INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.807/Y.1302

(07/2001)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital networks – General aspects

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE AND INTERNET PROTOCOL ASPECTS

Internet protocol aspects – Transport

Requirements for automatic switched transport networks (ASTN)

ITU-T Recommendation G.807/Y.1302

(Formerly CCITT Recommendation)

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TESTING EQUIPMENTS	G.500–G.599
TRANSMISSION MEDIA CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
General aspects	**G.800–G.809**
Design objectives for digital networks	G.810–G.819
Quality and availability targets	G.820–G.829
Network capabilities and functions	G.830–G.839
SDH network characteristics	G.840–G.849
Management of transport network	G.850–G.859
SDH radio and satellite systems integration	G.860–G.869
Optical transport networks	G.870–G.879
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999

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

ITU-T Recommendation G.807/Y.1302

Requirements for automatic switched transport networks (ASTN)

Summary

This Recommendation describes the network level requirements for the control plane of automatically switched transport networks (ASTN). Such a network provides a set of control functions for the purpose of setting up and releasing connections across a transport network. The requirements contained in this Recommendation are technology independent. The architecture of switched transport networks meeting the requirements in this Recommendation, and the technical details required to implement these networks for particular transport technologies, will be found in other Recommendations.

Source

ITU-T Recommendation G.807/Y.1302 was prepared by ITU-T Study Group 13 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 July 2001.

FOREWORD

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

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

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

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

NOTE

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

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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

CONTENTS

ITU-T Recommendation G.807/Y.1302

Requirements for automatic switched transport networks (ASTN)

1 Scope

This Recommendation describes the network level requirements for the control plane of automatically switched transport networks. Such a network provides a set of control functions for the purpose of setting up and releasing connections across a transport network. It is recognized that transport networks support multiple clients. As such, the automatic switched transport networks are intended to be client and technology independent. The architecture of switched transport networks meeting the requirements in this Recommendation, and the technical details required to implement these networks for particular transport technologies, will be found in other Recommendations.

2 References

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

– ITU-T G.805 (2000), *Generic functional architecture of transport networks*.

3 Terms and definitions

This Recommendation defines the following terms:

3.1 address: An address is a string of symbols that is valid regardless of the location of the source but changes if the destination moves. An address is used for the purpose of routeing. Source and destination addresses must be globally unique.

3.2 administrative domain: See ITU-T G.805.

3.3 automatic switched transport network (ASTN): A transport network where configuration connection management is implemented by means of a control plane.

3.4 client-server: See ITU-T G.805.

3.5 connection point (CP): See ITU-T G.805.

3.6 control plane: A set of communicating entities that are responsible for the establishment of connections including set-up, release, supervision and maintenance. A control plane is supported by a signalling network.

3.7 E-NNI: A bidirectional signalling interface between control plane entities belonging to different domains. (See also clause 7.)

3.8 interface: In the context of this Recommendation, interfaces represent logical relationships between ASTN control plane entities and are defined by the information flow between these entities. Such a relationship allows distribution of these entities in support of different equipment implementations and network architectures.

3.9 I-NNI: A bidirectional signalling interface between control plane entities belonging to one or more domains having a trusted relationship. (See also clause 7.)

3.10 layer network: See ITU-T G.805.

3.11 link connection: See ITU-T G.805.

3.12 multi-homing: Multiple links between an end-point and one or more transport networks. Multi-homing may be used, for example, for load balancing or protection via diverse routes.

3.13 name: A name, or identifier, is a location independent string with respect to both a source and a destination. If a string is the name of a destination, it remains unchanged if the destination moves. It is valid regardless of the source attempting communication with the destination.

3.14 permanent connection (PC): A PC is a connection type that is provisioned by the management system.

3.15 switched Connection (SC): An SC is any connection that is established, as a result of a request from the end user, between connection end-points using a signalling/control plane and involves the dynamic exchange of signalling information between signalling elements within the control plane(s).

3.16 soft Permanent Connection (SPC): An SPC is a user-to-user connection where by the user-to-network portion of the end-to-end connection is established by the network management system as a PC. The network portion of the end-to-end connection is established as a switched connection using the control plane. In the network portion of the connection, requests for establishment of the connection are initiated by the management plane and set-up by the control plane.

3.17 Service level agreement: A service level agreement is a contract between two parties such as a service provider and a customer. It defines the services available to the customer, and the grade of service of those services as offered to the customer. It also usually describes the service guarantee and potential penalties in case of service degradation or failure.

3.18 subnetwork: See ITU-T G.805.

3.19 supplementary services: Within a transport network, supplementary services are considered to be the set of services that are provided to end users over and above connection management.

3.20 third party signalling: A party that acts on behalf of a user and exchanges information between the user and the control plane for the purpose of connection supervision.

3.21 User-Network Interface for the control plane (UNI): A bidirectional signalling interface between service requester and service provider control plane entities. (See also clause 7.)

4 Abbreviations

This Recommendation uses the following abbreviations:

ASTN	Automatic Switched Transport Network
ATM	Asynchronous Transfer Mode
CAC	Connection Admission Control
E-NNI	External Network-to-Network Interface
GoS	Grade of Service
I-NNI	Internal Network-to-Network Interface
NE	Network Element
NNI	Network-to-Network Interface
PC	Permanent Connection
PNNI	Private Network-to-Network Interface

PVC	Permanent Virtual Connection
SC	Switched Connection
SPC	Soft Permanent Connection
SPVC	Soft Permanent Virtual Connection
SVC	Switched Virtual Connection
UNI	User-Network Interface for the Control Plane
VC	Virtual Circuit

5 Introduction

The principal functions of a control plane are signalling to support the capability to establish, teardown and maintain end-to-end connections, and routeing to select the most appropriate path. Closely coupled with these is the need to provide suitable naming and addressing schemes.

The distinction between switched services, and leased line services, continues to blur. Normally, switched services are considered as those where connections are set-up using a signalling control protocol, whilst the set-up of leased line services is by means of network management protocols. In technological terms, such a distinction is rather artificial. In many ways, the only reason for this distinction remaining is a general inertia that divides function into transmission and switch. Part of the reason for this distinction remaining is present tariff structures, but these are also changing at an accelerating rate and the existing formulae, such as *distance x time x bandwidth*, are under considerable pressure.

There is little justification for maintaining this distinction. Indeed, the creation of soft permanent connections, having the properties of a leased connection but which are set-up using a signalling protocol, removes the distinction. The main advantage of this approach is that it moves away from quasi static slow response connection control implemented via network management protocols and toward faster response to churn, shorter holding times and improved network utilisation.

In addition to the reasons given above, the introduction of a control plane may offer the following advantages:

- reactive traffic engineering that allows network resources to be dynamically allocated to routes;
- use of specialised control plane protocols rather than generalised network management protocols with small primitive sets;
- extendable capability sets for signalling;
- connection control in a multi-vendor environment;
- reactive restoration that takes into account the current state of the transport network;
- introduction of supplementary services (e.g. closed user groups and virtual private networks);
- rapid service provision;
- reduce the need for service providers to develop and maintain operational support systems software for configuration management for new technologies;
- reuse of control plane protocols for different transport technologies.

6 Fundamental Control Plane Functions

This clause defines the basic functions that are to be supported by the control plane.

6.1 Connection management

The control plane shall support either a switched connection (SC) or soft permanent connection (SPC) of the basic connection capability in the transport network. These connection capability types are defined below:

- Uni-directional point-to-point connection;
- Bidirectional point-to-point connection;
- Uni-directional point-to-multipoint connection.

NOTE – A further connection type can be considered, namely an asymmetric connection. This may be constructed either as two uni-directional point-to-point connections, having different properties in each direction, or as a special case of bidirectional connection.

6.2 Connection Control

The control of connectivity is essential to the operation of a transport network. The transport network itself can be described as a set of layer networks, each acting as a connecting function whereby associations are created and removed between the inputs and outputs of the function. These associations are referred to as connections. Three types of connection establishment are defined:

1) **Provisioned**: This form of connection is established by configuring every network element along the path with the required information to establish an end-to-end connection. Provisioning is provided either by means of management systems or by manual intervention. Where a network management system is used, access to a database model of the network is normally required first, to establish the most suitable route, and then to send commands to the network elements that support the connection. This type of connection is referred to as a hard permanent connection. See Figure 1.

2) **Signalled**: This form of connection is established on demand by the communicating end-points within the control plane using a dynamic protocol message exchange in the form of signalling messages. These messages flow across either the I-NNI or E-NNI within the control plane. This type of connection is referred to as a switched connection. Such connections require network naming and addressing schemes and control plane protocols. See Figure 2.

3) **Hybrid**: This form of connection establishment exists whereby a network provides a permanent connection at the edge of the network and utilises a switched connection within the network to provide end-to-end connections between the permanent connections at the network edges. Connections are established via network generated signalling and routeing protocols. The establishment of such connections is dependent upon the definition of an NNI. Provisioning is therefore only required on the edge connections. There is no defined UNI. This type of network connection is known as a soft permanent connection (SPC). From the perspective of the end-points a soft permanent connection appears no different than a provisioned, management controlled, permanent connection. See Figure 3.

The most significant difference between the three methods above is the party that sets up the connection. In the case of provisioning, connection set-up is the responsibility of the network operator, whilst in the signalled case, connection set-up may also be the responsibility of the end user. Additionally, third party signalling should be supported across a UNI.

NOTE – The type of connection may have impact on future billing systems.

The function of a UNI is to pass signalling messages directly to the network control plane entity. Alternatively, where a network operator already has extensive management systems in place that provide planning assignment and auto-configuration, these signalling messages may be passed directly to service management and network management system agents to effect connection set-up. Such an application will allow near real time automated service provision from the existing management platforms.

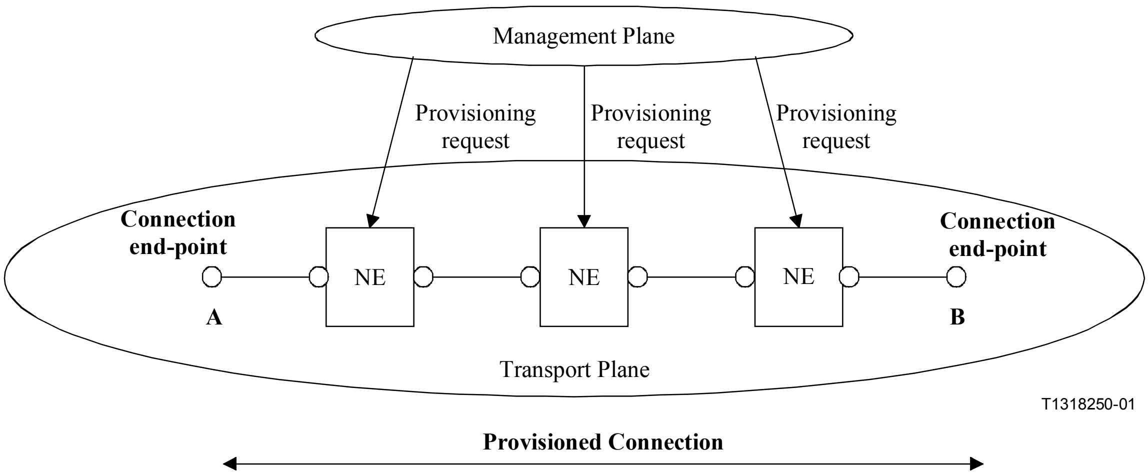

Figure 1/G.807/Y.1302 – Example of end-to-end transport connection set-up using provisioning via management plane

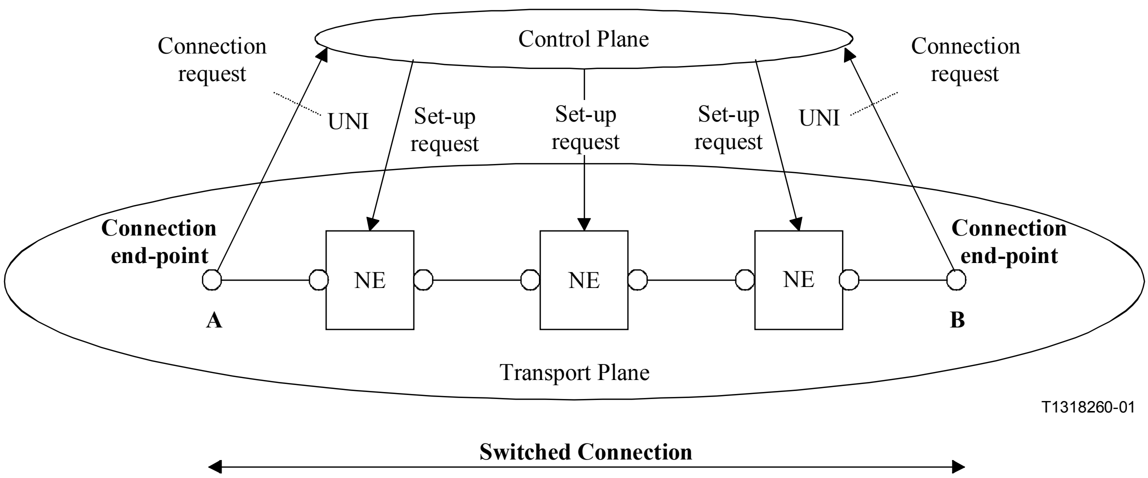

Figure 2/G.807/Y.1302 – Example of end-to-end transport connection set-up using control plane (switched connection from A to B)

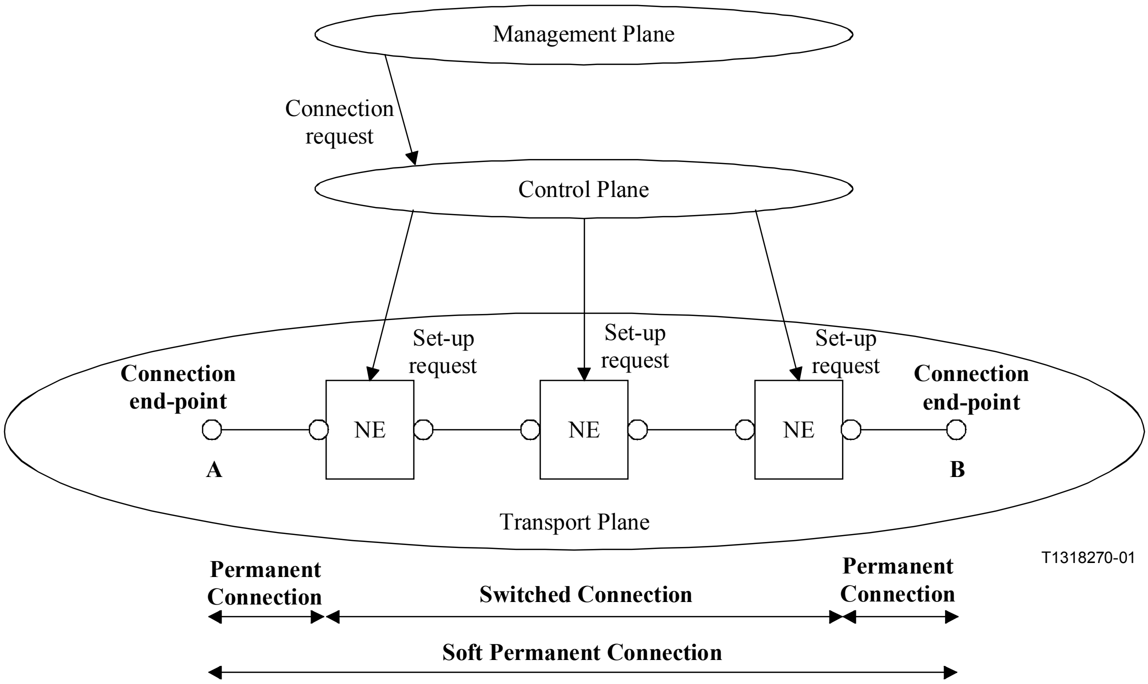

Figure 3/G.807/Y.1302 – Example of end-to-end transport connection set-up as soft permanent connection (SPC) as a hybrid case of switched and permanent connection types

6.3 Relationship between the UNI and network management systems

The function of a UNI is to pass signalling messages directly to the network control plane entity. Alternatively, where a network operator already has extensive management systems in place that provide planning assignment and auto-configuration, these signalling messages may be passed directly to service management and network management system agents to effect connection set-up. Such an application will allow near real time automated service provision from the existing management platforms.

Technology specific Recommendations shall specify the relationships between entities in each of the control, management and transport planes.

6.4 Connection Management in a Multi-homing environment

The control plane shall provide support for multi-homing, which supports more than one link between the end users and the network. This can be subdivided into multi-homing to a single network operator (e.g. for the purpose of resilience or load balancing) and multi-homing to multiple network operators. In developing solutions for multi-homing, careful consideration of the impact on addressing structure and ownership of address assignment must be considered.

6.5 Connection management in Support of Diverse connections

The control plane of the ASTN should provide the signalling and routeing capabilities to permit a user to request diversely routed connections from a carrier who supports this functionality. However, there are no specific parameters available to the end customer to verify diversity.

Implementation details are left to the technology specific Recommendations.

6.6 Support of Supplementary Services

The control plane shall provide support for the development of supplementary services that are independent of the bearer service. Where these are carried across networks using a range of protocols, it is necessary to ensure that the protocol interworking provides a consistent service as viewed by the user regardless of the network implementation.

The control plane shall support closed user groups. This allows a user group to create, for example, a virtual private network.

Supplementary services may not be required or possible for soft permanent connections.

7 Control Plane Functions for the Support of Connection Management

7.1 Signalling and Related Interfaces

Signalling is required by all entities communicating through a network's control plane. In the context of this Recommendation, interfaces represent logical relationships between ASTN control plane entities and are defined by the information flow between these entities, as illustrated in Figure 4. Such a relationship allows distribution of these entities in support of different equipment implementations and network architectures.

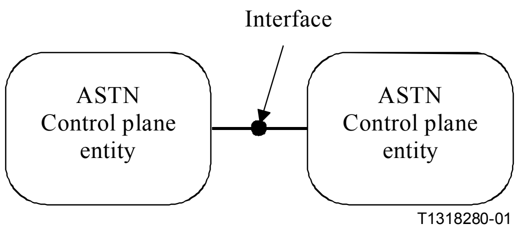

Figure 4/G.807/Y.1302 – Logical Interface for the Automatic Switched Transport Network

The information flowing over this logical interface may include:

- End-point name and address;
- Reachability/summarized network address information;
- Topology/routeing information;
- Authentication and connection admission control information;
- Connection service messages;
- Network resource control information (I-NNI only).

These information elements can be aggregated to form three types of logical interfaces as described below. For these interfaces, although similar types of information may flow over the interface (e.g. connection service messages), the detailed information flow may differ for the three types of interfaces.

UNI: This interface supports, as a minimum, the following information elements:

- End-point name and address;
- Authentication and connection admission control;
- Connection service messages.

E-NNI: This interface assumes an untrusted relationship between domains. The information elements supported include:

- Reachability/summarized network address information;
- Authentication and connection admission control;
- Connection service messages.

I-NNI: This interface supports, as a minimum, the following information elements:

- Topology/routeing information;
- Connection service messages;
- Information needed to *optionally* control network resources.

Figure 5 illustrates user end systems connecting to a global ASTN network, which may be comprised of multiple provider domains. There is no trusted relationship between provider domains so the instantiated interfaces are E-NNIs. Within a provider domain, the instantiated interface between control plane entities is the I-NNI .

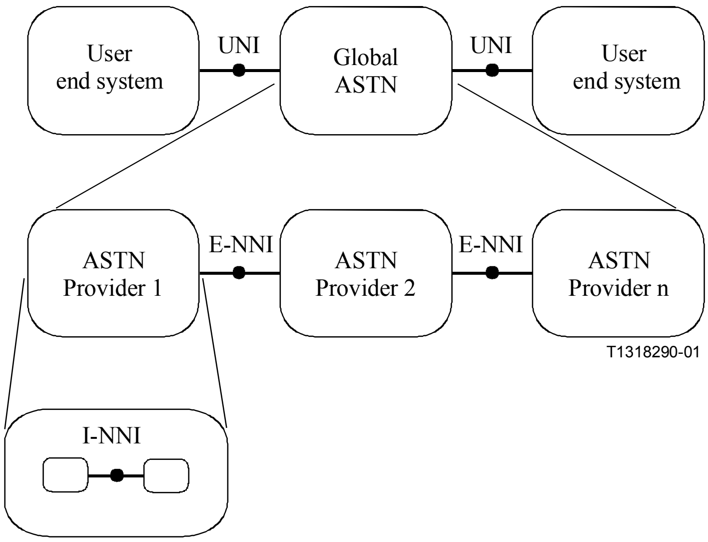

Figure 5/G.807/Y.1302 – Relationships and interfaces between ASTN entities

In the case of a single provider domain, there are situations in which an E-NNI is preferable to an I-NNI. Examples of such situations include the cases where the provider network is comprised of multiple partitions arising from:

- The use of different vendors subnetworks;
- Interconnections of different subnetworks administered by different business units;
- To reduce the volume of topology state information exchanged.

7.2 Routeing

Routeing is the control plane function used to select paths for the establishment of connections through one or more operator networks. This function relates incoming labels to outgoing labels. This requires knowledge of the topology and link state of the transport plane. In the case of the automatic switched transport network, labels are the names used to identify individual link connections within a link, and must be unique within a single link or switch. Examples of labels include time slots, wavelengths, virtual path identifiers, etc.

The topology (links and link connections) between switches should be automatically discovered by control plane functions. The individual link connections so discovered shall be aggregated into link information and distributed as required to support the routeing function. Note must be taken that the topology of the control plane is not necessarily the same as that of the transport plane being controlled (see clause 9, Signalling network).

7.3 Connection Admission Control

Connection admission control (CAC) is necessary for authentication of the user and controlling access to network resources. CAC shall be provided as part of the control plane functionality. It is the role of the CAC function to determine if there is sufficient free resource available to allow a new connection. If there is, the CAC may permit the connection request to proceed, alternatively, if there is not, it shall notify the originator of the connection request that the request has been denied. Connections may be denied on the basis of available free capacity or, alternatively, on the basis of prioritization, or on other policy decisions. CAC policies are outside the scope of this Recommendation.

7.4 Naming and Addressing

Naming and addressing requirements involve creating the bindings between:

a) the user domain names and service provider domain names (e.g. service provider identification); and

b) layer network names.

Names and addresses are defined in clause 3. In addition it is useful to introduce the following:

Value (of name or address): May be both a name and an address to different parties, e.g. a string that is an address within a client layer might be used as a name by the server layer. However, this may expose some privacy/security issues, and may well prevent the client from choosing a name that is useful to it.

Separation of server layer name and client layer name, as well as user domain name and service provider domain name, provides an abstraction barrier between name processing and connection operations. Some properties of the naming and addressing in the switched network are:

- **Name independence**: The client (user) name should not make assumptions on what capabilities are offered by the server (service provider) name, and thus the semantics of the two name spaces should be separate and distinct. This does not place any constraints on the syntax of client and server layer name spaces, or on the user and service provider name spaces.
- **Name uniqueness**: In order to uniquely identify user requests and subsequent identification of the connection set-up, it is desirable for names associated with a user request to be unique within some context (e.g. within one or more service provider domains). The extent to which the name is unique is for further study.
- **Connection identifier**: This is required to uniquely identify an end-to-end connection from the perspective of the user. The connection identifier may be made available to the end-user as a result of successful completion of a connection request.

  NOTE – For billing purposes, the scope of this identifier may need to be globally unique. This is outside the scope of this Recommendation.
- **Routeing address**: Within an operator domain, a unique address is required for each sub-network point within each network element. This is needed for routeing within a single operator domain. This address does not need to be globally unique.

- **Server layer name space**: The server layer name space provides identification of the node and the resources available for connection operations at that layer. Server names are applicable at the server layer only, and should not be communicated to the client layer.
- **Service provider name space**: The service provider name space provides identification of the node and the resources available for connection operations and is an NNI issue. Service provider names are applicable in the service provider domain, and should not be communicated to the user.
- **Name translation**: This provides multiple purposes. The translation function may provide mapping of the client layer name to server layer name (used for routeing decision through the server layer), user domain name to service provider domain name, or provide mapping of connection identifier to a connection in the server layer. These translation functions will likely be performed via one or more directory services.
- **Uniqueness of addresses**: Addresses must be globally unique within a layer network. In designing a transport network, it is essential that the potential size be considered. The trend in existing networks is that capacity that was considered to be core capacity migrates toward the edge in the sense that the previous transport connections become end user service connections. As this happens, the scale (number of end-points) increases rapidly. Therefore, it is expected that the global transport network will grow to many millions of end-points, many thousands of switches and hundreds of administrative domains. The addressing scheme must therefore scale to support such growth.
- **Address aggregation**: It shall be possible to aggregate addresses in a hierarchical manner. This provides support for hierarchical routeing.

Directory services are beyond the scope of this Recommendation.

8 Signalling Processes – Connection Management Processes

8.1 Connection management processes

In a connection oriented transport network, a connection must be established before data can be transferred. This requires, as a minimum, the following:

- Connection set-up and verification. Several attributes may be associated with a connection set-up. Depending upon the offered service, several of these attributes may be optionally provided as part of a request. Where appropriate, an operator may validate the connection based on the service level agreement before offering the connection to the user.
- Data transfer;
- Connection release.

The specific behaviours and detailed message sets required for connection set-up and release are outside the scope of this Recommendation. However, the UNI/NNI (except where noted) signalling shall support, but is not restricted, to the following basic features at the source:

- Connection request/release;
- Grade of Service (GoS) parameter selection procedures where appropriate;
- Supplementary services where appropriate (UNI only);
- Connection confirmation/release indication;
- Connection denied confirmation.

At the destination the UNI/NNI signalling shall support the following basic procedures:

- Incoming connection request/release;
- GoS parameter selection where appropriate;

- Supplementary services where appropriate (UNI only);
- Connection failure indication;
- Connection acceptance/release indication.

The following procedures may also be supported across the UNI/NNI:

- Handling of error and exception conditions;
- Authentication procedures. These can be subdivided into two subcategories, authentication for verification of user identity, and verification that user requests are not in breach of a service level agreement;
- Non-service affecting modification of appropriate connection attributes;
- Query connection attributes.

9 Signalling Network

A signalling network supports the control plane by the act of transferring service-related information between the user and the network, and also between network entities. For the support of on demand switched connections, the signalling network must be capable of allowing the user to inform the network control plane of the required connectivity needs. As such, the signalling network shall support the transfer of information elements that describe the features required for service instantiation. Information elements may be mandatory, optional or proprietary.

The signalling network shall be based upon common channel signalling, thereby allowing a network operator the capability of developing a separate signalling network. This allows the following advantages:

- It is highly scalable;
- The size of the signalling links can be optimised for economy;
- A high degree of resilience can be achieved;
- Signalling message sets can easily be extended.

Common channel signalling links are associated with user channels in the following ways (see Figure 6):

- Associated, whereby signalling messages related to traffic between two network elements are transferred over signalling links that directly connect the two network elements;
- Non-associated, whereby signalling messages between two network elements A and B are routed over several signalling links, whilst traffic signals are routed directly between A and B. The signalling links used may vary with time and network conditions;
- Quasi-associated, whereby signalling messages between nodes A and B follow a predetermined routeing path over several signalling links whilst the traffic channels are routed directly between A and B.

Associated signalling may be used where the number of traffic channels between two network elements is large, thereby allowing a single signalling channel to be shared amongst a large number of traffic channels.

Quasi-associated signalling may be used to improve resiliency. For example, consider a signalling channel that has failure mechanisms independent of the traffic channels. Failure of the signalling channel will result in loss of signalling capability for all traffic channels even if all the traffic channels are still functional. Quasi-associated signalling mitigates against this by employing alternative signalling routes. In other words, the signalling network must be designed such that failure of a signalling link shall not affect the traffic channels associated with that signalling channel.

The signalling network shall provide reliable message transfer and mechanisms for its own operations, administration and maintenance. This is not to be confused with operations, administration and maintenance functions in the transport plane.

The control plane protocols shall not assume that the signalling network topology is identical to that of the transport network. The control plane protocols must operate over a variety of signalling network topologies.

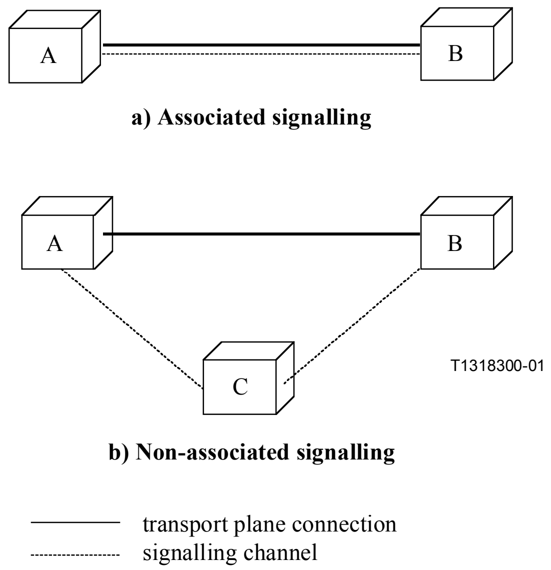

Figure 6/G.807/Y.1302 – Signalling routeing for associated and non-associated signalling

In the event that call arrival rates overload the signalling network, there will be a sharp drop in total call throughput. To avoid this, congestion control mechanisms shall be provided within the control plane.

10 Client view of server layer network topology

It is envisaged that, in common with other transport networks, an ASTN will support multiple client-server relationships. According to the client-server model of ITU-T G.805, the topology of the server layer is independent and may be hidden from the client layer. In effect, the server layer provides a service to the client layer in the form of a server layer trail supporting a client layer link connection. This model is followed in an ASTN network as well. As such, server layer network topology information cannot be assumed to be available to a client layer network.

11 Inter-domain view of network topology

It is assumed that the ASTN will be a network capable of providing global connectivity. To this effect, connections will potentially be set-up over a number of tandemed subnetworks operated by different administrations. This places restrictions on the signalling and routeing information that may traverse an NNI between different administrative domains.

There is no reason to assume that network operators will provide internal topology and/or resource information to each other. To do so would imply topology/resource state updates coming in and out of a network operator's domain, and of more concern, control of resources in one domain from another domain. This yields a number of serious security implications, not least because it implies a certain visibility of a network operators network state. It also potentially leaves a network open to storms of routeing update packets, in the event that an adjoining network operator reconfigures or mis-configures their network, suffers a major outage, have rogue/defects or potentially unauthorized access. The need for concealment of topology information in ASTN is similar in concept to the use of multiple autonomous systems in the Internet and PNNI hierarchies in ATM.

For these reasons, an NNI between two different domains exhibits different behaviour to an NNI within a single domain. The former is defined as an exterior NNI (E-NNI) and only provides information regarding reachability whilst the latter is an interior NNI (I-NNI) across which both reachability and topology information can be exchanged and resources can be controlled.

12 Resource management

Network resources may be partitioned between those under the authority of the management plane and those under the authority of the control plane. It shall not be possible for the control plane to modify resources that are under the authority of the management plane. This includes network resources not currently in use, but reserved for future use (e.g. by network planners). As such, resource management is performed by the management plane and is outside the scope of this Recommendation.

13 Support for transport network survivability

In a transport network, survivability can be controlled by the ASTN control plane or by transport network mechanisms that are independent of the control plane. Survivability can be achieved either by means of protection, which requires dedicated capacity, or restoration which uses available spare capacity. Specific survivability mechanisms such as protection schemes, or fast restoration schemes, are beyond the scope of this Recommendation.

Soft permanent connections are set-up/torn down in response to requests initiated by the network management system. As such, it is possible to determine survivability routeings using operational support systems, with explicit path information relayed to the control plane, or by the control plane itself.

In the case of switched connections, survivability mechanisms and routeings are determined by the control plane.

User requests for explicit survivability mechanisms (e.g. requests for 1:1, 1+1, ring, mesh protection, etc.) are not supported, as the user should not have access to the topology of the provider network and, in some instances, the connection may require different protection mechanisms for different parts of the connection. However, the user may request from the provider diverse connections (i.e. with no common routeing).

To provide diverse routeing, it is necessary to have access to information relating to the topology of the layer network in which the soft permanent connection, or switched connection, resides and all of the server layer networks including the fibre, cable and duct (also known as conduit). Full diversity also requires knowledge of the relationship between buildings/locations and transmission facilities. Mechanisms to support diverse routeing, for those carriers wishing to support this functionality, may be provided by either the management plane, for soft permanent connections, or the control plane for either soft permanent connections or switched connections.

ITU-T Y-SERIES RECOMMENDATIONS

GLOBAL INFORMATION INFRASTRUCTURE AND INTERNET PROTOCOL ASPECTS

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	**Y.1300–Y.1399**
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899

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

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	**Global information infrastructure and Internet protocol aspects**
Series Z	Languages and general software aspects for telecommunication systems

Geneva, 2001