Network Management - Virtual Routing and Forwarding Profile

Supersedes: None

Document Class: Normative

Document Status: Published

Document Language: en-US
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This document’s normative language is English. Translation into other languages is permitted.
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Foreword

The Network Management - Virtual Routing and Forwarding Profile (DSP1065) was prepared by the Network Services Management Working Group of the DMTF. DMTF is a not-for-profit association of industry members dedicated to promoting enterprise and systems management and interoperability.

Acknowledgments

The DMTF acknowledges the following individuals for their contributions to this document:

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- Dr. Bhumip Khasnabish - ZTE Corporation
- Lawrence Lamers – VMware
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- Steve Neely – Cisco Systems
- John Parchem – Microsoft Corporation
- Shishir Pardikar – Citrix
- Hemal Shah – Broadcom Corporation
- Alex Zhdankin – Cisco Systems
Introduction

The information in this specification should be sufficient for a provider or consumer of this data to identify unambiguously the classes, properties, methods, and values that shall be instantiated and manipulated to represent and manage Network Services and the associated configuration information. The target audience for this specification is implementers who are writing CIM-based providers or consumers of management interfaces that represent the component described in this document.

Document conventions

Typographical conventions

The following typographical conventions are used in this document:

- Document titles are marked in italics.
- ABNF rules are in monospaced font.
Network Management - Virtual Routing and Forwarding Profile

1 Scope

The Network Management - Virtual Routing and Forwarding Profile is a profile that will specify the CIM schema and use cases associated with the general and common aspects of routing and forwarding table including VRFs found in an Ethernet Switch with routing capabilities. This profile includes a specification of the Layer 3 interface configuration service, Sub-Interface, Tunnel Interface switch virtual interface and loopback interface.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated or versioned references, only the edition cited (including any corrigenda or DMTF update versions) applies. For references without a date or version, the latest published edition of the referenced document (including any corrigenda or DMTF update versions) applies.

- DMTF DSP0200, CIM Operations over HTTP 1.3.1, http://www.dmtf.org/standards/published_documents/DSP0200_1.3.pdf
- DMTF DSP1033, Profile Registration Profile 1.0, http://www.dmtf.org/standards/published_documents/DSP1033_1.0.pdf

3 Terms and definitions

In this document, some terms have a specific meaning beyond the normal English meaning. Those terms are defined in this clause.

The terms "shall" ("required"), "shall not", "should" ("recommended"), "should not" ("not recommended"), "may," "need not" ("not required"), "can" and "cannot" in this document are to be interpreted as described in ISO/IEC Directives, Part 2, Annex H. The terms in parenthesis are alternatives for the preceding term, for use in exceptional cases when the preceding term cannot be used for linguistic reasons. Note that ISO/IEC Directives, Part 2, Annex H specifies additional alternatives. Occurrences of such additional alternatives shall be interpreted in their normal English meaning.

The terms "clause", "subclause", "paragraph", and "annex" in this document are to be interpreted as described in ISO/IEC Directives, Part 2, Clause 5.
The terms "normative" and "informative" in this document are to be interpreted as described in ISO/IEC Directives, Part 2, Clause 3. In this document, clauses, subclauses, or annexes labeled "(informative)" do not contain normative content. Notes and examples are always informative elements.

The terms defined in DSP0004, DSP0223, and DSP1001 apply to this document. The following additional terms are used in this document (update the entire doc using the following revised terminology).

3.1
If
indicates requirements to be followed strictly to conform to the document when the specified conditions are met.

3.2
Shall
indicates requirements to be followed strictly to conform to the document and from which no deviation is permitted.

3.3
Should
indicates that among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.

3.4
May
indicates a course of action permissible within the limits of the document.

3.5
pending configuration
indicates the configuration that will be applied to an IP network connection the next time the IP network connection accepts a configuration.

3.6
referencing profile
indicates a profile that owns the definition of this class and can include a reference to this profile in its "Referenced Profiles" table.

3.7
unspecified
indicates that this profile does not define any constraints for the referenced CIM element or operation.

4 Symbols and abbreviated terms

The abbreviations defined in DSP0004, DSP0223, and DSP1001 apply to this document. The following additional abbreviations are used in this document.

4.1
IP
Internet Protocol

4.2
VLAN
Virtual Local Area Network
5 Synopsis

Profile name: Network Management - Virtual Routing and Forwarding Profile
Version: 1.0.0
Organization: DMTF
CIM Schema version: 2.52
Central class: CIM_VRFConfigurationService
Scoping class: CIM_System

The Network Management - Virtual Routing and Forwarding Profile is a base (abstract) profile that will specify the CIM schema and use cases associated with the general and common aspects of Network Policy Management. This profile includes a specification of the Network Policy Service, Network Policy, Network Policy Rule and Setting Data, Policy Conditions and Action and describes how the network Policies can be applied to the Managed Elements.

Table 1 identifies profiles on which this profile has a dependency.

<table>
<thead>
<tr>
<th>Profile Name</th>
<th>Organization</th>
<th>Version</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile Registration</td>
<td>DMTF</td>
<td>1.0</td>
<td>Mandatory</td>
<td>None</td>
</tr>
<tr>
<td>Virtual Ethernet Switch</td>
<td>DMTF</td>
<td>1.1</td>
<td>Mandatory</td>
<td>None</td>
</tr>
</tbody>
</table>

6 Description

The Network Management - Virtual Routing and Forwarding Profile is a base (abstract) profile that will specify the CIM schema and use cases associated with the general and common aspects of creating and configuring The routes and associated interfaces of a Virtual Routing and Forwarding table typically found in an Ethernet switch with routing capabilities. This includes the VRF configuration service, to instantiate and configure VRFs and their associated routes.

6.1 Class diagram

Figure 1 represents the class schema for the Network Management - Virtual Routing and Forwarding Profile. For simplicity, the CIM_ prefix has been removed from the names of the classes.
Figure 1 – Network Management - Virtual Routing and Forwarding Profile: Class diagram

Figure 1 is a class diagram for the configuration of the virtual routing and forwarding tables (VRF) typically found in an Ethernet switch that supports routing. The figure shows the CIM_VRFConfigurationService and the CIM_VirtualRoutingAndForwardingTable classes and the associated ports and interfaces that are within the VRF. A set of CIM_NextHopIPRoute instances describe the associated routes in the VRF. A VRF is hosted by a System typically either an instance of CIM_ComputerSystem, representing an Ethernet Switch or an Instance of a router possibly within a switch represented by CIM_AutonomousSystem.

6.2 CIM_VirtualRoutingAndForwardingTable

A VRF allows multiple routing tables with independent, the same or overlapping IP addresses within the same Ethernet switch. An instance of CIM_VirtualRoutingAndForwardingTable represents a single VRF. It is a subclass of CIM_SystemSpecificCollection where the members are interfaces, represented as CIM_ServiceAccessPoint instances or ports represented by CIM_EthernetPort. Also associated with the VRF are the routes configured for the VRF.

6.3 CIM_VRFConfigurationService

The VRF configuration service manages the creation and deletion of VRF, the addition and removal of ports and interfaces to the VRF and the configuration of the next hop routes associated with the VRF.
6.4 CIM_System

Subclasses of CIM_System represent either an Ethernet switch, CIM_ComputerSystem, or a router, CIM_AutonomousSystem. VRFs can be created and associated with any of these example subclasses of CIM_System.

6.5 CIM_ServiceAccessPoint

This is the base class for interfaces and service access points in an Ethernet switch or a router. An interface within an Ethernet switch or router can be a member of no more than one CIM_VirtualRoutingAndForwardingTable collection. An example would be an instance of CIM_RemoteServiceAccessPoint representing an NTP or RADIUS service. Another example would be a layer 3 interface such as CIM_IPSubinterface which also has CIM_ServiceAccessPoint as a super class.

6.6 CIM_EthernetPort

Represents the switch ports in an Ethernet switch. Once a VRF is configured, a port can be assigned to the VRF which would make the CIM_EthernetPort instance a member of the CIM_VirtualRoutingAndForwardingTable collection.

6.7 CIM_NextHopIPRoute

Each VRF can have an associated set of next hop routes. Static routes can be configured using the associated CIM_VRFCongfigurationService. Each route results in an instance of CIM_NextHopIPRoute that is associated to VRF through a CIM_VRFRoute instance.

7 Implementation

This clause details the requirements related to the arrangement of instances and properties of instances for implementations of this profile.

7.1 Representing the Virtual routing and forwarding table management capabilities

7.1.1 CIM_System

An instance of CIM_System shall be the scoping class for this profile. This scoping instance should be an instance of either CIM_ComputerSystem representing an Ethernet switch or an instance of CIM_AutonomousSystem representing a router.

The scoping class instance of CIM_System shall be associated to central class instance of CIM_VRFCongfigurationService through an instance of CIM_HostedService.

If a CIM_System instance can be the TargetRouter of a CIM_VRFCongfigurationService.CreateVRF() method call, the CIM_System instance shall be associated to that instance of the CIM_VRFCongfigurationService through an instance of CIM_ServiceAvailableToElement.

7.1.2 CIM_VRFCongfigurationService

One or more instances of CIM_VRFCongfigurationService shall be instantiated.

Each instance of the CIM_VRFCongfigurationService shall be associated with the instance of the scoping CIM_System through an instance of CIM_HostedService.
Instances of CIM_System that may be used as the HostSystem parameter of a
CIM_VRFConfigurationService.CreateVRF() method shall be associated to the
CIM_VRFConfigurationService instance through an instance of CIM_ServiceAvailableToElement.

The instances of the CIM_VRFConfigurationService class shall be associated to each
CIM_VirtualRoutingAndForwardingTable instance that may be used as the VRF parameter of its
AddRoute(), AddPortMember() or AddSAPMember() method through an instance of
CIM_ServiceAffectsElement.

7.1.3 CIM_VirtualRoutingAndForwardingTable

Each CIM_VirtualRoutingAndForwardingTable instance shall be associated to an instance of
CIM_System through an instance of CIM_HostedCollection.

If the CIM_VirtualRoutingAndForwardingTable instance was created with a
CIM_VRFConfigurationService.CreateVRF() method, the CIM_System instance referenced in the
TargetRouter method parameter shall be associated through an instance of CIM_HostedCollection.

If the CIM_VirtualRoutingAndForwardingTable instance was created with a
CIM_VRFConfigurationService.CreateVRF() method with a null TargetRouter method parameter, the
CIM_VirtualRoutingAndForwardingTable instance shall be associated to the scoping instance of
CIM_System through an instance of CIM_HostedCollection.

7.1.4 CIM_NextHopIPRoute

Each instance of CIM_NextHopIPRoute that describes a route for an instance of a
CIM_VirtualRoutingAndForwardingTable (see 7.1.3) shall be associated to that instance through an
instance of CIM_VRFRoute.

7.1.5 CIM_EthernetPort

Each instance of CIM_EthernetPort that describes a switch port contained in a VRF,
CIM_VirtualRoutingAndForwardingTable (see 7.1.3), shall be associated to the VRF instance through an
instance of CIM_MemberOfCollection. An instance of CIM_EthernetPort shall be associated to no more
than one instance of CIM_VirtualRoutingAndForwardingTable.

7.1.6 CIM_ServiceAccessPoint

Each instance of CIM_ServiceAccessPoint that describes an interface or a remote service access point
contained in a VRF, CIM_VirtualRoutingAndForwardingTable (see 7.1.3), shall be associated to the VRF
instance through an instance of CIM_MemberOfCollection. An instance of CIM_ServiceAccessPoint shall
be associated to no more than one instance of CIM_VirtualRoutingAndForwardingTable.

8 Methods

This clause details the requirements for supporting intrinsic operations and extrinsic methods for the CIM
elements defined by this profile.

8.1 Extrinsic Methods

If synchronous execution of a method succeeds, the implementation shall set a return value of
0 (Completed with No Error).

If synchronous execution of a method fails, the implementation shall set a return value of 2 (Failed) or a
more specific return code as specified with the respective method.
If a method is executed as an asynchronous task, the implementation shall perform all of the following actions:

- Set a return value of 4096 (Job Started).
- Set the value of the Job output parameter to refer to an instance of the CIM_ConcreteJob class that represents the asynchronous task.
- Set the values of the JobState and TimeOfLastStateChange properties in that instance to represent the state and last state change time of the asynchronous task.

In addition, the implementation may present state change indications as task state changes occur.

If the method execution as an asynchronous task succeeds, the implementation shall perform all of the following actions:

- Set the value of the JobState property to 7 (Completed).
- Provide an instance of the CIM_AffectedJobEntity association with property values set as follows:
  - The value of the AffectedElement property shall refer to the object that represents the top-level entity that was created or modified by the asynchronous task. For example, for the CIM_IPConfigurationService. AddIPProtocolEndpoint() method, this is an instance of the CIM_IPProtocolEndpoint class.
  - The value of the AffectingElement property shall refer to the instance of the CIM_ConcreteJob class that represents the completed asynchronous task.
  - The value of the first element in the ElementEffects[ ] array property (ElementEffects[0]) shall be set to 5 (Create) for the CIM_IPConfigurationService. AddIPProtocolEndpoint() method. Otherwise, this value shall be 0 (Unknown).

If the method execution as an asynchronous task fails, the implementation shall set the value of the JobState property to 9 (Killed) or 10 (Exception).

### 8.1.1 Job parameter

The implementation shall set the value of the Job parameter as a result of an asynchronous execution of a method of the CIM_IPConfigurationService as follows:

- If the method execution is performed synchronously, the implementation shall set the value to NULL.
- If the method execution is performed asynchronously, the implementation shall set the value to refer to the instance of the CIM_ConcreteJob class that represents the asynchronous task.

### 8.1.2 CIM_VRFConfigurationService.CreateVRF()

The implementation of the CreateVRF( ) method is optional, the provisions in this subclause apply in addition to behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the CreateVRF( ) method shall create an instance of CIM_VirtualRoutingAndForwardingTable as described in the subclause 7.1.3.

Table 2 contains requirements for parameters of this method.
Table 2 – CreateVRF() Method: Parameters

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>TargetRouter</td>
<td>CIM_System REF</td>
<td>See 8.1.2.1</td>
</tr>
<tr>
<td>IN</td>
<td>VRF</td>
<td>String</td>
<td>See 8.1.2.2</td>
</tr>
<tr>
<td>OUT</td>
<td>ResultingVRF</td>
<td>REF</td>
<td>See 8.1.2.3</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.2.4</td>
</tr>
</tbody>
</table>

8.1.2.1 TargetRouter

An optional reference to a CIM_System instance. The referenced instance shall comply with the subclause 7.1.1.

8.1.2.2 VRF

A required string containing one embedded instances of the class-subclass of CIM_VirtualRoutingAndForwardingTable that describes the configuration of the resultant CIM_VirtualRoutingAndForwardingTable instance. The populated properties of the embedded instance should not contain key properties, and any key property values may be ignored.

8.1.2.3 ResultingVRF

If the creation of the VRF was successful, a reference to the resultant instance of class CIM_VirtualRoutingAndForwardingTable that represents the newly defined VRF shall be returned. The created CIM_VirtualRoutingAndForwardingTable instance shall comply with subclause 7.1.3.

8.1.2.4 Job

See 8.1.1

8.1.3 CIM_VRFConfigurationService.RemoveVRF()

The implementation of the RemoveVRF() method is optional, the provisions in this subclause apply in addition behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the RemoveVRF() method shall remove the instance referenced in the methods VRF parameter and should also remove any associated CIM_NextHopRoute instances.

Table 3 contains requirements for parameters of this method.
Table 3 – RemoveVRF( ) Method: Parameters

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable REF</td>
<td>See 8.1.3.1</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.3.2</td>
</tr>
</tbody>
</table>

8.1.3.1 VRF
A reference to the instance of the class CIM_VirtualRoutingAndForwardingTable that shall be removed.

8.1.3.2 Job
See 8.1.1

8.1.4 CIM_VRFConfigurationService.AddRoute()

The implementation of the AddRoute( ) method is required, the provisions in this subclause shall apply in addition to the behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the AddRoute( ) method shall create an instance of CIM_NextHopIPRoute as described in the subclause 7.1.4. This instance shall be associated with the referenced VRF through an instance of CIM_VRFRoute.

Table 4 contains requirements for parameters of this method.

Table 4 – AddRoute( ) Method: Parameters

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable REF</td>
<td>See 8.1.4.1</td>
</tr>
<tr>
<td>IN</td>
<td>Route</td>
<td>String</td>
<td>See 8.1.4.2</td>
</tr>
<tr>
<td>OUT</td>
<td>ResultingRoute</td>
<td>CIM_NextHopIPRoute REF</td>
<td>See 8.1.4.3</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.4.4</td>
</tr>
</tbody>
</table>

8.1.4.1 VRF
A required reference to a CIM_VirtualRoutingAndForwardingTable instance.

8.1.4.2 Route
A required string containing one embedded instance of the class or subclass of CIM_NextHopIPRoute that describes the configuration of the resultant CIM_NextHopIPRoute instance. The populated properties of the embedded instance should not contain key properties, and any key property values may be ignored.

8.1.4.3 ResultingRoute
If the creation of the next hop route was successful, a reference to the resultant instance of class CIM_NextHopIPRoute that represents the newly defined route for the VRF shall be returned. The created CIM_NextHopIPRoute instance shall comply with subclause 7.1.4.
8.1.4.4 Job

See 8.1.1

8.1.5 CIM_VRFConfigurationService.RemoveRoute()

The implementation of the RemoveRoute() method is required, the provisions in this subclause shall apply in addition to the behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the RemoveRoute() method shall remove the instance referenced in the method’s Route parameter from the VRF referenced in the VRF parameter.

Table 5 contains requirements for parameters of this method.

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable REF</td>
<td>See 8.1.5.1</td>
</tr>
<tr>
<td>IN</td>
<td>Route</td>
<td>CIM_NextHopIPRoute REF</td>
<td>See 8.1.5.2</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.5.3</td>
</tr>
</tbody>
</table>

8.1.5.1 VRF

A required reference to a CIM_VirtualRoutingAndForwardingTable instance from which the route shall be removed.

8.1.5.2 Route

A reference to instance of the class CIM_NextHopIPRoute that shall be removed.

8.1.5.3 Job

See 8.1.1

8.1.6 CIM_VRFConfigurationService.AddPortMember()

The implementation of the AddPortMember() method is required, the provisions in this subclause shall apply in addition to the behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the AddPortMember() shall associate the referenced port in the PortMember method parameter to the referenced VRF in the VRF method parameter through an instance of CIM_MemberOfCollection.

Table 6 contains requirements for parameters of this method.

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable REF</td>
<td>See 8.1.6.1</td>
</tr>
<tr>
<td>IN</td>
<td>PortMember</td>
<td>CIM_EthernetPort REF</td>
<td>See 8.1.4.2</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.6.3</td>
</tr>
</tbody>
</table>
8.1.6.1 VRF
A required reference to a CIM_VirtualRoutingAndForwardingTable instance to which the port shall be added.

8.1.6.2 PortMember
A reference to the CIM_EthernetPort instance that is being added to the VRF.

8.1.6.3 Job
See 8.1.1

8.1.7 CIM_VRFConfigurationService.RemovePortMember()

The implementation of the RemovePortMember() method is required, the provisions in this subclause shall apply in addition to the behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the RemovePortMember() method shall remove the referenced CIM_EthernetPort passed in the PortMember parameter from the VRF passed in the VRF method parameter, by removing the CIM_MemberOfCollection instance forming the association.

Table 7 contains requirements for parameters of this method.

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable</td>
<td>See 8.1.7.1</td>
</tr>
<tr>
<td>IN</td>
<td>PortMember</td>
<td>CIM_EthernetPort REF</td>
<td>See 8.1.7.2</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.7.3</td>
</tr>
</tbody>
</table>

8.1.7.1 VRF
A required reference to a CIM_VirtualRoutingAndForwardingTable instance from which the port shall be removed.

8.1.7.2 PortMember
A required reference to instance of the class CIM_EthernetPort that shall be removed from the referenced VRF.

8.1.7.3 Job
See 8.1.1

8.1.8 CIM_VRFConfigurationService.AddSAPMember()

The implementation of the AddSAPMember() method is required, the provisions in this subclause shall apply in addition to the behavior applicable to all extrinsic methods as specified in 8.1.

The successful execution of the AddSAPMember() shall associate the referenced instance of CIM_ServiceAccessPoint in the SAPMember method parameter to the referenced VRF in the VRF method parameter through an instance of CIM_MemberOfCollection.

Table 8 contains requirements for parameters of this method.
### Table 8 – AddSAPMember( ) Method: Parameters

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable REF</td>
<td>See 8.1.8.1</td>
</tr>
<tr>
<td>IN</td>
<td>SAPMember</td>
<td>CIM_ServiceAccessPoint REF</td>
<td>See 8.1.8.2</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.8.3</td>
</tr>
</tbody>
</table>

#### 8.1.8.1 VRF

A required reference to a CIM_VirtualRoutingAndForwardingTable instance to which the instance of CIM_ServiceAccessPoint shall be added.

#### 8.1.8.2 SAPMember

A required reference to the instance of CIM_ServiceAccessPoint that shall be added to the referenced VRF.

#### 8.1.8.3 Job

See 8.1.1

### Table 9 – RemoveSAPMember( ) Method: Parameters

<table>
<thead>
<tr>
<th>Qualifiers</th>
<th>Name</th>
<th>Type</th>
<th>Description/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>VRF</td>
<td>CIM_VirtualRoutingAndForwardingTable</td>
<td>See 8.1.9.1</td>
</tr>
<tr>
<td>IN</td>
<td>SAPMember</td>
<td>CIM_ServiceAccessPoint REF</td>
<td>See 8.1.9.2</td>
</tr>
<tr>
<td>OUT</td>
<td>Job</td>
<td>CIM_ConcreteJob REF</td>
<td>See 8.1.9.3</td>
</tr>
</tbody>
</table>

#### 8.1.9.1 VRF

A required reference to a CIM_VirtualRoutingAndForwardingTable instance from which the CIM_ServiceAccessPoint shall be removed.

#### 8.1.9.2 SAPMember

A required reference to instance of the class CIM_ServiceAccessPoint that shall be removed from the referenced VRF.

#### 8.1.9.3 Job

See 8.1.1
8.2 Profile conventions for operations

For each profile class (including associations), the implementation requirements for operations, including those in the following default list, are specified in class-specific subclauses of this clause.

The default list of operations is as follows:

- GetInstance
- EnumerateInstances
- EnumerateInstanceNames
- Associators
- AssociatorNames
- References
- ReferenceNames

8.3 CIM_HostedService

Table 10 lists implementation requirements for operations. If implemented, these operations shall be implemented as defined in DSP0200. In addition, and unless otherwise stated in Table 10, all operations in the default list in 8 shall be implemented as defined in DSP0200.

NOTE Related profiles may define additional requirements on operations for the profile class.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Requirement</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associators</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>AssociatorNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>References</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>ReferenceNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
</tbody>
</table>

8.4 CIM_HostedCollection

Table 11 lists implementation requirements for operations. If implemented, these operations shall be implemented as defined in DSP0200. In addition, and unless otherwise stated in Table 10, all operations in the default list in 8 shall be implemented as defined in DSP0200.

NOTE Related profiles may define additional requirements on operations for the profile class.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Requirement</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associators</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>AssociatorNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>References</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>ReferenceNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
</tbody>
</table>
8.5 CIM_ServiceAvailableToElement

Table 12 lists implementation requirements for operations. If implemented, these operations shall be implemented as defined in DSP0200. In addition, and unless otherwise stated in Table 10, all operations in the default list in 8 shall be implemented as defined in DSP0200.

NOTE Related profiles may define additional requirements on operations for the profile class.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Requirement</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associators</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>AssociateNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>References</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>ReferenceNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
</tbody>
</table>

8.6 CIM_ServiceAffectsElement

Table 13 lists implementation requirements for operations. If implemented, these operations shall be implemented as defined in DSP0200. In addition, and unless otherwise stated in Table 10, all operations in the default list in 8 shall be implemented as defined in DSP0200.

NOTE Related profiles may define additional requirements on operations for the profile class.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Requirement</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associators</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>AssociateNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>References</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>ReferenceNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
</tbody>
</table>

8.7 CIM_VRFRoute

Table 14 lists implementation requirements for operations. If implemented, these operations shall be implemented as defined in DSP0200. In addition, and unless otherwise stated in Table 10, all operations in the default list in 8 shall be implemented as defined in DSP0200.

NOTE Related profiles may define additional requirements on operations for the profile class.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Requirement</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associators</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>AssociateNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>References</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>ReferenceNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
</tbody>
</table>
8.8 CIM_MemberOfCollection

Table 15 lists implementation requirements for operations. If implemented, these operations shall be implemented as defined in DSP0200. In addition, and unless otherwise stated in Table 10, all operations in the default list in 8 shall be implemented as defined in DSP0200.

NOTE Related profiles may define additional requirements on operations for the profile class.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Requirement</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associators</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>AssociatorNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>References</td>
<td>Unspecified</td>
<td>None</td>
</tr>
<tr>
<td>ReferenceNames</td>
<td>Unspecified</td>
<td>None</td>
</tr>
</tbody>
</table>

8.9 CIM_VRFConfigurationService

All operations in the default list in 0 shall be implemented as defined in DSP0200.

8.10 CIM_NextHopIPRoute

All operations in the default list in 0 shall be implemented as defined in DSP0200.

8.11 CIM_VirtualRoutingAndForwardingTable

All operations in the default list in 0 shall be implemented as defined in DSP0200.

8.12 CIM_System

All operations in the default list in 0 shall be implemented as defined in DSP0200.
9 Use cases

This clause contains object diagrams and use cases for the Network Management - Virtual Routing and Forwarding Profile.

9.1 Profile Registration

The object diagram in Figure 2 shows an example for advertising profile conformance. Figure 2 is an example where an instance of CIM_ComputerSystem that is a compliant Virtual Ethernet Switch is the scoping class.

![Object Diagram](image)

**Figure 2 – Registered profile with Computer System Profile**

9.2 VRF with Routes and Interfaces

The object diagram is Figure 3 contains the basic element used to model a VRF. The instance diagram shows a CIM_ComputerSystem instance CS0 hosting an instance of CIM_VRFConfigurationService, CS0VRF. In this instance diagram one instance of a VRF, ManagementVRF has been created and is under the CIM_VRFConfigurationService instance CS0VRF. The diagram also shows that the ManagementVRF has two members, one an Ethernet port (E0/1) the other a remote service access point (NPT0).

The following method calls through the CS0VRF instance of CIM_VRFConfigurationService were performed to create and configure the VRF.

The ManagementVRF was created with a CIM_VRFConfigurationService.CreateVRF() method with the following parameters. Note this is for illustration purposes; other properties can be populated in the embedded class instances as required.

- TargetRouter - Reference to CS0:CIM_ComputerSystem
- VRF
  - Embedded instance of CIM_VirtualRoutingAndForwardingTable {
    ElementName = ManagementVRF}
The method call would return:

- ResultingVRF – Reference to ManagementVRF: CIM_VirtualRoutingAndForwardingTable.

The Ethernet port E0/1 was added to the VRF with the CIM_VRFConfigurationService.AddMemberPort() method with the following parameters:

- VRF - Reference to CIM_VirtualRoutingAndForwardingTable: ManagementVRF
- MemberPort – Reference to CIM_EthernetPort: E0/1

The remote service access point NTP0 was added to the VRF with the CIM_VRFConfigurationService.AddMemberSAP() method with the following parameters:

- VRF - Reference to CIM_VirtualRoutingAndForwardingTable: ManagementVRF
- MemberSAP – Reference to CIM_RemoteServiceAccessPoint: NTP0

A single route was added using the CIM_VirtualRoutingAndForwardingTable.AddRoute method with the following parameters:

- VRF - Reference to CIM_VirtualRoutingAndForwardingTable: ManagementVRF
- Route -
  - Embedded instance of CIM_NextHopIPRoute {
    DestinationAddress = 192.0.2.0
    DestinationMask = 255.0.0.0
    NextHopInterface = ...E0/1
    NextHopAddress = 192.0.2.4
    AdminDistance = 1
  }

The method call would return:

- ResultingRoute – Reference Route0: CIM_NextHopIPRoute.
10 CIM Elements

Table 16 shows the instances of CIM Elements for this profile. Instances of the CIM Elements shall be implemented as described in Table 16. Clauses 7 (“Implementation”) and 8 (“Methods”) may impose additional requirements on these elements.

Table 16 – CIM Elements: Network Management - Virtual Routing and Forwarding Profile

<table>
<thead>
<tr>
<th>Element Name</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIM_VRFRoute</td>
<td>Optional</td>
<td>See clause 7.1.3</td>
</tr>
<tr>
<td>CIM_AutonomousSystem</td>
<td>Optional</td>
<td>See clause 7.1.1</td>
</tr>
<tr>
<td>CIM_EthernetPort</td>
<td>Optional</td>
<td>See clause 7.1.5</td>
</tr>
<tr>
<td>CIM_HostedCollection</td>
<td>Mandatory</td>
<td>See clause 7.1.3</td>
</tr>
<tr>
<td>CIM_HostedService</td>
<td>Mandatory</td>
<td>See clause 7.1.2</td>
</tr>
<tr>
<td>Element Name</td>
<td>Requirement</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>CIM_MemberOfCollection</td>
<td>Optional</td>
<td>See clause 7.1.5 and 7.1.6</td>
</tr>
<tr>
<td>CIM_NextHopIPRoute</td>
<td>Optional</td>
<td>See clause 7.1.4</td>
</tr>
<tr>
<td>CIM_ServiceAccessPoint</td>
<td>Optional</td>
<td>See clause 7.1.6</td>
</tr>
<tr>
<td>CIM_ServiceAffectsElement</td>
<td>Mandatory</td>
<td>See clause 7.1.2</td>
</tr>
<tr>
<td>CIM_ServiceAvailableToElement</td>
<td>Mandatory</td>
<td>See clause 7.1.2</td>
</tr>
<tr>
<td>CIM_System</td>
<td>Mandatory</td>
<td>See clause 7.1.1</td>
</tr>
<tr>
<td>CIM_VirtualRoutingAndForwardingTable</td>
<td>Mandatory</td>
<td>See clause 7.1.3</td>
</tr>
<tr>
<td>CIM_VRFConfigurationService</td>
<td>Mandatory</td>
<td>See clause 7.1.2</td>
</tr>
</tbody>
</table>

**Indications**

None defined in this profile

### 10.1 CIM_HostedService

CIM_HostedService relates the CIM_VRFConfigurationService instance to its scoping CIM_ComputerSystem instance. Table 17 provides information about the properties of CIM_HostedService.

#### Table 17 – Class: CIM_HostedService

<table>
<thead>
<tr>
<th>Elements</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antecedent</td>
<td>Mandatory</td>
<td><strong>Key</strong>: This shall be a reference to the Central Instance. Cardinality 1</td>
</tr>
<tr>
<td>Dependent</td>
<td>Mandatory</td>
<td><strong>Key</strong>: This shall be a reference to an instance of CIM_VRFConfigurationService. Cardinality *</td>
</tr>
</tbody>
</table>

### 10.2 CIM_VRFRoute

CIM_VRFRoute is used to associate a set of CIM_NextHopRoute instances with a CIM_VirtualRoutingAndForwardingTable instance. Table 18 provides information about the properties of CIM_HostedService.

#### Table 18 – Class: CIM_VRFRoute

<table>
<thead>
<tr>
<th>Elements</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antecedent</td>
<td>Mandatory</td>
<td><strong>Key</strong>: This shall be a reference to a CIM_VirtualRoutingAndForwardingTable instance. Cardinality 1</td>
</tr>
<tr>
<td>Dependent</td>
<td>Mandatory</td>
<td><strong>Key</strong>: This shall be a reference to an instance CIM_NextHopRoute. Cardinality *</td>
</tr>
</tbody>
</table>
10.3 CIM_REGISTEREDPROFILE

CIM_REGISTEREDPROFILE identifies the *Network Management - Virtual Routing and Forwarding Profile* in order for a client to determine whether an instance of CIM_IPProtocolEndpoint is conformant with this profile. The CIM_REGISTEREDPROFILE class is defined by the *Profile Registration Profile*. With the exception of the mandatory values specified for the properties in Table 19, the behavior of the CIM_REGISTEREDPROFILE instance is in accordance with the *Profile Registration Profile*.

Table 19 – Class: CIM_REGISTEREDPROFILE

<table>
<thead>
<tr>
<th>Elements</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RegisteredName</td>
<td>Mandatory</td>
<td>This property shall have a value of &quot;Network Management Routing and Forwarding Profile&quot;.</td>
</tr>
<tr>
<td>RegisteredVersion</td>
<td>Mandatory</td>
<td>This property shall have a value of &quot;1.0.0c&quot;.</td>
</tr>
<tr>
<td>RegisteredOrganization</td>
<td>Mandatory</td>
<td>This property shall have a value of &quot;DMTF&quot;.</td>
</tr>
</tbody>
</table>

10.4 CIM_VIRTUALFORWARDINGANDROUTINGTABLE

CIM_VIRTUALFORWARDINGANDROUTINGTABLE is a collection of interfaces and routes that form the context used for a virtual routing and forwarding table (VRF). Table 20 provides information about the properties of CIM_VIRTUALFORWARDINGANDROUTINGTABLE.

Table 20 – Class: CIM_VIRTUALFORWARDINGANDROUTINGTABLE

<table>
<thead>
<tr>
<th>Elements</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InstanceID</td>
<td>Mandatory</td>
<td>Key: This property shall contain a unique ID to uniquely identify the specific instance.</td>
</tr>
<tr>
<td>ElementName</td>
<td>Optional</td>
<td>This property should contain the friendly VRF context name.</td>
</tr>
<tr>
<td>RouteDistinguisher</td>
<td>Optional</td>
<td>If populated this shall be an eight Octet field that uniquely distinguishes a route when there are multiple VRFs in a single router.</td>
</tr>
</tbody>
</table>

10.5 CIM_NEXTHOPROUTE

CIM_NEXTHOPROUTE represents one of a series a “hops” to reach a network destination.

Table 21 – Class: CIM_NEXTHOPROUTE

<table>
<thead>
<tr>
<th>Elements</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InstanceID</td>
<td>Mandatory</td>
<td>Key: This property shall contain a unique ID to uniquely identify the specific instance.</td>
</tr>
<tr>
<td>DestinationAddress</td>
<td>Mandatory</td>
<td>The address of the destination that needs to be reached.</td>
</tr>
</tbody>
</table>
10.6 CIM_NextHopIPRoute

CIM_NextHopIPRoute contains the properties required to specialize CIM_NextHopRoute for an IP route.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InstanceID</td>
<td>Mandatory</td>
<td><strong>Key:</strong> This property shall contain a unique ID to uniquely identify the specific instance.</td>
</tr>
</tbody>
</table>
ANNEX A
(informative)

Change log

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0.0</td>
<td>2018-09-04</td>
<td></td>
</tr>
</tbody>
</table>