controller level. Based on instructions received over the SCAPI, the switching element creates and destroys cross-connects.
- **Connection controller application programming interface** – The CCAPI is the interface between the call controller and the connection controller.
- **Switching controller application programming interface** – The SCAPI is the interface between the connection controller and switching element.

9.1.1.2 Motivation for scenario

As noted above, these three physical components and two application programming interfaces comprise the service-independent portions. The service-dependent functions of the service control function (SCF) and the service data function (SDF) would be contained in physical systems above the proposed call controller, e.g. a service control point (SCP) which may have both SCF and SDF functionality.

The scenario presented in this subclause is included for the following reasons:

- The separation of call controller and connection controller aligns with the ITU-T target of separation of call and bearer control.
- The permanent virtual connection (PVC) switching systems being deployed in the mid-1990s are similar to the proposed switching element component. Thus, the introduction of call controller and connection controller products with standard interfaces could provide an evolutionary path from the PVC switching products to the SVC switching products.
- It appears that the differences between business broadband (e.g. data communications intensive) and mass market broadband (e.g. video entertainment intensive) services are generally confined to differences in the necessary call control functionality and the potential use of access networks for the mass market. Therefore, by having a separated call controller component, a common backbone network consisting of connection controllers and switching elements can accommodate both business broadband and mass market broadband services by introducing different call controllers.
- Physical components containing the service-dependent functions of SCF and SDF (such as an SCP) can interface, in many cases, to the service-independent call controller using the same interface that would be used to an integrated broadband switching system (BSS).

9.1.1.3 Architectural configurations

Because the call controllers, connection controllers and switching elements can exist as separate entities, there are many different component configurations that could exist within a network. This subclause defines possible configurations, so that the SCAPI and CCAPI can be defined such that they are functionally complete.

An important architectural issue is determining the potential N:M relationships among the modular components. In other words, the answers to the following statements will be implementation dependent:

- The number of call controllers there can be for a given connection controller.
- The number of connection controllers there can be for a given call controller.
- The number of connection controllers there can be for a given switching element.
- The number of switching elements there can be for a given connection controller.
- The number of call controllers there can be for a given switching element.
- The number of switching elements there can be for a given call controller.

9.1.2 Physical engineering scenario showing a separate transport network implementation

The following example focuses on that part of the network entitled *transport network*. A typical telecommunication network is composed of three networks: access network, switching network and transport network. The transport layer is responsible for bandwidth management, restoration (self-healing) and other aspects of transport layer control. The basic building blocks of this layer are cross-connect network elements and transport controllers.

This proposed scenario entails grouping the FEs of the unified functional model into three physical systems as follows:

- **Serving node** – The serving node contains the CC, BC, TC and FM FEs and is responsible for:
  - call control and bearer control signalling and processing (CC/BC);
  - interfacing with the access and transport networks by transport control signalling (TC);
  - creation and destruction of cross-connections between physical entities.
- **Relay node** – The relay node contains the BC, TC and FM FEs and is responsible for:
  - bearer control signalling and processing (BC);
  - interfacing with transport networks by transport control signalling (TC);
  - creation and destruction of cross-connections between physical entities.
- **Transport node –** The transport node is the basic building block of the transport network. It contains the TC and FM FEs and is responsible for:
  - interfacing with serving nodes and relay nodes and processing of transport control signalling (TC);
  - interfacing with management system and establishment of connections by provisioning;
  - creation and destruction of cross-connections between physical entities.

9.1.2.1 Definition of components and interfaces

Figure 9-2 depicts a scenario consisting of serving node, relay node and transport network. It also shows that the service-dependent system (the SCP/SDP) interfaces to the service layer components of the network. The access network and other components of a telecommunication network are not illustrated.

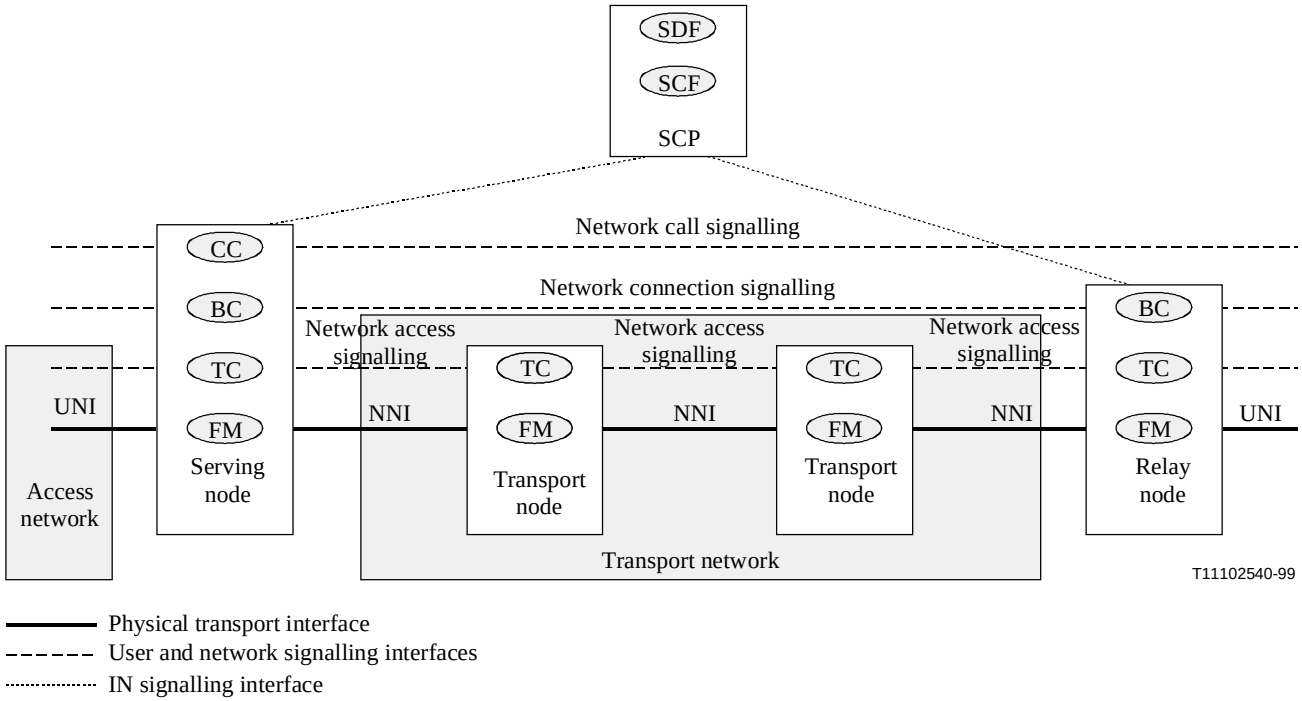


Figure 9-2 – Network components

The proposed modular ATM relates to the unified functional model as follows:

- **Serving node** – Serving nodes reside at the edge of the switching network. An end user interacts with the serving call controller (via the access network) to negotiate the parameters of a communications arrangement. If an acceptable set of parameters can be negotiated, the connection control uses the trunks (VPCs) provided by the transport network to establish connections necessary to provide the negotiated arrangement. When there is a conflict between the allocated bandwidth of a VPC and the offered traffic, the serving node and the transport node can re-negotiate the parameters of the connection and modify the allocated bandwidth.
- **Relay node** – Relay nodes (tandem nodes) reside throughout the network. The connection control FEs are responsible for establishing, maintaining and disconnecting the network resources necessary to provide the negotiated arrangement. One connection controller interacts with a peer connection controller to establish and disconnect network facilities on a link-by-link basis.
- **Transport node** – The transport node includes the TC and FM FEs. Network of transport nodes cross-connect a virtual path connection at one end of the network with a virtual path connection at another physical port via one or more cross-connects at various transport nodes located between serving and relay nodes and between relay nodes. The characteristics (bandwidth, QoS, restoration procedures, etc.) of this virtual path are based on parameters negotiated at the establishment and/or modification of the virtual path connection.

9.1.2.2 Motivation for scenario

As noted above, the transport nodes comprise the transport network portion of an inter-exchange network.

The scenario presented in this subclause is included for the following reasons:

- The separation of service layer and transport layer aligns with the practical engineering of existing PDH/SDH networks. The service layer components are responsible for all aspects of end-user service establishment and maintenance. The transport layer responsibility is to manage the network resources (bandwidth, processing) in response to network events (modification of user traffics, components failures, etc.).
- The VP cross-connects being deployed in the mid-1990s are the current building blocks of ATM transport networks. Thus, the introduction of transport nodes with transport control and standard signalling interfaces could provide an evolutionary path from static VP cross-connects (VPXCs) to dynamic VP cross-connects (dVPXCs) at the ATM transport layer.
- Signalling for semi-permanent VPs are defined in CS-2. They will serve as the basis for the new network transport signalling.
- It appears that the differences between various broadband communications services are confined to differences in the service layer. Therefore, by having a standard network transport signalling, a common transport network consisting of transport nodes can accommodate business broadband and mass market broadband.

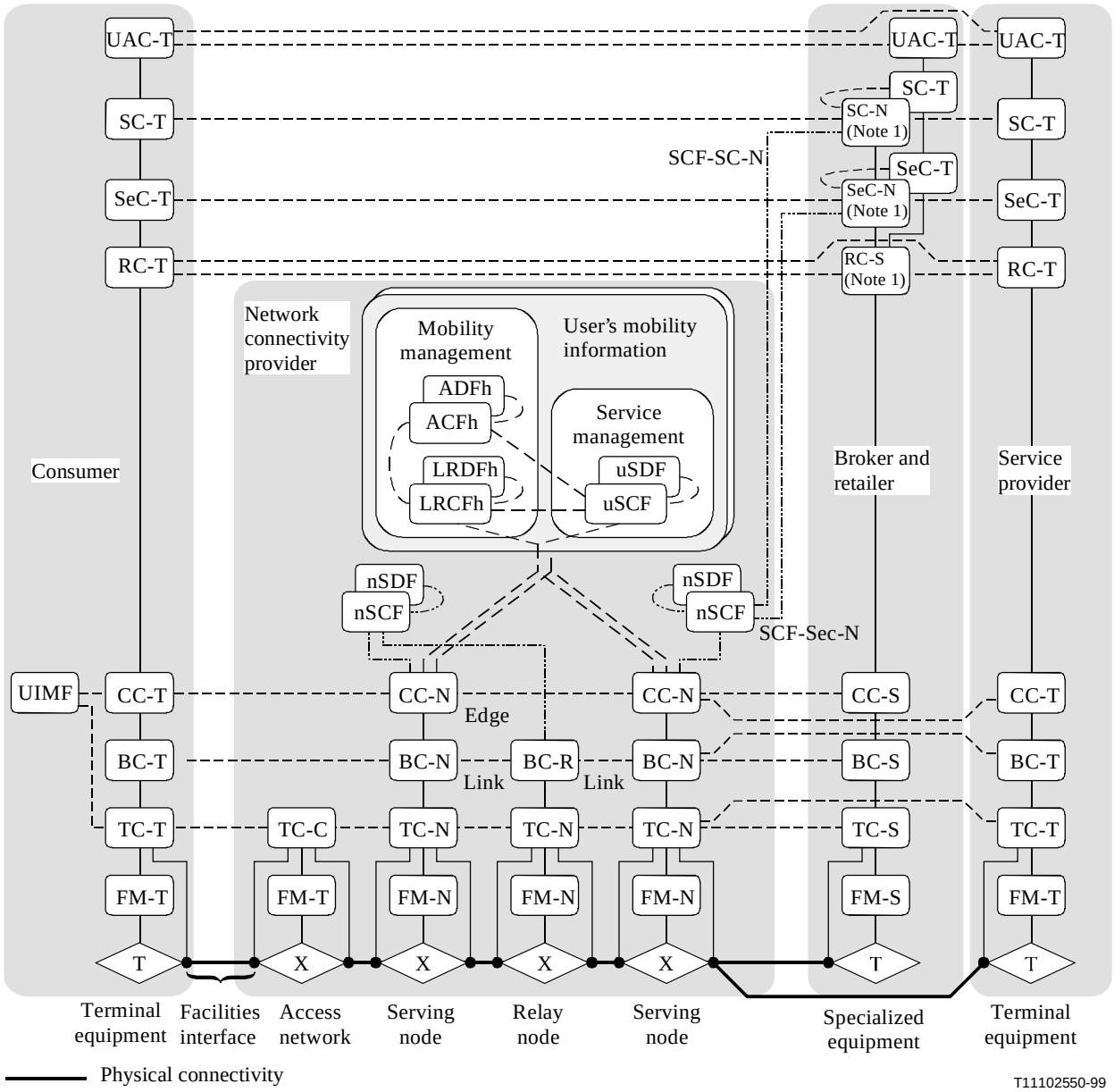
9.1.2.3 New signalling requirements

Transport nodes have to exchange information between themselves, and with the serving and relay nodes. This calls for the definition of network transport signalling of two types: transport-to-transport and transport-to-serving/relay.

9.2 Business view scenarios

9.2.1 Business view scenario showing network connectivity provider IN functionality

Figure 9-3 depicts the scenario showing the unified functional model mapped onto the business model.



This diagram presents a functional entity model without reference to any physical realization or architecture.

UAC level control may be carried by user SVC.
SC, SeC and RC level control may be carried by signalling SVC or user SVC.
CC, BC and TC level signalling carried by signalling SVC.

Specialized equipment may be attached to a serving node or a gateway node (not shown).

NOTE 1 – These functions could be emulated by the SCF; in such cases, the relationships towards these functions would lead to the SCF.
NOTE 2 – SC-N to SC-N relationships exist between different specialized equipment.
NOTE 3 – SeC-N to SeC-N relationships exist between different specialized equipment.
NOTE 4 – CC-N contains the FNA computational objects associated with SACF, LRCFv, LRDFv, ACFv and ADFv. CC-T contains the FNA MCF computational object.

Figure 9-3 – Distribution of the unified functional model onto the business model

9.2.1.1 Motivation for scenario

The mapping given in Figure 9-3 includes SCF and SDF functionality within the network connectivity provider and is more representative of IN CS2 functionality. This would mean:

- The network connectivity provider would only have to support a single point of entry from brokers into its network.
- With a single point of entry, brokers will not have to know the details of the network operator's network infrastructure.
- The network connectivity provider-to-broker interface would prove easier to operate, police and manage.

The SCF to SeC-N interface is the interface between the network connectivity provider and another licensed operator or third-party broker.

10 Description of management-related functionalities

The requirements for a service provider providing management have previously been identified within the business model. The TMN layering concept was developed to partition different management responsibilities and, as such, can be applied to the functionality of the service provider providing management. Example partitioning for service, network and element tasks is given below.

The service provider which provides service management functions is concerned with the management of customer-related issues such as:

- service provision;
- complaints;
- distribution of service data into the network.

The network management layer is responsible for the overall management of the network such as:

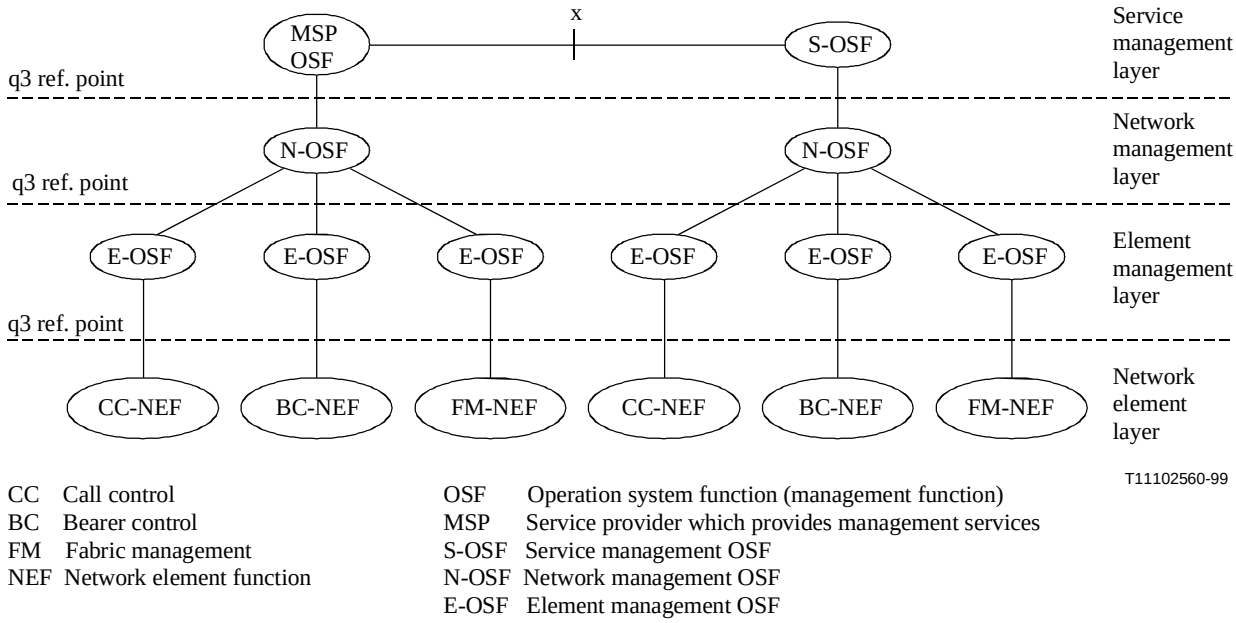
- traffic management;
- rerouting.

The element management layer is responsible for the management of individual network elements such as:

- switches;
- routers, racks of modems, etc.

10.1 TMN model incorporating functional entities

Call control and bearer control functions as well as corresponding physical elements fit very well into this concept as shown in Figure 10-1.



CC Call control
BC Bearer control
FM Fabric management
NEF Network element function

OSF Operation system function (management function)
MSP Service provider which provides management services
S-OSF Service management OSF
N-OSF Network management OSF
E-OSF Element management OSF

Figure 10-1 – Example functional TMN model

In Figure 10-1, specific network functionality is used; however, these could equally be replaced with physical elements such as user equipment and call controllers or integrated switching systems. The specific elements do not matter; however, the concept of how they are managed does. The point to note is that whatever control functionality is depicted, it is always viewed by management as a network element function managed by a TMN element OSF.

TMN element management should not be confused with that of fabric management. The former is concerned with the day-to-day configuration, alarm reporting, security, accounting concerned with the network and network elements as a whole, usually on a non real-time basis, whereas the latter is concerned with control of network resources contained within a particular network switching element.

10.2 TMN model incorporating physical elements

It is possible to represent the unified functional model in many different physical ways or engineering views. For example one could pull together the call control and bearer control functions into one physical box. In this case only one element agent would be required. The q3 reference point would be replaced by a Q3 interface fulfilling all of the interface protocol requirements it needs to conform. If one was to represent the functional Figure 10-1 using physical elements, then it may look like Figure 10-2:

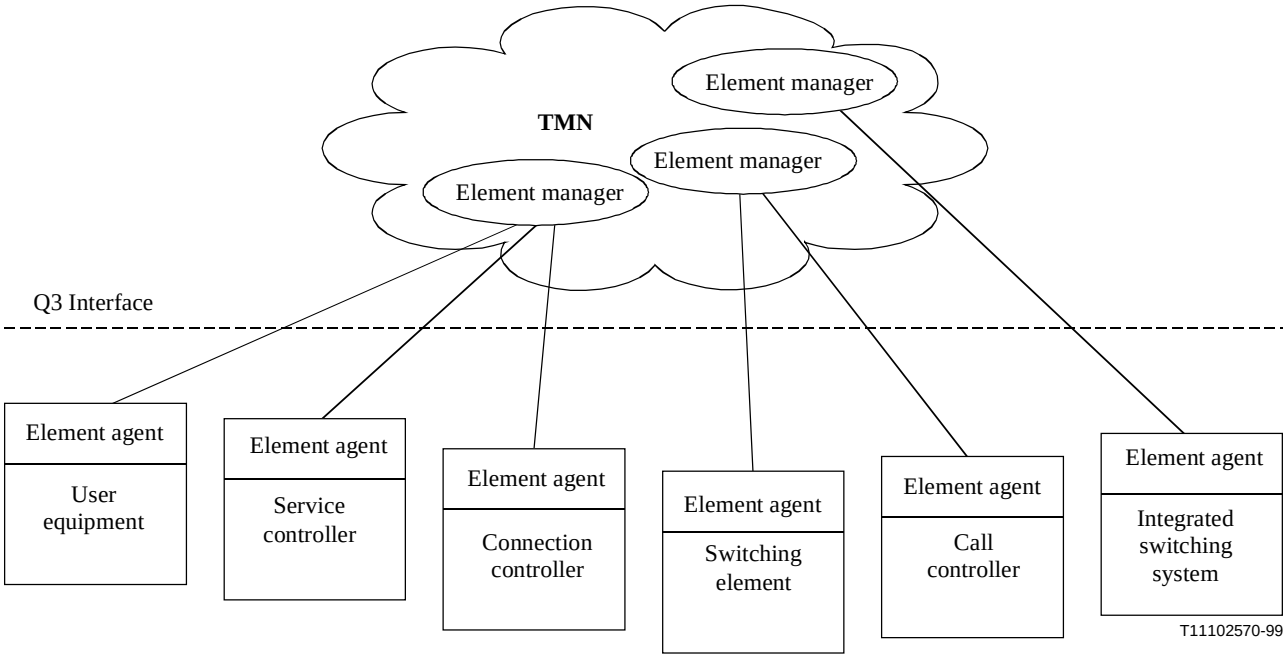


Figure 10-2 – Example physical TMN model

Functionality has been physically allocated (see 9.1.1 for a description of connection controller, etc.) as examples of possible implementation. For example, the user equipment contains the fabric management, call control and bearer control functionality. From a TMN viewpoint, each physical entity is now viewed as a separate network element. Each network element requires a method through which communication with the TMN can be facilitated and this is accomplished by the element manager through the element agent. The element manager is a physical representation of the element OSF. The interface through which management of the elements takes place is the Q3 interface, running CMIP (Common Management Interface Protocol) or some other appropriate protocol.

ANNEX A

Network connection topology types

Table A.1 – Connection topology types

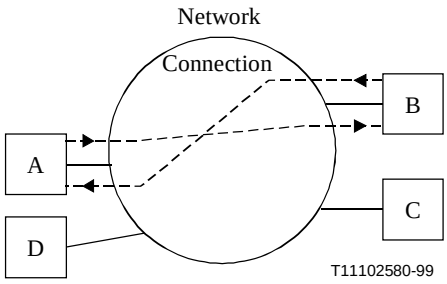
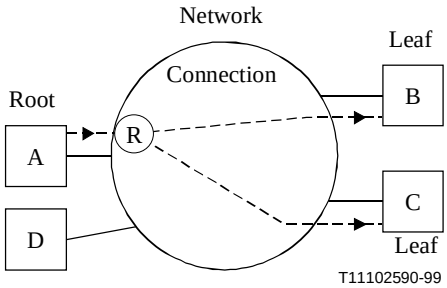
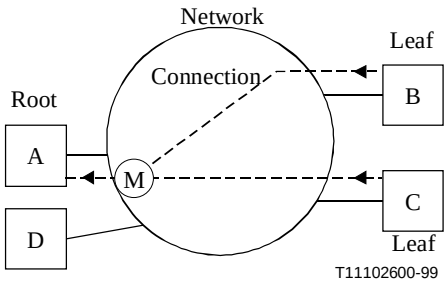
Type 1: Point-to-point network connection: **A unidirectional or bidirectional connection between two terminals** A point-to-point network connection may provide unidirectional or bidirectional asymmetric communications between parties "A" and "B". This network connection could be established, modified or released in one of two ways: Party "A" or "B" requests the action, or party "C" or "D" may request the action.	 **Point-to-point network connection**
Type 2: Point-to-multipoint network connection: **A unidirectional connection from a single source to two or more sinks (Note 1)** A point-to-multipoint network connection provides unidirectional communications from the "root" party "A" to "leaf" parties "B" and "C." This network connection may be established, modified or released in one of three ways: The "root" party may request the action, either "leaf" party may request the action or party D may request the action. The requester may be allowed to specify which called parties are required to agree to be part of the network connection before the network connection can be executed. "R" = Replication function (Note 2)	 **Unidirectional point-to-multipoint network connection**
Type 3: Multipoint-to-point network connection: **A unidirectional connection from two or more sources to a single sink (Note 4)** A multipoint-to-point network connection provides unidirectional communications from the "leaf" parties "B" and "C" to the "root" party "A". The bandwidth transmitted by the "leaf" parties may be different. In addition, the bandwidth received by the "root" party may be different from the sum of the transmitter's bandwidth. This network connection may be established, modified or released in one of three ways: The "root" party may request the action, either "leaf" party may request the action or party D may request the action. The requester may be allowed to specify which called parties are required to agree to be part of the network connection before the network connection can be executed. "M" = Merged function (Note 3)	 **Unidirectional multipoint-to-point network connection**

Table A.1 – Connection topology types *(continued)*

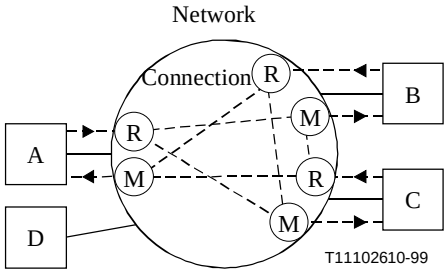
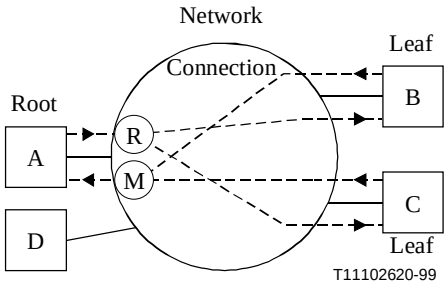
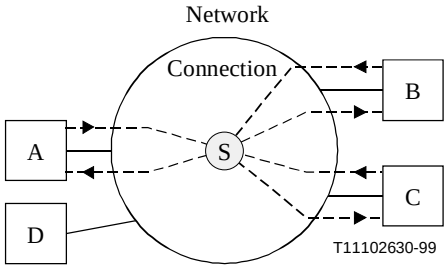
Type 4: Multipoint-to-multipoint network connection: A connection in which each of the parties acts as both source and sink so that each is receiving an orderly combination of information sent by every other party (Note 5) A multipoint-to-multipoint network connection provides the capability that all parties can communicate. The receiver bandwidth of each party may be different from the sum of the bandwidths transmitted and may be different for each party. The bandwidths transmitted by each party may be different from each other and different from the bandwidth received. This network connection may be established, modified or released in one of two ways: Any party that will be associated with the network connection may request the action or party D may request the action. The requester may be allowed to specify which called parties are required to agree to the network connection before the network connection can be executed.	 **Multipoint-to-multipoint network connection**
Type 5: Bidirectional point-to-multipoint network connection (Note 6) A bidirectional point-to-multipoint network connection provides communication between the "root" party "A" and between the "leaf" parties "B" and "C". This connection allows the "root" party to send information to the "leaf" parties, while "leaf" parties only communicate with the "root" party. The bandwidth received by the "leaf" parties may be different from the bandwidth transmitted by the "root". The bandwidth transmitted by the "leaf" parties may also be different. In addition, the bandwidth received by the "root" may be different than the sum of the bandwidth transmitted by the "leaf" parties. This network connection may be established, modified or released in one of three ways: The "root" party may request the action, either "leaf" party may request the action or party D may request the action. The requester may be allowed to specify which called parties are required to agree to be part of the network connection before the network connection can be executed.	 **Bidirectional point-to-multipoint network connection**

Table A.1 – Connection topology types *(concluded)*

Type 6: Multipoint-to-multipoint network connection: A connection supported by a server or bridge function, in which each of the parties acts as both source and sink so that each is receiving an orderly combination of information sent by every other party (Note 7) A multipoint-to-multipoint network connection provides the capability that all parties can communicate. The receiver bandwidth of each party may be different from the sum of the bandwidths transmitted and may be different for each party. The bandwidths transmitted by each party may be different from each other and different from the bandwidth received. This network connection may be established, modified or released in one of two ways: Any party that will be associated with the network connection may request the action or party D may request the action. The requester may be allowed to specify which called parties are required to agree to the network connection before the network connection can be executed.	 **Multipoint-to-multipoint network connection**

Notes to Table A.1

NOTE 1 – Type 2 network connections may be used to support multicast or broadcast services:

A multicast network connection is one in which sink parties are specified before the network connection is established, or by subsequent operations to add or remove parties from the network connection. The source of the network connection will always be aware of all parties to which the network connection travels.

Examples:

- A network connection that is established to a list of end addresses.
- A network connection that broadcasts to a community of terminals by some criteria other than network parties.
- A network connection that is associated with a "distribution list" not visible to the source, such as an email exploder.

A broadcast network connection is one in which the sink parties are not always known to the source. The major difference from multicast is that for a broadcast network connection, the network connection to individual sink parties is not under the control of the source, but is by request of the each sink party.

Example:

- A broadcast network connection to which any terminal can subscribe to without reference to the source, but perhaps subject to subscription restrictions.

NOTE 2 – Replication may occur in one or more network nodes to provide the multiple routes. A replication point is a point in a network connection where user plane data received from one incoming data flow is replicated on two or more outgoing data flows. Replication is possible in the ATM layer, within the AAL or in higher layers.

- Replication takes place within the ATM switch based on the VPI/VCI fields in the cell header. Each such cell arriving at the switch is copied onto two or more outgoing ATM cell streams, which in turn are mapped onto ATM virtual paths or virtual channels. This copying process does not alter cell information field contents. This form of replication is simple to implement but is not suitable for those AALs that rely on point-to-point retransmission for recovery of lost data. ATM replication points may occur in any node of the network.

- Replication takes place within an AAL handler attached to or integrated with the ATM switch. Each AAL packet is assembled from incoming cells, the user information is extracted, and this is then segmented again onto two or more outgoing AAL connections. Because the AAL is terminated and regenerated in this case, retransmission is handled directly by the replication point, not passed back to the origin of the information. Higher layer replication must take place within a specialized server function.

NOTE 3 – Merging of source streams may occur in one or more network nodes to provide the multiple routes. A merging point is a point in a network connection where user-plane data received from two or more incoming data flows are combined into a single outgoing data flow. A merging point may make use of ATM layer, AAL, or higher layer functionality.

In an ATM layer merging point, cells from two different incoming cell streams are interleaved onto a single ATM virtual channel of a single outgoing cell stream. This interleaving process does not alter cell information field contents. This function does not work where the user information packets are more than a single cell, unless some form of multiplexing field is present in the SAR sublayer of the AAL (i.e. in each cell). Where user information can be carried within a single cell, some form of identification of the point of origin is required.

An AAL merging point operates such that user information from two or more ATM virtual channels is assembled into AAL SDUs. These are then multiplexed onto a single outgoing virtual channel if multiplexing is supported by the AAL, or sent sequentially on the outgoing channel if multiplexing is not supported (or is disabled).

A higher layer merging point is one that operates above the AAL. User information received from two or more incoming ATM virtual channels (via appropriate AAL handlers) is combined in some predefined way, then enclosed in a new outgoing AAL for transmission via a single ATM virtual channel.

Examples of this are:

- combination of digitized audio signals into a single digitized audio signal;
- combination of multiple video pictures into a single "windowed" display;
- selection of a single video image from several images received, the choice being based on activity in an associated audio channel (to show the face of the current speaker in a conference);
- combination of music audio from one source with video images from another to form a single audiovisual presentation to the user.

NOTE 4 – Such connections may exist at for example the ATM layer if AAL type 3/4 or type X is used.

NOTE 5 – This network connection may be implemented in the ATM layer using AAL type 3/4 or type X. The important point is that all terminals can both send and receive in this configuration. The sender may or may not receive an echo of his own information depending on the service.

NOTE 6 – A type 5 network connection is formed when a type 2 network connection is overlaid on a type 3 network connection. The source of the type 2 network connection is the same end point as the sink for the type 3 network connection (the "root"), and the sinks for the type 2 network connection can act as source for the type 3 network connection (the "leaves"). All source/sink parties are specified by the "root" end point.

This network connection type may be implemented at the ATM layer using AAL type 3/4 or type X. The source of a feedback cell can be obtained from the MID field or equivalent, if necessary.

The feedback (type 3) network connection may have a non-uniform bandwidth allocation, perhaps increasing at each cell-interleaving point. Alternatively, the terminal's use of the feedback route may be controlled by an in-band flow control mechanism (such as token passing). This may not be necessary where the feedback function is of very low bandwidth, such as one cell at intervals of several minutes.

Example of multicast type 5 network connection:

- Data broadcast with opportunity for recipients to request retransmission.

Examples of broadcast type 5 network connections:

- Television show with viewers voting.
- Teleshopping where customer identification (customer account number, etc.) is embedded in the feedback cell.

NOTE 7 – This connection may be implemented at a higher layer such as a telephony conference bridge. The important point is that all terminals can both send and receive in this configuration. The sender may or may not receive an echo of his own information depending on the service.

ANNEX B

Ownership capability requirements

At the network service level, the following definitions about the ownership capabilities will apply:

Call owner: One who initiates a call is the call owner. There is only one call owner per call.

Party owner: One who adds a party to a call is the owner of that party. There may be several party owners within a call.

Network connection owner: One who initiates a network connection is the network connection owner. There is only one network connection owner per network connection. There may be several network connection owners per call. A network connection owner may be associated with the root, a leaf or a party not attached to the network connection.

Bearer branch owner: One who adds a bearer branch to a network connection is the owner of that bearer branch. There may be several bearer branch owners per network connection. A bearer branch owner may be associated with the root, a leaf or a party not attached to the network connection.

Any party has the permission to release itself from the call or to detach itself from the network connection.

Ownership is a joint relationship between the party and its associated SN. The SN may, in some service implementations, act as an ownership agent for the party. As an ownership agent, the SN may interact with IN service scripts in order to screen requests received from its associated party and other ownership agents within the network. Depending on service logic, the ownership agent may or may not interact with its associated party when it interacts with other ownership agents.

It will be the responsibility of call ownership agents and network connection ownership agents to notify other parties of any change in the call and network connection if the service logic so specifies.

The following general criteria are applied to develop the following tables. These criteria may change in the future:

1) Calls can exist with no connections.
2) There will normally be at least two parties in any connection.
3) There will normally be at least two parties in any call.

These criteria are the normal conditions and market requirements may need specific exceptions. Therefore, for example, a specific exception exists for connection type 2 in a call which may be joined, where such a call and connection may consist of one party only.

Table B.1 – Ownership capabilities (Establishing)

Permission	Call owner	Network connection owner	Any other party within the call	Any other party outside the call
Establish a call	N/A	N/A	N/A	This party initially becomes the call owner.
Add any party to the call	☑ This party initially becomes the new party's owner.	With permission from the call owner. This party initially becomes the new party's owner.	With permission from the call owner. This party initially becomes the new party's owner.	Forbidden
Join the requesting party to the call	N/A	N/A	N/A	With permission from the call owner. This party initially becomes the party owner.
Add a new network connection to an existing call	☑ This party initially becomes the new network connection's owner.	N/A	With permission from the call owner. This party initially becomes the new network connection's owner.	Forbidden
Attach an existing party to an existing network connection	With permission from the network connection owner. This party initially becomes the new bearer branch's owner.	☑ This party initially becomes the new bearer branch's owner.	With permission from the network connection owner. This party initially becomes the new bearer branch's owner.	Forbidden

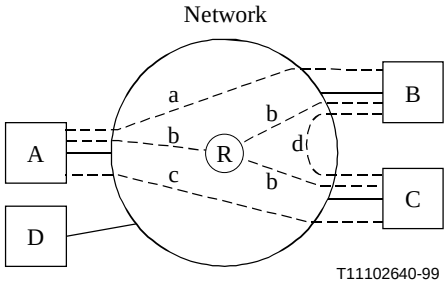
Table B.2 – Ownership capabilities (Releasing)

Permission	Call owner	Party owner	Network connection owner	Bearer branch owner
Release a call	☑			
Release a party from call	☑	Party owner requests the release of a party from the call. If the call owner agrees the party is released, otherwise party ownership is transferred to call owner.		
Release a network connection	☑		Network connection owner requests the release of the network connection. If the call owner agrees the connection is released, otherwise connection ownership is transferred to call owner.	
Detach a party from a network connection	☑		Network connection owner requests to detach a party from the network connection. If the call owner agrees the party is detached, otherwise the party remains attached.	Bearer branch owner requests to detach a party from the network connection. If the call owner agrees the party is detached, otherwise bearer branch ownership is transferred to call owner.

Table B.3 – Common actions for capabilities

When an action (automatic or requested by a party)	Then the following action/result occurs automatically
– releases the owner of a call	the call is released
– releases the owner of a party	the party is released
– leaves only one party in a call, where join is permitted, which does not contain a type 2 network connection, type 3 network connection or type 5 network connection	the call is released
– leaves only one party in a call, where join is permitted, which does contain a type 2 network connection, type 3 network connection or type 5 network connection	the call is retained
– releases the owner of a network connection	the network connection is released
– releases the last network connections to which a party is attached	the party is retained in the call
– releases the last network connection in a call	the call is retained
– releases the owner of a bearer branch	the bearer branch is released
– detach a party from the last network connection in which it is involved	the party is retained
– detach a party from one end of a type 1 network connection	the network connection is released
– detaches the root party of a type 2 network connection, type 3 network connection or type 5 network connection	the network connection is released
– detaches a leaf party who is an owner of a type 2 network connection, type 3 network connection or type 5 network connection	the modified network connection is retained. The party retains ownership of the network connection.
– detaches a leaf party who is a bearer branch owner	the bearer branch is retained. The party retains ownership of the bearer branch.
– detaches all leaf parties of a type 2 network connection, type 3 network connection or type 5 network connection in a call where join is not permitted	the network connection is released
– detaches all leaf parties of a type 2 network connection, type 3 network connection or type 5 network connection in a call where join is permitted	the network connection is released
– detach the last but one party of a type 4 or type 6 network connection	the network connection is released
NOTE – Any party has the permission to release itself from the call or to detach itself from the network connection.	

The unified services allow for the inclusion of several network connections per call. An example of a call with several network connections is shown in Figure B.1.



NOTE – Lines a, b, c and d = Connections

Figure B.1 – Example of a four-party call containing four network connections

Within Figure B.1:

- "R" is a replication function which may be implemented in multiple nodes within the network.
- Network connection "a" is a type 1 network connection between party "A" and party "B".
- Network connection "b" is a type 2 network connection between the "root" party "A" and the "leaf" parties "B" and "C".
- Network connection "c" is a type 1 network connection between party "A" and party "C".
- Network connection "d" is a type 1 network connection between party "B" and party "C".
- Party D is a member of the call but is not attached to any of the four network connections.

The following general requirements apply:

1) The network connection owner shall be the network connection initiating party.
2) The root party of a type 2, 3, 4, 5 or type 6 network connection is not necessarily the network connection owner.
3) A party that is not a network connection owner can add a new party to the existing network connection.
4) A third party may establish and add a network connection and attach an existing party to this network connection to which this party is not attached although it is the network connection owner.
5) It is possible for a party to have no network connections.
6) When multiple parties are contained in an information flow, they are all considered mandatory parties.
7) The negotiation of network connection characteristics (e.g. ATM cell rate) during the call establishment phase shall be provided.
8) It is necessary to be able to specify, within a single information flow, single or multiple parties, service components, service module and network connections.
9) All attached parties must be notified about network connection type changes to the network connection.
10) All serving nodes associated with parties that may invoke capabilities related to parties, network connections or attachments that are modified should be notified of these modifications.
11) Modification from type 1 to type 2 or from type 1 to type 3 network connections are only allowed if the type 1 network connection is unidirectional.

ANNEX C

UML notation

Figure C.1 summarizes the UML notation used within this supplement.

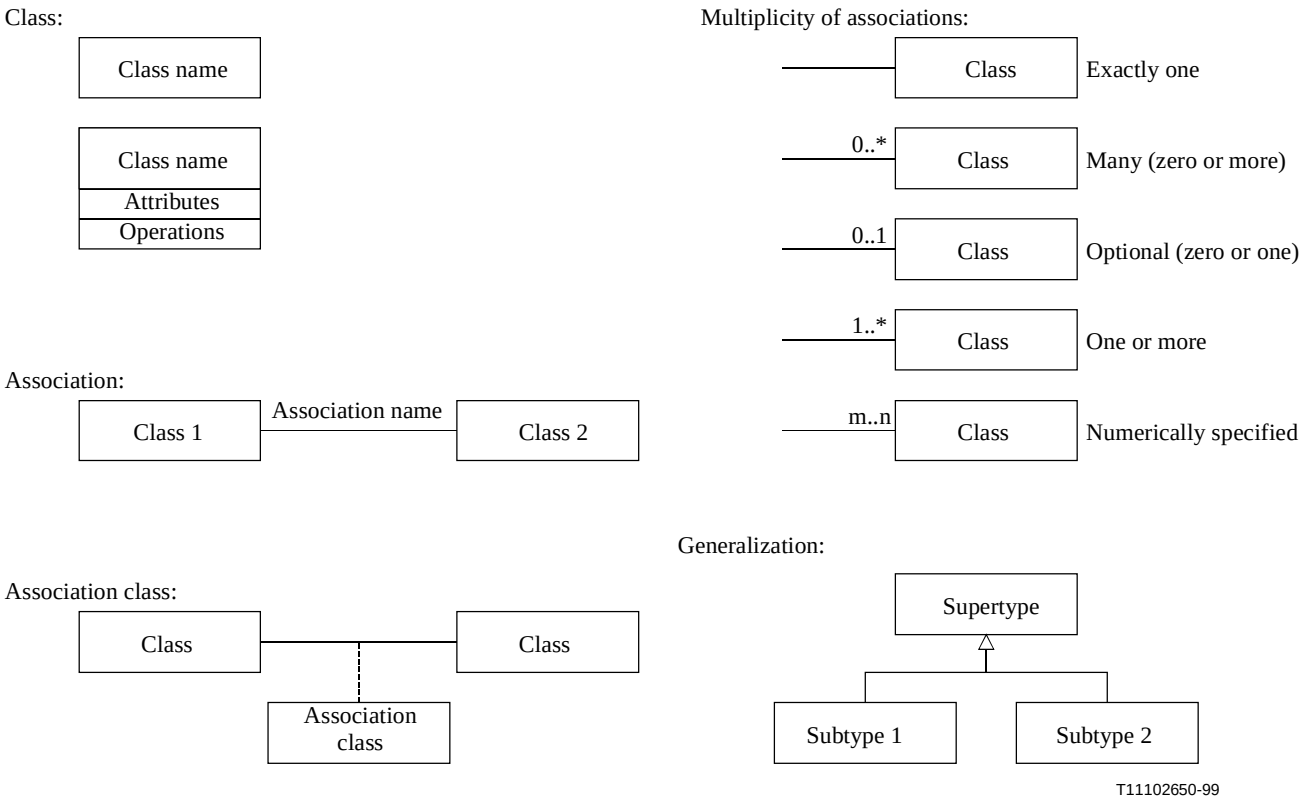


Figure C.1 – UML notation – Basic concepts

APPENDIX I

Business model logical reference points

I.1 Information flow reference model

Information flows are used to describe the actions that are requested across Inter-domain reference points. The business model contained in clause 6 of this signalling requirements document describes these domains and defines the Inter-domain logical reference points (LRP) associated with the model. Figure 6-1 illustrates the business model.

Figure 6-1 illustrates twenty-one logical reference points across which commands, responses and information may be exchanged. These logical reference points can be grouped in the following fashion:

- Network connectivity provider group.
- Retailer group.
- Broker group.
- Consumer-service provider group.

The following subclauses present these groups in more detail.

I.2 Network connectivity provider group

This group of logical reference points provides the capabilities to establish, modify and release communications paths (logical wires) between the various other domains within the model. These communication paths (in some cases implemented as network connections) may be associated with one or more call associations within the network connectivity provider's domain. The established communication paths are also associated with these reference points. The logical reference points associated with this group are LRP-CN, LRP-RN, LRP-SN and the LRP-NN.

LRP-CN Communication reference point between the consumer domain and the network connectivity provider domain.

NOTE 1 – The engineering view of this reference point may be equivalent to the user-network signalling interface when the engineering entity only contains a consumer domain.

LRP-RN Communication reference point between the retailer domain and the network connectivity provider domain.

NOTE 2 – The engineering view of this reference point may be equivalent to the user-network signalling interface or a special equipment-to-network signalling interface when the engineering entity only contains a retailer domain.

LRP-SN Communication reference point between the service provider domain and the network connectivity provider domain.

NOTE 3 – The engineering view of this reference point may be equivalent to the user-network signalling interface when the engineering entity only contains a service provider domain and TMN like functions.

LRP-NN Communication reference point between the network connectivity provider domain and another network connectivity provider domain.

NOTE 4 – The engineering view of this reference point may be equivalent to the network-to-network signalling interface when two or more physical entities are contained within one network provider or when two network providers are in communication; this reference point represents a gateway to gateway interface.

NOTE 5 – This communication reference point provides session level communications between federated network connectivity providers.

I.3 Retailer group

This group of logical reference points provides the capabilities to establish, modify, suspend, resume, join, leave and destroy service sessions and their associated resources. The service sessions provide an association between various other domains within the model. Resources associated with these service sessions may be mapped to one or more communication paths. The logical reference points associated with this group are LRP-CR, LRP-SR, and LRP-RR.

LRP-CR Communication reference point between the consumer domain and the retailer domain.

NOTE 1 – This communication reference point provides session level communications between the consumer and the retailer.

LRP-SR Communication reference point between the service provider domain and the retailer domain.

NOTE 2 – This communication reference point provides session level communications between the service provider and the retailer.

LRP-RR Communication reference point between the retailer domain and another retailer domain.

NOTE 3 – This communication reference point provides session level communications between federated retailers.

I.4 Broker group

This group of logical reference points provides the capabilities to resister, locate and translate identifiers used in various domains into a form that can be understood by the requesting domain's application. The broker provides application support services to the associated business domains. The logical reference points associated with this group are LRP-CB, LRP-SB, LRP-RB, LRP-NB and LRP-BB.

LRP-CB Communication reference point between the consumer domain and the broker domain.

NOTE 1 – This communication reference point provides application support level communications between the consumer and the broker.

LRP-SB Communication reference point between the service provider domain and the broker domain.

NOTE 2 – This communication reference point provides application support level communications between the service provider and the broker.

LRP-RB Communication reference point between the retailer domain and the broker domain.

NOTE 3 – This communication reference point provides application support level communications between the retailer and the broker.

LRP-NB Communication reference point between the broker domain and the network connectivity provider domain.

NOTE 4 – The engineering view of this reference point may be equivalent to the user-network signalling interface, a special equipment-to-network signalling interface or a network-to-service control function signalling interface when the engineering entity only contains a broker domain. In the latter case, the broker domain is contained in the IN SCF.

LRP-BB Communication reference point between the broker domain and another broker domain.

NOTE 5 – This communication reference point provides application support level communications between federated brokers.

I.5 Consumer-service provider group

This group of logical reference points provides the application-to-application control, system management capabilities and information exchange capabilities between the consumer and service provider domains. The logical reference points associated with this group are LRP-CS, LRP-CC and LRP-SS.

LRP-CS Communication reference point between the consumer domain and the service provider domain.

NOTE 1 – This communication reference point provides application level communications and system management capabilities between the consumer and the service provider.

LRP-CC Communication reference point between the consumer domain and another consumer domain.

NOTE 2 – This communication reference point provides application level communications between consumers.

LRP-SS Communication reference point between one service provider domain to another service provider domain and provision of system management capabilities.

NOTE 3 – This communication reference point provides application level communications between providers.

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