The ATM Forum

Technical Committee

# M4 Network-View Requirements and Logical MIB Addendum

af-nm-0074-000

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# M4 Network-View Requirements and Logical MIB



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# 1. Introduction

This addendum provides the proposed improvements to the M4 network-level protocol-independent MIB (AF-NM-0058.000), following the creation of a full M4 network-level CMIP MIB. These improvements are published as an addendum to the existing specification, by referencing the affected section or managed entity. These improvements are as follows:

1. topologicalLink and topologicalLinkTP additions/modifications:
    - Multiple server trail support.
    - Restoration support through the restorationMode attribute.
    - Support of VCI/VPI ranges and bandwidth allocation through the atmNetworkAccessProfile managed entity.
    - Single link setup operation.
    - Split of bandwidth attributes between Egress and Ingress.
2. Subnetwork creation modification:
    - Creation of subnetwork by the managing system.
3. networkTTP and CTP additions/modifications:
    - Addition of a Traffic Descriptor Profile managed entity.
    - Addition of an attribute linking the networkTTP and CTP to the NE ones and explicit association of CTPs to TTPs.
4. connection management additions/modifications:
    - Deferral of a connection setup supported through the atmTrailRequest object.
    - Explicit support of routing through the atmRoutingProfile object.
    - Restriction on “modify” operations to the characteristics of a connection only, and not to the identities of the end points (vpi/vci values).
    - Support of multipoint subnetworkConnections and trails.
    - Addition of the “retainedResourcePackage” attribute to tag what resources to retain if release action indicates resource retention.

# 2. topologicalLink and topologicalLinkTP Addition/Modifications

## 2.1 Multiple Server Trail Support

The proposed M4 network-level CMIP MIB supports links over multiple underlying Trail Termination Points. This capability is not clearly expressed in the M4 protocol-independent MIB and aligns the link concept in M4 to the link concept in ITU-T (e.g. in ITU G.85x series). Therefore, the following clarification to the existing text are necessary:

**In the vc/vpTopologicalLinkTP:**

**Relationships**

**For vcTopologicalLinkTP:**

Change the relationship with *underlyingTTPs* to:

*With serverTTPs*: Each vcTopologicalLinkTPs may be supported by one or more instance of a TTP managed entity in the serverLayer (vpNetworkTTPBidirectional for a vcLinkTP or where the NE view is supported along with the network-view, a vpBidirectionalTTP for a vcLinkTP).

*semi-formal representation modification for vcTopologicalLinkTP:*

**CHANGE FROM:**

IS_ASSOCIATED_WITH (1) vpTTPBidirectional

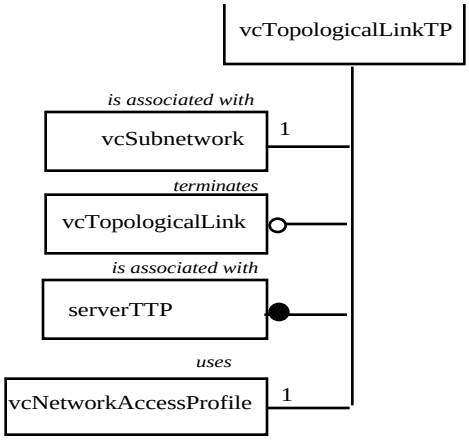
**TO:**

IS_ASSOCIATED_WITH (0..*) serverTTP

**REMOVE** the relationship: GROUPS (0..*) vcSnTP, which is covered by the *VPI or VCI Range* attribute in the vcNetworkAccessProfile.

*graphical representation:*

**CHANGE TO:**



Note that the vcNetworkAccessProfile managed entity is described below.

**For vpTopologicalLinkTP:**

Change the relationship with *underlyingTTPs* to:

*With serverTTPs*: Each vpTopologicalLinkTPs may be supported by one or more instance of a TTP managed entity in the serverLayer (a Transport network-level server TTP for a vpLinkTP or where the NE view is supported along with the network-view, a tcAdaptorTTPBidirectional for a vpLinkTP).

*semi-formal representation modification for vpTopologicalLinkTP:*

**CHANGE FROM:**

IS_ASSOCIATED_WITH (1) tcAdaptorTTPBidirectional

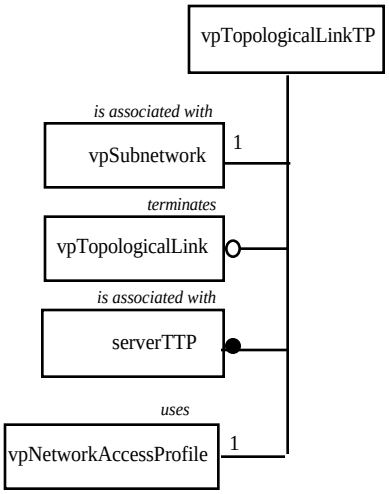
**TO:**

IS_ASSOCIATED_WITH (0..*) serverTTP

**REMOVE** the relationship: GROUPS (0..*) vpSnTP, which is covered by the *VPI or VCI Range* attribute in the vpNetworkAccessProfile.

*graphical representation:*

**CHANGE TO:**




Note that the vpNetworkAccessProfile managed entity is described below.

## 2.2 Restoration Mode

### 2.2.1 Additions to link and linkTP

Add to the vpTopologicalLink and vcTopologicalLink managed entities the following attribute:

*restorationMode:* This read/write attribute is used to configure the restoration mode of a link as: unavailable for routing and re-routing, available for routing and not re-routing; available for re-routing and not routing; or available for both routing and rerouting.

Add to the requirement section 4.1.1.2:

**(R-4.1.1.2)-cm-4:** The M4 interface shall support requests to configure the restoration mode of a link as: unavailable for routing and re-routing, available for routing and not re-routing; available for re-routing and not routing; or available for both routing and rerouting.

### 2.2.2 Additions to subnetworkConnection, and trail

In the subnetworkConnection, and trail managed entities, add the following attribute to mark them as restorable:

*restorableIndicator:* This read/write attribute is used to configure the entity as restorable or non-restorable.

## 2.3 vc and vpNetworkAccessProfile

Add the following Managed Entities:

**vcNetworkAccessProfile**

The vcNetworkAccessProfile managed entity contains information that describe the maximum ingress and egress bandwidth, along with the VCI values that are applies to the vcLink or the vcLinkTP instances that point to it.

This managed entity is created by the managing system.

**Attributes**

*vcNetworkAccessProfile ID:* This read-only attribute provides a unique name for the managed entity instance.

*total Egress Bandwidth:* This read/write attribute identifies the maximum egress bandwidth for a link or a linkTP.

*total Ingress Bandwidth:* This read/write attribute identifies the maximum ingress bandwidth for a link or a linkTP.

*maximum Number of Active Connection Allowed:* This read/write attribute identifies the maximum number of concurrently active VP (for a vpLayerNetworkDomain) or VC (for a vcLayerNetworkDomain) connections that a link or a linkTP may support.

*VPI or VCI ID Range:* This read/write attribute describes the virtual ID range (VCIs in the vcLayerNetworkDomain or VPIs in the vpLayerNetworkDomain) that may be used for linkConnections associated with a link.

**Notifications**

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

**Relationships:**

None originating from this managed entity.

**Operations:**

None beyond the setting and querying of the read/write attributes.

### vpNetworkAccessProfile

The vpNetworkAccessProfile managed entity contains information that describe the maximum ingress and egress bandwidth, along with the VPI values that are applies to the vpLink or the vpLinkTP instances that point to it.

This managed entity is created by the managing system.

### Attributes

*vpNetworkAccessProfile ID:* This read-only attribute provides a unique name for the managed entity instance.

*total Egress Bandwidth:* This read/write attribute identifies the maximum egress bandwidth for a link or a linkTP.

*total Ingress Bandwidth:* This read/write attribute identifies the maximum ingress bandwidth for a link or a linkTP.

*maximum Number of Active Connection Allowed:* This read/write attribute identifies the maximum number of concurrently active VP (for a vpLayerNetworkDomain) or VC (for a vcLayerNetworkDomain) connections that a link or a linkTP may support.

*VPI Range:* This read/write attribute describes the virtual ID range (VPIs) that may be used for linkConnections associated with a link.

### Notifications

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

### Relationships:

None originating from this managed entity.

### Operations:

None beyond the setting and querying of the read/write attributes.

**Additional relationship for the link and linkTP objects:**

**In the vcTopologicalLinkTP and the vpTopologicalLinkTP:**

add the relationship with *vc/vpNetworkAccessProfile*:

*With vc/vpNetworkAccessProfile*: Each vcTopologicalLinkTP may use one atmNetworkAccessProfile. Note that multiple server trails are supported, the vci or vpi range attribute of the access profile does not apply.

*semi-formal representation modification for vc/vpTopologicalLinkTP:*

*Semi-formal representation:*

USES (1) vc/vpNetworkAccessProfile

*graphical representation:* See above

**In the vcTopologicalLink and the vpTopologicalLink:**

add the relationship with *vc/vpNetworkAccessProfile*:

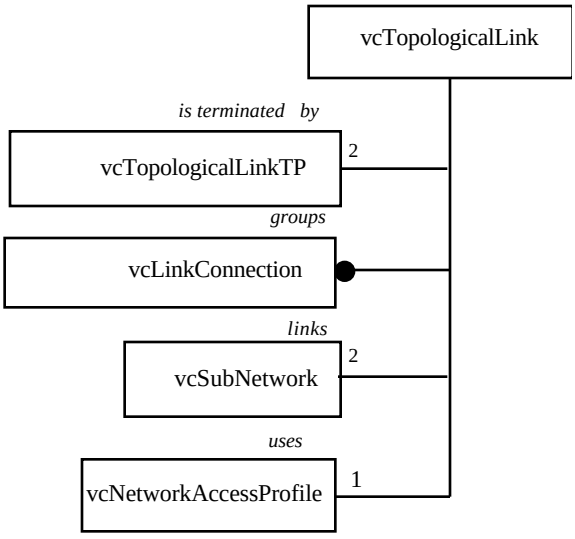
*With vc/vpNetworkAccessProfile*: Each vcTopologicalLinkTP may use one atmNetworkAccessProfile.

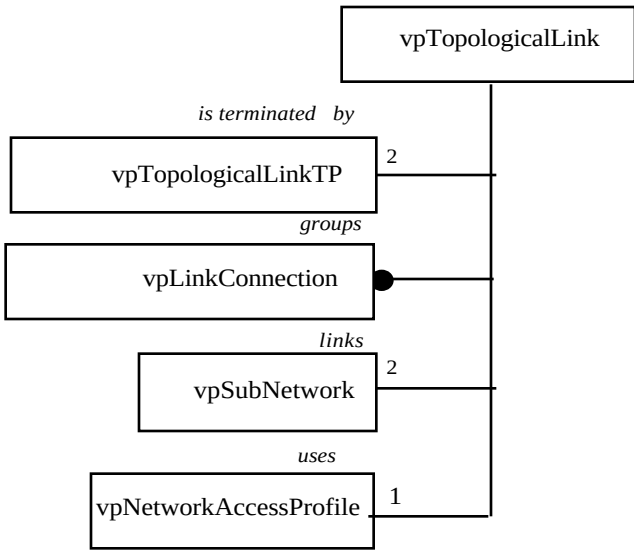
*semi-formal representation modification for vc/vpTopologicalLinkTP:*

*Semi-formal representation:*

USES (1) vc/vpNetworkAccessProfile

*graphical representations (VC and VP):*




vpTopologicalLink
is terminated by
vpTopologicalLinkTP
2
groups
vpLinkConnection
links
vpSubNetwork
2
uses
vpNetworkAccessProfile
1

## 2.4 Single Link Set-Up Operation

Add the operation “set up Link” to the vc and vp LayerNetworkDomain managed entities.

**layerNetworkDomain: link Management Operations:**

**Operation:** Setup Link

INPUT PARAMETERS:

see Section 5.1.2, and
linkTPa : choice of linkTPId, or linkDetails
linkTPz : choice of linkTPId, or linkDetails

linkDetail:
- ingressBandwitdth
- egressBandwidth
- interfaceId
- choice of atmNetworkAccessProfileID or profileDetails

ProfileDetails:
- vpiOrVciRange,
- maxNumActiveVPCAllowed,
- maxEgressBandwitdth,
- maxIngressBandwidth,
- maxNumActiveVCCAllowed

OUTPUT PARAMETERS:

newLink : linkId
linkTPa: linkTPId
linkTPz: linkTPId
atmNetworkAccessProfileA: atmNetworkAccessProfileId
atmNetworkAccessProfileZ: atmNetworkAccessProfileId

ERROR CONDITIONS:

protocol-specific addressing errors
incorrectTerminationPoints : linkTPId
linkTerminationPointConnected : linkTPId
non-matchingDetails(profile or link): set of linkTPId, interfaceId, or atmProfileId
operationFails

BEHAVIOUR:

This operation sets up a point-to-point link between two component subnetworks or Nes in the atmSubnetwork. The linkTPs are identified either directly or indirectly with an interface identifier, available bandwidth, and an atmAccessProfile identifier, or a set of descriptors providing VPI/VCI range, etc. This approach allows to create the linkTPs at the same time if needed. An error condition is raised if the link termination points are incorrect, already used, do not have matching range or bandwidth, or if the interface is unable to provide sufficient bandwidth.

## 2.5 Split of Bandwidth Attributes between Egress and Ingress

Modify the linkTP Managed Entity by replacing the bandwidth attributes as follows:

*Egress Maximum Assignable Bandwidth:* This read/write attribute identifies the maximum amount of bandwidth assignable on the link in the Egress direction (outbound or away from the ATM NE).

*Ingress Maximum Assignable Bandwidth:* This read/write attribute identifies the maximum amount of bandwidth assignable on the link in the Egress direction (inbound or towards the ATM NE).

*Egress available Bandwidth:* This read-only attribute identifies the amount of bandwidth left on the link in the Egress direction (outbound or away from the ATM NE).

*Ingress available Bandwidth:* This read-only attribute identifies the amount of bandwidth left on the link in the Egress direction (inbound or towards the ATM NE).

Remove the two attributes in the link managed entity, to avoid duplication between managed entity of the same attributes and consistency issues.

# 3. Subnetwork Creation/Modification

Subnetwork can be created by the managing system.

- Change the introduction of Section 4.1.1.1 to:

A subnetwork can be created automatically at the installation of the network or subnetwork management system which is going to manage it. Adding or removing a subnetwork is not precluded, but is not supported in this phase of the specification. In addition, subnetworks can be created by the managing system.

- Add the following requirement to Section 4.1.1.1:

**(R-4.1.1.1)-cm-10:** The M4 interface shall support requests to create and delete subnetworks, except for the top subnetwork contained in the layerNetworkDomains. No subnetwork shall be deleted if it contains subnetworkConnections.

- Remove the last sentence of the vp and vcSubnetwork managed entity introductions, which indicates support only for automatic creation.

# 4. networkTTP and CTP additions/modifications

## 4.1 Addition of the trafficDescriptorProfile

**trafficDescriptorProfile**

The atmTrafficDescriptorProfile contains information that describes the ingress and egress Peak Cell Rate, ingress and egress CDV Tolerance, ingress and egress substainable cell rate, and ingress and egress Maximum Burst Size.

**Attributes**

*trafficDescriptorProfile ID:* This read-only attribute provides a unique name for the managed entity instance within the management domain.

*Traffic Descriptors:* This read/write attribute identifies values for the following traffic descriptors:

- Ingress and Egress Peak Cell Rate for CLP=0+1 Traffic
- Ingress and Egress Peak Cell Rate for CLP=0 Traffic (Optional)
- Ingress and Egress CDV Tolerance for CLP=0+1 Traffic
- Ingress and Egress CDV Tolerance for CLP=0 Traffic (Optional)
- Ingress and Egress Sustainable Cell Rate for CLP=0 and CLP=0+1 Traffic (Optional)
- Ingress and Egress Burst Tolerance for CLP=0 and CLP=0+1 Traffic (Optional)

*QOS Class:* This read/write attribute identifies the QOS class assigned to the VC connection.

**Notifications**

*Attribute Value Change:* This notification is used to report changes of the user label.

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

**Relationships:**

None initiated from this Managed Entity.

**trafficDescriptorProfile Operations:**

None besides the read/write on attributes.

## 4.2 Modification of the network CTPs and TTPs

Replace the vcCTP, vcTTP, vpCTP, and vpTTP managed entity descriptions in the AF-00058 by the following descriptions.

### vcNetworkCTP

This managed entity is used to represent the termination of VC connections on an ATM subnetwork. An instance of the vcSubnetworkConnection or of an vcLinkConnection managed entity may be used to relate two instances of the VC Network Connection Termination Point managed entity (i.e., for point-to-point cross connection).

Instances of this managed entity may be created automatically by the subnetwork, as a result of a connection (link or subnetwork) being created, or explicitly by the management system. Similarly, instances of this managed entity may be deleted automatically by the subnetwork, as a result of a connection release request, or explicitly by the management system.

### Attributes

*vcCTP ID:* This read-only attribute provides a unique name for the managed entity instance in the subnetwork.

*VCI Value:* This read-only attribute identifies the VCI value associated with the VC connection being terminated.

*User Label:* This read/write attribute identifies the customer to which the service is delivered.

### Notifications

*Alarm:* This message is used to notify the management system when a failure has been detected or cleared. The following parameters shall be supplied with this notification:

- The Nature of the Alarm (i.e., see generic trouble list)
- Specific Problems (optional)
- The ID of the Managed Entity Reporting the Alarm
- The Failed Switch Component or List of Failed (or Possibly Failed) Components
- Back-up Status (optional)
  This is a Boolean indication as to whether or not the failed entity has been backed-up.
- Back-up Entity (optional)
  This is the ID of the managed entity providing back-up services to the failed entity. This parameter shall be NULL when the value of the "Back-up Status" parameter is *false*.
- Severity of Failure (critical, major, minor, warning, indeterminate, and cleared)
- Additional Information (optional)
- Proposed Repair Actions (optional)
- Time and Date Failure was Detected

*Attribute Value Change:* This notification is used to report changes to the attributes of this managed entity. The notification shall identify the attribute that changed, its old value, and its new value.

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

### Relationships

.
*With vcNetworkTTP*: Zero or one instance of the vcNetworkTTP managed entity may exist for each instance of a vcCTP managed entity.

*With subnetworkTerminationPoint*: Zero or more of the vcNetworkCTP managed entity may exist for each instance of a subnetworkTP managed entity.

*With trafficDescriptorProfile:* Zero or one instance of the vcNetworkTTP may characterize the CTP.

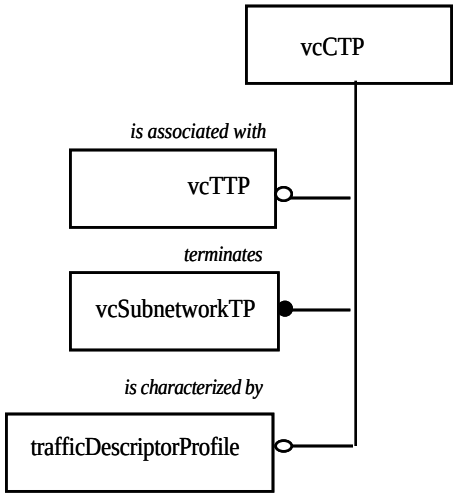
*Semi-formal representation:*

IS_ASSOCIATED_WITH (0..1) vcNetworkTTP

SUPPORTS (0..*) vcSubnetworkTP

IS_CHARACTERIZED_BY (0..1) trafficDescriptorProfile

*Graphical representation:*




**vcNetworkCTP: vcNetworkCTP Query/Association Operations**

**Operation:** associate vcNetworkCTP with vcNetworkTTP

INPUT PARAMETERS:
none (see Section 5.1.2)
associatedVcNetworkCTP: vcNetworkCTPId
OUTPUT PARAMETERS:
associatedVcNetworkTTP : vcNetworkTTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vcNetworkCTP can be associated with zero or one vcNetworkTTP. This operation allows the requester (client) to associate a vcNetworkCTP to a given vcNetworkTTP. The reply is a vcNetworkTTPId.

**Operation:** query vcNetworkCTP for associated vcNetworkTTP

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
associatedVcNetworkTTP : vcNetworkTTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vcNetworkCTP can be associated with zero or one vcNetworkTTP. This operation allows the requester (client) to query the associated vcNetworkTTP for a given vcNetworkCTP. It does not affect the relationship. It matches for the associated vcNetworkTTP. The reply is a vcNetworkTTPId.

**Operation:** query vcNetworkCTP for associated subnetworkTP

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
associatedSubnetworkTP : subnetworkTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vcNetworkCTP is associated with zero or one subnetworkTP. This operation allows the requester (client) to query the associated subnetworkTP for a given vcNetworkCTP. It does not affect the relationship. It matches for the associated subnetworkTP. The reply is a subnetworkTPId.

### vcConnectionTerminationPoint: vcConnectionTerminationPoint Loopback Operation

**Operation:** loopback vcTrail at vcNetworkCTP

INPUT PARAMETERS:
none (see Section 5.1.2)
loopbackType: end-to-end, segment
loopbackLocation: interfaceId
OUTPUT PARAMETERS:
loopbackResults: passed or failed
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR

This operation is used to request that the vcCTP insert a loopback OAM cell into the ATM cell stream, verify its return, and report the results of the loopback (i.e., passed or failed) back to the management system. Along with each request will be the location where the inserted OAM cell shall loop-back and an indication as to whether a segment or end-to-end OAM cell shall be used. The Loopback Location Code which indicates where the loopback is to take place may be used to identify the loopback location. Additionally, a globally unique default value (e.g., "end-point") may also be used to perform a loopback at the other end of a vcTrail.

### vcNetworkTTP

This managed entity represents the point in the ATM subnetwork where the VC Trail and associated overhead (F5 OAM cells) are terminated/originated. Management systems shall configure/remove VC Trail Terminations in the ATM subnetwork by creating/deleting instances of this managed entity.

Managed entities that represent AAL functions performed above VC Trail termination points are for further study.

### Attributes

*vcTTP ID:* This read-only attribute provides a unique name for the managed entity instance in the ATM subnetwork.

*availability Status:* This read-only attribute identifies whether or not the managed entity is capable of performing its normal functions (Failed or no unavailability condition existing).

### Notifications

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

*Attribute Value Change Notification:* This notification is used to report changes to the availability status attribute of this managed entity.

### Relationships

*With vcNetworkCTPs*: Zero or one instance of the VC Trail Termination managed entity may exist for each instance of a vcNetworkCTP managed entity.

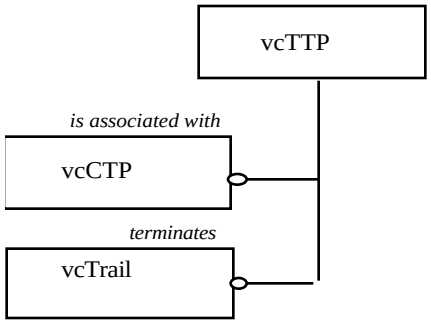
*With vcTrail*: A vcTrail is terminated by two vcTTPs.

*Semi-formal representation:*

IS_ASSOCIATED_WITH (0..1) vcCTP

TERMINATES (0..1) vcTrail

*Graphical representation:*



### vcNetworkTTP: vcNetworkTTP Query Operations

**Operation:** query vcNetworkTTP for associated vcNetworkCTP

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
associatedVcCTP : vcCTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vcNetworkTTP is associated with zero or one vcCTP. This operation allows the requester (client) to query the associated vcNetworkCTP. It does not affect the relationship. It matches for the associated vcNetworkCTP. The reply is a vcNetworkCTPId.

**Operation:** query vcTTP For terminated vcTrail

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
terminatedTrail: vcTrailId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR

An vcTrail is terminated on two vcTTPs. This operation allows the requester (client) to query the terminated vcTrail. It does not affect the relationship. It matches for the associated vcTrail. The reply is a vcTrailId.

### vcNetworkTTP: vcNetworkTTP Loopback Operation

**Operation:** loopback vcTrail at vcTTP

INPUT PARAMETERS:
see Section 5.1.2, and
loopbackType: end-to-end, segment
loopbackLocation: interfaceId
OUTPUT PARAMETERS:
loopbackResults: passed or failed
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR

This operation is used to request that the vcTTP insert a loopback OAM cell into the ATM cell stream, verify its return, and report the results of the loopback (i.e., passed or failed) back to the management system. Along with each request will be the location where the inserted OAM cell shall loop-back and an indication as to whether a segment or end-to-end OAM cell shall be used. The Loopback Location Code attribute value of the UNI, interNNI, or intraNNI where the loopback is to take place may be used to identify the loopback location. Additionally, a globally unique default value (e.g., "end-point") may also be used to perform a loopback at the other end of a vcTrail.

### vpNetworkCTP

This managed entity is used to represent the termination of VP connections on an ATM subnetwork. An instance of the vpSubnetworkConnection or of an vpLinkConnection managed entity may be used to relate two instances of the VP Network Connection Termination Point managed entity (i.e., for point-to-point cross connection).

Instances of this managed entity may be created automatically by the subnetwork, as a result of a connection (link or subnetwork) being created, or explicitly by the management system. Similarly, instances of this managed entity may be deleted automatically by the subnetwork, as a result of a connection release request, or explicitly by the management system.

#### Attributes

*vpCTP ID:* This read-only attribute provides a unique name for the managed entity instance in the subnetwork.

*VPI Value:* This read-only attribute identifies the VCI value associated with the VC connection being terminated.

*User Label:* This read/write attribute identifies the customer to which the service is delivered.

#### Notifications

*Alarm:* This message is used to notify the management system when a failure has been detected or cleared. The following parameters shall be supplied with this notification:

- The Nature of the Alarm (i.e., see generic trouble list)
- Specific Problems (optional)
- The ID of the Managed Entity Reporting the Alarm
- The Failed Switch Component or List of Failed (or Possibly Failed) Components
- Back-up Status (optional)
  This is a Boolean indication as to whether or not the failed entity has been backed-up.
- Back-up Entity (optional)
  This is the ID of the managed entity providing back-up services to the failed entity. This parameter shall be NULL when the value of the "Back-up Status" parameter is *false*.
- Severity of Failure (critical, major, minor, warning, indeterminate, and cleared)
- Additional Information (optional)
- Proposed Repair Actions (optional)
- Time and Date Failure was Detected

*Attribute Value Change:* This notification is used to report changes to the attributes of this managed entity. The notification shall identify the attribute that changed, its old value, and its new value.

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

#### Relationships

*With vpNetworkTTP*: Zero or one instance of the vpNetworkTTP managed entity may exist for each instance of a vpCTP managed entity.

*With subnetworkTerminationPoint*: Zero or more of the vpNetworkCTP managed entity may exist for each instance of a subnetworkTP managed entity.

*With trafficDescriptorProfile:* Zero or one instance of the vpNetworkTTP may characterize the CTP.

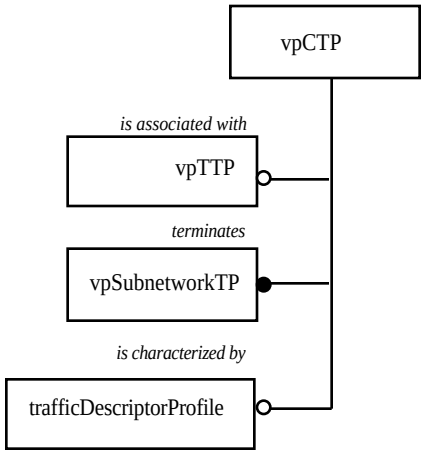
*Semi-formal representation:*

IS_ASSOCIATED_WITH (0..1) vpNetworkTTP

SUPPORTS (0..*) vpSubnetworkTP

IS_CHARACTERIZED_BY (0..1) trafficDescriptorProfile

*Graphical representation:*




**vpConnectionTerminationPoint: vcConnectionTerminationPoint Query/Association Operations**

**Operation:** associate vpNetworkCTP with vpNetworkTTP

INPUT PARAMETERS:
none (see Section 5.1.2)
associatedVpTTP: vpTTPId
OUTPUT PARAMETERS:
associatedVpTTP : vpTTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vpNetworkCTP can be associated with zero or one vpNetworkTTP. This operation allows the requester (client) to associate a vpCTP to a given vpTTP. The reply is a vpTTPId.

**Operation:** query vpNetworkCTP for associated vpNetworkTTP

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
associatedVpTTP : vpTTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vpNetworkCTP can be associated with zero or one vpNetworkTTP. This operation allows the requester (client) to query the associated vpNetworkTTP for a given vpNetworkCTP. It does not affect the relationship. It matches for the associated vpNetworkTTP. The reply is a vpNetworkTTPId.

**Operation:** query vpNetworkCTP for associated subnetworkTP

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
associatedSubnetworkTP : subnetworkTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vpNetworkCTP is associated with zero or one subnetworkTP. This operation allows the requester (client) to query the associated subnetworkTP for a given vpNetworkCTP. It does not affect the relationship. It matches for the associated subnetworkTP. The reply is a subnetworkTPId.

### vpNetworkCTP: vpNetworkCTP Loopback Operation

**Operation:** loopback vpTrail at vpNetworkCTP

INPUT PARAMETERS:
none (see Section 5.1.2)
loopbackType: end-to-end, segment
loopbackLocation: interfaceId
OUTPUT PARAMETERS:
loopbackResults: passed or failed
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR

This operation is used to request that the vpNetworkCTP insert a loopback OAM cell into the ATM cell stream, verify its return, and report the results of the loopback (i.e., passed or failed) back to the management system. Along with each request will be the location where the inserted OAM cell shall loop-back and an indication as to whether a segment or end-to-end OAM cell shall be used. The Loopback Location Code which indicates where the loopback is to take place may be used to identify the loopback location. Additionally, a globally unique default value (e.g., "end-point") may also be used to perform a loopback at the other end of a vcTrail.

### vpNetworkTTP

This managed entity represents the point in the ATM subnetwork where the VP Trail and associated overhead (F4 OAM cells) are terminated/originated. Management systems shall configure/remove VP Trail Terminations in the ATM subnetwork by creating/deleting instances of this managed entity.

#### Attributes

*VP TTP ID:* This read-only attribute provides a unique name for the managed entity instance in the ATM subnetwork.

*availability Status:* This read-only attribute identifies whether or not the managed entity is capable of performing its normal functions (Failed or no unavailability condition existing).

#### Notifications

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

*Attribute Value Change Notification:* This notification is used to report changes to the availability status attribute of this managed entity.

#### Relationships

*With vpNetworkCTPs*: Zero or one instance of the VP Trail Termination managed entity may exist for each instance of a vcNetworkCTP managed entity.

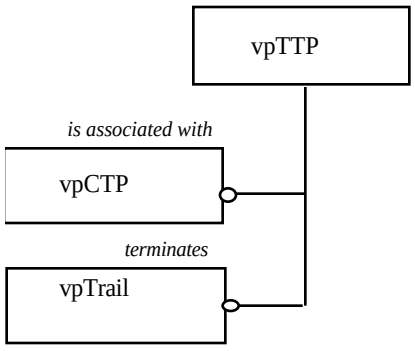
*With vpTrail*: A vcTrail is terminated by two vpTTPs.

*Semi-formal representation:*

IS_ASSOCIATED_WITH (0..1) vpNetworkCTP

TERMINATES (0..1) vpTrail

*Graphical representation:*




### vpNetworkTTP: vpNetworkTTP Query Operations

**Operation:** query vpNetworkTTP for associated vpNetworkCTP

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
associatedVcCTP : vcCTPId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR:

Each vpNetworkTTP is associated with zero or one vpNetworkCTP. This operation allows the requester (client) to query the associated vpNetworkCTP. It does not affect the relationship. It matches for the associated vpNetworkCTP. The reply is a vpNetworkCTPId.

**Operation:** query vpTTP For terminated vpTrail

INPUT PARAMETERS:
none (see Section 5.1.2)
OUTPUT PARAMETERS:
terminatedTrail: vcTrailId
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR

An vcTrail is terminated on two vc- or vp-TrailTerminationPoints. This operation allows the requester (client) to query the terminated vcTrail. It does not affect the relationship. It matches for the associated vcTrail. The reply is a vcTrailId.

### vpTTP: vpTTP Loopback Operation

**Operation:** loopback vcTrail at vcTTP

INPUT PARAMETERS:
see Section 5.1.2, and
loopbackType: end-to-end, segment
loopbackLocation: interfaceId
OUTPUT PARAMETERS:
loopbackResults: passed or failed
ERROR CONDITIONS:
protocol-specific
BEHAVIOUR

This operation is used to request that the vpTTP insert a loopback OAM cell into the ATM cell stream, verify its return, and report the results of the loopback (i.e., passed or failed) back to the management system. Along with each request will be the location where the inserted OAM cell shall loop-back and an indication as to whether a segment or end-to-end OAM cell shall be used. The Loopback Location Code attribute value of the UNI, interNNI, or intraNNI where the loopback is to take place may be used to identify the loopback location. Additionally, a globally unique default value (e.g., "end-point") may also be used to perform a loopback at the other end of a vcTrail.

# 5. Connection Management Additions/Modifications

## 5.1 Deferred Request Support

This capability allows to defer the execution of a trail set-up request:

**Add the following objective to Section 4.1.2.1.4:**

**(O-4.1.2.1.4)-cm-1:** The M4 interface shall support capability to defer the set-up of a trail.

**vcTrailRequest**

This managed entity represents a deferred request of the vcLayerNetworkDomain to either set-up, release, modify, or alter the end-points (multipoint case) of a vcTrail. If the requestType is not setup, the relationship to the vcTrail is established when the instance is created. In the case where requestType is setup, the relationship to vcTrail is established when the setup action activates a trail.

The atmTrailRequest object provides a mechanism to track scheduled requests made to the vcLayerNetworkDomain or vpLayerNetworkDomain.

It is created as result of an operation on the vcLayerNetworkDomain.

**Attributes**

*vcTrailrequest ID:* This read-only attribute provides a unique name for the managed entity instance within the management domain.

*Request Status:* This read-only attribute represents the status of the vcTrailRequest. It takes on values: not scheduled, scheduled, suspended, user canceled, being handled, or completed. This attribute is set when the managed entity is created.

*requestType:* This read-only attribute describes the type of request. It takes on values such as: setup, modify, release, addTps, or removeTps. This attribute is set when the managed entity is created.

*requestCommittedTime:* This read-only attribute describes the time at which the NML commits to performing the action. This attribute is set when the managed entity is created.

**Notifications**

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

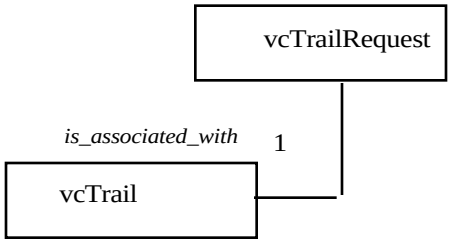
**Relationships:**

*With vcTrail*: A vcTrailRequest is associated to and an existing vcTrail. A vcTrailRequest pertains to at most one vcTrail; a vcTrail is altered by zero or more vcTrailRequests.

*Semi-formal representation:*

IS_ASSOCIATED_WITH (1) vcTTP

*Graphical representation:*




**Additional vcLayerNetworkDomain Setup operation:**

**Operation:** setup vcTrailRequest

INPUT PARAMETERS:
none (see Section 5.1.2)
requestActionInfo: setup, modify, release, addTps, removeTps
requestCommittedTime (optional)
relatedTrails: zero or one vcTrailId (optional)
OUTPUT PARAMETERS:
vcTrailrequest: vcTrailRequestId
ERROR CONDITIONS:
protocol-specific errors, and
invalidTrailId: trailId
invalidTime
operationFails
BEHAVIOUR

This operation allows the requester (client) to setup an vcTrailRequest.. The reply is a vcTrailRequestId.

**Additional vcLayerNetworkDomainRelationship:**

*With vcTrailRequest:* A vcLayerNetworkDomain can have zero or more vctrailRequests modifying the trails it groups.

*Semi-Formal representation:*

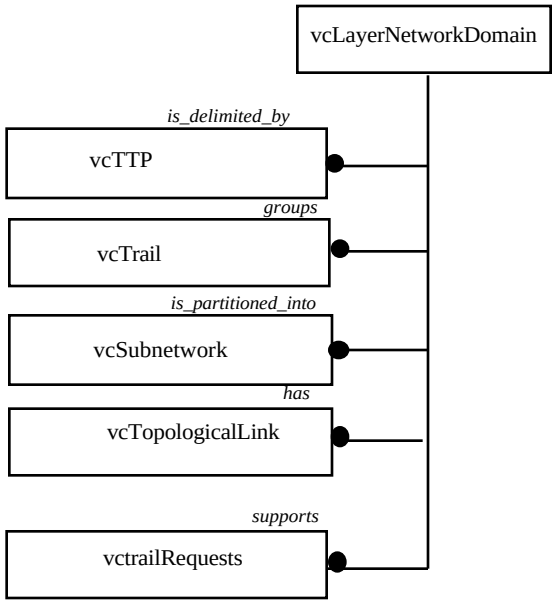
IS_DELIMITED_BY (0..*) vcTTP

GROUPS (0..*) vcTrail

IS_PARTITIONED_INTO (0..*) vcSubnetwork

SUPPORTS (0..*) vcTrailRequests

*Graphical representation:*


vcLayerNetworkDomain
is_delimited_by
vcTTP
groups
vcTrail
is_partitioned_into
vcSubnetwork
has
vcTopologicalLink
supports
vctrailRequests

### vpTrailRequest

This managed entity represents a deferred request of the vpLayerNetworkDomain to either set-up, release, modify, or alter the end-points (multipoint case) of an atmTrail. If the requestType is not setup, the relationship to the vpTrail is established when the instance is created. In the case where requestType is setup, the relationship to vpTrail is established when the setup action activates a trail.

The vpTrailRequest managed entity provides a mechanism to track scheduled requests made to the vpLayerNetworkDomain.

It is created as result of an operation on the vpLayerNetworkDomain or vpLayerNetworkDomain object.

### Attributes

*vpTrailrequest ID:* This read-only attribute provides a unique name for the managed entity instance within the management domain.

*Request Status:* This read-only attribute represents the status of the vpTrailRequest. It takes on values: not scheduled, scheduled, suspended, user canceled, being handled, or completed. This attribute is set when the managed entity is created.

*requestType:* This read-only attribute describes the type of request. It takes on values such as: setup, modify, release, addTps, or removeTps. This attribute is set when the managed entity is created.

*requestCommittedTime:* This read-only attribute describes the time at which the NML can commit to performing the action. This attribute is set when the managed entity is created.

### Notifications

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

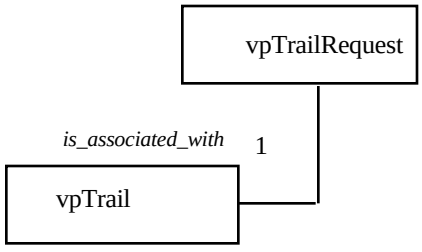
### Relationships:

*With vpTrail*: A vpTrailRequest is associated to and an existing vpTrail. An vpTrailRequest pertains to at most one vpTrail; a vpTrail is altered by zero or more vpTrailRequests.

*Semi-formal representation:*

IS_ASSOCIATED_WITH (1) vpTTP

*Graphical representation:*




### Additional vpLayerNetworkDomain Setup operation:

**Operation:** setup vpTrailRequest

INPUT PARAMETERS:
none (see Section 5.1.2)
requestActionInfo: setup, modify, release, addTps, removeTps
requestCommittedTime (optional)
relatedTrails: zero or one vcTrailId (optional)
OUTPUT PARAMETERS:
vpTrailrequest: vpTrailRequestId
ERROR CONDITIONS:
protocol-specific errors, and
invalidTrailId: trailId
invalidTime
operationFails
BEHAVIOUR

This operation allows the requester (client) to setup a vpTrailRequest.. The reply is a vpTrailRequestId.

**Additional vcLayerNetworkDomainRelationship:**

*With vpTrailRequest:* A vpLayerNetworkDomain can have zero or more vptrailRequests modifying the trails it groups.

*Semi-Formal representation:*

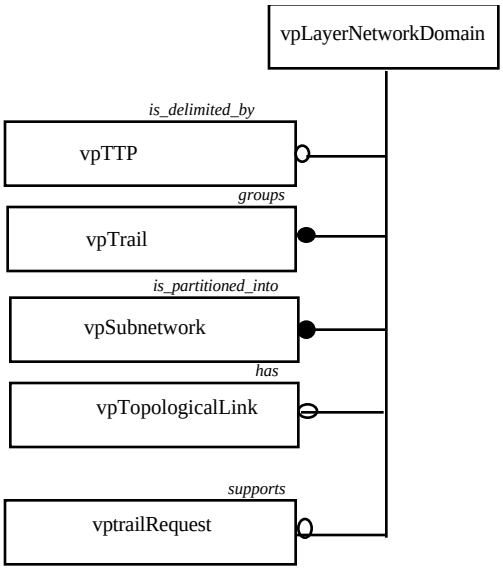
IS_DELIMITED_BY (0..*) vpTTP

GROUPS (0..*) vpTrail

IS_PARTITIONED_INTO (0..*) vpSubnetwork

SUPPORTS (0..*) vpTrailRequests

*Graphical representation:*



## 5.2 Routing Constraints

The following managed entities should be added:

### vc/vpRoutingProfile

This managed entity a set of routing constraints that can be applied to a new connection or trail during setup. A routing profile may be created automatically based on the routing description in the setup operation. The management system may also create profiles directly. Each vc/vpSubnetworkConnection or vc/vpTrail may point to an vc/vpRoutingProfile. Connections should not be established (or re-established) if the routing criteria cannot be met. If maxHops is specified, the connection should not be established (or re-established) if the maximum number of hops is exceeded

The maxHops attribute is the maximum number of hops between nodes that the new connection may traverse. This attribute may be set to NULL to indicate that the maxHops criteria does not apply.

The routeDescriptionList attribute is a list of objects (such as Links, Subnetworks, existing connections) and their use in routing (exclude, mandatory, preferred, same route, diverse route).

The connection types that the routing profile supports are indicated in the connectionTypesSupported attribute. For all types of multipoint connections at least the sameRoute criteria may be applied. All of the criteria may be applied to point-to-point connections.

Managed entities (such as vc/vpSubnetwork, vc/vpLink, or managedElement, etc) may be referenced by the routeDescriptionList as being excluded, mandatory, or preferred. If a managed entity is described as mandatory it must be used in setting up a new connection. An attempt must be made during setup to include a managed entity described as preferred. An excluded managed entity must not be used in a connection.

Connection objects (such as vc/vpTrail, vc/vpSubnetworkConnection, etc) may be referenced by the routeDescriptionList as same route or diverse route. A new connection being created should follow the same route as a sameRoute referenced managed entity. A new connection must follow a different route than a referenced managed entity referred to as diverseRoute.

The routing information in setup operations may be either explicitly stated in the operation or the operation can point to an existing instance of the atmRoutingProfile managed entity.

#### Attributes

*vc/vpRoutingProfile ID:* This read-only attribute provides a unique name for the managed entity instance within the management domain.

*connectionTypeSupported:* This read/write attribute represents the type of connection supported (e.g. point-to-point, full multipoint,...).

*routeDescriptionList:* This read/write attribute is a list of objects (such as Links, Subnetworks, existing connections) and their use in routing (exclude, mandatory, preferred, same route, diverse route).

*maxHops:* This read/write attribute is the maximum number of hops between nodes that the new connection may traverse. This attribute may be set to NULL to indicate that the maxHops criteria does not apply

#### Notifications

*Managed Entity Creation:* This notification is used to report the creation of an instance of this managed entity.

*Managed Entity Deletion:* This notification is used to report the deletion of an instance of this managed entity.

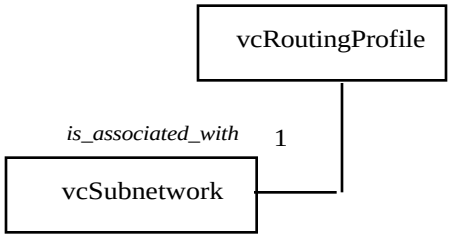
**Relationships:**

*With vc/vpSubnetwork*: An atmRoutingProfile is associated with a given subnetwork. It can apply to any subnetworkConnection within that network.

*Semi-formal representation:*

IS_ASSOCIATED_WITH (1) vcSubnetwork

*Graphical representation:*




**Additional Subnetwork Operation:**

**Operation:** setup vcRoutingProfile

INPUT PARAMETERS:
none (see Section 5.1.2)
routeDescriptionList: list of subnetworkConnectionId, LinkId, SubnetworkId (optional)
connectionTypeSupported: broadcast, merge, composite, multipoint, pt-to-pt
maxHops: integerorNULL (optiona)
OUTPUT PARAMETERS:
vcRoutingProfile: vcRoutingProfileId
ERROR CONDITIONS:
protocol-specific errors, and
invalidSubnetworkId: subnetworkId
operationFails
BEHAVIOUR

This operation allows the requester (client) to setup a vcRoutingProfile. The reply is a vcTrailRequestId.

**Additional subnetworkConnection Relationship:**

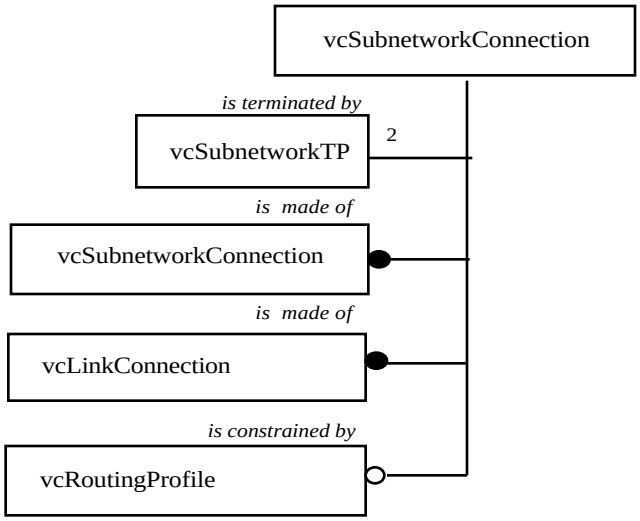
**Additional Relationships:**

*With routingProfiles:* A subnetwork connection may be constrained by a routingProfile.

*Semi-formal representation:*

IS_CONSTRAINED_BY (0..1) routingProfile

*Graphical representation (VC layer only shwon. Same at VP layer):*


vcSubnetworkConnection
is terminated by
vcSubnetworkTP
2
is made of
vcSubnetworkConnection
is made of
vcLinkConnection
is constrained by
vcRoutingProfile

## 5.3 Modification of subnetworkConnections and links

Trails, subnetworkConnections, and links modification shall affect their characteristics, but not their endpoints. Therefore, the following requirements are clarified as follows:

**(R-4.1.2.2)-cm -2 :** The M4 interface shall support requests to modify a VP/VC subnetwork connection within a subnetwork. Provided with each subnetwork connection modification request, shall be the following information:

1. The identity of each connection to modify, specified as (a) or (c) for VP connection, and (b) or (d) for VC connection:
   a) the VPI value of a VP termination within a specific ATM Interface for one end
   b) the VCI value of a VC termination within a specific VPC for one end
   c) the identity of the VP connection
   d) the identity of the VC connection
2. The parameters to modify:
   a) Ingress and Egress Peak Cell Rate for CLP=0 and CLP=0+1 Traffic
   b) Ingress and Egress Sustained Cell Rate for CLP=0 and CLP=0+1 Traffic
   c) Ingress and Egress Maximum Burst Tolerance for CLP=0 and CLP=0+1 Traffic
   d) Ingress and Egress Implicit CDV Tolerance for CLP=0 and CLP=0+1 Traffic
   e) Ingress and Egress QOS class

**(R-4.1.2.2)-cm -8 :** The M4 interface shall support requests to modify a VP/VC link connection. Provided with each link connection modification request, shall be the following information:

1. The identity of each link connection to modify, specified as (a) or (c) for VP connection, and (b) or (d) for VC connection:
   a) the VPI value of a VP termination within a specific ATM Interface for one end
   b) the VCI value of a VC termination within a specific VPC for one end
   c) the identity of the VP link connection
   d) the identity of the VC connection
2. The parameters to modify:
   a) Ingress and Egress Peak Cell Rate for CLP=0 and CLP=0+1 Traffic
   b) Ingress and Egress Sustained Cell Rate for CLP=0 and CLP=0+1 Traffic
   c) Ingress and Egress Maximum Burst Tolerance for CLP=0 and CLP=0+1 Traffic
   d) Ingress and Egress Implicit CDV Tolerance for CLP=0 and CLP=0+1 Traffic
   e) Ingress and Egress QOS class

**Additional Operation:** modify vcSubnetworkConnection (same for linkConnection)

INPUT PARAMETERS:

see Section 5.1.2, and
snTPa : choice of subnetworkTPId, or Descriptor
snTPz : choice of subnetworkTPId, or Descriptor

Descriptor:
- vpi (optional)
- vci (optional)
- trafficDescriptors (optional)
- qos (optional)

OUTPUT PARAMETERS:

SNC : SNCId

ERROR CONDITIONS:

protocol-specific addressing errors
incorrectTerminationPoints : subnetworkTPId
reflectedTPDisabled : subnetworkTPId

reflectedTPLocked: subnetworkTPId
non-matchingDescriptors: set of subnetworkTPId
operationFails

BEHAVIOUR:

This operation allows the requester (user) to modify a connection between subnetworkTPs of the addressed subnetwork. The subnetworkTPs to modify are identified directly. A set of optional descriptors may be provided (vpi, vci, traffic descriptors, qos). An error condition will be raised if the termination points are incorrect (e.g. do not belong to the subnetwork), or if the subnetwork is unable to provide sufficient bandwidth (operations failure).

## 5.4 Support of multipoint subnetworkConnections and trails

The following operation needs to be added (equivalent operation for trail, only subnetworkConnection is used here):

**Operation:** addTps To SubnetworkConnection:

INPUT PARAMETERS:
see Section 5.1.2, and
subnetworkConnection : subnetworkConnectionId
snTPz : choice of subnetworkTPId, or Descriptor
AdministrativeState (optional)

Descriptor:
interfaceId (Choice of subnetworkTPId, or server TTPId)
vpi (optional)
vci (optional)
trafficDescriptors (optional)
qos (optional)

OUTPUT PARAMETERS:
snTPz: subnetworkTPId

ERROR CONDITIONS:
protocol-specific addressing errors
incorrectSubnetworkConnection : subnetworkConnectionId
incorrectTerminationPoints : subnetworkTPId
reflectedTPDisabled : subnetworkTPId
reflectedTPLocked: subnetworkTPId
subnetworkTerminationPointConnected : subnetworkTPId
non-matchingDescriptors: set of subnetworkTPId
operationFails

BEHAVIOUR:

This operation allows the requester (user) to add a point to a multipoint connection. The subnetworkTP to connect are identified directly or indirectly. In the latter case, a set of optional descriptors may be provided (vpi, vci, traffic descriptors, qos). An error condition will be raised if the termination points are incorrect (e.g. do not belong to the subnetwork), if the subnetworkTP is already used, or if the subnetwork is unable to provide sufficient bandwidth (operations failure). The result of the operation is:

- the association of a subnetworkTP with a subnetworkConnection,
- possibly, the creation of a subnetworkTP.

## 5.5 Addition of “retainedResourcePackage”

Addition of the following attribute in the trail, subnetworkConnection, and linkConnection managed entities:

*retainedResource:* This read/write attribute indicates if the managed entity instance needs to be retained when component of a composite connection (linkConnection, subnetworkConnection), or when supporting a linkConnection (trail)

This attribute needs to be added as an input parameters to the trail (layernetworkDomain), subnetworkConnection (subnetwork), and linkConnection (link) setup actions.

Modify the following objective to connection release (O-4.1.2.3)-cm-1:

**(O-4.1.2.3)-cm-1:** When a subnetwork connection, a link connection or a trail is released, the M4 interface should allow the underlying connectivity resources (e.g. link connection and subnetwork connection) to remain.

Add the following objective to Connection Release:

**(O-4.1.2.3)-cm-2:** If the capability to retain an underlying resource is supported, the M4 interface should support requests to tag the underlying connectivity resources as “remaining” or not.

# 6. State Monitoring of Trails and Connections

Replace in the vcLinkConnection, vcSubnetworkConnection, vcTrail, vpLinkConnection, vpSubnetworkConnection and vpTrails, the “operational state” attribute by:

*availability Status:* This read-only attribute identifies whether or not the managed entity is capable of performing its normal functions (Failed or no unavailability condition existing).

# 7. Updated Managed Entity List

The following managed entities are specified for the M4 network-view:

network
vcLayerNetworkDomain
vcLinkConnection
**vcNetworkAccessProfile**
**vcRoutingProfile**
vcSubnetwork
vcSubnetworkConnection
vcSubnetworkTP
vcTopologicalLink
vcTopologicalLinkTP
**vcTrafficDescriptorProfile**
vcTrail
vpLayerNetworkDomain
vpLinkConnection
**vpNetworkAccessProfile**
**vpRoutingProfile**
vpSubnetwork
vpSubnetworkConnection
vpSubnetworkTP
vpTopologicalLink
vpTopologicalLinkTP
**vpTrafficDescriptorProfile**
vpTrail

The managed entities below have the same information content as in the NE-view, and are specified here because of their relationships with the network-view managed entities.

vcNetworkCTP
vcNetworkTTP
vpNetworkCTP
vpNetworkTTP

The following managed entities needed in the M4 network-view are already specified in the NE-view:

alarmRecord
alarmSeverityAssignmentProfile
eventForwardingDiscriminator
log