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Fibre Channel Host Bus Adapter Diagnostics Profile

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CONTENTS

Figures

Tables

Foreword

The *Fibre Channel Host Bus Adapter Diagnostics Profile* (DSP1104) was prepared by the Diagnostics Working Group of the DMTF.

DMTF is a not-for-profit association of industry members dedicated to promoting enterprise and systems management and interoperability. For information about the DMTF, see http://www.dmtf.org.

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Introduction

A *profile* is a collection of Common Information Model (CIM) elements and behavior rules that represent a specific area of management. The purpose of the profile is to ensure interoperability of Web-Based Enterprise Management (WBEM) services for a specific subset of the CIM schema — in this case, CPU diagnostics.

Diagnostics is a critical component of systems management. Diagnostic services are used in problem containment to maintain availability, achieve fault isolation for system recovery, establish system integrity during boot, increase system reliability, and perform routine proactive system verification. The goal of the Common Diagnostic Model (CDM) is to define industry-standard building blocks, based on and consistent with the DMTF CIM, which enable seamless integration of vendor-supplied diagnostic services into system and storage area network management frameworks.

The goal of the *Fibre Channel Host Bus Adapter Diagnostics Profile* is to define industry-standard building blocks that enable seamless problem determination support for Fibre Channel Host Bus Adapters (FC HBA) and to troubleshoot network problems involving FC HBAs. The profile extends the standard diagnostic profile by identifying a base set of FC HBA functions that should be diagnosed by provider implementations. Suppliers can differentiate their diagnostic offering by providing this base set of diagnostics and developing diagnostics to analyze proprietary features of the FC HBA.

Document conventions

Typographical conventions

The following typographical conventions are used in this document:

- Document titles are marked in *italics*.
- Important terms that are used for the first time are marked in *italics*.

ABNF usage conventions

Format definitions in this document are specified using ABNF (see RFC5234), with the following deviations:

- Literal strings are to be interpreted as case-sensitive Unicode characters, as opposed to the definition in RFC5234 that interprets literal strings as case-insensitive US-ASCII characters.

147 # Fibre Channel Host Bus Adapter Diagnostics Profile

148 ## 1 Scope

149 The *Fibre Channel Host Bus Adapter Diagnostics Profile* specializes the *Diagnostics Profile* by defining
150 the diagnostic tests needed to determine the health of an FC HBA as well as the tests needed to
151 troubleshoot storage area network problems involving FC HBAs. The diagnostic tests are defined as
152 subclasses of CIM_DiagnosticTest.

153 ## 2 Normative references

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

158 DMTF DSP0004, *CIM Infrastructure Specification 2.6*,
159 http://dmtf.org/sites/default/files/standards/documents/DSP0004_2.6.pdf

160 DMTF DSP0200, *CIM Operations over HTTP 1.3*,
161 http://dmtf.org/sites/default/files/standards/documents/DSP0200_1.3.pdf

162 DMTF DSP1001, *Management Profile Specification Usage Guide 1.0*,
163 http://dmtf.org/sites/default/files/standards/documents/DSP1001_1.0.pdf

164 DMTF DSP1002, *Diagnostics Profile 2.0*,
165 http://dmtf.org/sites/default/files/standards/documents/DSP1002_2.0.pdf

166 DMTF DSP1033, *Profile Registration Profile 1.0*,
167 http://dmtf.org/sites/default/files/standards/documents/DSP1033_1.0.pdf

168 IETF RFC5234, *ABNF: Augmented BNF for Syntax Specifications, January 2008*,
169 http://tools.ietf.org/html/rfc5234

170 ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*,
171 http://isotc.iso.org/livelink/livelink.exe?func=ll&objId=4230456&objAction=browse&sort=subtype

172 T11, *Fibre Channel Generic Services – 5* (FC-GS-5), T11 document T11/1677-D, Rev 8.51,
173 (Login required) http://www.t11.org/ftp/t11/pub/fc/gs-5/06-192v3.pdf

174 T11, *Fibre Channel Storage Network Ping* (SNPing), T11 document T11/07-116v5, Rev 0.65,
175 (Login required) http://www.t11.org/ftp/t11/pub/sm/snping/07-116v5.pdf

176 T11, *Storage Management – HBA – 2nd Generation* (SM-HBA-2), T11 document T11/1841-D, Rev 0.20,
177 ftp://ftp.t10.org/t11/document.06/06-691v1.pdf

178 ## 3 Terms and definitions

179 In this document, some terms have a specific meaning beyond the normal English meaning. Those terms
180 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, DSP0200, and DSP1001 apply to this document.

4 Symbols and abbreviated terms

The following symbols and abbreviations are used in this document.

4.1
CDM
Common Diagnostic Model

4.2
CIM
Common Information Model

4.3
CIMOM
CIM Object Manager

4.4
CRU
Customer Replaceable Unit

4.5
CT
Common Transport

4.6
FRU
Field Replaceable Unit

4.7
FC
Fibre Channel

4.8
HBA
Host Bus Adapter

4.9
ICMP
Internet Control Message Protocol

4.10
LED
Light-Emitting Diode

4.11
LUN
Logical Unit Number

4.12
ME
Managed Element

4.13
MOF
Managed Object Format

4.14
PD
Problem Determination

4.15
PFA
Predictive Failure Analysis

4.16
POST
Power-On Self-Test

4.17
SAN
Storage Area Network

4.18
SLP
Service Location Protocol

4.19
SM-HBA
Storage Management Host Bus Adapter

4.20
SNPing
Storage Network Ping

4.21
WBEM
Web-Based Enterprise Management

4.22
WWPN
World Wide Port Name

5 Synopsis

Profile name: FC HBA Diagnostics

Version: 1.0.0

Organization: DMTF

CIM Schema version: 2.31

Central class: CIM_FCHBADiagnosticTest

Scoping class: CIM_ComputerSystem

Specializes: Diagnostics Profile 2.0.0

The *Fibre Channel Host Bus Adapter Diagnostics Profile* extends the management capability of referencing profiles by adding common methods for determining that the FC HBA is operating normally and for troubleshooting Fibre Channel network problems involving the FC HBA in a managed system.

CIM_FCHBADiagnosticTest shall be the Central Class of this profile. The instance of CIM_FCHBADiagnosticTest shall be the Central Instance of this profile. CIM_ComputerSystem shall be the Scoping Class of this profile. The instance of CIM_ComputerSystem with which the Central Instance is associated through an instance of CIM_HostedService shall be the Scoping Instance of this profile.

The CIM_ManagedElement is CIM_PortController or a subclass of it.

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

Table 1 – Referenced profiles

Profile name	Organization	Version	Description
Diagnostics	DMTF	2.0	Specializes
Profile Registration	DMTF	1.0	Mandatory
FC HBA	SNIA	1.3.0	Optional

6 Description

Two categories of Fibre Channel Host Bus Adapter (FC HBAs) diagnostics are useful in SAN environments: those that diagnose the FC HBA itself and those used to help troubleshoot network problems. These two classes can be further categorized into two different types: destructive and non-destructive.

The *Diagnostics Profile* defines destructive tests as those that have the potential for destroying data, permanently altering the state, or reconfiguring the device. In the case of an FC HBA, any test that could cause a previously executing application to lose access to the SAN should be considered destructive because it could cause the data contained in an active transaction to be lost. An example would be using a loopback to verify data pathways. When the loopback runs, the FC HBA cannot carry normal traffic.

Non-destructive diagnostics are those that can be safely executed without disrupting normal traffic, such as using a form of echo to verify the accessibility of a SAN device. Practical SAN management requires both types and both categories of diagnostics to maintain operations in production environments. As such, all FC HBA diagnostics shall work in a normal operating system environment. Special pre-boot environments shall not be required. The diagnostic tests specified in this profile may be implemented in the FC HBA's firmware, the driver, or the FC HBA Diagnostics Provider itself. The goal of the *Fibre*

Channel Host Bus Adapter Diagnostics Profile is to define a set of standard diagnostics that meet these needs and are both vendor and hardware agnostic.

FC HBAs are field replaceable units (FRUs); when defective, they are simply replaced. When the host system or SAN management framework wishes to verify the health of an FC HBA it should not have to be concerned with testing the individual FC HBA components. Rather it needs to be able to call upon a single diagnostic that tests the entire FC HBA. This self-test shall be comprehensive, similar to a Power-On Self-Test (POST). By its nature, this test is destructive. All FC HBA diagnostic providers shall support a Self-Test.

Verifying the health of an FC HBA non-destructively is problematic. Any definitive health verification disrupts, suspends or corrupts normal data traffic. However, it is possible to determine relative health of the FC HBA using data such as its current operational state, error counts, and the results of its last POST. Diagnostics providers should take advantage of this test to report any detected degraded conditions before they become problems. Executing this test would also verify that basic communications with the FC HBA are operational. All FC HBA diagnostic providers shall support a Status test.

To enable the isolation of certain types of faults, FC HBAs should also be testable at their boundaries. The boundaries of an FC HBA are its connection to the system bus and its connection to the Fibre Channel SAN. Being able to test at these boundaries makes it possible to isolate problems to the FC HBA or to the SAN. For instance, if the transmit side of the cable from the FC HBA to the switch broke, the HBA would still have a link but would not receive any responses. From the viewpoint of the host, the source of the problem would not be clear; it could be a problem with the FC HBA or something on the SAN itself. Putting the FC HBA into loopback would show that the pathway from the host through the HBA was working properly and that the problem is something on the SAN.

There are both internal and external Fibre Channel loopbacks. Internal loopbacks are desirable because they allow the HBA to be tested remotely without having to physically reconfigure the SAN. However, because internal loopbacks are implemented in circuitry and not in the FC optics, they do not test the entire data pathway through the FC HBA. By their nature, FC loopback tests are destructive. All FC HBA diagnostic providers shall support both internal and external FC loopback tests.

Loopbacks can also be implemented at the FC HBA's host bus interface. These loopbacks are helpful in isolating problems occurring between the FC HBA and the host system. If an FC HBA is failing internal loopback tests, the problem lies in the data path of the HBA if that HBA can pass host bus interface loopback tests. As with FC loopbacks, host bus interface loopbacks are destructive. All FC HBA diagnostic providers shall support host bus interface loopbacks only if the FC HBA being tested supports them.

One of the most familiar and powerful tools in an IP network maintenance engineer's "toolbox" is the Ping utility. This utilizes the Internet Control Message Protocol (ICMP) that is supported by every Network Interface Card (NIC) to provide a simple method of testing for the presence of a NIC at a specified address. To minimize the use of SAN bandwidth, both the size of the data packet to be transmitted and the number of iterations should be kept small. The input parameters of the Ping test are similar to those defined by T11's *Fibre Channel Storage Network Ping* (SNPing) utility specification for Fibre Channel devices. All FC HBA diagnostic providers shall support a Ping test, and the Ping test shall be non-destructive.

Another common network troubleshooting technique is to repeatedly send traffic to a specific device, have it echoed back, and then verify that the data is still intact. This is similar to Ping, except that it is acceptable to generate enough traffic for the test to become destructive (that is, disruptive to other network traffic). This Echo test can be useful when resolving network configuration or performance issues. The size and content of the data packet to be sent may be varied. Because sustained Echo tests increase network latency and can be disruptive, they should be considered destructive. All FC HBA diagnostic providers shall support an Echo test.

Like any other programmed device, FC HBAs can sometimes be affected by software errors that can cause them to behave erratically, enter an unknown state, or stop working altogether. Resetting an FC

HBA often clears these conditions and restores the host's access to the FC SAN. Because resetting an FC HBA causes it to lose its current state information and any transactions that are in progress, Reset shall be considered destructive. All FC HBA diagnostic providers shall support a Reset test.

Many host systems contain multiple FC HBAs. If one of these HBAs is known to be malfunctioning, it can be difficult to visually identify which HBA is the defective unit when attempting to replace it. Flashing one or more LEDs on the HBA in a known pattern, or beaconing, resolves this problem. The flashing LEDs allow the HBA in question to be easily identified. Beaconing is non-destructive. All FC HBA diagnostic providers shall support a Beacon test only if the FC HBA under test supports it.

The *Fibre Channel Host Bus Adapter Diagnostics Profile* describes the set of tests necessary for diagnosing FC HBA issues and troubleshooting some SAN issues. Each test is a specialization of CIM_DiagnosticTest. The supported service modes, user controls, log options, and loop controls for each test are advertised through the CIM_FCHBADiagnosticsServiceCapabilities instance. For tests with specifiable parameters, the default parameter values are advertised through instances of CIM_ElementSettingData that associate an instance of CIM_FCHBADiagnosticSettingData to the test. Where supported, clients specify non-default test parameters by creating instances of CIM_FCHBADiagnosticSettingData that are associated to instances of CIM_FCHBADiagnosticTest.

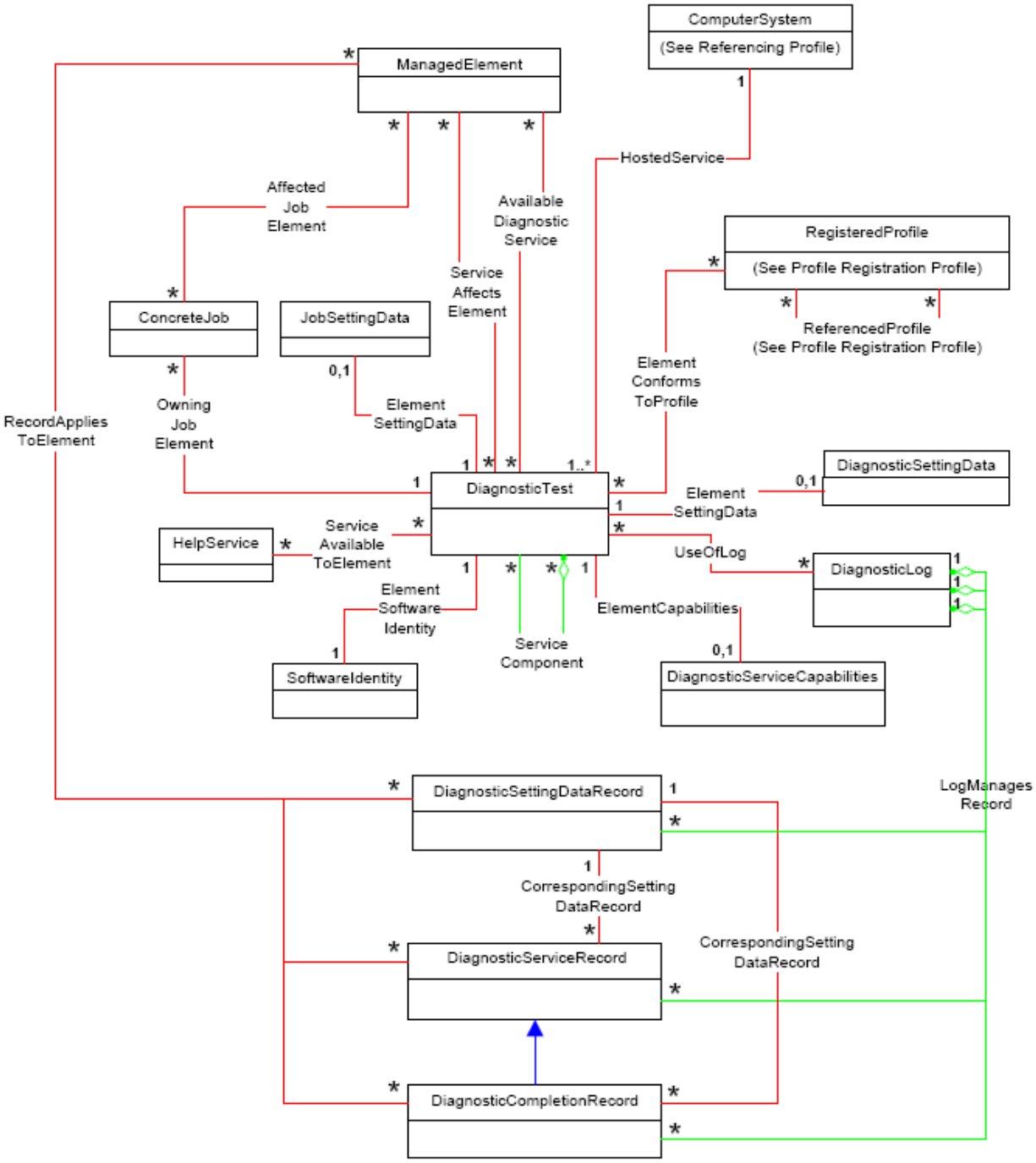

Figure 1 – Fibre Channel Host Bus Adapter Diagnostics Profile: Profile class diagram

7 Implementation

This clause provides additional implementation details for the various diagnostic tests of this profile.

7.1 FC HBA test information

Table 2 contains information about the test types.

Table 2 – Test type information

Test name	Test information	
Beacon	**Description**	The diagnostic causes at least one of the LEDs of an FC HBA to flash on and off.
	Coverage Range	FC HBA LEDs
	Destructive	No
	User Control	The user may specify the number of iterations or the duration that the LED blinks on and off.
	Execution Time	The test shall run on the order of seconds or minutes.
	Built into Device	Yes
	Details	The LED flash pattern is determined by the vendor, but the pattern shall be distinct from that of normal activity. The LED to be flashed may be the normal activity/status LEDs or separate LEDs provided solely for beaconing.
Echo	**Description**	The diagnostic verifies the data path from host to target.
	Coverage Range	The complete data path from host to target
	Destructive	The diagnostic can cause a loss of network bandwidth and cause problems for some applications.
	User Control	The user may specify the type of Echo test, the buffer size and buffer pattern to be used, and the target device.
	Execution Time	The test shall run on the order of seconds or minutes.
	Built into Device	Yes
	Details	The FC HBA must be connected to a SAN that contains a device that supports Echo.
External Loopback	**Coverage Area**	The diagnostic verifies that the entire data path through an FC HBA is working properly.
	Coverage Range	The entire FC HBA data path
	Destructive	The diagnostic blocks all access to the SAN while it is in progress.
	User Control	The user may specify the buffer size and buffer pattern to be used.
	Execution Time	The test shall run on the order of seconds or minutes.
	Built into Device	Yes
	Details	A loopback connector is required. With an external loopback connector attached to the FC HBA, data packets are sent to the FC HBA and then read back. The results are compared to verify that the data does not change.

Test name	Test information	
Host Bus Loopback	**Coverage Area**	The diagnostic tests an FC HBA's host bus interface.
	Coverage Range	The data path from the host system's memory to the FC HBA's host bus interface.
	Destructive	This test blocks all access to the SAN while it is in progress.
	User Control	The user may specify the buffer size and buffer pattern to be used.
	Execution Time	The test shall run on the order of seconds.
	Built into Device	Yes
	Details	After activating the host bus loopback, data packets are sent to the FC HBA and then read back. The results are compared to verify that the data has not changed.
Internal Loopback	**Coverage Area**	The diagnostic verifies the integrity of internal data paths in the FC HBA.
	Coverage Range	The data path from the host through most of the FC HBA is tested. The actual placement of the loopback is vendor-dependent, but it is normally before the Fibre Channel optics.
	Destructive	The diagnostic blocks all access to the SAN while it is in progress.
	User Control	The user may specify the buffer size and buffer pattern to be used.
	Execution Time	The test shall run on the order of seconds.
	Built into Device	Yes
	Details	After activating the internal loopback, data packets are sent to the FC HBA and then read back. The results are compared to verify that the data has not changed.
Ping	**Coverage Area**	The diagnostic verifies the existence and accessibility of devices on the SAN.
	Coverage Range	Complete data path from host to target
	Destructive	No
	User Control	The user may specify the type of Ping test, the buffer size and buffer pattern to be used, and the target device.
	Execution Time	The test shall run on the order of seconds or minutes.
	Built into Device	Yes

Test name	Test information	
	Details	The FC HBA must be connected to a SAN that contains a device that supports the desired Ping mechanism. Fibre Channel protocol does not contain any constructs similar to ICMP Ping that are universally implemented. The closest match to Ping is the optional Fibre Channel Echo Extended Link (FC Echo). It sends a single frame of data to a recipient that then returns it without modifying its content. Determining that the content has not changed verifies that the recipient is present and can be communicated with correctly. Another possible mechanism for implementing Ping functionality would be to use SCSI commands such as Inquiry to access the device. This would provide coverage for all SCSI devices connected to the SAN. Because no one mechanism can provide coverage for all FC devices, a Ping test shall support both FC and SCSI Inquiry. Other mechanisms such as FC Trace Route may also be used. To minimize the use of SAN bandwidth, both the size of the data packet to be transmitted and the number of iterations should be kept small. The input parameters of this Ping test should be similar to those defined by T11's *Fibre Channel Storage Network Ping* (SNPing) utility specification for Fibre channel devices.
Reset	**Coverage Area**	The diagnostic causes the FC HBA to reinitialize itself.
	Coverage Range	The entire FC HBA
	Destructive	Any traffic in progress is lost, and the FC HBA is unable to carry traffic while this test is in progress.
	User Control	None
	Execution Time	The test shall run on the order of seconds.
	Built into Device	Yes
	Details	The implementation of this test is vendor-specific.
Self-Test	**Coverage Area**	This test allows all components of the FC HBA to be tested.
	Coverage Range	The entire FC HBA except for the FC optics
	Destructive	The FC HBA is unable to carry traffic while this test is in progress.
	User Control	None
	Execution Time	The test shall run on the order of seconds.
	Built into Device	Yes
	Details	The details of the Self-Test are vendor-specific. It is expected that the test will be comprehensive, testing all possible components on the FC HBA. The test is not expected to test the FC optics. The test must leave the HBA in the same state that it was in before the test was run.
Status	**Coverage Area**	The diagnostic checks the health of the FC HBA, not including the FC optics.
	Coverage Range	The data path to the FC HBA and the entire FC HBA except for the FC optics is tested.
	Destructive	No
	User Control	None
	Execution Time	The test shall run on the order of seconds.
	Built into Device	Yes

Test name	Test information	
	Details	The implementation of this test is vendor-unique but should take into consideration the state of the FC port. Other possible data sources to be used include the results of the last POST or Self-Test, trends in error counts, and vendor-specific data.

7.2 CIM_FCHBADiagnosticTest

The CIM_FCHBADiagnosticTest class can be used for a variety of tests necessary for diagnosing FC HBA issues. Table 3 defines the valid property values and whether the test is mandatory or optional. An implementation may extend this class and add vendor-defined tests using the Vendor Defined range of the FCHBATestType valuemap.

Table 4 provides additional information about the CIM_FCHBADiagnosticTest class.

Table 3 – CIM_FCHBADiagnosticTest property requirements

Test name	Criteria	ElementName*	FCHBATestType	TestType*
Beacon	Optional	FC HBA Beacon Test	2	(2) Functional
Echo	Mandatory	FC HBA Echo Test	3	(3) Stress (5) Access Test
External Loopback	Mandatory	FC HBA External Loopback Test	4	(2) Functional (5) Access Test
Host Bus Loopback	Optional	FC HBA Host Bus Loopback Test	5	(2) Functional
Internal Loopback	Mandatory	FC HBA Internal Loopback Test	6	(2) Functional
Ping	Mandatory	FC HBA Ping Test	7	(5) Access Test
Reset	Mandatory	FC HBA Reset Test	8	(2) Functional
Self	Mandatory	FC HBA Self-Test	9	(2) Functional
Status	Mandatory	FC HBA Status Test	10	(4) Health Check

An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticSettingData.

Table 4 – CIM_FCHBADiagnosticTest property requirements

Test name	Characteristics*	Comment
Beacon		
Echo	4 (Is Destructive) 10 (Additional Hardware Required)	The FC HBA must be connected to a SAN that contains a device that supports Echo.
External Loopback	4 (Is Destructive) 10 (Additional Hardware Required)	A loopback connector is required.
Host Bus Loopback	4 (Is Destructive)	
Internal Loopback	4 (Is Destructive)	
Ping	4 (Is Destructive) 10 (Additional Hardware Required)	The FC HBA must be connected to a SAN that contains a device that supports the desired Ping mechanism.
Reset	4 (Is Destructive)	
Self-Test	4 (Is Destructive)	
Status		
Beacon		

An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticTest

7.3 CIM_FCHBADiagnosticSettingData

One or more instances of the CIM_FCHBADiagnosticSettingData class may be implemented. They are associated to CIM_FCHBADiagnosticTest using CIM_ElementSettingData. The vendor-defined default values may be specified and advertised using an instance of CIM_FCHBADiagnosticSettingData that is referenced by the instance of CIM_ElementSettingData whose property value for IsDefault is 1 (Is Default).

A diagnostic test may require parameters to run. Some parameters may affect how the test is run, while other parameters provide the values to be used by the test.

The CIM_DiagnosticSettingData class contains properties that affect how a diagnostic test is run (for example, LoopControl, QuickMode), how errors are handled (for example, HaltOnError), or how results are logged (for example, LogOptions). CIM_DiagnosticSettingData is an argument to the CIM_DiagnosticTest.RunDiagnosticService( ) extrinsic method. If additional properties are needed that control the behavior of the diagnostic test, they should be defined in a subclass of CIM_DiagnosticSettingData.

The client may use the vendor-defined default CIM_FCHBADiagnosticSettingData instance as an argument to the CIM_FCHBADiagnosticTest.RunDiagnosticService( ) extrinsic method. Alternatively, the client may create its own instance of CIM_FCHBADiagnosticSettingData and use it instead.

The CIM_FCHBADiagnosticSettingData class defines the parameters that may be used by some of the FC HBA tests. Table 5 lists these test parameters and shows which tests might use them. An implementation may extend this class and define additional parameters for any other Vendor Defined tests.

401 **Table 5 – CIM_FCHBADiagnosticSettingData property requirements**

Test name	ElementName*	Target device	Echo mechanism	LUN	Buffer sizes	Buffer pattern	Ping mechanism
Beacon	FC HBA Beacon Test						
Echo	FC HBA Echo Test	Used	Used	Used	Used	Used	
External Loopback	FC HBA External Loopback Test				Used	Used	
Host Bus Loopback	FC HBA Host Bus Loopback Test				Used	Used	
Internal Loopback	FC HBA Internal Loopback Test				Used	Used	
Ping	FC HBA Ping Test	Used		Used	Used	Used	Used
Reset	FC HBA Reset Test						
Self	FC HBA Self-Test						
Status	FC HBA Status Test						
Stress	FC HBA Beacon Test						

402 An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticSettingData.

403 ### 7.3.1 CIM_FCHBADiagnosticSettingData.TargetDevice

404 This property is used by a client for the Echo and Ping tests to specify which device they are targeting.

405 The Echo and Ping tests send packets of data from the local host to a remote device on the FC SAN. The
406 CIM_DiagnosticService.RunDiagnosticService( ) extrinsic method requires a reference to the managed
407 element (local FC HBA) to be used in the test. However, in order to run the test, the address of the
408 remote device is needed.

409 When FC Echo is being used, this property contains either the World Wide Port Name (WWPN) or the FC
410 port address of the device to be targeted. Typically, a port address is used for point-to-point and
411 arbitrated loops, while a WWPN is normally used in fabrics. When SCSI Inquiry is to be used, the property
412 must contain a WWPN.

413 The string is formatted as ASCII characters representing hexadecimal digits. The only characters to be
414 used shall be 0–9 and A–F. Leading zeros are permitted. WWPNs shall contain 16 characters. FC port
415 addresses shall contain six characters.

416 For the Echo and Ping tests, TargetDevice has no default value; that is, a value must be specified.

417 NOTE When SCSI commands are used, in addition to specifying the target device, the client must specify a LUN
418 on the target device using CIM_FCHBADiagnosticSettingData.LUN.

419 ### 7.3.2 CIM_FCHBADiagnosticSettingData.TargetDeviceFormat

420 This property specifies the format of the TargetDevice value, which is a string formatted as ASCII
421 characters representing hexadecimal digits. The only characters to be used shall be 0–9 and A–F.
422 Leading zeros are permitted. WWPNs shall contain 16 characters. FC port addresses shall contain six
423 characters.

424 ### 7.3.3 CIM_FCHBADiagnosticSettingData.EchoMechanism

425 This property is used by a client for the Echo test to specify one of the Echo test types listed in Table 6.

426 **Table 6 – CIM_FCHBADiagnosticSettingData.EchoMechanism**

EchoMechanism value	Criteria	Notes
1 (Other)	Optional	
2 (FC Echo)	Mandatory	The default
3 (SCSI read/write)	Mandatory	
4 (FC Trace Route)	Optional	
5 (FC Test)	Optional	

427 Fibre Channel Echo Extended Link (FC Echo) can be used to implement the Echo test against many, but
428 not all, FC devices. CT Pass Through allows SCSI read/write buffer commands to be used to implement
429 Echo against SCSI or SAS devices attached to the SAN. Because no one mechanism can be used to
430 implement the Echo test against all possible devices, FC HBA providers shall support both of these
431 mechanisms in order to maximize the number of testable devices.

432 Support for FC Trace Route is optional and requires the use of the HBA_SendCTPassThruV2 function to
433 send an FC Trace Route CT payload. Support for FC Test is also optional and requires the use of the
434 SMHBA_SendTEST function. Both of these functions require that the FC HBA, the associated HBAAPI
435 library, and the target support SM-HBA.

436 7.3.4 CIM_FCHBADiagnosticSettingData.LUN

437 This property is used by a client for the tests shown in Table 5 to specify which LUN they are targeting
438 when SCSI commands are used as the Echo mechanism or Ping mechanism.

439 The typical default value is 0. The vendor-defined default value is advertised using the default instance of
440 CIM_FCHBADiagnosticSettingData.

441 If no value is specified by the client, the vendor-defined default value will be used.

442 7.3.5 CIM_FCHBADiagnosticSettingData.BufferSizes

443 This array property is used by a client for the tests shown in Table 5 to specify the data buffer sizes to be
444 used during the test.

445 The vendor-defined default value is advertised using the default instance of
446 CIM_FCHBADiagnosticSettingData.

447 If no value is specified by the client, the vendor-defined default value will be used.

448 7.3.6 CIM_FCHBADiagnosticSettingData.BufferPattern

449 This octet array property is used by a client for the tests shown in Table 5 to specify the data pattern to be
450 used by the test. If the buffer pattern is smaller than BufferSize, the pattern will be repeated as necessary
451 to fill the buffer. If the buffer pattern is larger than BufferSize, the pattern will be truncated.

452 The vendor-defined default value is advertised using the default instance of
453 CIM_FCHBADiagnosticSettingData.

454 If no value is specified by the client, the vendor-defined default pattern will be used.

455 7.3.7 CIM_FCHBADiagnosticSettingData.PingMechanism

456 This property is used by a client for the Ping test to specify the tests shown in Table 7. Vendors may
457 extend PingMechanism to include other mechanisms for implementing Ping. The mechanism used

458 depends upon the capabilities of the device being tested. Clients may not know which mechanism is
459 appropriate for a particular device. Therefore, providers shall have a mode where every mechanism is
460 tried in succession until one is successful or all have been tried.

461 **Table 7 – CIM_FCHBADiagnosticSettingData.PingMechanism**

PingMechanism value	Criteria	Notes
1 (Other)	Optional	
2 (Use All)	Mandatory	The default
3 (FC Echo)	Mandatory	
4 (SCSI Inquiry)	Mandatory	

462 ## 7.4 CIM_FCHBADiagnosticServiceCapabilities

463 The SupportedLoopControl property lists the loop controls that are supported by the Diagnostic Service.
464 The values are: 0 (Unknown), 1 (Other), 2 (Continuous), 3 (Count), 4 (Timer), 5 (ErrorCount), and 0x8000
465 (No Loop Control). Table 8 provides more information.

466 **Table 8 – CIM_FCBHADiagnosticServiceCapabilities property requirements**

Test name	SupportedLoopControl*	BufferSizesSupported	MaxPatternSizeSupported
Beacon	3 (Count) 4 (Timer)		
Echo	0x8000 (No Loop Control)	Used	Used
External Loopback	2 (Continuous) 3 (Count)	Used	Used
Host Bus Loopback	2 (Continuous) 3 (Count)	Used	Used
Internal Loopback	2 (Continuous) 3 (Count)	Used	Used
Ping	3 (Count)	Used	Used
Reset	0x8000 (No Loop Control)		
Self	0x8000 (No Loop Control)		
Status	0x8000 (No Loop Control)		

467 An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticServiceCapabilities.

468 ### 7.4.1 CIM_FCHBADiagnosticServiceCapabilities.SupportedLoopControl

469 This array property is used by a provider for the tests shown in Table 8 to specify whether the test
470 supports loop control. If loop control is not supported, the value of this property is 0x8000 (No Loop
471 Control). If the test can be run a specified number of iterations, this array property shall contain the value
472 3 (Count). If the test can be run in a continuous manner, this array property shall contain the value 2
473 (Continuous).

474 ### 7.4.2 CIM_FCHBADiagnosticServiceCapabilities.BufferSizesSupported

475 This array property is used by a provider for those tests shown in Table 8 to specify the buffer sizes
476 supported by the test.

7.4.3 CIM_FCHBADiagnosticServiceCapabilities.MaxPatternSizeSupported

This property is used by a provider for those tests shown in Table 8 to specify the size of the largest pattern a client may specify in octets (8 bits). If the buffer pattern is smaller than the size of the data buffer, the pattern will be repeated as necessary to fill the buffer. If the buffer pattern is larger than the data buffer size, the pattern will be truncated.

8 Methods

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

8.1 CIM_FCHBADiagnosticTest.RunDiagnosticService( )

The RunDiagnosticService( ) method shall return one of the return code values defined in the *Diagnostics Profile*, Table 2 – RunDiagnosticsService( ) Method: Return Code Values.

When failures occur during the execution of a diagnostic test, the failure shall be recorded in the instance of CIM_DiagnosticServiceRecord associated with the test. The reason for the failure shall be recorded in CIM_DiagnosticServiceRecord.ErrorCode[ ], and the corresponding CIM_DiagnosticServiceRecord.ErrorCount[ ] shall be incremented. Other occurrences of the same failure during the same test shall not create additional entries in CIM_DiagnosticServiceRecord.ErrorCode[ ], but they shall cause the corresponding CIM_DiagnosticServiceRecord.ErrorCount[ ] to be incremented.

8.2 Profile conventions for operations

Support for operations for each profile class (including associations) shall be as mandated in the *Diagnostics Profile*, clauses 8.5 through 8.29.

9 Use cases

9.1 Overview

This clause contains use cases for the *Fibre Channel Host Bus Adapter Diagnostics Profile*.

How to discover, configure, and run the individual diagnostic tests is detailed in the *Diagnostics Profile*. This clause focuses on how to use the FC HBA diagnostic tests to diagnose common SAN issues.

9.2 Use case summary

Table 9 summarizes the use cases that are described in this clause. The use cases are categorized and named, and references are provided to the subclause that describes the use case.

NOTE Although use case names follow the convention for naming classes, properties and methods in the schema, this naming was done for readability only and does not imply any functionality attached to the name.

The CIM_ prefix has been omitted from the class names in the use cases for readability.

508 **Table 9 – Fibre Channel Host Bus Adapter Diagnostics Profile use cases**

Category	Use case name	Description
Verifying FC HBA Health See 9.3.	Verify Health	Verify the health of an FC HBA without impacting host system access to the SAN. See 9.3.1.
	Verify Hardware	Examine an FC HBA to discover any hardware issues. See 9.3.2.
	Identify HBA	Make a particular FC HBA easy to physically identify. See 9.3.3.
Troubleshooting SAN Issues See 9.4.	Verify Device Accessibility	Verify that a particular device on the SAN is accessible. See 9.4.1
	Stress Test	Create a high volume of traffic to a particular SAN device to help uncover SAN issues. See 9.4.2.
	Troubleshoot an Existing Connection	Discover why a previously accessible device can no longer be accessed. See 9.4.3.
	Troubleshoot a New Connection	Discover why a new SAN device cannot be accessed. See 9.4.4.

509 ## 9.3 Verifying FC HBA health

510 The use cases in this clause describe how the client can use the diagnostic tests to verify the health of
511 FC HBAs and to locate them.

512 ### 9.3.1 Verify health

513 To substantiate that an FC HBA is healthy and not developing problems, without disrupting the
514 functioning of the host system, the client can use StatusTest.

515 ### 9.3.2 Verify hardware

516 The client can confirm that the FC HBA hardware is functioning properly with the following procedure:

517 1) If available, use the Host Bus Loopback Test to prove that the data path between the host
518 system and the FC HBA is functioning properly.

519 2) Use the Self-Test to verify the functionality of the FC HBA hardware components. This covers
520 all components except for the Fibre Channel optics.

521 3) If the FC HBA is connected to the SAN, Ping or Echo may be used to verify that the FC optics
522 are working properly. However, if there is a problem on the SAN itself, these tests will fail. Thus,
523 while passing these tests proves that the FC HBA is functioning, failing these tests does not
524 prove that the FC HBA is defective.

4) If the FC HBA is not connected to the SAN, or if Ping or Echo fails, the client should use the External Loopback Test to verify that the FC optics are functional.

9.3.3 Identify HBA

When it has been determined that a particular FC HBA has to be replaced, the client can use the Beacon Test to cause the FC HBA's LEDs to flash. This makes it easy to visually identify the defective FC HBA in a host system with multiple FC HBAs.

9.4 Troubleshooting SAN issues

The use cases in this clause describe how the client can use the diagnostic tests to isolate problems occurring on the SAN.

9.4.1 Verify device accessibility

The client can use Ping to verify that a particular FC device can be physically accessed. Echo can also be used, but it generates much more SAN traffic than is necessary for verifying accessibility.

9.4.2 Stress test

Some problems only occur when there are high levels of traffic on the SAN. To help reproduce traffic problems, clients can use Echo. By configuring it with large buffer sizes and high loop counts, large amounts of traffic can be generated.

9.4.3 Troubleshoot an existing connection

There are many reasons why an FC HBA could lose the ability to communicate with a device on the SAN: a cable could be pulled out or broken, a switch could be broken or could lose configuration information, the device itself may be broken, or the device itself could have lost configuration information. Clients can use the following procedure to discover where the problem lies:

1) Use Status Test to verify that the FC HBA believes itself to be healthy. If an FC HBA issue is suspected, use the procedure in 9.3.2 to validate the hardware. If loss of link is reported, inspect the cabling.

2) Perform an Internal Loopback Test to verify that data can pass between the host system and the FC HBA properly. If the loopback fails, replace the FC HBA.

3) Use Ping to verify whether the physical connection to the device has been lost. If the physical connection to the device is still present, the configuration of the device itself should be investigated.

4) Use Echo to verify that the FC HBA can communicate with all devices in its communication path. If the Echo fails, investigate the cabling between the device and the switch. A broken cable usually results in the link being lost at one end. If the cabling appears intact, investigate the device itself. Repeat this step for each device in the communications path until a cabling problem is found or the faulty device is found.

9.4.4 Troubleshoot a new connection

When a new device is added to a SAN and a host that should be able to access the SAN cannot access it, the issue is usually caused by a configuration error in either the device or the switch. If a configuration error cannot be found, the client can use the following procedure to isolate the problem:

1) Use Echo to verify that the FC HBA can communicate with all devices in its communication path. If the Echo fails, investigate the cabling between the device and the switch. A broken cable usually results in the link being lost at one end. If the cabling appears intact, investigate

566 the device itself. Repeat this step for each device in the communications path until a cabling
567 problem is found or the faulty device is found.

568 10 CIM elements

569 Table 10 shows the instances of CIM elements for this profile. Instances of the CIM elements shall be
570 implemented as described in Table 10. Clause 7 (“Implementation”) and Clause 8 (“Methods”) may
571 impose additional requirements on these elements.

572 **Table 10 – CIM elements: Fibre Channel Host Bus Adapter Diagnostics Profile**

Element name	Requirement	Description
Classes		
CIM_FCHBADiagnosticTest	Mandatory	See 10.1.
CIM_FCHBADiagnosticSettingData	Optional	See 10.2.
CIM_FCHBADiagnosticServiceCapabilities	Optional	See 10.3.
CIM_RegisteredProfile	Mandatory	See 10.4.
CIM_AffectedJobElement	Optional	See 10.5.
CIM_AvailableDiagnosticService	Mandatory	See 10.6.
CIM_ElementCapabilities	Optional	See 10.7.
CIM_ElementSettingData (DiagnosticSettingData)	Optional	See 10.8.
CIM_ElementSettingData (JobSettingData)	Optional	See 10.9.
CIM_ElementSoftwareIdentity	Mandatory	See 10.10.
CIM_HostedService	Mandatory	See 10.11.
CIM_OwningJobElement	Mandatory	See 10.12.
CIM_RecordAppliesToElement	Optional	See 10.13.
CIM_ServiceAffectsElement	Mandatory	See 10.14.
CIM_ServiceAvailableToElement	Optional	See 10.15.
CIM_ServiceComponent	Optional	See 10.16.
CIM_UseOfLog	Mandatory	See 10.17.
Indications		
None defined in this profile		

573 10.1 CIM_FCHBADiagnosticTest

574 The CIM_FCHBADiagnosticTest class is used to represent the Diagnostic Testing for an FC HBA. This
575 class specializes CIM_DiagnosticTest as defined in the *Diagnostics Profile*. The constraints listed in Table
576 11 are in addition to those specified in the *Diagnostics Profile*. See the *Diagnostics Profile* for other
577 mandatory elements that must be implemented.

578 **Table 11 – Class: CIM_FCHBADiagnosticTest**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.2.
Characteristics	Mandatory	See 7.2.
OtherCharacteristicsDescriptions	Conditional	If Characteristics includes the value of 1 (Other), this property is Mandatory.
FCHBATestType	Mandatory	See 7.2.
OtherFCHBATestTypeDescription	Conditional	If FCHBATestType has a value of 1 (Other), this property is Mandatory.
TestType	Optional	See 7.2.

579 ## 10.2 CIM_FCHBADiagnosticSettingData

580 The CIM_FCHBADiagnosticSettingData class is used to pass in test parameters and to specify other test
581 control parameters. This class specializes CIM_DiagnosticSettingData as defined in the *Diagnostics*
582 *Profile*. The constraints listed in Table 12 are in addition to those specified in the *Diagnostics Profile*. See
583 the *Diagnostics Profile* for other mandatory elements that must be implemented.

584 **Table 12 – Class: CIM_FCHBADiagnosticSettingData**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.3.
TargetDevice	Optional	See 7.3.1.
TargetDeviceFormat	Optional	See 7.3.2.
EchoMechanism	Optional	See 7.3.3.
OtherEchoMechanism	Conditional	If EchoMechanism has a value of 1 (Other), this property is Mandatory.
LUN	Optional	See 7.3.4.
BufferSizes	Optional	See 7.3.5.
BufferPattern	Optional	See 7.3.6.
PingMechanism	Optional	See 7.3.7.
OtherPingMechanism	Conditional	If PingMechanism has a value of 1 (Other), this property is Mandatory.

585 ## 10.3 CIM_FCHBADiagnosticServiceCapabilities

586 The CIM_FCHBADiagnosticServiceCapabilities class is used to provide information on the capabilities for
587 the FC HBA Diagnostic Service. This class specializes CIM_DiagnosticServiceCapabilities as defined in
588 the *Diagnostics Profile*. The constraints listed in Table 13 are in addition to those specified in the
589 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory elements that must be implemented.

590 **Table 13 – Class: CIM_FCHBADiagnosticServiceCapabilities**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.4.
SupportedLoopControl	Optional	See 7.4.1.
BufferSizesSupported	Optional	See 7.4.2.
MaxPatternSizeSupported	Optional	See 7.4.3.

591 ## 10.4 CIM_RegisteredProfile

592 The CIM_RegisteredProfile class is defined by the *Profile Registration Profile*. The requirements denoted
593 in Table 14 are in addition to those mandated by the *Profile Registration Profile*. See the *Profile*
594 *Registration Profile* for the other mandatory elements that must be implemented.

595 **Table 14 – Class: CIM_RegisteredProfile**

Elements	Requirement	Notes
RegisteredName	Mandatory	The value of this property shall be “FC HBA Diagnostics”.
RegisteredVersion	Mandatory	The value of this property shall be “1.0.0”.
RegisteredOrganization	Mandatory	The value of this property shall be 2 (DMTF).

596 ## 10.5 CIM_AffectedJobElement

597 Although defined in the *Diagnostics Profile*, the CIM_AffectedJobElement class is listed here because the
598 AffectedElement reference is scoped down to CIM_PortController, which is a subclass of
599 CIM_ManagedElement. The constraints listed in Table 15 are in addition to those specified in the
600 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
601 CIM_AffectedJobElement that must be implemented.

602 **Table 15 – Class: CIM_AffectedJobElement**

Properties	Requirement	Notes
AffectedElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_PortController.
AffectingElement	Mandatory	The property shall be a reference to an instance of CIM_ConcreteJob.

603 ## 10.6 CIM_AvailableDiagnosticService

604 Although defined in the *Diagnostics Profile*, the CIM_AvailableDiagnosticService class is listed here
605 because the ServiceProvided reference is scoped down to CIM_FCHBADiagnosticTest, which is a
606 subclass of CIM_DiagnosticTest, and the UserOfService reference is scoped down to
607 CIM_PortController, which is a subclass of CIM_ManagedElement. The constraints listed in Table 16 are
608 in addition to those specified in the *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory
609 properties of CIM_AvailableDiagnosticService that must be implemented.

610 **Table 16 – Class: CIM_AvailableDiagnosticService**

Properties	Requirement	Notes
ServiceProvided (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.
UserOfService (overridden)	Mandatory	The property shall be a reference to an instance of CIM_PortController.

611 ## 10.7 CIM_ElementCapabilities

612 Although defined in the *Diagnostics Profile*, the CIM_ElementCapabilities class is listed here because the
613 ManagedElement reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
614 CIM_DiagnosticTest, and the Capabilities reference is scoped down to
615 CIM_FCHBADiagnosticServiceCapabilities, which is a subclass of CIM_DiagnosticServiceCapabilities.
616 The constraints listed in Table 17 are in addition to those specified in the *Diagnostics Profile*. See the
617 *Diagnostics Profile* for other mandatory properties of CIM_ElementCapabilities that must be implemented.

618 **Table 17 – Class: CIM_ElementCapabilities**

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.
Capabilities (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticServiceCapabilities.

619 ## 10.8 CIM_ElementSettingData (DiagnosticSettingData)

620 Although defined in the *Diagnostics Profile*, the CIM_ElementSettingData class is listed here because the
621 ManagedElement reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
622 CIM_DiagnosticTest, and the SettingData reference is scoped down to
623 CIM_FCHBADiagnosticSettingData, which is a subclass of CIM_DiagnosticSettingData. The constraints
624 listed in Table 18 are in addition to those specified in the *Diagnostics Profile*. See the *Diagnostics Profile*
625 for other mandatory properties of CIM_ElementSettingData that must be implemented.

626 **Table 18 – Class: CIM_ElementSettingData**

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.
SettingData (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticSettingData.
IsDefault	Mandatory	If the instance of CIM_FCHBADiagnosticSettingData is the default setting, this property shall have the value of TRUE.

627 ## 10.9 CIM_ElementSettingData (JobSettingData)

628 Although defined in the *Diagnostics Profile*, the CIM_ElementSettingData class is listed here because the
629 Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
630 CIM_DiagnosticTest, and the SettingData reference is scoped down to CIM_JobSettingData, which is a
631 subclass of CIM_SettingData. The constraints listed in Table 19 are in addition to those specified in the

632 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
633 CIM_ElementSettingData that must be implemented.

634 **Table 19 – Class: CIM_ElementSettingData**

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.
SettingData (overridden)	Mandatory	The property shall be a reference to an instance of CIM_JobSettingData.
IsDefault	Mandatory	If the instance of CIM_JobSettingData is the default setting, this property shall have the value of TRUE.

635 10.10 CIM_ElementSoftwareIdentity

636 Although defined in the *Diagnostics Profile*, the CIM_ElementSoftwareIdentity class is listed here because
637 the Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
638 CIM_DiagnosticTest. The constraints listed in Table 20 are in addition to those specified in the
639 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
640 CIM_ElementSoftwareIdentity that must be implemented.

641 **Table 20 – Class: CIM_ElementSoftwareIdentity**

Properties	Requirement	Notes
Antecedent	Mandatory	The property shall be a reference to an instance of CIM_SoftwareIdentity.
Dependent (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

642 10.11 CIM_HostedService

643 Although defined in the *Diagnostics Profile*, the CIM_HostedService class is listed here because the
644 Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
645 CIM_DiagnosticTest. The constraints listed in Table 21 are in addition to those specified in the
646 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of CIM_HostedService that
647 must be implemented.

648 **Table 21 – Class: CIM_HostedService**

Properties	Requirement	Notes
Antecedent	Mandatory	The property shall be a reference to an instance of CIM_ComputerSystem.
Dependent (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

649 10.12 CIM_OwningJobElement

650 Although defined in the *Diagnostics Profile*, the CIM_OwningJobElement class is listed here because the
651 OwningElement reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
652 CIM_DiagnosticTest. The constraints listed in Table 22 are in addition to those specified in the

653 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
654 CIM_OwningJobElement that must be implemented.

655 **Table 22 – Class: CIM_OwningJobElement**

Properties	Requirement	Notes
OwningElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.
OwnedElement	Mandatory	The property shall be a reference to an instance of CIM_ConcreteJob.

656 ## 10.13 CIM_RecordAppliesToElement

657 Although defined in the *Diagnostics Profile*, the CIM_RecordAppliesToElement class is listed here
658 because the Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
659 CIM_DiagnosticTest. The constraints listed in Table 23 are in addition to those specified in the
660 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
661 CIM_RecordAppliesToElement that must be implemented.

662 **Table 23 – Class: CIM_RecordAppliesToElement**

Properties	Requirement	Notes
Antecedent	Mandatory	The property shall be a reference to an instance of CIM_RecordForLog.
Dependent (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

663 ## 10.14 CIM_ServiceAffectsElement

664 Although defined in the *Diagnostics Profile*, the CIM_ServiceAffectsElement class is listed here because
665 the AffectedElement reference is scoped down to CIM_PortController, which is a subclass of
666 CIM_ManagedElement, and the AffectingElement reference is scoped down to
667 CIM_FCHBADiagnosticTest, which is a subclass of CIM_DiagnosticTest. The constraints listed in Table
668 24 are in addition to those specified in the *Diagnostics Profile*. See the *Diagnostics Profile* for other
669 mandatory properties of CIM_ServiceAffectsElement that must be implemented.

670 **Table 24 – Class: CIM_ServiceAffectsElement**

Properties	Requirement	Notes
AffectedElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_PortController.
AffectingElement (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

671 ## 10.15 CIM_ServiceAvailableToElement

672 Although defined in the *Diagnostics Profile*, the CIM_ServiceAvailableToElement class is listed here
673 because the UsersOfService reference is scoped down to CIM_FCHBADiagnosticTest, which is a
674 subclass of CIM_DiagnosticTest. The constraints listed in Table 25 are in addition to those specified in
675 the *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
676 CIM_ServiceAvailableToElement that must be implemented.

677 **Table 25 – Class: CIM_ServiceAvailableToElement**

Properties	Requirement	Notes
ServiceProvided	Mandatory	The property shall be a reference to an instance of CIM_HelpService.
UsersOfService (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

678 ## 10.16 CIM_ServiceComponent

679 Although defined in the *Diagnostics Profile*, the CIM_ServiceComponent class is listed here because the
680 GroupComponent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
681 CIM_DiagnosticTest, and the PartComponent reference is scoped down to CIM_FCHBADiagnosticTest,
682 which is a subclass of CIM_DiagnosticTest. The constraints listed in Table 26 are in addition to those
683 specified in the *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of
684 CIM_ServiceComponent that must be implemented.

685 **Table 26 – Class: CIM_ServiceComponent**

Properties	Requirement	Notes
GroupComponent (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.
PartComponent (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

686 ## 10.17 CIM_UseOfLog

687 Although defined in the *Diagnostics Profile*, the CIM_UseOfLog class is listed here because the
688 Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
689 CIM_DiagnosticTest. The constraints listed in Table 27 are in addition to those specified in the
690 *Diagnostics Profile*. See the *Diagnostics Profile* for other mandatory properties of CIM_UseOfLog that
691 must be implemented.

692 **Table 27 – Class: CIM_UseOfLog**

Properties	Requirement	Notes
Antecedent	Mandatory	The property shall be a reference to an instance of CIM_DiagnosticLog.
Dependent (overridden)	Mandatory	The property shall be a reference to an instance of CIM_FCHBADiagnosticTest.

693 # ANNEX A
694 (informative)
695
696 # Change log

Version	Date	Description
1.0.0	2011-12-15	

697