I n t e r n a t i o n a l   T e l e c o m m u n i c a t i o n   U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.8080/Y.1304
Amendment 1
(03/2008)

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

Packet over Transport aspects – Ethernet over Transport aspects

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Internet protocol aspects – Transport

Architecture for the automatically switched optical network (ASON)

Amendment 1

Recommendation ITU-T G.8080/Y.1304 (2006) – Amendment 1

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
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
Ethernet over Transport aspects	**G.8000–G.8099**
MPLS over Transport aspects	G.8100–G.8199
Quality and availability targets	G.8200–G.8299
Service Management	G.8600–G.8699
ACCESS NETWORKS	G.9000–G.9999

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

Recommendation ITU-T G.8080/Y.1304

Architecture for the automatically switched optical network (ASON)

Amendment 1

Summary

Amendment 1 to Recommendation ITU-T G.8080/Y.1304 contains:

- G.8080/Y.1304 Corrigendum 1 (09/2007)
- G.8080/Y.1304 Erratum 1 (04/2007)
- Additions to allow ASON to apply to packet transport networks
- Updates to TAP and LRM, including clarification of SNP binding states.

Source

Amendment 1 to Recommendation ITU-T G.8080/Y.1304 (2006) was approved on 29 March 2008 by ITU-T Study Group 15 (2005-2008) under Recommendation ITU-T A.8 procedure.

FOREWORD

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

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

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

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

NOTE

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

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Recommendation ITU-T G.8080/Y.1304

Architecture for the automatically switched optical network (ASON)

Amendment 1

Summary

Replace the existing summary with the following:

This Recommendation describes the reference architecture for the control plane of the Automatically Switched Optical Network as applicable to connection-oriented circuit or packet transport networks, as defined in Recommendation ITU-T G.805. This reference architecture is described in terms of the key functional components and the interactions between them.

1 Scope

Replace the first paragraph with the following:

This Recommendation specifies the architecture and requirements for the automatic switched transport network as applicable to connection-oriented circuit or packet transport networks, as defined in [ITU-T G.805].

2 References

Add the following references:

[ITU-T G.800] Recommendation ITU-T G.800 (2007), *Unified functional architecture of transport networks*.

[ITU-T G.7718] Recommendation ITU-T G.7718/Y.1709 (2005), *Framework for ASON management*.

3 Definitions

Add the following definition:

FwPt: See [ITU-T G.800].

<u>*Add the following definitions after definition 3.53:*</u>

<u>**3.54 potential (resource) label range**: The potential (resource) label range is the range of resource labels in the transport plane name space that an adaptation function supports to distinguish different information flows.</u>

<u>**3.55 configured (resource) label**: A "configured (resource) label" is a label that has been configured in the transport plane in support of a connection. For each configured label, a forwarding table entry exists on the receiving end of the link such that packets can be forwarded based on the label value of the received packet.</u>

<u>**3.56 allocated (resource) label range**: The "allocated label range" is the set of labels that can be used by the adaptation function of a particular link to carry user traffic. It is a subset of the potential resource label range. The allocated labels are entities that can be referenced in the transport plane name space. Each allocated label is associated with one or multiple SNP IDs that exist in the control plane name space (1:n relationship). TAP holds this binding information.</u>

3.57 potential SNPs: Potential SNPs are those SNPs that are associated with a (resource) label. In general, multiple SNPs can be associated with a single label. The different SNPs associated with the same (resource) label typically belong to different SNPPs.

3.58 assigned SNPs: Assigned SNPs are those SNPs out of the set of potential SNPs that have been assigned to a particular connection. This means that the associated label corresponds to a configured label.

6.1 Transport entities

Replace the sentence:

A number of transport systems support variable adaptation, whereby a single server layer trail may dynamically support different multiplexing structures.

With the following:

A number of transport systems support variable adaptation, whereby a single server layer trail may dynamically support different clients. For example, different GFP mappings for packet clients or different multiplexing structures for SDH/OTN. The description below illustrates the application to the latter.

Add the following to the end of the clause

In the case of circuit switching, the SNP is bound to a resource label, which provides a resource reservation and allocation. In the case of packet switching, the SNP is not directly bound to a resource label, and the resource label does not carry either any resource allocation. Therefore, in the case of packet switching, when a connection is established, an SNP is selected from a range of SNPs that is bound to a resource label. The connection request should include a resource reservation (CIR and EIR).

6.3 Topology and discovery

Replace this clause as follows:

The routing function understands topology in terms of SNPP links. Before SNPP links can be created, the underlying transport topology, i.e., the trail relationship between the access points, must be established. These relationships may be discovered (or confirmed against a network plan) using a number of different techniques; for example, use of a test signal or derived from a trail trace in the server layer. They may also be provided by a management system based on a network plan. The capability of the transport equipment to support flexible adaptation functions (and thus link connections for multiple client layer networks) may also be discovered or reported.

Link connections that are equivalent for routing purposes are then grouped into links. This grouping is based on parameters, such as link cost, delay, quality or diversity. Some of these parameters may be derived from the server layer but in general they will be provisioned by the management plane.

Separate links may be created (i.e., link connections that are equivalent for routing purposes may be placed in different links) to allow the division of resources between different ASON networks (e.g., different VPNs) or between resources controlled by ASON and the management plane.

The link information (e.g., the constituent link connections or resource label range with the available link bandwidth) is then used to configure the LRM instances (as described in clause 7.3.3) associated with the SNPP link. Additional characteristics of the link, based on parameters of the (potential) link connections, may also be provided. The LRMs at each end of the link must establish a control plane adjacency that corresponds to the SNPP link. The interface SNPP ids may be negotiated during adjacency discovery or may be provided as part of the LRM configuration. The link connections and CP names or resource labels (and link connections) are then mapped to interface SNP ids (and SNP Link Connection names). In the case where both ends of the link are within the same routing area the local and interface SNPP id and the local and interface SNP ids may be identical. Otherwise, at each end of the link the interface SNPP id is mapped to a local SNPP id and the interface SNP ids are mapped to local SNP ids. This is shown in Figure 11.

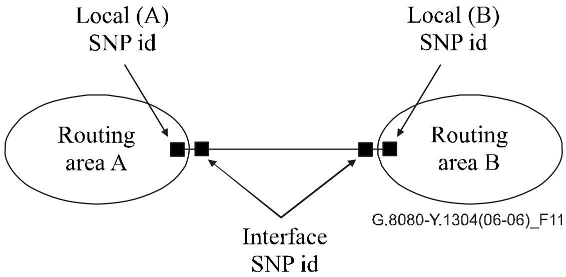


Figure 11 – Relationship between local and interface ids

The resulting SNP link connections may then be validated by a discovery process. The degree of validation required at this stage is dependent on integrity of the Link Connection relationships initially provided by the transport plane or management plane and the integrity of the process used to map CPs to SNPs.

Validation may be derived from a trail trace in the server layer or by using a test signal and test connections. If test connections are used, the discovery process may set up and release these connections using either the management plane or the control plane. If the control plane is used, the Link must be made temporarily available to routing and connection control, for test connections only.

Once the SNPP link validation is completed, the LRMs inform the RC component (see clause 7.3.2) of the SNPP Link adjacency and the link characteristics, e.g., cost, performance, quality, diversity, and bandwidth.

7 Control plane architecture

Replace the following bullet:

– Support various transport infrastructures, such as the SONET/SDH transport network, as defined in ITU-T Rec. G.803, and the Optical Transport Network (OTN), as defined in ITU-T Rec. G.872.

With the following:

– Support various transport infrastructures, such as those covered by [ITU-T G.805].

7.3.1 Connection controller (CC) component

Replace Table 2 with the following updated table:

Table 2 – Connection controller component interfaces

Input interface	Basic input parameters	Basic return parameters
Connection Request In	A pair of local SNP names and optionally a route	A subnetwork connection
Peer coordination In	1) A pair of SNP names; or 2) SNP and SNPP; or 3) SNPP pair; or 4) route	Confirmation signal

Output interface	Basic output parameters	Basic return parameters
Route Query	Unresolved route fragment	Route
Link Connection Request	–	A Link Connection (an SNP pair)
Connection Request Out	A pair of local SNP names	A subnetwork connection
Peer coordination Out	1) A pair of SNP names; or 2) SNP and SNPP; or 3) SNPP pair; or 4) route	Confirmation signal
Remote topology status Out	Topology information (link and/or subnetwork) including resource availability	–

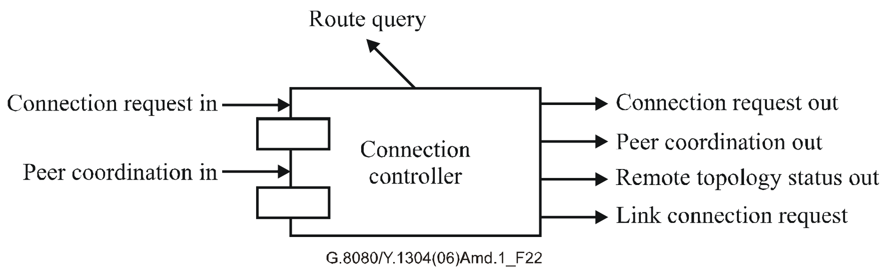


Figure 22 – Connection controller component

7.3.3 Link resource manager (LRMA and LRMZ) component

Replace this clause as follows:

The LRM components are responsible for the management of an SNPP link; including the assignment and unassignment of SNP link connections (to a connection), managing resource reservation, configuration of policing and shaping functions (if required), providing topology and status information. LRM functions for circuit and packet switching are shown in Figure 23.1. Since an SNPP link can be either public or private, an LRM can also be either public or associated to exactly one VPN.

Layer network using circuit switching

The TAP supplies FwPt[1] and the corresponding resource labels to the LRM and associates these resource labels to SNP identifiers. When the TAP allocates a SNP identifier, the transport plane link connection is created; this provides an implicit reservation of the link resource. Tracking the assigned SNP identifiers allows the LRM to track link utilization. Since traffic loading is inherently constrained, policing and shaping functions are not required. In general, the same SNP identifier and resource label are used for both directions of a bidirectional connection.

Layer network using packet switching

The TAP supplies capacity and resources label to the LRM and associates these resource labels to SNP identifiers. The transport plane FwP and link connections are not created until a SNP identifier is assigned by the LRM. When a connection is requested, the LRM must record and track the requested bandwidth (CIR and EIR). The LRM (in cooperation with the TAP) should also configure the appropriate policing and shaping functions. The link information must include the admission control policy (e.g., amount of overbooking allowed for the CIR and EIR). The LRM advises the TAP when a SNP is assigned or unassigned. Different SNP identifiers and resource labels may be used for each direction of a bidirectional connection.

Required LRM functions for packet switching

- Bandwidth management function: the connection request must include bandwidth parameters (CIR and EIR). Due to the fact that the bandwidth is now the important link resource, SNPs and the corresponding labels identifying a flow are of less significance compared to circuit switching. In circuit switching, the SNP of a particular layer network has an implicit bandwidth, and the availability of an SNP also implies that the associated bandwidth is available. The LRMA shall provide a bandwidth management function that keeps track of the allocated bandwidth provided by the TAP and the assigned bandwidth that the currently existing connections have been granted.
- Connection admission control (CAC) function: When the LRMA receives a connection create request or connection modification request, the LRM's connection admission control function determines whether the request can be granted or whether it has to be rejected.
- SNP assignment function: If the CAC function result is positive, the connection create request is further processed and an SNP has to be selected and assigned to the connection. When a connection is deleted, the SNP is unassigned.

[1] FwPt – Forwarding Port from [ITU-T G.800]. This is the end of an unbound link connection. It is converted into a FwP (Forwarding Point) when a subnetwork connection is established. This does not change the associated resource label.

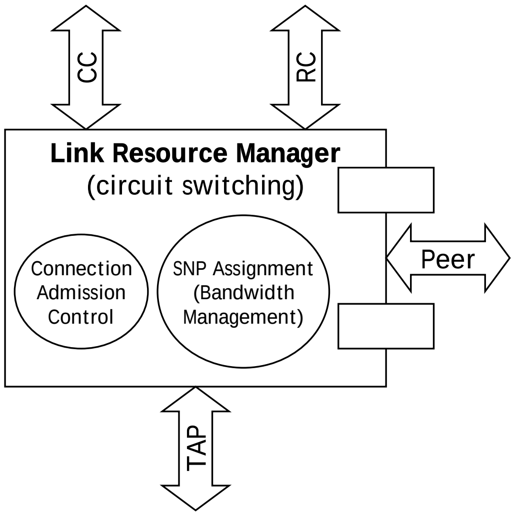


Figure 23.1 – Basic LRM functions for circuit switching and packet switching

Two LRM components are used – the LRMA and LRMZ. An SNPP link is managed by a pair of LRMA and LRMZ components one managing each end of the link. Requests to assign SNP link connections are only directed to the LRMA. If the required link resources are not available, then the LRM must either request additional capacity from the TAP or reject the connection request.

The two cases for SNPP link are illustrated in Figure 24.

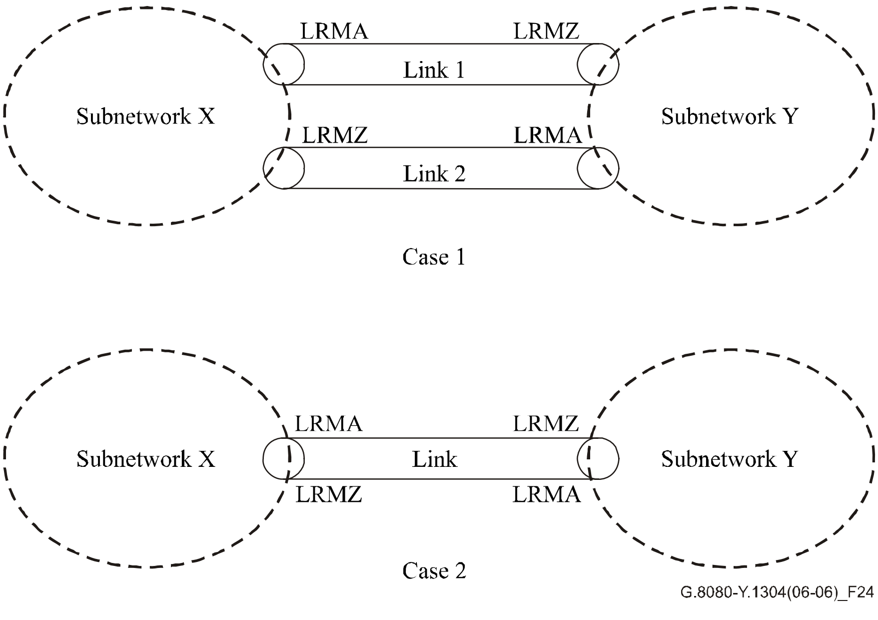


Figure 24 – SNPP link cases

In case 1, link 1 is dedicated to connection set-up requests originating from subnetwork X. Requests for SNP link connections from subnetwork X are directed to the adjacent LRMA for link 1, which can process the request without negotiation with the far end of the link. This LRMA can assign the SNP identifier and capacity (and hence the link connection) without negotiation with the LRMZ for link 1. Similarly, link 2 is dedicated to connection set-up requests originating from subnetwork Y. Requests for SNP link connections from subnetwork Y are directed to the adjacent LRMA for link 2. This LRMA can assign the SNP identifier without negotiation with the LRMZ for link 2. In this case, the same SNP identifier is used for both directions of transmission in a bidirectional connection. For a packet-switched network, the bandwidth assigned to a bidirectional connection may be asymmetric and must be tracked, by LRMA, independently for each direction. Also for packet-switched networks, the LRMA and LRMZ, in addition to assigning the SNP identifier, must communicate with the TAP to configure the policing and shaping functions.

In case 2, the link is shared between subnetworks X and Y for connection set-up. Requests for SNP link connections from subnetwork X are directed to the adjacent LRMA, since an LRMA component at the far end of the link can independently allocate SNP identifiers and link resources, the LRMA may need to negotiate an SNP identifier and capacity assignment with the LRMA at the far end (via the LRMZ at the far end). A similar process is required for request from subnetwork Y to its adjacent LRMA. Case 2 can be broken down into three sub-cases:

a) The same SNP identifier is used for both directions of a bidirectional connection.

b) The SNP identifiers are assigned independently for each direction at the source end of the link.

c) The SNP identifiers are assigned independently for each direction at the sink end of the link.

7.3.3.1 LRMA

Replace this clause as follows:

The LRMA is responsible for the management of the A end of the SNPP link as described below.

The LRMA component interfaces are provided in Table 4 and illustrated in Figure 25.

Table 4 – LRMA component interfaces

Input interface	Basic input parameters	Basic return parameters
connection request	Request id SNP Id (optional) CIR and EIR (Packet switched only)	Request id SNP id pair or denied
connection deletion	SNP Id; or Request id	Confirm or denied
Configuration	Link information	–
Translation	Local id	Interface id
Connection modification	SNP Id; or request id New CIR and EIR (Packet switched only)	Confirm or deny
SNP binding state	Busy, Potential, Allocated, Shutting down	Resource released (in response to the shutting down state)
SNP operational state	Enabled, disabled	
Add SNP	List of SNP identifiers	confirm
Withdraw SNP	List of SNP identifiers	confirm

Table 4 – LRMA component interfaces

Output interface	Basic output parameters	Basic return parameters
Assign SNP (Case 1 only)	SNP id	confirm
SNP negotiation (Case 2 only)	Request id List of SNP ids CIR and EIR (packet switched only)	Request id SNP id
SNP release (unassign)	List of SNP id	Confirm
Topology	Link information	–
SNP id assignment/ unassignment (packet switched only)	SNP id CIR and EIR (to TAP)	Confirm or deny (TAP must bind the SNP to the resource label and configure the policing functions)
Capacity change request (packet switched only)	SNP id CIR and EIR	Link configuration

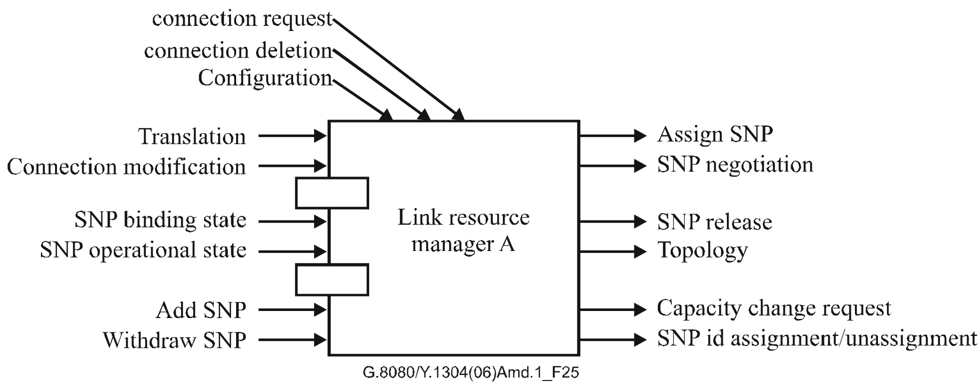


Figure 25 – Link resource manager A component

- **Functions**

– *Assignment of a link connection to a connection*

When a connection request is received, connection admission is invoked to decide if there is sufficient free resource to allow a new connection. Connection admission can also be decided based on prioritization or on other policy decisions. Connection admission policies are outside the scope of standardization.

For the purposes of the description below, the network configuration is shown in Figure 24, and the connection request originates from subnetwork X. The designations x and y are added to the LRM components to clarify the location and role.

If there are insufficient local resources, the request is rejected or the local LRMAx may request the TAP to convert a SNP with a binding state of potential and the associated potential capacity to allocated (if the policy allows such requests).

If sufficient local resources are available, the connection request is allowed to process as described in the cases below. Note that, for circuit switched-networks, the local LRMAx can determine if sufficient capacity is available since the bandwidth is always symmetric and is implicit in the availability of a SNP. For packet-switched networks, since the bandwidth may be asymmetric and must be tracked explicitly, it is possible that there are insufficient far-end resources available to support a connection, in which case the connection request will be rejected.

– Case 1 circuit-switched layer network: Since the SNP identifiers (and the corresponding link connections) are only assigned from one end of the SNPP link, the LRMAx can select the SNP identifier without interaction with the LRMZy at the far end of the link. The LRMAx passes the SNP identifier to the connection controller.

– Case 1 packet-switched layer networks: Since the link resources are only assigned from one end of the link, the LRMAx can perform the admission control and bandwidth reservation process without interaction with LRMZy at the far end of the link. LRMAx selects the SNP identifier, configures the policing and shaping functions and informs LRMZy. LRMZy must assign the SNP id and communicate with the TAP to configure the policing and shaping functions. LRMAx tracks the capacity assigned to connections for both directions of transmission on the link. The LRMAx passes the SNP identifier to the connection controller.

– Case 2a circuit-switched layer networks: Since the SNP identifiers (and the corresponding link connections) may be used by the LRMA at either end of the SNPP link, the LRMAx passes a list of usable SNP ids to the LRMZy. The LRMZy (in cooperation with its local LRMAy) selects one of the SNPs and returns the id to the originating LRMAx. The originating LRMAx passes the SNP identifier to the connection controller.

– Case 2a packet-switched layer networks: LRMAx adds the requested capacity for the A to Z direction of transmission on the link to its local copy of the link capacity assignment. Since the resources are assigned independently by the LRMA at either end of the SNPP link and SNPs are assigned from a common pool, the LRMAx passes a list of the useable SNP ids and the bandwidth parameters for the Z to A direction of transmission to the LRMZy at the far end of the link. The LRMZy passes this information to the local LRMAy which confirms that the link capacity is available, adds this to its local copy of the assigned link capacity and selects and assigns a SNP identifier and communicates with the TAP to configure the policing and shaping functions. If the available resources are insufficient to support the connection, the request is rejected; or the LRMAy may request additional resources from the TAP. This information is returned to the originating LRMAx. If the request has been accepted by the remote LRMAy, the local LRMAx assigns the SNP, communicates with the TAP to configure the policing and shaping functions. The LRMAx passes the SNP identifier to the connection controller. If the request is denied by the remote LRMAy, the local LRMAx rejects the connection request and removes any local reservations.

– Case 2b packet-switched layer networks: LRMAx adds the requested capacity for the A to Z direction of transmission on the link to its local copy of the link capacity assignment, and selects a SNP identifier for the A to Z direction of transmission. Since the resources are assigned independently by the LRMA at either end of the SNPP link, the LRMAx passes the selected SNP (for the A to Z) and the bandwidth parameters for the Z to A direction of transmission to the LRMZy at the far end of the link. The LRMZy passes the bandwidth requirements to the local LRMAy which confirms that the link capacity is available, adds this to its local copy of the assigned link capacity, and selects and assigns a SNP identifier (from its local pool for the A to Z direction of transmission) and communicates with the TAP to configure the policing and shaping functions. If the available resources are insufficient to support the connection, the request is rejected; or the LRMAy may request additional resources from the TAP. This information is returned to the local LRMZy which then assigns the SNP provided by the remote LRMAx and passes the information to the remote (originating) LRMAx. If the request has been accepted by the remote LRMAy, the local LRMAx assigns the SNP (for the A to Z direction of transmission), provides the Z to

A SNP to the local LRMZx and communicates with the TAP to configure the policing and shaping functions. The LRMAx passes the SNP identifiers to the connection controller. If the request is denied by the remote LRMAy, the local LRMAx rejects the connection request and removes any local reservations.

– Case 2c packet-switched layer networks: LRMAx adds the requested capacity for the A to Z direction of transmission on the link to its local copy of the link capacity assignment and selects a SNP identifier for the Z to A direction of transmission. Since the resources are assigned independently by the LRMA at either end of the SNPP link, the LRMAx passes the selected SNP and the bandwidth parameters for the Z to A direction of transmission to the LRMZy at the far end of the link. The LRMZy passes the bandwidth requirements and SNP to the local LRMAy which confirms that the link capacity is available, adds this to its local copy of the assigned link capacity and selects a SNP identifier (from its local pool for the Z to A direction of transmission), assigns the SNP identifier provided by the remote LRMAx and communicates with the TAP to configure the policing and shaping functions. If the available resources are insufficient to support the connection, the request is rejected; or the LRMAy may request additional resources from the TAP. This information is returned to the local LRMZy which then assigns the SNP provided by the local LRMAy and passes the information to the remote (originating) LRMAx. If the request has been accepted by the remote LRMAy, the local LRMAx assigns the SNP (for the A to Z direction of transmission), provides the Z to A SNP to the local LRMZx, communicates with the TAP to configure the policing and shaping functions. The LRMAx passes the SNP identifiers to the connection controller. If the request is denied by the remote LRMAy, the local LRMAx rejects the connection request and removes any local reservations.

– *Deletion of a connection*

  Case 1: When a request to delete a connection is received, the corresponding SNP is marked as unassigned and the corresponding resources are removed from the assigned link capacity. The associated LRMZy is informed so that it can release the SNP identifier.

  Case 2: When a request to delete a connection is received, LRMAx marks the corresponding SNP identifier as unassigned and the corresponding resources are removed from the assigned link capacity. Both the local LRMZx and the LRMZy at the far end of the link are informed. The LRMZ releases the SNP identifier. The remote LRMZy passes the request to its local LRMAy which marks the SNP identifier as unassigned and removes the resource reservation.

– *Interface to local id translation*

If required, the LRM provides the translation of an interface id to a local id. This is used, for example, if the ends of the SNPP link are in different routing areas.

• **Topology**

This function provides the link topology using the interface SNPP ids; the allocated SNP ids; assigned SNP ids; allocated capacity (packet switched only); assigned capacity (packet switched only).

It also provides link characteristics, e.g., link cost, diversity and quality. Some characteristics, for example, link cost, may vary with link utilization. The process used to modify link characteristics is controlled by a local policy.

7.3.3.2 LRMZ

Replace this clause as follows:

The LRMZ is responsible for the management of the Z end of the SNPP link as described below.

The LRMZ component interfaces are provided in Table 5 and illustrated in Figure 26.

Table 5 – LRMZ component interfaces

Input interface	Basic input parameters	Basic return parameters
SNP assignment	SNP id CIR and EIR (packet switched only)	Confirmation
SNP negotiation In (Case 2 only)	Request id List of SNP ids CIR and EIR (packet switched only)	Request id SNP id or denied
SNP unassignment	SNP id	Confirmation
Configuration	Link information	–
Translation	Local id	Interface id

Output interface	Basic output parameters	Basic return parameters
Topology	Link information	–
SNP id assignment/unassignment	(Packet switched only) SNP id	

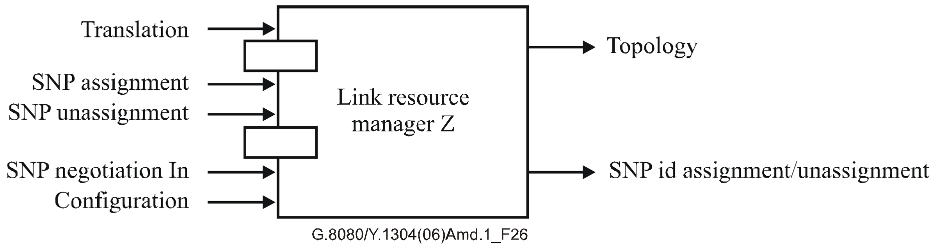


Figure 26 – Link resource manager Z component

- **Functions**

– *Assignment of SNP identifiers (case 1 only)*

When the remote LRMAx requests LRMZy to assign a SNP, LRMZy implements the request and, in the case of packet-switched networks, it also informs the TAP which configures the shaping and policing function (if required).

– *Negotiation and assignment of SNP (only used for case 2)*

- Case 2a circuit-switched networks: When a list of usable SNP ids is received from the remote LRMAx, one is selected (by the local LRMAy) and returned.
- Case 2a packet-switched networks: When a list of usable SNP ids and connection bandwidth parameters are received, the local LRMAy is informed. If sufficient capacity is available, the local LRMAy selects and returns a SNP identifier to the LRMZy. The LRMZy assigns this SNP identifier and informs the originating LRMAx. If the local LRMAy determines that the available link capacity is not sufficient, the request is denied.
- Case 2b packet-switched networks: When a SNP id and connection bandwidth parameters are received, the local LRMAy is informed. If sufficient capacity is available, the local LRMAy selects and returns a SNP identifier to the LRMZy. The LRMZy assigns the SNP identifier provided by the remote LRMAx and returns the SNP id provided by the local LRMAy to the remote (originating) LRMAx. The

originating LRMAx provides this SNP id to its local LRMZx so that it can be assigned. If the local LRMAy determines that the available link capacity is not sufficient, the request is denied.

- Case 2c packet-switched networks: When a SNP id and connection bandwidth parameters are received, the local LRMAy is informed. If sufficient capacity is available, the local LRMAy selects and returns a SNP identifier to the LRMZy. The LRMZy assigns this SNP identifier and returns it to the remote (originating) LRMAy. The originating LRMA then provides the SNP id to the local LRMZx so that it can be assigned. If the local LRMAy determines that the available link capacity is not sufficient, the request is denied.

– *Unassignment of SNP identifiers in case 1*

When the associated LRMAx indicates that a SNP has been unassigned, the corresponding SNP identifier in LRMZy is marked as available.

– *Unassignment of SNP identifier (only used for case 2)*

When the associated LRMAx indicates that a SNP has been unassigned, the SNP is marked as available. The local LRMAy is also informed.

– *Interface to local id translation (case 1 only)*

If required, the LRM provides the translation of an interface id to a local id. This is used, for example, if the ends of the SNPP link are in different routing areas.

- **Topology (case 1 only)**

This function provides the link topology using the interface SNPP ids; allocated SNP ids; assigned SNP ids; allocated capacity (packet switched only); assigned capacity (packet switched only).

7.3.5.1 Calling/called party controller

Replace Table 6 with the following updated table:

Table 6 – Calling/called party call controller component interfaces

Input interface	Basic input parameters	Basic return parameters
Call Accept	Transport Resource Identifier, VPN Transport Resource Identifier or Call Name	Confirmation or Rejection of call request
Call Release In	Transport Resource Identifier or VPN Transport Resource Identifier	Confirmation of call release
Call Modification Accept	Call Name, parameters to change	Confirmation or rejection of call modification

Output interface	Basic output parameters	Basic return parameters
Call Request	Transport Resource Identifier or VPN Transport Resource Identifier; Route (optional, for VPN only)	Confirmation or Rejection of call request
Call Release Out	Transport Resource Identifier or VPN Transport Resource Identifier	Confirmation of call release
Call Modification Request	Call Name, parameters to change	Confirmation or rejection of call modification

7.3.5.2 Network call controller

Replace the first paragraph of clause 7.3.5.2:

Network call controllers are instantiated at domain boundaries (i.e., at E-NNI reference points, where the call parameters need to be examined e.g., different administrations, different recovery domains etc.).

With:

Network call controllers are instantiated at domain boundaries (i.e., at E-NNI reference points or UNI reference points, where the call parameters need to be examined, e.g., different administrations, different recovery domains, etc.).

7.3.6 Discovery Agent (DA)

After Figure 33, add the following:

The applicability of this component to packet-switched networks is for further study.

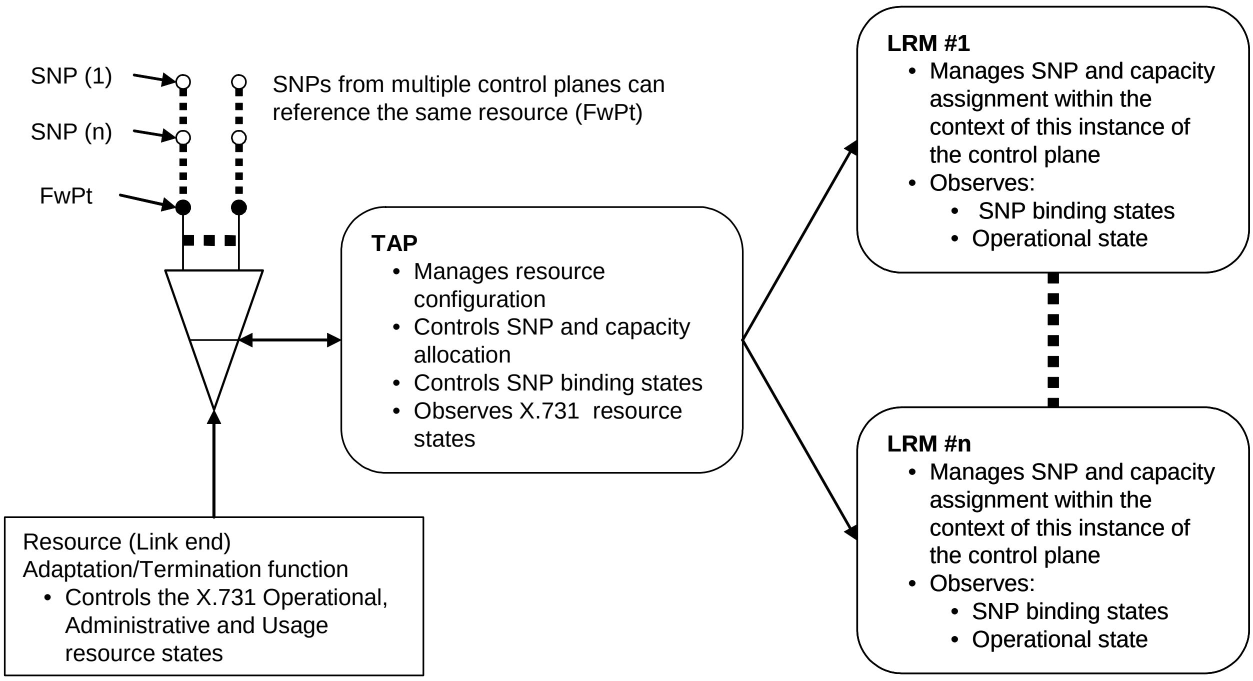
7.3.7 Termination and adaptation performers

Replace this clause as follows:

The TAP is collocated with the adaptation and termination function. It provides the control plane (the LRM) with a view of the status and utilization of the resource supporting a link, and hides any hardware and technology with a specific details of the adaptation and termination control.

7.3.7.1 TAP resource model

Only those resources that will be utilized by a control plane are made visible to the TAP. Before a resource is permanently withdrawn from the control plane, all SNPs referencing the resource must be deleted. The relationship between TAP and other components is shown in Figure 33.1.



FwPt (Forwarding Port) – The (unbound) end of a link connection. It is converted into a FwP (Forwarding Point) when it is bound to a subnetwork connection. The binding does not change the resource label.

Figure 33.1 – Relationship between TAP, LRM, and transport plane

The termination and adaptation performer (TAP) operates at two different times and provides two different functions.

When a resource is assigned to a control plane, the TAP is configured with a list of the resource identifiers, the capacity of the link resource, together with the capacity reservation policy. For a circuit-switched network, only the resource labels are configured since they carry an implicit resource capacity and reservation policy. The link resources may be shared between multiple control planes (e.g., different layer networks or different layer 1 VPNs). For each LRM that is within the scope of the TAP (i.e., references resources controlled by the TAP), the TAP is configured with the permitted bindings between the resource labels and SNPs. The TAP controls the allocation of SNP identifiers and capacity to each LRM. In the case of packet-switched networks, the TAP provides the potential and allocated capacity (EIR and CIR) to each LRM, together with the capacity assignment policy. The LRM can only assign SNP identifiers or resource capacity that has been allocated by the TAP.

The TAP makes resources visible to a LRM by binding a resource label to a SNP identifier. The existence of the SNP identifier is independent of the configuration of the resources.

In the case of a circuit-switched network, when the TAP allocates the resource to a LRM (i.e., sets the SNP binding state to allocated), it also configures those resources and creates the transport plane FwPt and link connection. This configuration action is independent of the assignment of those resources to a connection. A LRM may request the TAP to modify the list of allocated SNP identifiers (i.e., change the binding state of the SNPs to allocated from potential or from allocated to potential).

In the case of a packet-switched network, when the TAP allocates capacity and resource labels to a LRM (i.e., sets the SNP binding state to allocated), it only performs configuration required to allow those resources to be activated. When the LRM assigns a SNP to a connection, the TAP creates the FwP (i.e., it activates the binding between the SNP and the resource label), it also configures the shaping and policing functions, if required. The LRM is responsible for the assignment of the allocated capacity within the constraints of the capacity reservation policy provided by the TAP. A LRM may request the TAP to modify the allocated capacity or the list of allocated SNP identifiers (i.e., change capacity or the binding state of the SNPs to allocated from potential or from allocated to potential).

Figure 33.2 below depicts the relationships between the potential and allocated resource identifiers, or resource labels, and SNPs. Moreover, it shows that the assigned SNPs are associated with labels from the allocated label range that are configured labels, i.e., a link connection exists for those SNPs.

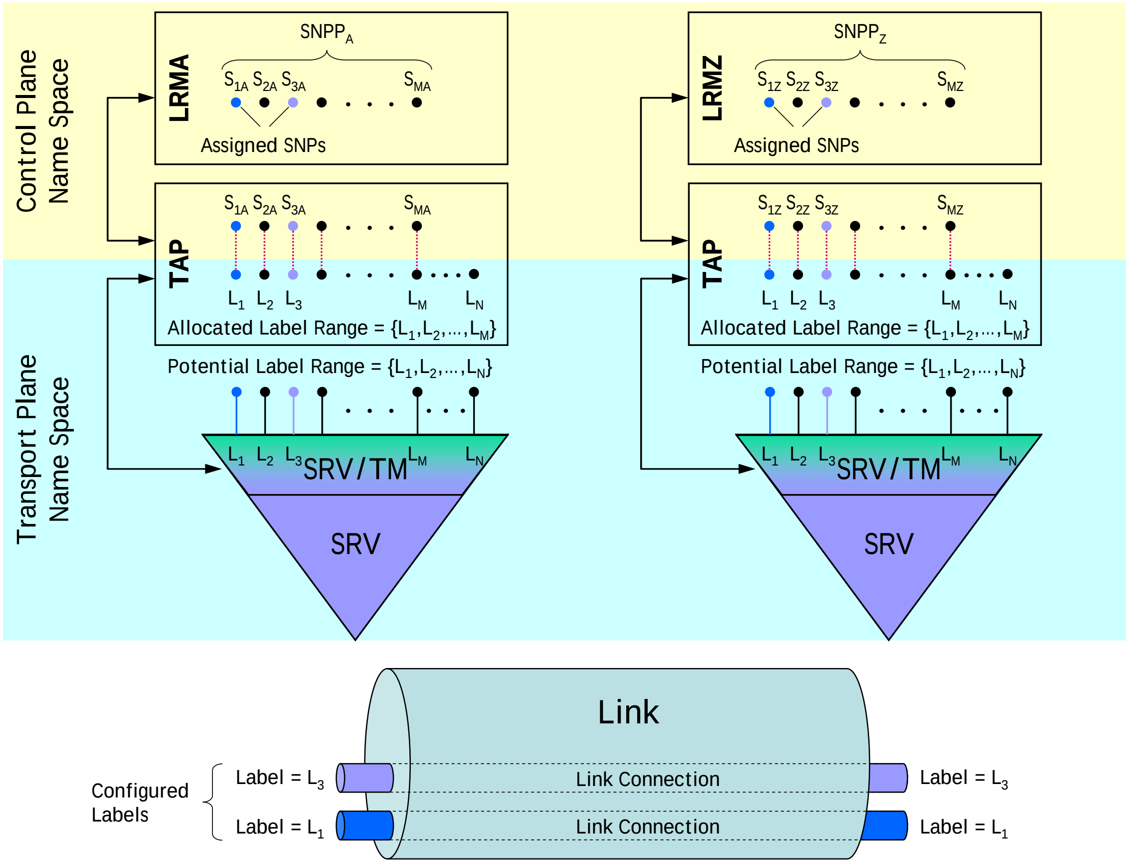


Figure 33.2 – Control plane and transport plane link resource model

The various types of resource labels are:

– **Potential (resource) label range**

The "potential label range" is the full label range of resource labels in the transport plane name space that an adaptation function supports. In packet switching layers, this range can be much larger than the allocated label range. Example: the 20-bit MPLS label provides 2^{20} = 1'048'576 possible label values including reserved labels (label values 0..15) for specific purposes.

– **Configured (resource) label**

A "configured label" is a label that has been configured in the transport plane in support of a connection. If a label is configured, a forwarding table entry exists on the receiving end of the link such that packets can be forwarded to an outgoing link if a packet is received with a label value that is equal to the configured label. If a label is configured, a packet flow can be distinguished from other flows and can be forwarded based on the label value. This is equivalent to the existence of a link connection. This means that a link connection is created whenever a label has been configured consistently on either end of a link. The deletion of the configuration entry in the transport plane also deletes the link connection.

– **Allocated (resource) label range**

The "allocated label range" is the set of labels that can be used by the adaptation function of a particular link to carry user traffic. It is a subset of the potential label range. The allocated label range must not include reserved label values. When a system uses a per platform (system) label space, each interface is typically configured with an (allocated) label range that does not overlap with the label ranges of the other interfaces, and a specific label value is selected from this label range in response to, e.g., a control plane connection request.

The allocated labels are entities that can be referenced in the transport plane name space. Each allocated label is associated with one or multiple SNP IDs that exist in the control plane name space (1:n relationship). In the simplest case, there is exactly one SNP ID per allocated label (1:1 relationship between allocated label and SNP ID). TAP holds the binding information between SNPs and an allocated label.

– **Potential SNPs**

Potential SNPs are those SNPs that are associated with a label. In general, multiple SNPs can be associated with a single label.

– **Assigned SNPs**

Assigned SNPs are those SNPs out of the set of potential SNPs that have been assigned to a particular connection. This means that the associated label is a configured label.

Figure 33.3 depicts how VPNs can be modelled. In the provided example, the allocated label range is subdivided into three sub-sets, a sub-set that can exclusively be used by VPN1, a sub-set that can exclusively be used by VPN2, and a sub-set that is shared between VPN1 and VPN2. Each label of the sub-sets for exclusive use has a single SNP associated, whereas each label of the shared sub-set is associated with two SNPs, one SNP within the scope of LRM_{VPN1} and another one SNP within the scope of LRM_{VPN2}. When an SNP is assigned, e.g., by LRM_{VPN1} that corresponds to a label from the shared label sub-set, the SNP in LRM_{VPN2} becomes busy.

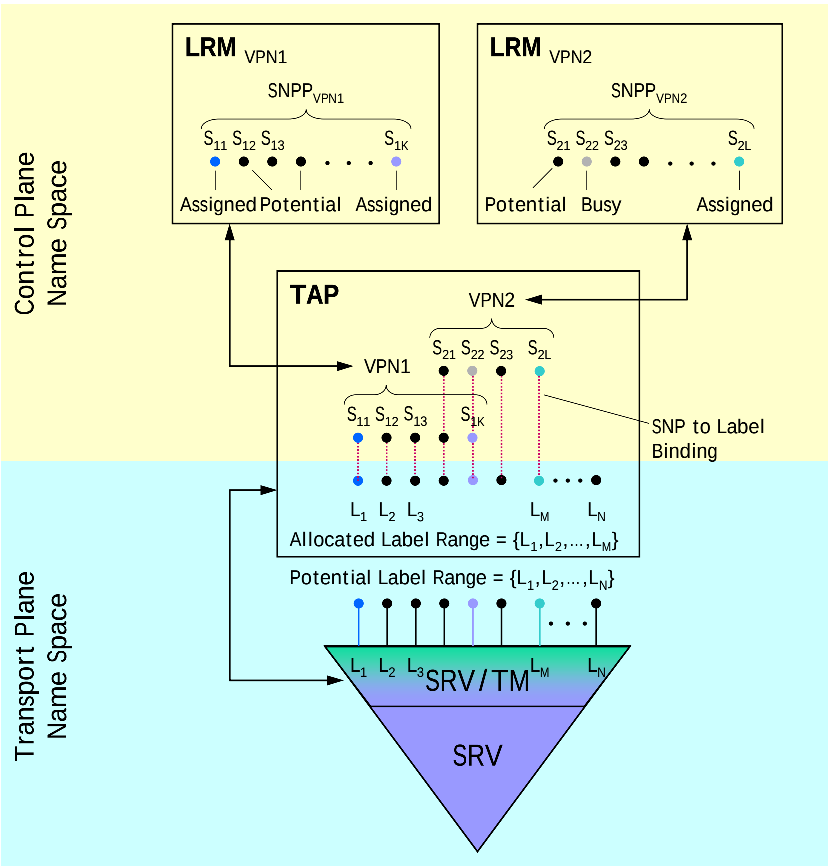


Figure 33.3 – Control plane organizational model for VPNs

7.3.7.2 TAP states

The TAP holds the SNP binding states and the capacity allocation to each LRM, and provides a specific (coordinated) view to each LRM. As described in Table 9, the SNP binding states that the TAP provides to the LRM are constrained by the administrative state of the resources.

The transport plane resources are aware, from the X.731 usage state (idle/busy), if the resources have been allocated to the TAP. The resources have no visibility of any allocation that the TAP makes to LRMs. Therefore, the resources should use the shutting down state to withdraw resources from the TAP.

The TAP uses the SNP binding states to allocate resources to LRMs. The TAP has no visibility of the assignment of those resources to connections. Therefore, the TAP should use the SNP binding state of shutting down to remove resources from the LRM.

Table 9 – SNP binding states

State	Description
Busy	Permitted binding, the resource label and capacity being referenced by the SNP is currently allocated to another control plane or the management plane
Potential	Permitted binding, currently the resource label and capacity being referenced by the SNP is not allocated to any control plane or the management plane
Allocated	Permitted binding and the resource label and capacity being referenced by the SNP has been configured for and allocated to this LRM
Shutting down	TAP notification that the resource label and capacity being referenced by the SNP must be returned within an explicit timeframe e.g.: – Immediately (interrupt the current call); – Quickly (reroute call before dropping); – Next maintenance window; – When call is dropped.

When a SNP identifier is in the Allocated state, the TAP must correctly configure the resources (e.g., variable adaptation) and set the state of any other SNPs referencing the same resource to Busy.

When SNP identifiers are bound to their corresponding FwP, the TAP is responsible for holding the SNP-FwP binding. A local TAP cooperates with a remote TAP via the LRM to coordinate any variable adaptation or other coordination required when forming the FwP link connections.

If a LRM wishes to use capacity or a SNP with a binding state of "potential" to satisfy a connection request then during connection set-up, a pair of TAPs cooperate via the LRM to coordinate any adaptation set-up, or link resource allocation, required by the link connection.

When the TAP modifies the resource capacity that is allocated to a LRM, it also makes a corresponding adjustment to the potential resource capacity.

The TAP provides SNP state information to the LRM and accepts resource state status from the (transport plane) adaptation and termination functions to ensure that the management plane indications are consistent. Management plane consistency includes ensuring that the alarm state of the link connection is consistent, so that spurious alarms are neither generated nor reported.

There are three X.731 states for transport resources:

- Operational: This state reflects the combined status of the trail supporting the link and adaptation function. It is controlled by the underlying resources and is observed by TAP.
- Administrative: This state reflects the permission to use the resource which is managed by a management interface to the TAP.

- Usage: This state reflects whether the resource is actively in use. As TAP allocates and deallocates resources to the control plane, it adjusts the usage state accordingly.

Permitted combinations of the resource states and the SNP binding state for each SNP are described in Table 9.1 below:

Table 9.1 – Resource and SPN binding states

X.731 resource states			**SNP binding states**	
Operational	**Administrative**	**Usage**	**LRM x**	**All other LRMs (Note 2)**
enabled/disabled (Note 1)	unlocked	Busy	Potential	Potential
enabled/disabled (Note 1)	unlocked	Busy	Allocated (Note 3)	Busy
enabled/disabled (Note 1)	shutting down (Note 4)	Busy	Shutting down	Busy
enabled/disabled	Locked (Note 5)	Idle	Busy (Note 6)	Busy (Note 6)

NOTE 1 – When an LRM observes that the operational state of a link is disabled, it may notify the routing controller component, it may also notify the connection controllers for the connections that are impacted. The call controller manages the recovery of any connections that are using a failed link.

NOTE 2 – If an LRM does not contain a SNP that references the same resource, then the binding state is not present.

NOTE 3 – The LRM assigns allocated SNPs and resource capacity to a connection. These assignments are not visible to the TAP.

NOTE 4 – If the resource administrative state is changed from unlocked to shutting down, then the TAP must change the binding state of any allocated SNPs that are referencing that resource to shutting down.

NOTE 5 – If the resource administrative state is set to locked, then the TAP must set the SNP binding state to busy.

NOTE 6 – This combination occurs when the resource is allocated to the management plane or when the resource is being withdrawn from the control plane. The management plane will operate directly on the transport plane resources. Changes to the X.731 states will not be visible to the TAP during this time.

7.3.7.3 Adding/removing resources from a control plane

The resource administrative and usage states may be used to control the addition or withdrawal of a resource from the control plane. This is illustrated in the administrative state transition diagram in Figure 33.4.

This is visible to TAP and is the X.731 resource state.

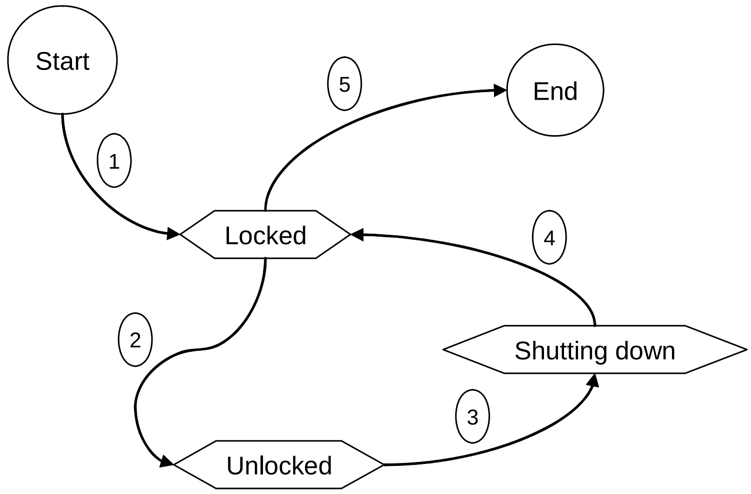


Figure 33.4 – Resource administrative state

Transition descriptions:

Transition	Description	Interface
1	Resource is made visible to the TAP	MI, usage update
2	TAP is permitted to use the resource The usage state is set to Busy	Resource state
3	The resource is being withdrawn	Resource state
4	TAP has set the binding state of all SNPs that reference the resource to busy	Usage update
5	Resource is withdrawn from the control plane: If the withdrawal is permanent, then the TAP is instructed via the MI to delete all SNPs that referenced the resource	Resource state

The MI, or Management Interface, for TAP is any of the management interfaces assumed for any ASON component as shown in Figure 18.

7.3.7.4 SNPx binding state transitions per LRM

Figure 33.5 shows the SNP binding state held by an LRM. This is the view that the TAP provides to each LRM based on the X.731 state of the resources. Operations on the TAP affect each LRMs' SNP binding state view.

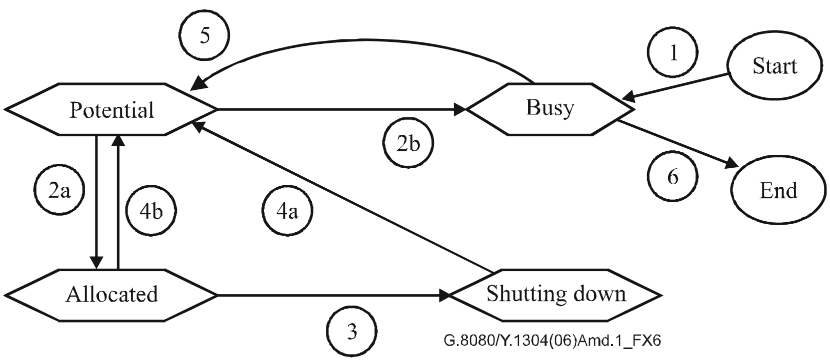


Figure 33.5 – SNP binding state in LRM

Transition descriptions:

Transition	Description	Interface
1	TAP adds SNP in the scope of the LRM	Add SNP
2a	TAP allocates resource to an LRM	SNP binding state; SNP operational state
2b	TAP sets the SNP binding state to busy when: a) The TAP has allocated the resource to another LRM; or b) The administrative state of the resource has been set to shutting down	SNP binding state
3	TAP requests return of a resource	SNP binding state
4a	LRM is no longer using the resource TAP modifies states to potential	Release SNP
4b	LRM is no longer using the resource TAP modifies states to potential	Release SNP
5	TAP moves resource to potential since it is: a) No longer allocated; or; b) The administrative state has been set to unlocked	SNP binding state
6	SNP is removed from the scope of the LRM.	Withdraw SNP

7.3.7.5 TAP component interfaces

Table 10 – Termination and adaptation performer (TAP) component interface

Input interface	Basic input parameters	Basic return parameters
Operational state	Enabled, disabled:	Confirm
Administrative state	Locked, unlocked; shutting down	Confirm for Locked, Unlocked. User Quit for Shutting Down
SNP id assigned/unassigned (packet switched only)	SNP id (From LRM) CIR and EIR	
Capacity change request	List of SNP ids CIR and EIR (packet switched only)	Link configuration

Output interface	Basic output parameters	Basic return parameters
Control	Hardware specific	Hardware specific
(Link) Configuration	List of SNP ids CIR and EIR, capacity assignment policy (packet switched only)	confirm
Capacity change (packet switched only)	CIR EIR	Confirm
SNPx binding state	Busy, Potential, Allocated, Shutting down	Resource released (in response to the shutting down state)
SNPx operational state	Enabled, disabled	Confirm
Add SNP	List of SNP identifiers	Confirm
Withdraw SNP	List of SNP identifiers	Confirm
Usage update	New user, User quit	Usage state (idle, busy)

Operational state: This interface accepts resource state information from transport plane adaptation and termination functions.

Administrative state: This interface accepts administrative state from the MI.

SNP id assigned/unassigned: This interface receives notification of SNP binding actions from LRM.

Capacity change request: This interface receives requests from LRM to change the capacity of packet resources associated with its assigned SNPs.

Control: This hardware specific interface allows the TAP to communicate with the resources that it controls.

Configuration: This interface allows the TAP to provide the link end configuration information to a LRM.

Capacity change: This interface is used by the TAP to advise the LRM if the capacity of the link has been modified. This interface is only used for packet switching.

SNPx binding state: SNP binding state is sent to an LRM.

SNPx operational state: SNP operational state is sent to an LRM

Add SNP: This interface is used to inform an LRM of a new SNP.

Withdraw SNP: This interface is used to inform an LRM of the removal of an SNP.

Usage update: This interface provides resource state usage information to transport plane adaptation and termination functions.

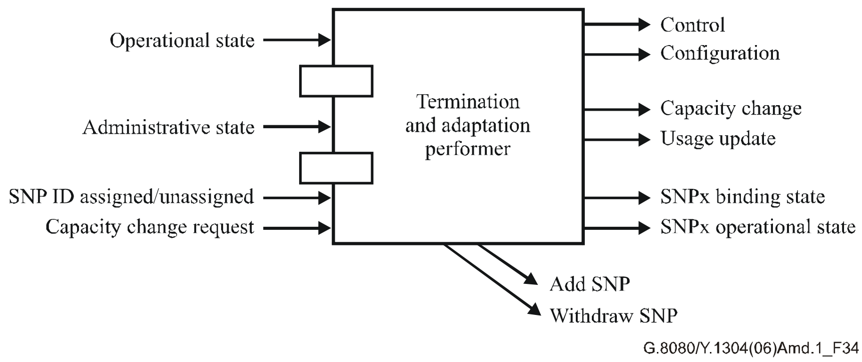


Figure 34 – Termination and adaptation performer component

7.3.8 Link discovery process

Replace the penultimate paragraph:

In order to assign an SNP-SNP link connection to an SNPP link, it is only necessary for the transport name for the link connection to exist. Thus it is possible to assign link connections to the control plane without the link connection being physically connected. This assignment procedure may be verified by the LRMs exchanging the Transport link name that corresponds to the SNP.

With:

In order to assign an SNP-SNP link connection to an SNPP link, it is only necessary for the transport name for the link connection to exist. Thus it is possible to assign link connections to the control plane without the link connection being physically connected. This assignment procedure may be verified by the LRMs exchanging the Transport link connection name (i.e., CP-CP name or TCP-TCP name) that corresponds to the SNP.

9 Network management of control plane entities

Replace this clause with the following text.

There is interaction between the control plane and management plane as described in clause 5. Management of the control plane is specified in [ITU-T G.7718].

Bilbliography

Add the following to the bibliography:

[b-ITU-T G.8110.1] Recommendation ITU-T G.8110.1/Y.1370.1 (2006), *Architecture of Transport MPLS (T-MPLS) layer network*.

[b-ITU-T X.731] Recommendation ITU-T X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology – Open Systems Interconnection – Systems management: State management function*.

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Printed in Switzerland
Geneva, 2009