The Virtual Fabrics MIB

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Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for information related to the Fibre Channel network’s Virtual Fabrics function.

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1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for information related to the Fibre Channel network's Virtual Fabric function.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410]. Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP).

Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

3. Short Overview of Fibre Channel

The Fibre Channel (FC) is logically a bidirectional point-to-point serial data channel, structured for high performance. Fibre Channel provides a general transport vehicle for higher-level protocols such as Small Computer System Interface (SCSI) command sets, the High-Performance Parallel Interface (Hippi) data framing, IP (Internet Protocol), IEEE 802.2, and others.

Physically, Fibre Channel is an interconnection of multiple communication points, called N_Ports, interconnected either by a switching network, called a Fabric, or by a point-to-point link. A Fibre Channel "node" consists of one or more N_Ports. A Fabric may consist of multiple Interconnet Elements, some of which are switches. An N_Port connects to the Fabric via a port on a switch called an F_Port. When multiple FC nodes are connected to a single port on a switch via an "Arbitrated Loop" topology, the switch port is called an FL_Port, and the nodes’ ports are called NL_Ports. The term Nx_Port is used to refer to either an N_Port or an NL_Port. The term Fx_Port is used to refer to either an F_Port or an FL_Port. A switch port, which is interconnected to another switch port via an
Inter-Switch Link (ISL), is called an E_Port. A B_Port connects a bridge device with an E_Port on a switch; a B_Port provides a subset of E_Port functionality.

Many Fibre Channel components (including the Fabric, each node, and most ports) have globally-unique names. These globally-unique names are typically formatted as World Wide Names (WWNs). More information on WWNs can be found in [FC-FS]. WWNs are expected to be persistent across agent and unit resets.

Fibre Channel frames contain 24-bit address identifiers that identify the frame’s source and destination ports. Each FC port has both an address identifier and a WWN. When a Fabric is in use, the FC address identifiers are dynamic and are assigned by a switch. Each octet of a 24-bit address represents a level in an address hierarchy, with a Domain_ID being the highest level of the hierarchy.

Virtual Fabrics allow a single physical Fabric to be divided into multiple logical Fabrics. Each Virtual Fabric may be managed independently like traditional Fabrics. Virtual Fabrics are designed to achieve a better utilization of a physical infrastructure and to isolate events in one Virtual Fabric from affecting other Fabrics. When one Core Switch provides switching functions for multiple Virtual Fabrics, that Core Switch is modeled as containing multiple Virtual Switches, one for each Virtual Fabric.

Each Virtual Fabric is identified by a 12-bit Virtual Fabric ID (VF_ID). When frames from multiple Virtual Fabrics are transmitted over a physical link, the VF_ID carried in a frame’s Virtual Fabric Tagging Header (VFT_Header) identifies which Virtual Fabric the frame belongs to. The use of VFT_Headers is enabled through an initial negotiation exchange between the two connected ports.

4. Relationship to Other MIBs

This MIB extends beyond [RFC4044] to cover the functionality, in Fibre Channel switches, of providing Fibre Channel’s Virtual Fabrics function.

5. MIB Overview

This MIB module provides the means for monitoring the operation of, and configuring some parameters of, one or more instances of Fibre Channel Virtual Fabric functionality. (Note that there are no definitions in this MIB module of "managed actions" which can be invoked via a remote network management protocol such as SNMP.)
The following MIB module has IMPORTS from [RFC2578], [RFC2579], [RFC2580], [RFC2863], [RFC4044], and [RFC4439]. In REFERENCE clauses, it refers to [FC-SW-4].

5.1. Fibre Channel Management Instance

A Fibre Channel management instance is defined in [RFC4044] as a separable managed instance of Fibre Channel functionality. Fibre Channel functionality may be grouped into Fibre Channel management instances in whatever way is most convenient for the implementation(s). For example, one such grouping accommodates a single SNMP agent having multiple AgentX [RFC2741] sub-agents, with each sub-agent implementing a different Fibre Channel management instance.

The object, fcmInstanceIndex, is IMPORTed from the FC-MGMT-MIB [RFC4044] as the index value to uniquely identify each Fibre Channel management instance, for example within the same SNMP context ([RFC3411] section 3.3.1). The t11vfVirtualSwitchTable augments the fcmSwitchTable, and the primary index variable of the fcmSwitchTable is fcmInstanceIndex.

5.2. Representing Core and Virtual Switches

In the presence of Virtual Switches, fcmSwitchTable in RFC4044 contains a row for each Virtual Switch. fcmSwitchTable, t11vfCoreSwitchTable, and t11vfVirtualSwitchTable are complementary. The t11vfCoreSwitchTable and t11vfVirtualSwitchTable contain information that helps the management client determine which Switches are Virtual Switches and how each relates to a Core Switch. A Virtual Switch must reside in a single Core Switch, and a Core Switch is defined as a set of entities with the same Core Switch_Name.

RFC 4044 was defined before Virtual Switches were standard and represented only physical Switches, so the RFC 4044 tables were not defined as read-create. With the advent of Virtual Switches, Virtual Switches can now be created by administrators, and read-create tables are required. The StorageType of RFC 4044 tables were not defined, and StorageTypes used in this MIB should also apply to the RFC 4044 tables that this MIB augments.
6. The T11-FC-VIRTUAL-FABRIC-MIB Module

T11-FC-VIRTUAL-FABRIC-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE,
    Unsigned32, mib-2
FROM SNMPv2-SMI -- [RFC2578]
  MODULE-COMPLIANCE, OBJECT-GROUP
    FROM SNMPv2-CONF -- [RFC2580]
  RowStatus, StorageType FROM SNMPv2-TC -- [RFC2579]
  InterfaceIndex FROM IF-MIB -- [RFC2863]
  fcmInstanceIndex, FcNameIdOrZero,
  fcmPortEntry, fcmSwitchEntry
    FROM FC-MGMT-MIB -- [RFC4044]
  T11FabricIndex
    FROM T11-TC-MIB; -- [RFC4439]

T11FcVirtualFabricMIB MODULE-IDENTITY
  LAST-UPDATED "200611100000Z"
  ORGANIZATION "IETF IMSS (Internet and Management Support
                for Storage) Working Group"
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DESCRIPTION
  "This module defines management information specific to
   Fibre Channel Virtual Fabrics. A Virtual Fabric is a
Fabric composed of partitions of switches, links and N_Ports with a single Fabric management domain, Fabric Services and independence from other Virtual Fabrics.

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REVISION        "200611100000Z"
DESCRIPTION      "Initial version of this MIB module, published as RFC 4747."

::= { mib-2 147 }
t11vfObjects OBJECT IDENTIFIER ::= { t11FcVirtualFabricMIB 1 }
t11vfConformance OBJECT IDENTIFIER ::= { t11FcVirtualFabricMIB 2 }

-- MIB object definitions
--
t11vfCoreSwitchTable OBJECT-TYPE
SYNTAX      SEQUENCE OF T11vfCoreSwitchEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION      "A table of core switches supported by the current management entity."
 ::= { t11vfObjects 1 }

T11vfCoreSwitchEntry OBJECT-TYPE
SYNTAX      T11vfCoreSwitchEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION      "Each entry represents one core switch."
INDEX   { fcmInstanceIndex, t11vfCoreSwitchSwitchName }
 ::= { t11vfCoreSwitchTable 1}

T11vfCoreSwitchEntry ::= SEQUENCE {
  t11vfCoreSwitchSwitchName   FcNameIdOrZero,
  t11vfCoreSwitchMaxSupported Unsigned32,
  t11vfCoreSwitchStorageType  StorageType
}

t11vfCoreSwitchSwitchName OBJECT-TYPE
SYNTAX      FcNameIdOrZero (SIZE(8 | 16))
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION

"The Core Switch_Name (WWN) of this Core Switch."
::= { t11vfCoreSwitchEntry 1 }

t11vfCoreSwitchMaxSupported OBJECT-TYPE
SYNTAX      Unsigned32 (1..4095)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"In switches that do not support Virtual Fabrics, this object has the value of 1. If Virtual Fabrics are supported, this object is the maximum number of Virtual Fabrics supported by the Core Switch. For the purpose of this count, the Control VF_ID is ignored."
::= { t11vfCoreSwitchEntry 2 }

t11vfCoreSwitchStorageType OBJECT-TYPE
SYNTAX      StorageType
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"The storage type for this conceptual row. Conceptual rows having the value 'permanent' need not allow write-access to any columnar objects in the row."
DEFVAL { nonVolatile }
::= { t11vfCoreSwitchEntry 3 }

-- Virtual Switch table

t11vfVirtualSwitchTable  OBJECT-TYPE
SYNTAX      SEQUENCE OF T11vfVirtualSwitchEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"A table of Virtual Switches. When one Core Switch provides switching functions for multiple Virtual Fabrics, that Core Switch is modeled as containing multiple Virtual Switches, one for each Virtual Fabric. This table contains one row for every Virtual Switch on every Core Switch. This table augments the basic switch information in the fcmSwitchTable Table in the FC-MGMT-MIB."
REFERENCE
"fcmSwitchTable is defined in the FC-MGMT-MIB [RFC4044]."
::= { t11vfObjects 2 }

t11vfVirtualSwitchEntry OBJECT-TYPE
SYNTAX      T11vfVirtualSwitchEntry

---

Kipp, et al. Standards Track [Page 7]
An entry of the Virtual Switch table. Each row is for a Virtual Switch.

This table augments the fcmSwitchTable, i.e., every entry in this table has a one-to-one correspondence with an entry in the fcmSwitchTable. At the time when the fcmSwitchTable was defined, it applied to physical switches. With the definition and usage of virtual switches, fcmSwitchTable now applies to virtual switches as well as physical switches, and (in contrast to physical switches) it is appropriate to provide the capability for virtual switches to be created via remote management applications, e.g., via SNMP.

So, this entry contains a RowStatus object (to allow the creation of a virtual switch), as well as a StorageType object. Obviously, if a row is created/deleted in this table, the corresponding row in the fcmSwitchTable will be created/deleted.

REFERENCE
"fcmSwitchEntry is defined in the FC-MGMT-MIB module [RFC4044]."

AUGMENTS { fcmSwitchEntry }
::= { t11vfVirtualSwitchTable 1}

t11vfVirtualSwitchEntry ::= SEQUENCE {
  t11vfVirtualSwitchVfId T11FabricIndex,
  t11vfVirtualSwitchCoreSwitchName FcNameIdOrZero,
  t11vfVirtualSwitchRowStatus RowStatus,
  t11vfVirtualSwitchStorageType StorageType
}

t11vfVirtualSwitchVfId OBJECT-TYPE
SYNTAX T11FabricIndex
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The VF_ID of the Virtual Fabric for which this virtual switch performs its switching function. The Control VF_ID is implicitly enabled and is not set. Communication with the Control VF_ID is required."

REFERENCE
"FC-SW-4, REV 7.5, section 12.2"
::= { t11vfVirtualSwitchEntry 1 }
t11vfVirtualSwitchCoreSwitchName OBJECT-TYPE
SYNTAX          FcNameIdOrZero (SIZE(8 | 16))
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The Core Switch_Name (WWN) of the Core Switch that contains this Virtual Switch."
REFERENCE       "FC-SW-4, REV 7.5, section 12.2."
 ::= { t11vfVirtualSwitchEntry 2 }

-- Port table

t11vfPortTable OBJECT-TYPE
SYNTAX          SEQUENCE OF T11vfPortEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "A table of Port attributes related to Virtual Fabrics."
 ::= { t11vfObjects 3 }

Kipp, et al. Standards Track [Page 9]
these four additional columns to the fcmPortEntry row.

REFERENCE
"fcmPortEntry is defined in the FC-MGMT-MIB module."

AUGMENTS { fcmPortEntry }
::= { t11vfPortTable 1 }

t11vfPortEntry ::= SEQUENCE {
    t11vfPortVfId                T11FabricIndex,
    t11vfPortTaggingAdminStatus   INTEGER,
    t11vfPortTaggingOperStatus    INTEGER,
    t11vfPortStorageType        StorageType
}

t11vfPortVfId OBJECT-TYPE
SYNTAX      T11FabricIndex
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"The Port VF_ID assigned to this Port. The Port VF_ID is the
default Virtual Fabric that is assigned to untagged frames
arriving at this Port. The Control VF_ID is implicitly
enabled and is not set. Communication with the Control
VF_ID is required."

REFERENCE
"FC-SW-4, REV 7.5, section 12.1"
DEFVAL    {1}
::= { t11vfPortEntry 1 }

t11vfPortTaggingAdminStatus OBJECT-TYPE
SYNTAX INTEGER {
    off(1),
    on(2),
    auto(3)
} MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"This object is used to configure the administrative status
of Virtual Fabric tagging on this Port.

<table>
<thead>
<tr>
<th>SET operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>off(1)</td>
<td>To disable Virtual Fabric tagging on this Port.</td>
</tr>
<tr>
<td>on(2)</td>
<td>To enable Virtual Fabric tagging on this Port.</td>
</tr>
</tbody>
</table>
Port if the attached Port doesn’t prohibit it.

auto(3) To enable Virtual Fabric tagging if the peer requests it.

REFERENCE
"FC-SW-4, REV 7.5, section 12.4"
::= { t11vfPortEntry 2 }

t11vfPortTaggingOperStatus OBJECT-TYPE
SYNTAX INTEGER {
  off(1),
  on(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object is used to report the operational status of Virtual Fabric tagging on this Port.

SET operation Description
---------- -------------------------------------------
off(1) Virtual Fabric tagging is disabled on this Port.
on(2) Virtual Fabric tagging is enabled on this Port."

REFERENCE
"FC-SW-4, REV 7.5, section 12.4"
::= { t11vfPortEntry 3 }

t11vfPortStorageType OBJECT-TYPE
SYNTAX StorageType
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The storage type for this conceptual row, and for the corresponding row in the augmented fcmPortTable.

Conceptual rows having the value ‘permanent’ need not allow write-access to any columnar objects in the row."
DEFVAL { nonVolatile }
::= { t11vfPortEntry 4 }

-- Locally Enabled Table

t11vfLocallyEnabledTable OBJECT-TYPE
A table for assigning and reporting operational status of locally-enabled Virtual Fabric IDs to Ports. The set of Virtual Fabrics operational on the Port is the bit-wise 'AND' of the set of locally-enabled VF_IDs of this Port and the locally-enabled VF_IDs of the attached Port.

 ::= { t11vfObjects 4 }

t11vfLocallyEnabledEntry OBJECT-TYPE
SYNTAX T11vfLocallyEnabledEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "An entry for each locally-enabled VF_ID on each Port."
REFERENCE "FC-SW-4, REV 7.5, section 12.4"
INDEX { t11vfLocallyEnabledPortIfIndex, t11vfLocallyEnabledVfId }

 ::= { t11vfLocallyEnabledTable 1}

T11vfLocallyEnabledPortIfIndex OBJECT-TYPE
SYNTAX InterfaceIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The value of the ifIndex that identifies the Port."
 ::= { t11vfLocallyEnabledEntry 1 }

T11vfLocallyEnabledVfId OBJECT-TYPE
SYNTAX T11FabricIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A locally-enabled VF_ID on this Port."
 ::= { t11vfLocallyEnabledEntry 2 }
t11vfLocallyEnabledOperStatus OBJECT-TYPE
SYNTAX INTEGER {
  off(1),
  on(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object is used to report the operational status of
Virtual Fabric tagging on this Port.

<table>
<thead>
<tr>
<th>SET operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>off(1)</td>
<td>Virtual Fabric tagging is disabled on this Port.</td>
</tr>
<tr>
<td>on(2)</td>
<td>Virtual Fabric tagging is enabled on this Port.</td>
</tr>
</tbody>
</table>

REFERENCE
"FC-SW-4, REV 7.3, section 12.4"
::= { t11vfLocallyEnabledEntry 3 }

t11vfLocallyEnabledRowStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The status of this conceptual row.

When a row in this table is in ‘active(1)’ state,
no object in that row can be modified except
t11vfLocallyEnabledRowStatus and
t11vfLocallyEnabledStorageType."
::= { t11vfLocallyEnabledEntry 4 }

t11vfLocallyEnabledStorageType OBJECT-TYPE
SYNTAX StorageType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The storage type for this conceptual row.
Conceptual rows having the value ‘permanent’ need not
allow write-access to any columnar objects in the row."
DEFVAL { nonVolatile }
::= { t11vfLocallyEnabledEntry 5 }

--**************************
t11vfMIBCompliances OBJECT IDENTIFIER ::= { t11vfConformance 1 }
t11vfMIBGroups OBJECT IDENTIFIER ::= { t11vfConformance 2 }

t11vfMIBCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION "Describes the requirements for compliance to the
  Fibre Channel Virtual Fabric MIB."
  MODULE -- this module
  MANDATORY-GROUPS { t11vfGeneralGroup }

  OBJECT t11vfCoreSwitchMaxSupported
  MIN-ACCESS read-only
  DESCRIPTION "Write access is not required."

  OBJECT t11vfCoreSwitchStorageType
  MIN-ACCESS read-only
  DESCRIPTION "Write access is not required."

  OBJECT t11vfVirtualSwitchVfId
  MIN-ACCESS read-only
  DESCRIPTION "Write access is not required."

  OBJECT t11vfVirtualSwitchRowStatus
  SYNTAX RowStatus { active(1) }
  MIN-ACCESS read-only
  DESCRIPTION "Write access is not required."

  OBJECT t11vfVirtualSwitchStorageType
  MIN-ACCESS read-only
  DESCRIPTION "Write access is not required."

  OBJECT t11vfPortVfId
  MIN-ACCESS read-only
  DESCRIPTION "Write access is not required."

  OBJECT t11vfPortTaggingAdminStatus
  MIN-ACCESS read-only
  DESCRIPTION
"Write access is not required."

OBJECT t11vfPortStorageType
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT t11vfLocallyEnabledRowStatus
SYNTAX RowStatus { active(1) }
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT t11vfLocallyEnabledStorageType
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

::= { t11vfMIBCompliances 1 }

-- Units of conformance

t11vfGeneralGroup OBJECT-GROUP
OBJECTS { t11vfCoreSwitchMaxSupported,
    t11vfVirtualSwitchVfId,
    t11vfVirtualSwitchCoreSwitchName,
    t11vfVirtualSwitchRowStatus,
    t11vfPortVfId,
    t11vfPortTaggingAdminStatus,
    t11vfLocallyEnabledOperStatus,
    t11vfPortTaggingOperStatus,
    t11vfLocallyEnabledRowStatus,
    t11vfCoreSwitchStorageType,
    t11vfVirtualSwitchStorageType,
    t11vfPortStorageType,
    t11vfLocallyEnabledStorageType
}
STATUS current
DESCRIPTION
"A collection of objects for monitoring and configuring Virtual Fabrics in a Fibre Channel switch."
::= { t11vfMIBGroups 1 }

END
7. Security Considerations

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- t11vfCoreSwitchMaxSupported, t11vfVirtualSwitchVfId, t11vfCoreSwitchStorageType, t11vfVirtualSwitchStorageType and t11vfVirtualSwitchRowStatus
  - the ability to change the configuration of Virtual Fabrics on a particular switch.

- t11vfPortTaggingAdminStatus, t11vfLocallyEnabledRowStatus, t11vfPortVfId, t11vfPortStorageType and t11vfLocallyEnabledStorageType
  - the ability to change the configuration of Virtual Fabrics on a port of a particular switch.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- t11vfVirtualSwitchCoreSwitchName, t11vfPortTaggingOperStatus, t11vfLocallyEnabledOperStatus,
  - the ability to discover configuration of Virtual Fabrics on a virtual switch or a port.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).
Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

8. IANA Considerations

IANA has assigned 147 for the MIB module under the appropriate subtree.

9. Acknowledgements

This document was developed by the INCITS Task Group T11.5. We wish to acknowledge the contributions and comments from the INCITS Technical Committee T11 and the IMSS WG, including the following:

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T11 Vice Chair: Claudio Desanti, Cisco Systems
T11.5 Chair: Roger Cummings, Symantec
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10. Normative References


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