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5 **FC HBA Diagnostics Profile**

Information for Work-in-Progress version:

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Foreword

104 The *FC HBA Diagnostics Profile* (DSP1104) was prepared by the Diagnostics Working Group of the
105 DMTF.

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

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120

Introduction

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

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

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

137 Document conventions

138 Typographical conventions

139 The following typographical conventions are used in this document:

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

142 ABNF usage conventions

143 Format definitions in this document are specified using ABNF (see [RFC5234](#)), with the following
144 deviations:

- 145 • Literal strings are to be interpreted as case-sensitive Unicode characters, as opposed to the
146 definition in [RFC5234](#) that interprets literal strings as case-insensitive US-ASCII characters.

147

FC HBA Diagnostics Profile

148 1 Scope

149 The *FC HBA Diagnostics Profile* specializes the Diagnostics Profile by defining the diagnostic tests
150 needed to determine the health of an FC HBA as well as the tests needed to troubleshoot Storage Area
151 Network (SAN) problems involving FC HBAs. The diagnostic tests are defined as subclasses of
152 CIM_DiagnosticTest.

153 2 Normative References

154 The following referenced documents are indispensable for the application of this document. For dated
155 references, only the edition cited applies. For undated references, the latest edition of the referenced
156 document (including any amendments) applies.

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

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

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

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

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

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

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

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

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

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

177 3 Terms and Definitions

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

180 The terms "shall" ("required"), "shall not," "should" ("recommended"), "should not" ("not recommended"),
181 "may," "need not" ("not required"), "can" and "cannot" in this document are to be interpreted as described

182 in [ISO/IEC Directives, Part 2](#), Annex H. The terms in parenthesis are alternatives for the preceding term,
183 for use in exceptional cases when the preceding term cannot be used for linguistic reasons. Note that
184 [ISO/IEC Directives, Part 2](#), Annex H specifies additional alternatives. Occurrences of such additional
185 alternatives shall be interpreted in their normal English meaning.

186 The terms "clause," "subclause," "paragraph," and "annex" in this document are to be interpreted as
187 described in [ISO/IEC Directives, Part 2](#), Clause 5.

188 The terms "normative" and "informative" in this document are to be interpreted as described in [ISO/IEC](#)
189 [Directives, Part 2](#), Clause 3. In this document, clauses, subclauses, or annexes labeled "(informative)" do
190 not contain normative content. Notes and examples are always informative elements.

191 The terms defined in [DSP0004](#), [DSP0200](#), and [DSP1001](#) apply to this document.

192 **4 Symbols and Abbreviated Terms**

193 The following symbols and abbreviations are used in this document.

194 **4.1**

195 **CDM**

196 Common Diagnostic Model

197 **4.2**

198 **CIM**

199 Common Information Model

200 **4.3**

201 **CIMOM**

202 CIM Object Manager

203 **4.4**

204 **CRU**

205 Customer Replaceable Unit

206 **4.5**

207 **FRU**

208 Field Replaceable Unit

209 **4.6**

210 **FC**

211 Fibre Channel

212 **4.7**

213 **HBA**

214 Host Bus Adapter

215 **4.8**

216 **ICMP**

217 Internet Control Message Protocol

218 **4.9**

219 **LED**

220 Light-Emitting Diode

- 221 **4.10**
- 222 **LUN**
- 223 Logical Unit Number

- 224 **4.11**
- 225 **ME**
- 226 Managed Element

- 227 **4.12**
- 228 **MOF**
- 229 Managed Object Format

- 230 **4.13**
- 231 **PD**
- 232 Problem Determination

- 233 **4.14**
- 234 **PFA**
- 235 Predictive Failure Analysis

- 236 **4.15**
- 237 **POST**
- 238 Power-On Self-Test

- 239 **4.16**
- 240 **SAN**
- 241 Storage Area Network

- 242 **4.17**
- 243 **SLP**
- 244 Service Location Protocol

- 245 **4.18**
- 246 **SM-HBA**
- 247 Storage Management Host Bus Adapter

- 248 **4.19**
- 249 **SNPing**
- 250 Storage Network Ping

- 251 **4.20**
- 252 **WBEM**
- 253 Web-Based Enterprise Management

- 254 **4.21**
- 255 **WWPN**
- 256 World Wide Port Name

257 **5 Synopsis**

258 **Profile Name:** FC HBA Diagnostics

259 **Version:** 1.0.0a
 260 **Organization:** DMTF
 261 **CIM schema version:** 2.28
 262 **Central Class:** CIM_FCHBADiagnosticTest
 263 **Scoping Class:** CIM_ComputerSystem
 264 **Specializes:** Diagnostic Profile 2.0.0

265 The *FC HBA Diagnostics Profile* extends the management capability of referencing profiles by adding
 266 common methods for determining that the FC HBA is operating normally and for trouble shooting Fibre
 267 Channel network problems involving the FC HBA in a managed system
 268

269 CIM_FCHBADiagnosticTest shall be the Central Class of this profile. The instance of
 270 CIM_FCHBADiagnosticTest shall be the Central Instance of this profile. CIM_ComputerSystem shall be
 271 the Scoping Class of this profile. The instance of CIM_ComputerSystem with which the Central Instance
 272 is associated through an instance of CIM_HostedService shall be the Scoping Instance of this profile
 273

274 The CIM_ManagedElement is CIM_PortController or a subclass of it.

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

276 **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

277 **6 Description**

278
 279 Two categories of Fibre Channel Host Bus Adapter (FC HBAs) diagnostics are useful in SAN
 280 environments: those that diagnose the FC HBA itself and those used to help trouble shoot network
 281 problems. These two classes can be further categorized into two different types: destructive and non-
 282 destructive.

283
 284 The *Diagnostics Profile* defines destructive tests as those that have the potential for destroying data,
 285 permanently altering the state, or reconfiguring the device. In the case of an FC HBA, any test that could
 286 cause a previously executing application to lose access to the SAN should be considered destructive
 287 because it could cause the data contained in an active transaction to be lost. An example would be using
 288 a loopback to verify data pathways. When the loopback runs the FC HBA cannot carry normal traffic.
 289

290 Non-destructive diagnostics are those that can be safely executed without disrupting normal traffic; such
 291 as using a form of echo to verify the accessibility of a SAN device. Practical SAN management requires
 292 both types and both categories of diagnostics to maintain operations in production environments. As such
 293 all FC HBA diagnostics shall work in a normal operating system environment. Special pre-boot
 294 environments shall not be required. The diagnostic tests specified in this profile may be implemented in
 295 the FC HBA's firmware, the driver, or in the FC HBA Diagnostics Provider itself. The goal of the *FC HBA*
 296 *Diagnostics Profile* is to define a set of standard diagnostics that meet these needs and are both vendor
 297 and hardware agnostic.

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

304
305 Verifying the health of an FC HBA non-destructively is problematic. Any definitive health verification
306 disrupts, suspends or corrupts normal data traffic. However, it is possible to determine relative health of
307 the FC HBA using data such as its current operational state, error counts, and the results of its last POST.
308 Diagnostics providers should take advantage of this test to report any detected degraded conditions
309 before they become problems. Executing this test would also verify that basic communications with the
310 FC HBA are operational. All FC HBA Diagnostic providers shall support a Status test.

311
312 To enable the isolation of certain types of faults, FC HBAs should also be testable at their boundaries.
313 The boundaries of a FC HBA are its connection to the system bus and its connection to the Fibre Channel
314 SAN. Being able to test at these boundaries makes it possible to isolate problems to the FC HBA or to the
315 SAN. For instance, if the transmit side of the cable from the FC HBA to the switch broke, the HBA would
316 still have a link but would not receive any responses. From the viewpoint of the host, the source of the
317 problem would not be clear; it could be a problem with the FC HBA or something on the SAN itself.
318 Putting the FC HBA into loopback would show that the pathway from the host through the HBA was
319 working properly and that the problem is something on the SAN.

320
321 There are both internal and external Fibre Channel loopbacks. Internal loopbacks are desirable because
322 they allow the HBA to be tested remotely without having to physically reconfigure the SAN. However
323 because internal loopbacks are implemented in circuitry and not in the FC optics, they do not test the
324 entire data pathway through the FC HBA. By their nature FC loopback tests are destructive. All FC HBA
325 Diagnostic providers shall support both internal and external FC loopback tests.

326
327 Loopbacks can also be implemented at the FC HBA's host bus interface. These loopbacks are helpful in
328 isolating problems occurring between the FC HBA and the host system. If an FC HBA is failing internal
329 loopback tests, the problem lies in the data path of the HBA if that HBA can pass host bus interface
330 loopback tests. As with FC loopbacks, host bus interface loopbacks are destructive. All FC HBA
331 Diagnostic providers shall support host bus loopbacks only if the FC HBA under test supports them.

332
333 One of the most familiar and powerful tools in an IP network maintenance engineer's "toolbox" is the Ping
334 utility. This utilizes the Internet Control Message Protocol (ICMP) that is supported by every Network
335 Interface Card (NIC) to provide a simple method of testing for the presence of a NIC at a specified
336 address. To minimize the use of SAN bandwidth, both the size of the data packet to be transmitted and
337 the number of iterations should be kept small. The input parameters of the Ping test are similar to those
338 defined by T11's Fibre Channel Storage Network Ping utility specification (SNPing) for Fibre Channel
339 devices. All FC HBA Diagnostic providers shall support a Ping test and it shall be non-destructive.

340
341 Another common network trouble shooting technique is to repeatedly send traffic to a specific device,
342 have it echoed back and then verify that the data is still intact. This is similar to ping, except that it is
343 acceptable to generate enough traffic for the test to become destructive (disruptive to other network
344 traffic). This echo test can be useful when resolving network configuration or performance issues. The
345 size and content of the data packet to be sent may be optionally varied. Because sustained Echo tests
346 increase network latency and can be disruptive, they should be considered destructive. All FC HBA
347 Diagnostic providers shall support an Echo test.

348 Like any other programmed device, FC HBAs can sometimes be affected by software errors that can
349 cause them to behave erratically, enter an unknown state, or stop working all together. Resetting an FC
350 HBA often clears these conditions and restores the host's access to the FC SAN. Because resetting an
351 FC HBA causes it to lose its current state information and any transactions that are in progress, Reset
352 shall be considered destructive. All FC HBA Diagnostic providers shall support a Reset test.

353

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

359
360 The *FC HBA Diagnostics Profile* describes the set of tests necessary for diagnosing FC HBA issues and
361 troubleshooting some SAN issues. Each test is a specialization of `CIM_DiagnosticTest`. The supported
362 service modes, user controls, log options, and loop controls for each test are advertised through the
363 `CIM_FCHBADiagnosticsServiceCapabilities` instance. For tests with specifiable parameters, the default
364 parameter values are advertised through instances of `CIM_ElementSettingData` which associates an
365 instance of `CIM_FCHBADiagnosticSettingData` to the test. Where supported, clients specify non-default
366 test parameters by creating instances of `CIM_FCHBADiagnosticSettingData` that are associated to
367 instances of `CIM_FCHBADiagnosticTest`.
368

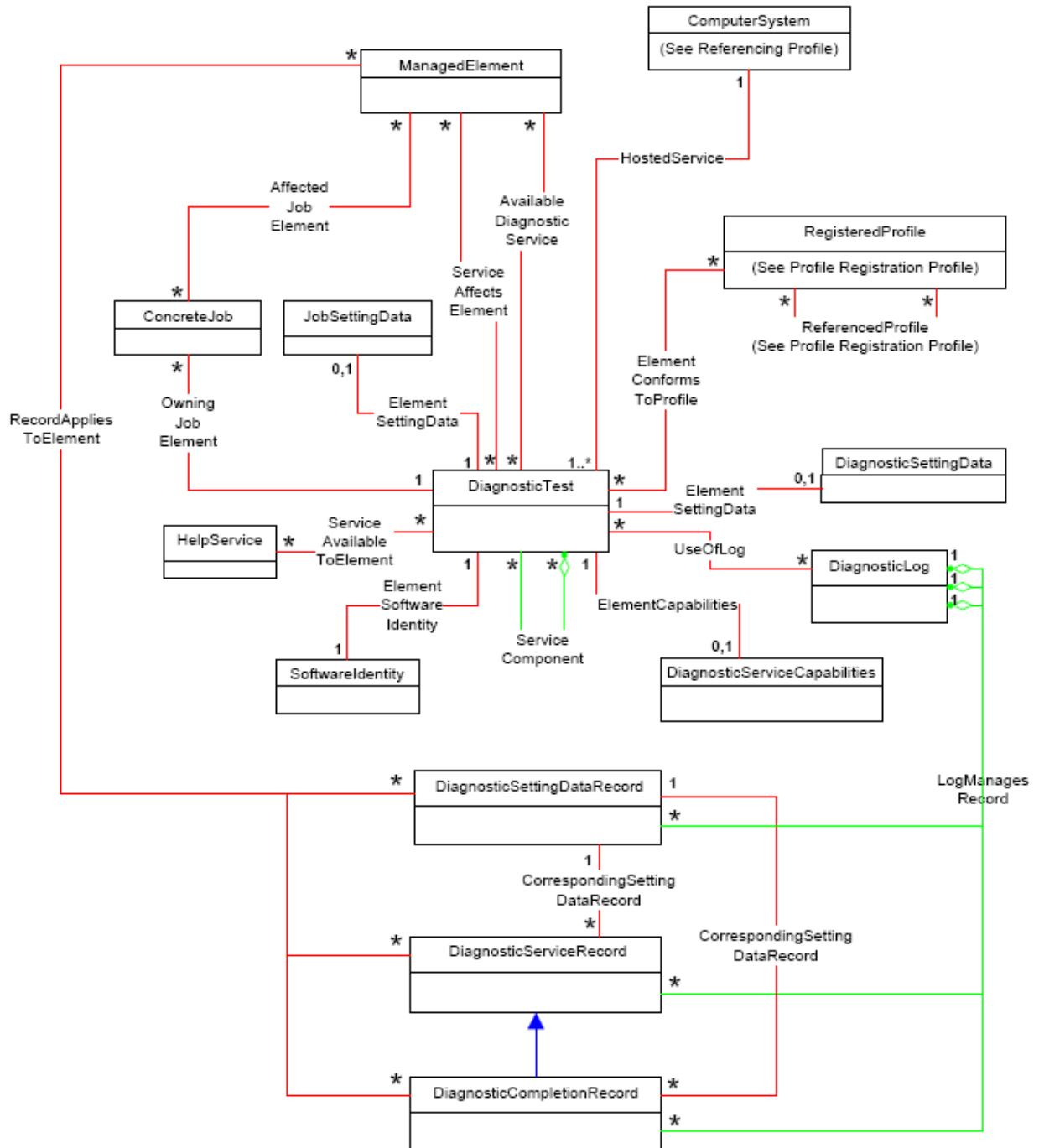


Figure 1 – FC HBA Diagnostics Profile: Profile Class Diagram

369
370
371
372

373 **7 Implementation**

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

375 **7.1 FC HBA Test Information**

376 **Error! Reference source not found.** contains information about the test types.

377 **Table 2 – Test Type Information**

Test Name	Test Information	
Beacon	Description	The diagnostic causes at least one of the LEDs of a 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 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.
HostBus Loopback	Coverage Area	The diagnostic tests a 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
Ping	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.
	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
Reset	Details	<p>The FC HBA must be connected to a SAN that contains a device that supports the desired Ping mechanism.</p> <p>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 which then returns it without modifying its content.</p> <p>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 utility specification (SNPing) for Fibre channel devices.</p>
	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.
	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
	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

378 **7.2 CIM_FCHBADiagnosticTest**

379 The CIM_FCHBADiagnosticTest can be used for a variety of tests necessary for diagnosing FC HBA
 380 issues. Table 3 defines the valid property values and whether or not the test is mandatory or optional. An
 381 implementation may extend this class and add vendor-defined tests using the Vendor Defined range of
 382 the FCHBATESTTYPE valuemap. Table 4 provides additional information about
 383 CIM_FCHBADiagnosticTest.

384 **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
HostBus Loopback	Optional	FC HBA HostBus 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

385

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 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		

386 **7.3 CIM_FCHBADiagnosticSettingData**

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

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

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

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

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

406

Table 5 – CIM_FCHBADiagnosticSettingData Property Requirements

Test Name	ElementName*	TargetDevice	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	

HostBus 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						

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

408 **7.3.1 CIM_FCHBADiagnosticSettingData.TargetDevice**

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

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

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

418 The string is formatted as ASCII characters representing hexadecimal digits. The only characters to be
 419 used shall be 0 – 9 and A – F. Leading zeros are permitted. WWPNs shall contain 16 characters. FC port
 420 addresses shall contain 6 characters.

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

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

424 **7.3.2 CIM_FCHBADiagnosticSettingData.TargetDeviceFormat**

425 This property specifies the format of the TargetDevice value which is a string formatted as ASCII
 426 characters representing hexadecimal digits. The only characters to be used shall be 0 – 9 and A – F.
 427 Leading zeros are permitted. WWPNs shall contain 16 characters. FC port addresses shall contain 6
 428 characters.

429 **7.3.3 CIM_FCHBADiagnosticSettingData.EchoMechanism**

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

431 **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	

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

437 Support for FC Trace Route is optional and requires the use of the HBA_SendCTPassThruV2 function to
 438 send a FC Trace Route CT payload. Support for FC Test is also optional and requires the use of the
 439 SMHBA_SendTEST function. Both of these functions require that the FC HBA, associated HBAAPI library
 440 and that the target support SM-HBA.

441 **7.3.4 CIM_FCHBADiagnosticSettingData.LUN**

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

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

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

447 **7.3.5 CIM_FCHBADiagnosticSettingData.BufferSizes**

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

450 The vendor-defined default value is advertised using the default instance of
 451 CIM_FCHBADiagnosticSettingData.

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

453 **7.3.6 CIM_FCHBADiagnosticSettingData.BufferPattern**

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

457 The vendor-defined default value is advertised using the default instance of
 458 CIM_FCHBADiagnosticSettingData.

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

460 **7.3.7 CIM_FCHBADiagnosticSettingData.PingMechanism**

461 This property is used by a client for the Ping test to specify the tests shown in Table 7. Vendors may
 462 extend PingMechanism to include other mechanisms for implementing ping. The mechanism used
 463 depends upon the capabilities of the device being tested. Clients may not know which mechanism is
 464 appropriate for a particular device. Therefore, providers shall have a mode where every mechanism is
 465 tried in succession until one is successful or all have been tried.

466 **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	

467 **7.4 CIM_FCHBADiagnosticServiceCapabilities**

468 The SupportedExecutionControls property lists the job controls that are supported by the Diagnostic
 469 Service. The values are: 0 (Unknown), 1 (Other), 2 (Job Creation), 3 (Kill Job), 4 (Suspend Job), 5
 470 (Terminate Job), 0x8000 (No Execution Controls). Table 8 provides more information.

471 The SupportedLoopControl property lists the loop controls that are supported by the Diagnostic Service.
 472 The values are: 0 (Unknown), 1 (Other), 2 (Continuous), 3 (Count), 4 (Timer), 5 (ErrorCount), 0x8000 (No
 473 Loop Control). Table 9 provides more information.

474 **Table 8 – CIM_FCHBADiagnosticServiceCapabilities Property Requirements**

Test Name	ElementName*	SupportedExecutionControls*	OtherSupportedExecution Controls*
Beacon	FC HBA Beacon Test	0x8000 (No Execution Control)	
Echo	FC HBA Echo Test	1 (Other)	TargetDevice EchoMechanism LUN BufferSizes BufferPattern
External Loopback	FC HBA External Loopback Test	1 (Other)	BufferSizes BufferPattern
Host Bus Loopback	FC HBA Host Bus Loopback Test	1 (Other)	BufferSizes BufferPattern
Internal Loopback	FC HBA Internal Loopback Test	1 (Other)	BufferSizes BufferPattern
Ping	FC HBA Ping Test	1 (Other)	TargetDevice PingMechanism LUN BufferSizes BufferPattern
Reset	FC HBA Reset Test	0x8000 (No Execution Control)	
Self	FC HBA Self Test	0x8000 (No Execution Control)	
Status	FC HBA Status Test	0x8000 (No Execution Control)	

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

476 **Table 9 – CIM_FCBHADiagnosticServiceCapabilities Property Requirements**

Test Name	SupportedLoopControl*	BufferSizes	PatternSize
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)		

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

478 **7.4.1 CIM_FCHBADiagnosticServiceCapabilities.SupportedExecutionControls**

479 This array property is used by a provider for the tests shown in Table 8 to specify whether or not the test
 480 supports execution controls. If there are no execution controls, the value of this property is 0x8000 (No
 481 Execution Control). Otherwise, the value is 1 (Other).

482 **7.4.2 CIM_FCHBADiagnosticServiceCapabilities.OtherSupportedExecutionControls**

483 This array property is used by a provider for the tests shown in Table 8 to specify the execution controls
 484 supported by the test when the value of SupportedExecutionControls is 1 (Other).

485 **7.4.3 CIM_FCHBADiagnosticServiceCapabilities.SupportedLoopControl**

486 This array property is used by a provider for the tests shown in Table 9.

487 to specify whether or not the test supports loop control. If loop control is not supported, the value of this
 488 property is 0x8000 (No Loop Control). If the test can be run a specified number of iterations, this array
 489 property shall contain the value 3 (Count). If the test can be run in a continuous manner, this array
 490 property shall contain the value 2 (Continuous).

491 **7.4.4 CIM_FCHBADiagnosticServiceCapabilities.BufferSizes**

492 This array property is used by a provider for those tests shown in Table 9 to specify the buffer sizes
 493 supported by the test.

494 **7.4.5 CIM_FCHBADiagnosticServiceCapabilities.PatternSize**

495 This property is used by a provider for those tests shown in Table 9 to specify the size of the largest
 496 pattern a client may specify in octets (8 bits). If the buffer pattern is smaller than the size of the data
 497 buffer, the pattern will be repeated as necessary to fill the buffer. If the buffer pattern is larger than the
 498 data buffer size, the pattern will be truncated.

499 **8 Methods**

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

502 **8.1 CIM_FCHBADiagnosticTest.RunDiagnosticService()**

503 The RunDiagnosticService() method shall return one of the return code values defined in [DSP1002](#),
 504 Table 2 – RunDiagnosticsService() Method: Return Code Values.

505 When failures occur during the execution of a diagnostic test, the failure shall be recorded in the instance
 506 of CIM_DiagnosticServiceRecord associated with the test. The reason for the failure shall be recorded in
 507 CIM_DiagnosticServiceRecord.ErrorCode[] and the corresponding
 508 CIM_DiagnosticServiceRecord.ErrorCount[] shall be incremented. Other occurrences of the same failure

509 during the same test shall not create additional entries in CIM_DiagnosticServiceRecord.ErrorCode[], but
 510 shall cause the corresponding CIM_DiagnosticServiceRecord.ErrorCount[] to be incremented.

511 **8.2 Profile Conventions for Operations**

512 Support for operations for each profile class (including associations) shall be as mandated in [DSP1002](#)
 513 clauses 8.5 through 8.29

514 **9 Use Cases**

515 **9.1 Overview**

516 This clause contains use cases for the *FC HBA Diagnostics Profile*.

517 How to discover, configure and run the individual diagnostic tests is detailed in [DSP1002](#). This clause
 518 focuses on how to use the FC HBA diagnostic tests to diagnose common SAN issues.

519 **9.2 Use Case Summary**

520 Table 10 summarizes the use cases that are described in this clause. The use cases are categorized and
 521 named, and references are provided to the body test that describes the use case.

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

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

525 **Table 10 – FC HBA 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.
	Trouble Shoot an Existing Connection	Discover why a previously accessible device can no longer be accessed. See 9.4.3.

	Trouble Shoot a New Connection	Discover why a new SAN device cannot be accessed. See 9.4.4.
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526 **9.3 Verifying FC HBA Health**

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

529 **9.3.1 Verify Health**

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

532 **9.3.2 Verify Hardware**

533 The client can confirm that the FC HBA hardware is functioning properly with the following procedure.

- 534 1) If available, use the Host Bus Loopback Test to prove that the data path between the host
535 system and the FC HBA is functioning properly.
- 536 2) Use the Self-Test to verify the functionality of the FC HBA hardware components. This covers all
537 components except for the Fibre Channel optics.
- 538 3) If the FC HBA is connected to the SAN, Ping or Echo may be used to verify that the FC optics
539 are working properly. However, if there is a problem on the SAN itself, these tests will fail. Thus,
540 while passing these tests proves that the FC HBA is functioning, failing these tests does not
541 prove that the FC HBA is defective.
- 542 4) If the FC HBA is not connected to the SAN, or if Ping or Echo fails, the client should use the
543 External Loopback Test to verify that the FC optics are functional.

544 **9.3.3 Identify HBA**

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

548 **9.4 Troubleshooting SAN Issues**

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

551 **9.4.1 Verify Device Accessibility**

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

554 **9.4.2 Stress Test**

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

558 9.4.3 Troubleshoot an Existing Connection

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

- 563 1) Use Status Test to verify that the FC HBA believes itself to be healthy. If an FC HBA issue is
564 suspected, use the procedure in 9.3.2 to validate the hardware. If loss of link is reported inspect
565 the cabling.
- 566 2) Perform an Internal Loopback Test to verify that data can pass between the host system and the
567 FC HBA properly. If the loopback fails, replace the FC HBA.
- 568 3) Use Ping to verify whether the physical connection to the device has been lost. If the physical
569 connection to the device is still present, the configuration of the device itself should be
570 investigated.
- 571 4) Use Echo to verify that the FC HBA can communicate with the device to which it is directly
572 attached. This device is usually a switch. If the Echo fails, investigate the cabling between the
573 device and the switch. A broken cable usually results in the link being lost at one end. If the
574 cabling appears intact, investigate the device itself.
- 575 5) Repeat step 4 with the next device in the communications path. This is usually the target device,
576 but it may be another switch. If this Echo fails, check the cabling between the device in the
577 previous step and the current device. Also investigate the health of the current device. In
578 addition, check the configuration of the device in the previous step. If the device in the previous
579 step was a switch, zoning information could have been lost.
- 580 6) Repeat step 5 until a cabling problem is found or the issue is isolated to a particular device.

581 9.4.4 Troubleshoot a New Connection

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

- 585 1) Use Echo to verify that the FC HBA can communicate with the device to which it is directly
586 attached. This device is usually a switch. If the Echo fails investigate the cabling between the
587 device and the switch. A broken cable usually results in the link being lost at one end. If the
588 cabling appears intact investigate the device itself.
- 589 2) Repeat step 1 with the next device in the communications path. This device is usually the target
590 device, but it may be another switch. If this Echo fails, check the cabling between the device in
591 the previous step and the current device. Also investigate the health of the current device. In
592 addition, check the configuration of the device in the previous step. If the device in the previous
593 step was a switch, zoning information could have been lost.
- 594 3) Repeat step 2 until a cabling problem is found or the issue is isolated to a particular device.

595 **10 CIM Elements**

596 Table 11 shows the instances of CIM Elements for this profile. Instances of the CIM Elements shall be
 597 implemented as described in Table 11. Clause 7 (“Implementation”) and Clause 8 (“Methods”) may
 598 impose additional requirements on these elements.

599 **Table 11 – CIM Elements: FC HBA 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		

600 **10.1 CIM_FCHBADiagnosticTest (Specializes CIM_DiagnosticTest)**

601 CIM_FCHBADiagnosticTest is used to represent the Diagnostic Testing for a FC HBA. This class
 602 specializes CIM_DiagnosticTest as defined in the [Diagnostics Profile](#). The constraints listed in Table 12
 603 the [Diagnostics Profile](#) for other mandatory elements that must be implemented.

604 **Table 12 – 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.

605 **10.2 CIM_FCHBADiagnosticSettingData (Specializes CIM_DiagnosticSettingData)**

606 CIM_ FCHBADiagnosticSettingData is used to pass in test parameters and to specify other test control
 607 parameters. This class specializes CIM_DiagnosticSettingData as defined in the [Diagnostics Profile](#). The
 608 constraints listed in Table 13 are in addition to those specified in the [Diagnostics Profile](#). See the
 609 [Diagnostics Profile](#) for other mandatory elements that must be implemented.

610 **Table 13 – 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.

611 **10.3 CIM_FCHBADiagnosticServiceCapabilities (Specializes**
 612 **CIM_DiagnosticServiceCapabilities.**

613 CIM_ FCHBADiagnosticServiceCapabilities is used to provide information on the capabilities for the FC
 614 HBA Diagnostic Service. This class specializes CIM_DiagnosticServiceCapabilities as defined in the
 615 [Diagnostics Profile](#). The constraints listed in Table 14 are in addition to those specified in the [Diagnostics](#)
 616 [Profile](#). See the [Diagnostics Profile](#) for other mandatory elements that must be implemented.

617 **Table 14 – Class: CIM_ FCHBADiagnosticServiceCapabilities**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.4.
BufferSizes	Optional	See 7.4.4.
PatternSize	Optional	See 7.4.5.

618 **10.4 CIM_RegisteredProfile**

619 The CIM_RegisteredProfile class is defined by the [Profile Registration Profile](#). The requirements denoted
 620 in Table 15 are in addition to those mandated by the [Profile Registration Profile](#). See the [Profile](#)
 621 [Registration Profile](#) for the other mandatory elements that must be implemented.

622 **Table 15 – Class: CIM_ RegisteredProfile**

Elements	Requirement	Notes
RegisteredName	Mandatory	Shall be “FC HBA Diagnostics”.
RegisteredVersion	Mandatory	Shall be “1.0.0”.
RegisteredOrganization	Mandatory	Shall be 2 (DMTF).

623 **10.5 CIM_AffectedJobElement**

624 Although defined in the [Diagnostics Profile](#), the CIM_AffectedJobElement class is listed here because the
 625 AffectedElement reference is scoped down to CIM_PortController, which is a subclass of
 626 CIM_ManagedElement. The constraints listed in Table 16 in addition to those specified in the [Diagnostics](#)
 627 [Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_AffectedJobElement that must
 628 be implemented.

629 **Table 16 – Class: CIM_AffectedJobElement**

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

630 **10.6 CIM_AvailableDiagnosticService**

631 Although defined in the [Diagnostics Profile](#), the CIM_AvailableDiagnosticService class is listed here
 632 because the ServiceProvided reference is scoped down to CIM_FCHBADiagnosticTest, which is a
 633 subclass of CIM_DiagnosticTest, and the UserOfService reference is scoped down to
 634 CIM_PortController, which is a subclass of CIM_ManagedElement. The constraints listed in Table 17 in
 635 addition to those specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory
 636 properties of CIM_AvailableDiagnosticService that must be implemented.

637 **Table 17 – Class: CIM_AvailableDiagnosticService**

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

638 **10.7 CIM_ElementCapabilities**

639 Although defined in the [Diagnostics Profile](#), the CIM_ElementCapabilities class is listed here because the
 640 ManagedElement reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 641 CIM_DiagnosticTest, and the Capabilities reference is scoped down to
 642 CIM_FCHBADiagnosticServiceCapabilities, which is a subclass of CIM_DiagnosticServiceCapabilities.
 643 The constraints listed in Table 18 in addition to those specified in the [Diagnostics Profile](#). See the
 644 [Diagnostics Profile](#) for other mandatory properties of CIM_ElementCapabilities that must be implemented.

645 **Table 18 – Class: CIM_ElementCapabilities**

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

646 **10.8 CIM_ElementSettingData (DiagnosticSettingData)**

647 Although defined in the [Diagnostics Profile](#), the CIM_ElementSettingData class is listed here because the
 648 ManagedElement reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 649 CIM_DiagnosticTest, and the SettingData reference is scoped down to

650 CIM_FCHBADiagnosticSettingData, which is a subclass of CIM_DiagnosticSettingData. The constraints
 651 listed in Table 19 in addition to those specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for
 652 other mandatory properties of CIM_ElementSettingData that must be implemented.

653 **Table 19 – Class: CIM_ElementSettingData**

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	Shall be a reference to an instance of CIM_FCHBADiagnosticTest.
SettingData (overridden)	Mandatory	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.

654 **10.9 CIM_ElementSettingData (JobSettingData)**

655 Although defined in the [Diagnostics Profile](#), the CIM_ElementSettingData class is listed here because the
 656 Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 657 CIM_DiagnosticTest, and the SettingData reference is scoped down to CIM_JobSettingData, which is a
 658 subclass of CIM_SettingData. The constraints listed in Table 20 in addition to those specified in the
 659 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 660 CIM_ElementSettingData that must be implemented.

661 **Table 20 – Class: CIM_ElementSettingData**

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	Shall be a reference to an instance of CIM_FCHBADiagnosticTest.
SettingData (overridden)	Mandatory	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.

662 **10.10 CIM_ElementSoftwareIdentity**

663 Although defined in the [Diagnostics Profile](#), the CIM_ElementSoftwareIdentity class is listed here because
 664 the Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 665 CIM_DiagnosticTest. The constraints listed in Table 21 in addition to those specified in the [Diagnostics](#)
 666 [Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_ElementSoftwareIdentity that
 667 must be implemented.

668 **Table 21 – Class: CIM_ElementSoftwareIdentity**

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

669 **10.11 CIM_HostedService**

670 Although defined in the [Diagnostics Profile](#), the CIM_HostedService class is listed here because the
 671 Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 672 CIM_DiagnosticTest. The constraints listed in Table 22 in addition to those specified in the [Diagnostics](#)
 673 [Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_HostedService that must be
 674 implemented.

675 **Table 22 – Class: CIM_HostedService**

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

676 **10.12 CIM_OwningJobElement**

677 Although defined in the [Diagnostics Profile](#), the CIM_OwningJobElement class is listed here because the
 678 OwningElement reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 679 CIM_DiagnosticTest. The constraints listed in Table 23 in addition to those specified in the [Diagnostics](#)
 680 [Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_OwningJobElement that must
 681 be implemented.

682 **Table 23 – Class: CIM_OwningJobElement**

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

683 **10.13 CIM_RecordAppliesToElement**

684 Although defined in the [Diagnostics Profile](#), the CIM_RecordAppliesToElement class is listed here
 685 because the Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 686 CIM_DiagnosticTest. The constraints listed in Table 24 in addition to those specified in the [Diagnostics](#)
 687 [Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_RecordAppliesToElement that
 688 must be implemented.

689 **Table 24 – Class: CIM_RecordAppliesToElement**

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

690 **10.14 CIM_ServiceAffectsElement**

691 Although defined in the [Diagnostics Profile](#), the CIM_ServiceAffectsElement class is listed here because
 692 the AffectedElement reference is scoped down to CIM_PortController, which is a subclass of
 693 CIM_ManagedElement, and the AffectingElement reference is scoped down to
 694 CIM_FCHBADiagnosticTest, which is a subclass of CIM_DiagnosticTest. The constraints listed in Table

695 25 in addition to those specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other
 696 mandatory properties of CIM_ServiceAffectsElement that must be implemented.

697 **Table 25 – Class: CIM_ServiceAffectsElement**

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

698 **10.15 CIM_ServiceAvailableElement**

699 Although defined in the [Diagnostics Profile](#), the CIM_ServiceAvailableToElement class is listed here
 700 because the UsersOfService reference is scoped down to CIM_FCHBADiagnosticTest, which is a
 701 subclass of CIM_DiagnosticTest. The constraints listed in Table 26 in addition to those specified in the
 702 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 703 CIM_ServiceAvailableToElement that must be implemented.

704 **Table 26 – Class: CIM_ServiceAvailableToElement**

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

705 **10.16 CIM_ServiceComponent**

706 Although defined in the [Diagnostics Profile](#), the CIM_ServiceComponent class is listed here because the
 707 GroupComponent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 708 CIM_DiagnosticTest, and the PartComponent reference is scoped down to CIM_FCHBADiagnosticTest,
 709 which is a subclass of CIM_DiagnosticTest. The constraints listed in Table 27 in addition to those
 710 specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 711 CIM_ServiceComponent that must be implemented.

712 **Table 27 – Class: CIM_ServiceComponent**

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

713 **10.17 CIM_UseOfLog**

714 Although defined in the [Diagnostics Profile](#), the CIM_UseOfLog class is listed here because the
 715 Dependent reference is scoped down to CIM_FCHBADiagnosticTest, which is a subclass of
 716 CIM_DiagnosticTest. The constraints listed in Table 28 in addition to those specified in the [Diagnostics](#)
 717 [Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_UseOfLog that must be
 718 implemented.

719 **Table 28 – Class: CIM_UseOfLog**

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

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Annex A (informative)

Change Log

Version	Date	Description
0.1	2009-02-03	Initial Version
0.2	2009-06-03	Updated
0.3	2009-12-13	Updated
0.4	2009-08-24	Now consistent in style to DSP1002 2.0.0
0.5	2010-11-29	Now consistent with CPUB style
1.0.0.a	2011-04-06	Work In Progress

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