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12 This document's normative language is English. Translation into other languages is permitted.

CONTENTS

14 1 Foreword

15 The Platform Management Communications Infrastructure (PMCI) working group of the DMTF prepared the *PMCI Test Tools Interface and Design Specification* (DSP0280). DMTF is a not-for-profit association of industry members that promotes enterprise and systems management and interoperability. For information about the DMTF, see DMTF.

16 1.1 Acknowledgments

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

18 **Contributors:**

- Daniil Egranov — Arm Ltd.
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19 2 Introduction

20 The *PMCI Test Tools Interface and Design Specification* defines *messages*, data objects, and sequences for testing PMCI protocol implementations in devices over a variety of transport media. The description of message exchanges includes secure registration of test clients, administrative messages for configuring test sessions, and specific messages for testing individual messages in the various PMCI protocols. The message exchanges are demonstrated via an example test client.

21 2.1 Conventions

22 The following conventions apply to this specification.

23 2.1.1 Document conventions

- Document titles appear in *italics*.
- The first occurrence of each important term appears in *italics* with a link to its definition.
- ABNF rules appear in a monospaced font.

24 2.1.2 Reserved and unassigned values

25 Unless otherwise specified, any reserved, unspecified, or unassigned values in enumerations or other numeric ranges are reserved for future definition by the DMTF.

26 Unless otherwise specified, reserved numeric and bit fields shall be written as zero (`0`) and ignored when read.

27 2.1.3 Byte ordering

28 Unless otherwise specified, for this specification byte ordering of multi-byte numeric fields or multi-byte bit fields is "Little Endian" (that is, the lowest byte offset holds the least significant byte, and higher offsets hold the more significant bytes).

29 2.1.4 Test Interface data types

30 The Test interface data types table lists the abbreviations and descriptions for common data types used in this specification. These definitions follow DSP0240.

31 **Test Tool Interface data types**

Data type	Interpretation
`ver8`	Eight-bit encoding of the PTTI version number. Version encoding defines the encoding of the version number.
`bitfield8`	Byte with 8-bit field. Each of these bit fields can be defined separately.
`bitfield16`	Two-byte word with 16-bit field. Each of these bit fields can be defined separately.
`sint8`	8-bit signed integer.
`sint16`	16-bit signed integer.
`sint32`	32-bit signed integer.
`sint64`	64-bit signed integer.
`uint8`	8-bit unsigned integer.
`uint16`	16-bit unsigned integer.
`uint32`	32-bit unsigned integer.
`uint64`	64-bit unsigned integer.
`bool8`	8-bit boolean value. `0x00` is false; all other values are true
`real32`	32-bit real value, formatted per ANSI/IEEE Standard 754
`real64`	64-bit real value, formatted per ANSI/IEEE Standard 754
`strASCII`	Null-terminated ASCII-encoded string.
`strUTF8`	Null-terminated UTF-8-encoded string.
`enum8`	A sequential enumeration, starting from 0 as the default, with mandatory numeric declarator. The number 8 indicates that the enumeration is encoded using an 8-bit binary number. Example: `enum8 { CPU = 0, Memory = 1, Network = 2, Storage = 3 }`

32

2.1.5 Version encoding

33 A field with data type `ver8` encodes the supported version of the PTTI specification through a combination of *Major* and *Minor* nibbles, encoded as follows:

Version	Matches	Incremented when
Major	Major version field	Protocol modification breaks backward compatibility.
Minor	Minor version field	Protocol modification maintains backward compatibility.

34 EXAMPLE:

35 Version 3.7 → `0x37`

36 Version 1.0 → `0x10`

37 Version 1.2 → `0x12`

38 A *Test Agent* that supports Version 1.2 can interoperate with an older Test Agent that supports Version 1.0 only, but the available functionality is limited to what specification Version 1.0 defines.

39 A Test Agent that supports Version 1.2 only and a Test Agent that supports Version 3.7 only are not interoperable and shall not attempt to communicate beyond the initial *Connect* admin message. If the Test Service detects that it is incompatible, it must respond to the *Connect* message with an `INCOMPATIBLE_VERSION` message response code and the Test Client must not communicate any further. If the Test Client receives a `SUCCESS` message response code from the *Connect* message, but is unable to use the Test Service Version from the *Connect* response message, it shall issue a *Disconnect* admin message and then cease communication with the Test Service.

40 2.1.6 Notations

41 This specification uses the following notations:

Notation	Description
`M:N`	In field descriptions, this notation typically represents a range of byte offsets starting from byte `M` and continuing to and including byte `N` (`M ≤ N`). The lowest offset is on the left. The highest offset is on the right.
`[4]`	Square brackets around a number typically indicate a bit offset. Bit offsets are zero-based values. That is, the least significant bit.
`[M:N]`	A range of bit offsets where M is greater than or equal to N. The most significant bit is on the left, and the least significant bit is on the right.
`1b`	A lowercase `b` after a number consisting of `0` s and `1` s indicates that the number is in binary format.
`0x12A`	Hexadecimal, indicated by the leading `0x` .
`N+`	Variable-length byte range that starts at byte offset N.

42

3 Scope

43 This specification describes messages and flows used to capture PMCI upper (data model) layer data from a device. The data may be used to assess conformance of a device vendor firmware that implements PMCI protocols. This document specifies a specially protected interface to a Control Plane (such as a BMC) that supports a test API for tool clients.

44 Techniques for verifying that the captured data demonstrates compliance or conformance to PMCI specifications are not in scope for this specification. DMTF and PMCI Working Group will not certify protocol implementations in device vendor firmware. Any test clients provided by DMTF and the PMCI Working Group are offered as-is.

45 4 Normative references

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

- *ISO/IEC Directives, Part 2, Principles and rules for the structure and drafting of ISO and IEC documents - 2018 (8th edition)*
- DMTF DSP0218, *Platform Level Data Model (PLDM) for Redfish Device Enablement*, https://www.dmtf.org/dsp/DSP0218
- DMTF DSP0222, *Network Controller Sideband Interface (NC-SI) Specification*, https://www.dmtf.org/dsp/DSP0222
- DMTF DSP0236, *MCTP Base Specification*, https://www.dmtf.org/dsp/DSP0236
- DMTF DSP0239, *MCTP IDs and Codes*, https://www.dmtf.org/dsp/DSP0239
- DMTF DSP0240, *Platform Level Data Model (PLDM) Base Specification*, https://www.dmtf.org/dsp/DSP0240
- DMTF DSP0241, *Platform Level Data Model (PLDM) Over MCTP Binding Specification*, https://www.dmtf.org/dsp/DSP0241
- DMTF DSP0245, *Platform Level Data Model (PLDM) IDs and Codes Specification*, https://www.dmtf.org/dsp/DSP0245
- DMTF DSP0248, *Platform Level Data Model (PLDM) for Platform Monitoring and Control Specification*, https://www.dmtf.org/dsp/DSP0248
- DMTF DSP0249, *Platform Level Data Model (PLDM) State Set Specification*, https://www.dmtf.org/dsp/DSP0249
- DMTF DSP0261, *NC-SI over MCTP Binding Specification*, https://www.dmtf.org/dsp/DSP0261
- DMTF DSP0267, *Platform Level Data Model (PLDM) for Firmware Update Specification*, https://www.dmtf.org/dsp/DSP0267
- DMTF DSP0274, *Security Protocol and Data Model (SPDM) Specification*, https://www.dmtf.org/dsp/DSP0274
- DMTF DSP0275, *Security Protocol and Data Model (SPDM) over MCTP Binding Specification*, https://www.dmtf.org/dsp/DSP0275
- DMTF DSP0276, *Secured Messages using SPDM over MCTP Binding Specification*, https://www.dmtf.org/dsp/DSP0276
- DMTF DSP0277, *Secured Messages using SPDM Specification*, https://www.dmtf.org/dsp/DSP0277
- IETF RFC5248, *The Transport Layer Security (TLS) Protocol Version 1.2*, https://datatracker.ietf.org/doc/html/rfc5246

47 5 Terms and definitions

48 In this document, some terms have a specific meaning beyond the normal English meaning. This clause defines those terms.

49 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 (see Clause 7). 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 (see Clause 7) specifies additional alternatives. Occurrences of such additional alternatives shall be interpreted in their normal English meaning.

50 The terms "clause", "subclause", "paragraph", and "annex" in this document are to be interpreted as described in ISO/IEC Directives, Part 2 (see Clause 6).

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

52 The terms that DSP0236, DSP0239, and DSP0275 define also apply to this document.

53 This specification uses these terms:

Term	Definition
Asynchronous Message	A *Request Message* that originates at the *Test Service* and flows to the *Test Client*, either due to a message from a *DUT* or an administrative event within the Test Service.
Client Session	A session established between the *Test Client* and the *Test Service* for the purpose of PMCI upper layer protocols validation.
Command Code	A numeric identifier, typically one byte, inserted into a message to indicate an operation to be performed.
Control Plane	An entity that provides hardware monitoring and control functions for a platform. Commonly, this is a BMC as defined in DSP0236, though it may also be a primary/secondary BMC pair, a network of peer BMCs, or another management entity altogether in a complex, multi-chassis environment.
DUT	Device Under Test; A managed device like Host Firmware, Network Controller, etc.
Device Identifier	A value identifying a device. This does not determine a physical interface or path. There is only one Device Identifier per device.
DMTF	Formerly known as the Distributed Management Task Force, the DMTF creates open manageability standards that span diverse emerging and traditional information technology (IT) infrastructures, including cloud, virtualization, network, servers, and storage. Member companies and alliance partners worldwide collaborate on standards to improve the interoperable management of IT.

Term	Definition
DUT Connection ID	A value returned by the *Configure Device Under Test* message which identifies a specific path and interface to a DUT for use in protocol Test Messages.
Interface Identifier	A value that identifies a specific interface to a device. There can be multiple Interface Identifiers per device.
Message	A sequence of data communicated between a requester and a responder, such as a *Test Client* and a *Test Service*, to effect an operation specified by a *Command Code*. A message may be classified as either a *Request Message* or a *Response Message*.
Request Message	A *Message* that asks the recipient to initiate an operation.
Response Message	A *Message* that provides the results of an operation to the entity that requested it.
Test Agent	Either a *Test Client* or a *Test Service*, entities which can communicate over the Test Interface using the protocols defined in this specification.
Test Client	The part of a testing tool or suite which is responsible for the communication with a *Test Service* via a *Test Interface*.
Test Interface	An interface that is used for the communication between the *Test Service* and the *Test Client(s)*.
Test Message	A *Request Message* that originates at the *Test Client* and flows to the *Test Service* that instructs the Test Service to send an Upper-layer protocol message to a DUT
Test Protocol	*Messages* and sequences for testing PMCI protocol implementations in devices over a variety of transport mediums using the *Test Interface* that is defined in this specification.
Test Service	An application that communicates with the Test Client(s) through a *Test Interface* for the purpose of PMCI upper layer protocols validation. The Test Service runs on the *Control Plane*, and analyzes the messages sent via a *Test Interface* and sends the corresponding messages (like PLDM/NC-SI/SPDM) to a *DUT*.

54 6 Symbols and abbreviated terms

55 The following abbreviations are used in this document.

Abbreviation	Definition
DMTF	Formerly the *Distributed Management Task Force*
PMCI	Platform Management Communications Infrastructure
DUT	*Device Under Test*
PTTI	PMCI Test Tools Interface
TC	Test Client
TLS	Transport Layer Security
TS	Test Service

56 7 PMCI Test Architecture

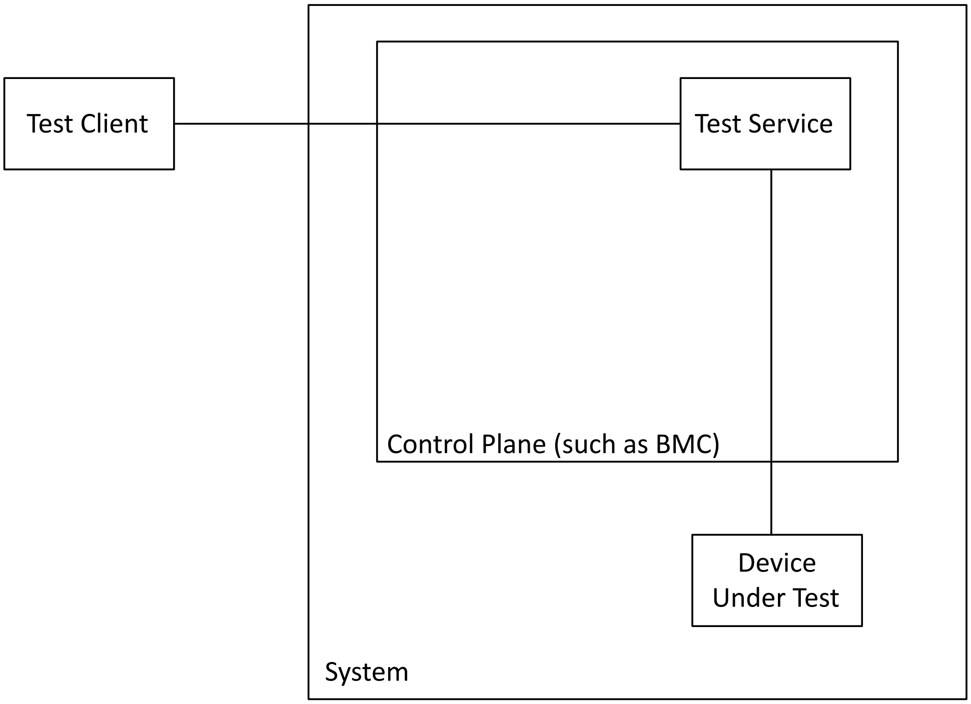
57 This clause provides a high-level view of the components of the PMCI Test Architecture. It contains three main components:

- Test client software
- Test service software or firmware
- Devices that support PMCI protocols that can be tested

58 The test client is a piece of software that performs test and validation functions for one or more PMCI protocols. Test clients may be written in any language so long as they have the ability to communicate with the test service over the network via the TLS protocol.

59 The next component is the test service, which can be either firmware or software. Typically a part of the system's control plane (often a management controller), the test service offers an API by which test clients can register themselves and interrogate the system under test as to the number or type of target devices against which they can perform test functions.

60 The last component is the collection of devices in the system that support various PMCI protocols. The test service provides APIs by which test clients can target specific devices with test messages that validate their implementations of PMCI protocols. The connection from the test service to a particular device under test can be via any of the hardware buses that are supported in the PMCI protocol stack.


Test Client
Test Service
Control Plane (such as BMC)
Device
Under Test
System

61 8 PMCI Test Tools Interface Concepts

62 8.1 Interface Scope

63 The PMCI Test Tools Interface is intended for testing upper layer PMCI protocols. However, NC-SI Pass-through and MCTP Control are not within the scope of PTTI, and Test Service implementations may elect to prohibit testing these protocols altogether.

64 8.2 Security

65 8.2.1 Overview

66 The PMCI Test Tools Interface can be utilized in a number of circumstances, such as:

- Development of devices or device firmware
- Acceptance test of a new device or new device firmware
- Manufacturing of systems containing devices
- Debugging a device in a production system

67 PTTI opens up a communication path between an external entity (Test Client) and a device under test inside a system. Therefore, it is strongly recommended to consider the security of this communication path. In some cases it may be necessary for the Test Client to be on a remote network, and this scenario requires even more thought.

68 PTTI is built upon TLS, which provides a number of benefits:

- The Test Client and Test Server are authenticated to one another.
- The Test Client, using TLS certificates, verifies that it is talking to the expected control plane.
- The link between Test Agents is encrypted and can prevent replay and man-in-the-middle attacks.

69 8.2.2 Security Requirements

1. The Test Client shall connect to the Test Service with a secure, authenticated protocol (TLS).
2. The Test Client shall verify that the target system is the intended system by validating the Test Service's TLS certificate.
3. The Test Client shall verify that the protocol version returned from the *Connect* message is supported.

70 8.2.3 Security Best Practices

71 Test Agents should log all interactions with their partner Test Agent, including authorization credentials.

72 The Test Service should be disabled by default on the control plane, and it should require special authorization to enable the Test Service. The control plane should log all authorization credentials when an administrator attempts to enable the Test Service.

73 The Test Client should verify that the control plane and the Test Service are at an acceptable level of firmware via the *Query System Inventory* message.

74 When a remote Test Client (that is, a Test Client on a separate network from the control plane) is required, the control plane administrator should only enable the Test Service to run when required, and shall disable the Test Service as soon as the connection with the Test Client is ended. The Test Client should be required to go through some additional form of authentication, such as a Virtual Private Network.

75 It is not recommended to enable the Test Service when the system is in production, when devices in the system are in production, or when devices in the system store persistent data. If the target system or devices are in production and the Test Service must be run, then:

- The control plane should not be directly connected to the internet.
- The control plane administrator should ensure that the Security Parameter to the *Connect* message is very strong (such as a long password or certificate).
- A device under test is offline whenever possible (for example, a network card is disconnected from any network and not available to users of the system).
- A device under test with persistent data should be reset before and after the connection with the Test Client.

76 8.3 Test Client and Test Service Interface

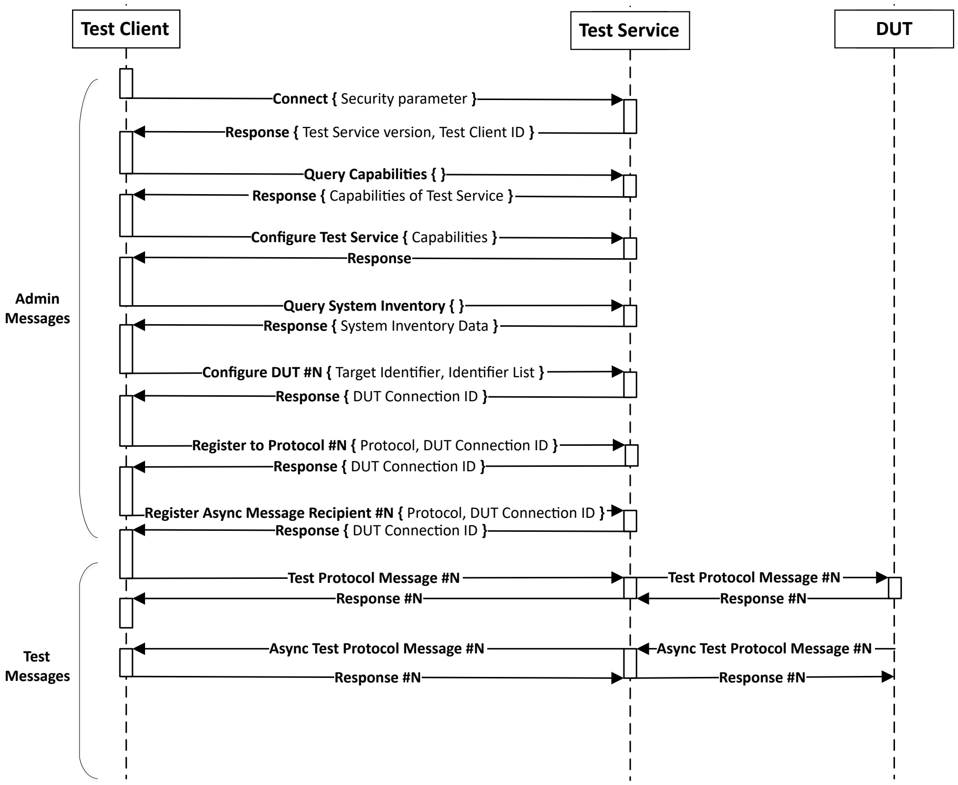
77 There are two kinds of messages that can be sent over the test client and test service interface:

- Messages related to Admin Messaging Protocol
- Messages related to Test Messaging Protocol

78 The differences between two protocols and also the scope, are described later on in this chapter. The Admin and Test Protocols Messages Flow depicts the high-level flow diagram for the Test Client and Test Service communication.

79 8.3.1 Admin and Test Protocols Messages Flow

80


Test Client
Test Service
DUT
Connect { Security parameter }
Response { Test Service version, Test Client ID }
Query Capabilities { }
Response { Capabilities of Test Service }
Configure Test Service { Capabilities }
Response
Query System Inventory { }
Response { System Inventory Data }
Configure DUT #N { Target Identifier, Identifier List }
Response { DUT Connection ID }
Register to Protocol #N { Protocol, DUT Connection ID }
Response { DUT Connection ID }
Register Async Message Recipient #N { Protocol, DUT Connection ID }
Response { DUT Connection ID }
Admin Messages
Test Protocol Message #N
Response #N
Test Protocol Message #N
Response #N
Async Test Protocol Message #N
Async Test Protocol Message #N
Response #N
Response #N
Test Messages

81 8.3.2 Admin Messaging Protocol

82 The admin messaging protocol is used to set up the test service and to register a test client that will perform testing. Admin messages provide support for the following functionality:

- Establishing connections to test clients (see Client Session Establishment)
- Providing a system inventory of available devices against which testing may be performed
- Registering a test client to specific protocols and to specific target devices
- Configuring a device for testing, including the hardware path to be used for testing it
- Registering a test client to receive asynchronous messages sent from devices

83 8.3.2.1 Client Session Establishment

84 There are multiple steps in establishing a session between the Test Client and the Test Service. First, the Test Service

must open a TLS port and begin listening on that port. This document does not specify how the TLS port is opened, which will vary based on the vendor that produces the Test Service.

85 Second, the TLS port number and the Test Service's certificate must be provided as inputs to the Test Client. Again, this document does not specify any procedure for providing these inputs, and in many cases this will be a manual setup step. The Test Client is responsible for verifying the correctness of the provided certificate.

86 The Test Client will initiate a TLS connection with the Test Service as detailed in the TLS specification, using the provided certificate and port. Once the TLS connection is established, the data flowing between the Test Client and Test Service is encrypted and protected from man-in-the-middle attacks.

87 Next, the Test Client will send a *Connect* admin message over the secure channel. The Security Parameter of the *Connect* message proves that the Test Client has authorization to send PTTI messages to the Test Service. This document does not specify the manner by which the Test Service validates the Security Parameter.

88 If the Security Parameter is invalid, the Test Service will respond to the *Connect* message with an `AUTHENTICATION_ERROR` message response code. However, if the Security Parameter is valid, the Test Service will respond to the *Connect* message with a `SUCCESS` message response code as well as a Test Client ID and a Test Service Version. The Test Client ID serves as a token that must be passed as a parameter with all subsequent messages. This Test Client ID is just a handle and has no meaning other than to identify the Test Client to the Test Service. The Test Service Version returned by the Test Service should be validated by the Test Client to ensure that the Test Client is able to communicate with the Test Service.

89 Once the Test Client has obtained a Test Client ID and has validated that it can use the Test Service Version, it should issue the following admin messages:

- *Query Capabilities* to ensure that the Test Service provides all the capabilities necessary for the Test Client's operation.
- *Query System Inventory* to collect the inventory of available devices that may be tested.

90 From the inventory provided by the Test Service, the Test Client may select one device to designate as the Device Under Test. The Test Client shall use the *Configure Device Under Test* admin message to inform the Test Service that it wishes to test a specified device, and it optionally may select the path by which the Control Plane will talk to the device by using information from the system inventory.

91 After a DUT is successfully configured, the Test Client shall issue one or more *Register To Protocol* admin messages to request that the Test Service allow the Test Client to test particular protocols or protocol types. Optionally, the Test Client may issue one or more *Register Async Message Recipient* admin messages in order to receive messages asynchronously originating from the DUT.

92 Having completed all the messages to establish a test session, the Test Client may now begin testing using the Test Messaging Protocol.

93 8.3.3 Test Messaging Protocol

94 The test messaging protocol is used by a test client to send request messages to the test service for relay to a device under test. The test service then collects the device's response to the request messages and returns them to the test client for evaluation and further processing. The test messaging protocol supports a variety of upper-level protocols and provides support for testing messages in each of these protocols.

95 In addition to message relay, the test messaging protocol collects timing information for the amount of time that a device took to respond to the Test Message. It also reports on various errors that may have occurred in the processing of the message.

96 The Test Client is permitted at most one outstanding Test Message per Protocol Type to each Device Under Test at a time. The Test Service is responsible for ensuring that the DUT responds in the appropriate amount of time, and if it does not, the Test Service must send a response to the Test Client with the `TIMEOUT` Message Response Code.

97 If the Test Service does not respond to the Test Message in a time frame that is reasonable to the Test Client, the Test Client may terminate its connection to the Test Service. In this case, the Test Client may wish to send a *Log Event* admin message with Reason Code `ClientTimeout` before disconnecting.

98 8.3.4 NC-SI Testing Considerations

99 Special care should be taken when implementing tests for NC-SI. There are no provisions made in this specification for testing NC-SI Pass-through traffic, and it is recommended that the Test Service reject any NC-SI Pass-through tests (for example, those using MCTP Type 3).

100 NC-SI Control is supported by this specification. However, in certain architectures, the Test Service running on a Control Plane (such as a BMC) may be connected to the external network or the Test Client using NC-SI Pass-Through. The recommendation is that the implementer review the architecture of the system and avoid using the NC-SI *Deselect* command for a package that may be providing network connectivity to the Control Plane. Details about NC-SI packages may be found in the `"NC-SIInfo"` section of the System Inventory, and it is recommended that Test Services return the `"NC-SIInfo"` JSON object when NC-SI Control testing is supported to a DUT.

101 9 Test service behavior

102 9.1 Device security arbiter

103 The Test Service may optionally maintain a database of Test Clients and the devices for which they have permission to access. The Test Service may allow or deny access to devices for test purposes, and the Test Service may allow or deny access to certain protocols or protocol types. Further, the Test Service may allow or deny access to asynchronous messages originating from the device, on a protocol or protocol type basis.

104 The Test Client may check which protocols it has been granted permission for by issuing the *Query Status* admin message.

105 9.2 Connection Watchdog

106 The Test Service may optionally implement a Connection Watchdog, by which the Test Service may disconnect Test Clients that are no longer communicating with the Test Service. The Test Service must reset the Connection Watchdog timeout after receiving any message from the Test Client that has a valid Test Client ID. Upon expiration of the Watchdog timer, the Test Service will send the *Log Event* message with Reason Code `WatchdogTimeout` to indicate the connection will be disconnected and the Test Client ID will become invalid afterwards. The Test Service should reject any further messages from the Test Client with an `AUTHENTICATION_ERROR` message response code.

107 If implemented, the Connection Watchdog timeout must be reported in the *Query Capabilities* response message. The Test Client can configure the watchdog timeout using the *Configure Test Service* message and the maximum watchdog timeout that can be configured must be reported in the *Query Capabilities* response message. Should the Test Client wish to keep the connection open without sending Test Messages to the Test Service, the Test Client may use the *Query Status* message with the Query Type set to `Ping`.

108 9.3 Proxying of messages

109 The primary purpose of the test service is to act as a proxy, receiving messages from test clients, submitting them to a device under test, collecting response messages from the device, and relaying those responses back to the test client. It is imperative that the test service be as transparent as possible; to the maximum extent possible, it should appear to both the test client and the device under test that they are communicating directly. The main exception to this is that the test service is responsible for simplifying the communication pathways, enabling the test client to reach the device under test via an abstract DUT Connection ID rather than needing to know the physical hardware addresses for the device under test. Similarly, low-level details such as the packetization of MCTP messages is taken care of by the control plane so that the test client can focus on higher-level protocol testing.

110 9.4 Collection of timing information

111 Upon request, the test service is responsible for collecting timing information for how long it takes a device to respond to a request message. This measurement shall be the amount of time elapsed between when the last byte of the request message is sent and the first byte of the response message is received. In the event that multiple tries are required to obtain a response from the device under test, the test service shall only report the timing for the final request.

112 9.5 Relaying of device-initiated messages to registered test clients

113 Test clients may optionally register to receive asynchronous communications for specific protocols from a device under test. If the test client has so registered and the device emits a message that matches the registration criteria, the test service shall intercept that message and relay it to the test client.

114 For PLDM events, the Control Plane is responsible for collecting events whether those events come from device-initiated *PlatformEventMessage* messages or by Control Plane-initiated *PollForPlatformEventMessage* messages. In either case, the Control Plane must deliver these events to its Test Service so that they may be relayed to the Test Client.

115 10 Messages

116 This clause details the various messages used in the test interface.

117 10.1 Message structure

118 The basic structure of all PTTI request and response messages consists of two parts: a Test Service Wrapper and Message Data. For Admin requests and responses, the first byte of the Message Data indicates the specific Admin Command Code. For Test requests and responses, the full Upper-layer message (header and data) is contained in the Message Data.

	Byte	Description
Test Service Wrapper	0:7	Message header for the test service
Message Data	8+	Protocol-specific message payload data

119 10.1.1 Test Service Wrapper

120 The test service wrapper is a header specific to the test interface and shall be present for all request and response messages.

	Type	Byte	Description
Version	`ver8`	0	PTTI Protocol Version
Protocol Type	`byte`	1	Protocol Type
Flags	`bitfield16`	2:3	Test Service Wrapper Flags
Test Client ID	`uint32`	4:7	Client ID as assigned by the *Connect* response message

121 10.1.1.1 Protocol Type

122 The Protocol Type field identifies the protocol for the current message.

Protocol	ID
PTTI Admin	`0xFF`
PTTI Vendor Defined Admin	`0xF1`
Test Messages (values from DSP0239)	`0x00 - 0x7F`

123 10.1.1.2 Test Service Wrapper Flags

124 The test service wrapper flags contain attributes of the current message.

Bits	Field	Description
[0:1]	Direction	0: TC → TS Request Message 1: TS → TC Response Message 2: TS → TC Request Message 3: TC → TS Response Message
[2:15]	R	Reserved

125 10.1.2 Message Response Codes

126 The following table enumerates the possible response codes for messages. Response codes with value `0x80` and higher are reserved for command-specific message responses.

Code	Name	Description
0	`SUCCESS`	The responding test agent received a request and performed all required actions successfully.
1	`TIMEOUT`	The responding test agent received a request but a timeout occurred prior to completing the request.
2	`INVALID_PROTOCOL`	The Test Service received a Test request for an unsupported Protocol Type such as MCTP Control (0) or NC-SI Pass-through (3)
3	`TRANSPORT_ERROR`	The Test Service was unable to send the Test Message due to a transport-level error.
4	`PHYSICAL_ERROR`	The Test Service was unable to send the Test Message due to a physical-level error.
5	`AUTHENTICATION_ERROR`	The Test Service was unable to send the Test Message as the Test Client ID failed authentication checks.
6	`PRIVILEGE_ERROR`	The Test Service was unable to process the request because the Test Client has insufficient privilege to perform the requested action.
7	`INTEGRITY_CHECK_ERROR`	The responding test agent received a request but could not complete the request due to a data integrity check error.
8	`INCOMPATIBLE_VERSION`	The responding test agent received a message, but the Test Service Wrapper Version is incompatible with the test agent.
9	`INVALID_DUT_CONNECTION_ID`	The DUT Connection ID given by the requesting test agent is invalid.
10	`OUTSTANDING_MESSAGE`	The Test Agent already has an outstanding Test Message to the specified DUT, or already has an outstanding Admin message to its partner Test Agent, so this message is not permitted.

Code	Name	Description
`0x80..0xEF`	`COMMAND_SPECIFIC_RESERVED`	Reserved for command-specific message responses.
`0xF0..0xFF`	`OEM_SPECIFIC_RESERVED`	Reserved for OEM-specific message responses.

127 10.2 Admin Messages

128 Admin messages are used to setup the test service and register a test client. Admin messages are distinguished by the Protocol Type in the Test Wrapper, and have a Command Code as the first byte of their Message Data.

129 The Test Client is permitted one outstanding Admin message to the Test Service at a time, in addition to having one outstanding Test Message to each Device Under Test. If the Test Service detects a second Admin message has been received before it responds to the first Admin message, it may respond with the `OUTSTANDING_MESSAGE` Message Response Code.

130 If the Test Service does not respond to the Admin message in a time frame that is reasonable to the Test Client, the Test Client may terminate its connection to the Test Service. In this case, the Test Client may wish to send a *Log Event* admin message with Reason Code `ClientTimeout` before disconnecting.

131 10.2.1 Command Codes

132 The Command Code is the first byte of the Message Data in an Admin request or response message. It identifies which Admin command is contained within the message and enables interpretation of the message payload.

Command	Code
Connect	`0x00`
Disconnect	`0x01`
Query Capabilities	`0x10`
Query Status	`0x11`
Query System Inventory	`0x12`
Configure Test Service	`0x20`
Configure Device Under Test	`0x21`
Register to Protocol	`0x22`
Register Async Message Recipient	`0x23`
Log Event	`0x30`

133 10.2.2 *Connect* (`0x00`)

134 The *Connect* message connects a Test Client to a Test Service. The *Connect* message does not require a valid Test Client ID parameter in the Test Service Wrapper.

135 A security parameter must be passed in the *Connect* request message. The process for generating this security parameter is dependent on the Test Service vendor, and will not be specified in this document. The security parameter may be a password, encryption key, certificate, or other construct as determined by the Test Service vendor.

136 When the Test Service receives a security parameter that it accepts, the Test Service will respond to the *Connect* message with a 4-byte Test Client ID that must be passed in the Test Service Wrapper, by the Test Client, on all subsequent messages. The Test Service also provides the version of the Test Service API that it supports. In the event that the Test Client is incompatible with this version, it shall use the *Disconnect* message to cease testing.

137 While connected, this Test Service is unavailable to other Test Clients and will refuse connection requests. A connection is terminated by the *Disconnect* message or a Connection Watchdog timeout.

138 ***Connect* request message format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x00` - See Command Codes
1	Security Parameter Length	`uint32`	Length of the security parameter
5	Security Parameter	Variable	Security parameter provided by the Test Service vendor

139 ***Connect* response message format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x00` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes and the below specific codes. `0x80` : `OTHER_CLIENT_CONNECTED` - The test service is already connected to another client.
2	Test Service Version	`ver8`	The version of the Test Service API that the Test Service implements
3	Test Client ID	`uint32`	Test Client ID for use in the Test Service Wrapper on subsequent messages

140 10.2.3 *Disconnect* (`0x01`)

141 The *Disconnect* message terminates the connection between a Test Client and a Test Service. Any outstanding messages shall be canceled (if possible) or quiesced (otherwise) by the Test Service prior to response to this message.

Registration for asynchronous notification of messages initiated by devices under test shall be implicitly canceled by the issuing of this message.

142 After the *Disconnect* message is issued, the Test Client ID parameter in the Test Service Wrapper is no longer valid, and a new *Connect* message must be issued with a valid security parameter in order to obtain a new Test Client ID.

143 ***Disconnect* request message format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x01` - See Command Codes

144 ***Disconnect* response message format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x01` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes

145 10.2.4 *Query Capabilities* (`0x10`)

146 The *Query Capabilities* message shall be used by the Test Client to determine the capabilities of the Test Service. A Test Client must issue the *Query Capabilities* message after every successful *Connect* message. The Test Service must guarantee that the capabilities do not change while the Test Client ID obtained from the *Connect* message remains valid.

147 A Test Service may optionally support each of the following capabilities. For all one-bit fields, a value of `1b` indicates that the Test Service supports the feature, and a value of `0b` indicates that the Test Service does not support the feature.

148 ***Test Service Capabilities***

Name	Capability ID	Description
Maximum Connection Watchdog Timeout (Read Only)	1	Maximum Watchdog timeout in seconds
Current Connection Watchdog Timeout	2	Current Watchdog timeout in seconds
Reserved for future use	3-32763	Reserved for future use
Vendor Capabilities Set #1 IANA Enterprise ID	32764	IANA Enterprise ID of the vendor owning the capabilities in ID range 32768-40959

Name	Capability ID	Description
Vendor Capabilities Set #2 IANA Enterprise ID	32765	IANA Enterprise ID of the vendor owning the capabilities in ID range 40960-49151
Vendor Capabilities Set #3 IANA Enterprise ID	32766	IANA Enterprise ID of the vendor owning the capabilities in ID range 49152-57343
Vendor Capabilities Set #4 IANA Enterprise ID	32767	IANA Enterprise ID of the vendor owning the capabilities in ID range 57344-65535
Vendor Capabilities Set #1	32768-40959	Vendor Capabilities Set #1
Vendor Capabilities Set #2	40960-49151	Vendor Capabilities Set #2
Vendor Capabilities Set #3	49152-57343	Vendor Capabilities Set #3
Vendor Capabilities Set #4	57344-65535	Vendor Capabilities Set #4

149 ### ***Query Capabilities*** Message request format

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x10` - See Command Codes

150 ### ***Query Capabilities*** Message response format

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x10` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes
2	Reserved	`uint8`	Reserved for future use
3	Number of Capabilities Fields	`uint16`	Count of capabilities in this structure
5	First Capability ID	`uint16`	From the Table of Capability IDs
7	First Capability Value	`uint32`	Value for the first Capability
11	Second Capability ID	`uint16`	From the Table of Capability IDs
13	Second Capability Value	`uint32`	Value for the second Capability
...	...	...	...
N*6+5	Final Capability ID	`uint16`	From the Table of Capability IDs
N*6+9	Final Capability Value	`uint32`	Value for the final Capability

151 10.2.5 *Query Status* (`0x11`)

152 The *Query Status* message may be used by the Test Client to query the status of its connection to the Test Service and, optionally, the protocol and async-handling registrations for a device under test.

153 ***Query Status* Message request format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x11` - See Command Codes
1	Query Type	`enum8`	The type of status query being performed. `{ Ping = 0, Device List = 1 }`

154 ***Query Status* Message response format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x11` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes
2	Query Type	`enum8`	The type of status query that was performed. See values in *Query Status* request.
3	Query Response Data Length	`uint32`	The length of the Query Response Data.
7	Query Response Data	variable	The data in response to the query, which is interpreted based on the Query Type.

155 ***Query Status* Ping Response Data**

156 If the Query Type is `Ping`, the Query Response Data Length will be 0, and there will be no Query Response Data.

157 ***Query Status* Device List Response Data**

158 If the Query Type is `Device List`, the Query Response Data will be in the following format:

Offset	Field	Type	Description
0	Device Count	`uint8`	The number of devices returned in this query.
1	Device Data Structures	Repeating List	A repeating list of Query Status Device Data structures based on the Device Count

159 ***Query Status* Device Data**

160 The Test Client may use this structure to understand the test status of a particular DUT. In addition to a DUT

Connection ID, the structure contains a list of protocol/type pairs. The protocol value of the pair indicates the specific protocol that is registered, such as `0x01` for PLDM. The type value of the pair indicates a type of message within the protocol, such as `0x02` for PLDM for Platform Monitoring and Control. For a protocol that does not have multiple types, the value `0x00` shall be used for the type. The Test Service will also indicate whether it will forward asynchronous messages that originate from the DUT to the Test Client.

Offset	Field	Type	Description
0	DUT Connection ID	`uint32`	The DUT Connection ID for the device.
4	Device Registered Protocol Type Count	`uint8`	The count of protocol/type pairs for the device registered by the Test Client using Register to Protocol
5	Device Registered Protocol #1	`enum8`	A protocol value for the first registered Protocol/Type pair
6	Device Registered Protocol Type #1	`enum8`	A protocol type value for the first registered Protocol/Type pair
7	Async Registered for Protocol Type #1	`bool8`	The Test Client has registered to receive asynchronous messages for the first Protocol/Type pair
8	Device Registered Protocol #2	`enum8`	A protocol value for the second registered Protocol/Type pair
9	Device Registered Protocol Type #2	`enum8`	A protocol type value for the second registered Protocol/Type pair
10	Async Registered for Protocol Type #2	`bool8`	The Test Client has registered to receive asynchronous messages for the second Protocol/Type pair
...	...	...	...
N*3+5	Device Registered Protocol #N	`enum8`	A protocol value for the final registered Protocol/Type pair
N*3+6	Device Registered Protocol Type #N	`enum8`	A protocol type value for the final registered Protocol/Type pair
N*3+7	Async Registered for Protocol Type #N	`bool8`	The Test Client has registered to receive asynchronous messages for the final Protocol/Type pair

161 10.2.6 *Query System Inventory* (`0x12`)

162 The *Query System Inventory* message retrieves an inventory of the hardware and firmware present in the system exposed by the test service. The resulting inventory is supplied in JSON format per the SystemInventory JSON schema. A mockup and the schema may be found in Annex A.

163 The inventory returned by the Test Service may be constructed via both standard and vendor proprietary methods. For example, the `Protocol` information may be supplied by the cached results of an MCTP *Get Message Type Support* command, but the `PCI-ID` information would typically be obtained outside of PMCI protocol messages. As each platform and Control Plane are unique, the methods for constructing a System Inventory must also be unique to that platform and Control Plane.

164 The fields in the system inventory are as follows:

- `Schema definition` : A link to the SystemInventory schema
- `ControlPlane` : An object containing information about the control plane (such as a management controller) with which the test service interacts to provide test functionality
  - `Manufacturer` : The manufacturer of the control plane
  - `Model` : The model of the control plane (if applicable)
  - `Firmware versions` : An array of named firmware associated with the control plane and/or system environment. It is recommended that the `"Name"` of the firmware component be consistent with the Package Classification Type from the ComponentClassification values table in PLDM For Firmware Update whenever possible.
  - `Device Identifier` : The code identifying the control plane for the system under test. This is usually 0.
  - `Interfaces` : An array of the hardware and software interfaces the control plane supports for communicating with devices, as well as an indication of whether devices can initiate messages on them
- `Devices` : A list of the devices in the system that can be reached for test purposes. For each of these devices:
  - `Manufacturer` : The manufacturer of the device
  - `Location` : The physical location of the device, such as a particular slot in the chassis
  - `Device Identifier` : A code that can be used to test against the specific device when the test client doesn't care which interface messages are routed over
  - `UniqueID` : A unique value that can be used to identify a device that does not change over the lifetime of the device. The UniqueID can be MCTP Endpoint UUID, NC-SI Package UUID or any other unique identifier such as a serial number. The format of the UniqueID is outside the scope of this specification.
  - `PCI-ID` : The four-part PCI device identifier for the device:
    - `DID` : The device identifier
    - `SDID` : The sub-device identifier
    - `VID` : The vendor identifier
    - `SVID` : The sub-vendor identifier
  - `Firmware versions` : An array of named firmware associated with the device
  - `Interfaces` : An array of interfaces with which the MC can reach the device. For each interface:
    - `Name` : The name of the interface
    - `Interface Identifier` : An identifier that can be used as part of a compound sequence to build up a specific path to a device to force testing on specific paths and interfaces via the *Configure Device Under Test* message
    - `Parent Device Identifier` : The Device Identifier for the bridge or control plane to which that the interface is attached. Zero for the main management controller/control plane.
    - `Protocol support` : A list of the protocols for which the device advertises support:
      - `Protocol` : The name of the protocol
      - `Types` : An array of sub-types of the protocol supported by the device:
        - `Type` : The numeric sub-type value
        - `Name` : The name of the protocol sub-type, such as PLDM for Platform Monitoring and Control

  - `Versions` : A list of specific specification versions the device supports for the sub-type
- `NC-SIInfo` : Additional information if the Protocol is NC-SI
  - `ChannelID` : Network Controller Channel ID to address the Network Controller Channel
  - `Pass-through` : The status of the channel to allow Pass-through packets

165 **Admin Query System Inventory Message request format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x12` - See Command Codes

166 **Admin Query System Inventory Message response format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x12` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes
2	System Inventory	`uint8` * N	UTF-8 formatted JSON SystemInventory data

167 10.2.7 *Configure Test Service* (`0x20`)

168 The *Configure Test Service* shall be used by the test client to configure the capabilities of the test service. A Test Client must issue the *Query Capabilities* message after every successful *Connect* message. The Test Client can configure the Test Service after determining the capabilities of the Test Service from the response of *Query Capabilities*. Test client can issue *Query Capabilities* after *Configure Test Service* to ensure the capability is configured as expected. The test client might configure the test service before issuing the *Configure Device Under Test*, after which the test service can reject the *Configure Test Service* request from the test client.

169 **Admin Configure Test Service Message request format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x20` - See Command Codes
1	Number of Capabilities Fields	`uint16`	Count of capabilities in this structure
3	First Capability ID	`uint16`	From the Table of Capability IDs
5	First Capability Value	`uint32`	Value for the first Capability
9	Second Capability ID	`uint16`	From the Table of Capability IDs
11	Second Capability Value	`uint32`	Value for the second Capability
...	...	...	...

Offset	Field	Type	Description
N*6+3	Final Capability ID	`uint16`	From the Table of Capability IDs
N*6+5	Final Capability Value	`uint32`	Value for the final Capability

170 **Admin Configure Test Service Message response format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x20` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes

171 10.2.8 *Configure Device Under Test* (`0x21`)

172 The *Configure Device Under Test* message enables the test client to configure the Test Service to communicate with a device it wishes to perform testing against. This may either be via the Device Identifier from the System Inventory, if the test does not require a certain path or interface to reach the device; or it may be via a sequence of Device Identifiers and Interface Identifiers that specify the exact sequence of interfaces to use to reach it.

173 If the Target Identifier is a Device Identifier and the Identifier Count is 0, the Test Service determines the path to reach the device and the interface to use. If the Target Identifier is an Interface Identifier and the Identifier Count is 0, the Test Service will determine a path that uses the given interface to connect to the associated device.

174 In the case where an Identifier List is provided and the Identifier Count is greater than 0, the test service will verify that the path is valid. If the given path is invalid, the Test Service shall send a response with the Response Code set to `INVALID_PATH`. The DUT Connection IDs, Device Identifiers, and Interface Identifiers all exist in the same name-space, removing any ambiguities between them.

175 In all cases other than for invalid paths, the Test Service returns a Configure Device Under Test Response with the newly created DUT connection ID and the path chosen to reach the DUT. Using the DUT Connection ID in future messages guarantees the returned path will be used. To facilitate debugging in the invalid path case, the response Identifier List can contain the Interface Identifiers up to, but not including the first invalid connection.

176 **Admin Configure Device Under Test Message request format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x21` - See Command Codes
1	Target Identifier	`uint32`	The device or interface identifier for the device being configured
5	Identifier Count	`uint8`	The number of identifiers supplied in the remainder of this message
6	Identifier List	`uint32` * N	The sequence of interface identifier(s) to the device under test if the Identifier Count is 0

177 **Admin Configure Device Under Test Message response format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x21` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes and the below specific codes. `0x90` : `INVALID_PATH` - Path given in Interface List of Configure DUT request is invalid
2	DUT Connection ID	`uint32`	The DUT Connection ID to use with subsequent messages
6	Identifier Count	`uint8`	The number of interface identifiers in the path to the DUT
7	Identifier List	`uint32` * N	The sequence of interface identifiers in the path to the DUT

178 10.2.9 Configure Device Under Test Examples

179 The figure below is an examples of a topology containing a control plane, two bridges, and three devices. Explanations of some example calls to Configure Device Under Test follow the figure below.

```
+----------+          +-----------+
|          |          | Device    |
|          |          | Dev ID 02 |
|          |          |           |
|  Control |          |  IfcID 0C |
|  Plane   |          +-----------+
| Dev ID 00|                |                      +-----------+
|          |                |                      |           |
|  IfcID 0A+----------------+----------------------+IfcID 0F   |
|          |                                       |           |
|          |      +---------------------+          | Device    |
|  IfcID 0B|------+IfcID 0D             |          | Dev ID 04 |
+----------+      |       Bridge        |          |           |
                  |      Dev ID 03      |          |           |
                  |             IfcID 0E+----+-----|IfcID 10   |
                  |                     |    |     |           |
                  +---------------------+    |     +-----------+
  +----------+                               |
  | Device   |    +---------------------+    |
  | Dev ID 06|    |       Bridge        |    |
  |          |    |      Dev ID 05      |    |
  |  IfcID 13+----+IfcID 11             |    |
  |          |    |             IfcID 12+----+
  +----------+    |                     |
                  +---------------------+
```

180 10.2.9.1 Example 1

- Client sends `ConfigureDUTRequest(TargetIdentifier: 02, IdentifierCount: 0, IdentifierList: [])`
- Path: Test Service picks only available path via Interface `0A` to Interface `0C`
- DUT Connection ID: Test Service picks available Identifier 20
- Test Service sends `ConfigureDUTResponse(ResponseCode: 0<SUCCESS>, DUTConnectionID: 20, IdentifierCount: 2, IdentifierList: [0A, 0C])`

181 10.2.9.2 Example 2

- Client sends `ConfigureDUTRequest(TargetIdentifier: 04, IdentifierCount: 0, IdentifierList: [])`
- Path: Test Service has two choices of paths, and must choose any valid path. For example, Interface `0A` to Interface `0F`.
- DUT Connection ID: Test Service picks available Identifier 21
- Test Service sends `ConfigureDUTResponse(ResponseCode: 0<SUCCESS>, DUTConnectionID: 21, IdentifierCount: 2, IdentifierList: [0A, 0F])`

182 10.2.9.3 Example 3

- Client sends `ConfigureDUTRequest(TargetIdentifier: 10, IdentifierCount: 3, IdentifierList: [0B, 0D, 0E])`
- Path: Test Service determines the given path is valid.
- DUT Connection ID: Test Service picks available Identifier 22
- Test Service sends `ConfigureDUTResponse(ResponseCode: 0<SUCCESS>, DUTConnectionID: 22, IdentifierCount: 4, IdentifierList: [0B, 0D, 0E, 10])`

183 10.2.9.4 Example 4

- Client sends `ConfigureDUTRequest(TargetIdentifier: 13, IdentifierCount: 5, IdentifierList: [0A, 0D, 0E, 12, 11])`
- Path: Test Service determines the given path is invalid, noting the last good interface identifier along the path is `0A`.
- DUT Connection ID: Test Service does not create a DUT Connection ID
- Test Service sends `ConfigureDUTResponse(ResponseCode: 90<INVALID_PATH>, DUTConnectionID: 00, IdentifierCount: 1, IdentifierList: [0A])`

184 10.2.9.5 Example 5

- Client sends `ConfigureDUTRequest(TargetIdentifier: 13, IdentifierCount: 0, IdentifierList: [])`
- Path: Test Service picks only available path to interface `13` of device 06.

- DUT Connection ID: Test Service picks available Identifier 23
- Test Service sends `ConfigureDUTResponse(ResponseCode: 0<SUCCESS>, DUTConnectionID: 23, IdentifierCount: 6, IdentifierList: [0B, 0D, 0E, 12, 11, 13])`

185

10.2.10 *Register to Protocol* (`0x22`)

186 The *Register to Protocol* message enables the test client to specify the particular device(s), protocol(s), and type(s) it plans to test against. This is a hook by which the test service may deny permission to a test client for protocol access. A response of success grants permission to access the protocol/type(s) on the requested device. If the device is not available on the requested protocol or the path given in the Configure Device DUT message does not support it, this message shall fail.

187 The *Register to Protocol* message includes a field to specify types of messages within a Protocol Type. For example, there are multiple types of PLDM messages (Platform Monitoring and Control, Redfish Device Enablement, etc.) defined in DSP0245, and a test client may register for any combination of these PLDM types. NC-SI and SPDM do not have types within their protocols, and so the `Type Count` would be set to `0` for these protocols.

188 This message only sets up communication from the Test Client to the DUT (via the Test Service). In order for the Test Client to receive asynchronous communication originating from the DUT, the Test Client must use the Register Async Message Recipient message.

189 **Admin Register to Protocol Message request format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x22` - See Command Codes
1	Protocol Type	`enum8`	The protocol the test client wishes to test against
2	DUT Connection ID	`uint32`	The DUT the test client is requesting to test against
6	Type Count	`uint8`	The number of types within the protocol the client wishes to test against (`0` if no types in protocol)
7	Types	`uint8` * N	The specific individual types within the Protocol Type (for example, Redfish Device Enablement)

190 **Admin Register to Protocol Message response format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x22` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes
2	DUT Connection ID	`uint32`	The DUT that the test client requested to test against

191 10.2.11 *Register Async Message Recipient* (`0x23`)

192 The *Register Async Message Recipient* message informs the test service that the test client wishes to receive asynchronous messages caused by a particular device. The test service shall forward asynchronous messages for registered types to the test client for processing. Except in matters of physical safety of the hardware, the test service shall not process forwarded messages itself.

193 The Test Service shall not permit the Test Client to register for asynchronous messages from a device if the Test Client has not previously registered to send synchronous (Test Client-initiated) messages to that device using the Register To Protocol message.

194 **Admin Register Async Message Recipient Message request format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x23` - See Command Codes
1	Protocol Type	`enum8`	The protocol the test client wishes to test against
2	DUT Connection ID	`uint32`	The DUT for which the test client requests to receive asynchronous events
6	Type Count	`uint8`	The number of types within the protocol the client wishes to receive asynchronously (`0` if no types in protocol)
7	Types	`uint8` * N	The specific individual types within the Protocol Type (for example, Platform Monitoring and Control - see discussion in *Register To Protocol*)

195 **Admin Register Async Message Recipient Message response format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x23` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes
2	DUT Connection ID	`uint32`	The DUT for which the test client requested to receive asynchronous events

196 10.2.12 *Log Event* (`0x30`)

197 The *Log Event* message is used by a Test Agent to log event messages to its peer Test Agent. The receiving Test Agent may, at its discretion, ignore the Log Data. This may be desirable in the case that the receiving Test Agent does not have the space to store the Log Data.

198 ***Log Event* request message format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x30` - See Command Codes
1	Reason Code	`enum8`	The reason for the *Log Event* `{ CorruptMessage = 1, ClientTimeout = 2, WatchdogTimeout = 3, OemReserved = 0xF0..FF }`
2	Log Data Format	`enum8`	The format for the Log Data (see DSP0267 String Type values) `{ Binary = 0, ASCII = 1, UTF8 = 2, UTF-16 = 3, UTF-16LE = 4, UTF16-BE = 5 }`
3	Log Data Length	`uint32`	Length of the Log Data
7	Log Data	variable	Log Data

199 ***Log Event* response message format**

Offset	Field	Type	Description
0	Command Code	`enum8`	`0x30` - See Command Codes
1	Response Code	`enum8`	See Test Service Response Codes

200 10.3 Vendor Defined Admin

201

202 PTTI Vendor Defined Admin messages are used when a tester wants to send custom messages between their Test Client and Test Service. In contrast, MCTP Vendor Defined Messages are used when a tester wants to send custom messages between their Test Client and DUT. MCTP Vendor Defined Messages are sent via Test Request and Response Messages with the appropriate Protocol Type from DSP0239, and not via the Vendor Defined Admin mechanism.

203 PTTI Vendor Defined Admin messages are identified using the Protocol Type of the Test Service Wrapper. The IANA Enterprise ID of the requester and responder must be provided as the first 4 bytes.

204 A PTTI Vendor Defined Admin message may not be sent when a standard PTTI Admin message is outstanding, and a standard PTTI Admin message may not be sent when a PTTI Vendor Defined Admin message is outstanding. In such cases, the Test Service shall respond with an `OUTSTANDING_MESSAGE` Test Service Response Code.

205 ***Vendor Defined Admin* request message format**

Offset	Field	Type	Description
0	IANA Enterprise ID	`uint32`	IANA Enterprise ID for Vendor. MSB first. This is formatted per the Vendor Data Field for IANA enterprise vendor ID in the MCTP Base Specification.
4+	Vendor Defined Data	Variable	Data for Vendor Defined Admin request message

206 ***Vendor Defined Admin* response message format**

Offset	Field	Type	Description
0	IANA Enterprise ID	`uint32`	IANA Enterprise ID for Vendor. MSB first. This is formatted per the Vendor Data Field for IANA enterprise vendor ID in the MCTP Base Specification.
4	Response Code	`enum8`	See Test Service Response Codes
5+	Vendor Defined Data	Variable	Data for Vendor Defined Admin request message

207 10.4 Test Messages

208

209 Test Messages instruct the Test Service to send a message, of the protocol specified in the Protocol Type field of the Test Service Wrapper, to the DUT using the connection specified in the DUT Connection ID. Test Clients must correctly set the Test Service Wrapper Flags to indicate that the Test Message Request originates with the Test Client (TC → TS Request). Likewise, the Test Service must set the flags indicating that the Response originates from the Test Service (TS → TC Response).

210 When constructing a PTTI Test Message, the Test Client should use the Protocol Type value defined in DSP0239, even when the underlying transport layer is not MCTP. MCTP Type 0 (MCTP Control) and Type 3 (NC-SI Pass-through) are not supported by this specification, and it is recommended that the Test Service reject such requests with the `INVALID_PROTOCOL` message response code.

211 If the Test Service detects that a second Test Message for the same Protocol Type has been received for a DUT before the Test Service has responded to the first Test Protocol message for the same Protocol Type and DUT, the Test Service may respond with the `OUTSTANDING_MESSAGE` Message Response Code and not forward the Test Message to the DUT.

212 10.4.1 Device-originated (Async) Protocol Messages

213 Certain upper-layer messages, such as AEN packets in NC-SI and the PlatformEventMessage message in PLDM for Platform Monitoring and Control, may asynchronously originate from the DUT and flow to the Control Plane. If the Test Client wishes to receive these messages, they may register this request using the *Register Async Message Recipient* message to the Test Service.

214 When the Test Service receives a message originating from the device that matches the forwarding criteria established by the Test Client, the Test Service will send a Test Message to the Test Client with the correct Protocol Type. The Test Service must take care that the Test Service Wrapper Flags are set such that Request originates from

the Test Service (TS → TC Request). Likewise, the Test Client must set the flags indicating that the Response originates from the Test Client (TC → TS Response).

215 10.5 *Test* Request and Response Messages

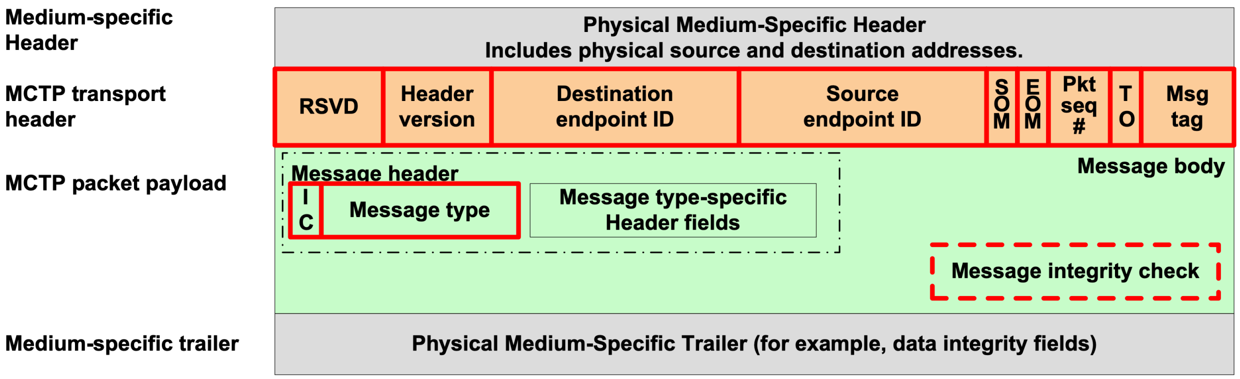
216 ***Test Message*** **request format**

Offset	Field	Type	Value
0	DUT Connection ID	`uint32`	*DUT Connection ID* returned by *Configure Device Under Test* message
4	Maximum Wait Time (µs)	`uint32`	The maximum time that the Test Service should wait, after transmitting the last byte of this request, before returning a `TIMEOUT` message response code. For protocols such as PLDM, this may be a fixed value for all messages. For certain SPDM messages, this value may vary based on negotiation between the Test Client and the DUT.
8	Upper-layer Protocol Request Message	Variable	A fully-formed Upper-layer Protocol message such as a complete PLDM, NC-SI Control, or SPDM message.

217 ***Test Message*** **response format**

Offset	Field	Type	Value
0	Response Code	`enum8`	See Test Service Response Codes
1	DUT Connection ID	`uint32`	*DUT Connection ID* returned by *Configure Device Under Test* message
5	Elapsed Time (µs)	`uint32`	The elapsed time from when the Test Service sent the last byte of the test message request to when the Test Service received the first byte of the response.
9	Upper-layer Protocol Response Message	Variable	If the Response Code is `SUCCESS`, the response message from the DUT shall be in this field. If the Response Code is not `SUCCESS`, this field shall have zero length.

218 10.6 Handling MCTP Packets



219 To build one or more MCTP packets from a *Test* Request message, the Test Service (and the Control Plane hosting the Test Service) may take the following steps:

1. The Physical Medium-Specific Header and Trailer will typically be created by Control Plane logic that manages the appropriate physical interface. It may be necessary for the Test Service to look up the physical interface using the DUT Connection ID, and the Test Service may reject any unregistered requests with a `PRIVILEGE_ERROR` Message Response Code.
2. The MCTP Header version, Start Of Message, End Of Message, Packet Sequence #, Tag Owner, and Message tag fields shall be filled out as appropriate (for example, for a first/middle/last packet in a message). Packetization of Upper-layer Protocol messages is described in DSP0236, and it may be necessary for the Test Service or Control Plane to build multiple MCTP packets to handle a single *Test* request.
3. The Destination endpoint ID shall be obtained by using the DUT Connection ID to look up the DUT's Destination endpoint ID.
4. The Source endpoint ID shall be the Control Plane's MCTP EID.
5. The MCTP Message type may be obtained directly from the Test Service Wrapper's Protocol Type field.
6. The remainder of the MCTP packet payload is contained within the Upper-layer Protocol Request Message of the *Test* request.
7. Once the entire MCTP message is constructed and sent to the DUT, the Test Service must start a timer to capture the elapsed request-to-response time in a *Test* response. If the timer exceeds the Maximum Wait Time from the Test Client, the Test Service shall respond with a `TIMEOUT` Message Response Code.

220 Likewise, the Test Service may handle an MCTP message received from the DUT in this way:

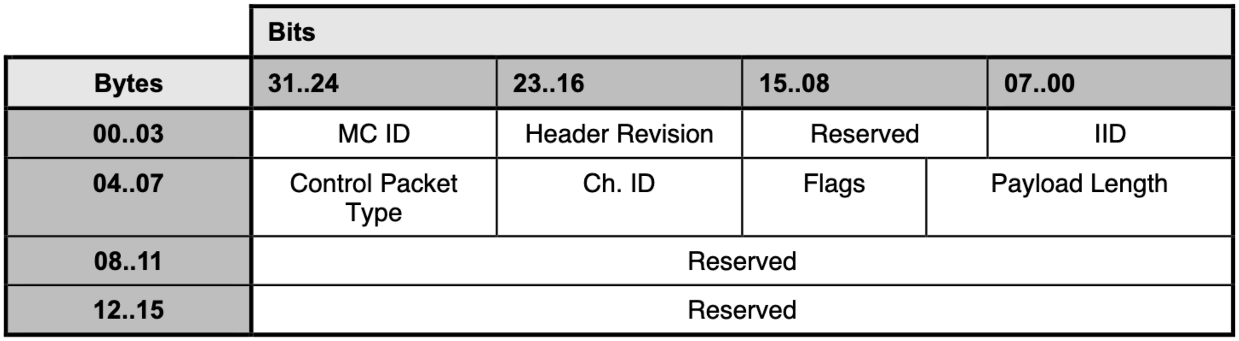
1. If the Test Service receives a message that cannot be interpreted or correlated to a request message, the Test Service should send a *Log Event* message with Reason Code `CorruptMessage` to the Test Client with relevant information, and then continue waiting for a response if appropriate. It is possible

that the Test Service will eventually exceed the Maximum Wait Time in this scenario, in which case a `TIMEOUT` Message Response code should be sent.

2. The control plane should check the Physical Medium-Specific Header and Trailer for any errors. If one is found, but it is possible to correlate the message to a request message, it is appropriate to send a `PHYSICAL_ERROR` message response code to the Test Client.
3. The control plane or Test Service should check the MCTP Header version, Destination endpoint ID, Start Of Message, End Of Message, Packet Sequence #, Tag Owner, and Message tag fields for accuracy. If any errors are found, but it is possible to correlate the message to a request message, it is appropriate to send a `TRANSPORT_ERROR` message response code to the Test Client. It may be necessary to wait for multiple MCTP packets before the MCTP message is ready.
4. Use the Source endpoint ID, Message type, and Message type-specific Header fields to discover whether this is a response to an outstanding *Test* request. If so, a *Test* response should be constructed with the TS → TC Response bits set in the Test Service Wrapper. If the Test Service receives an asynchronous MCTP message, and the Test Client has registered to receive async messages from the DUT, then a new *Test* request should be constructed with the TS → TC Request bits set.
5. When constructing either a *Test* response or an async *Test* request to the Test Client, the Protocol Type (in the Test Service Wrapper) shall be set to the MCTP Message type from the MCTP packet payload, the DUT Connection ID shall be set to the appropriate value for the device and physical interface, and the Upper-layer Protocol Response Message shall be all bytes of the MCTP packet payload, excluding the MCTP Message type byte.
6. For *Test* response messages, the Elapsed Time shall be filled in using the timer that was started during the *Test* request.

221

10.7 Handling NC-SI over RBT Packets



	Bits			
Bytes	**31..24**	**23..16**	**15..08**	**07..00**
00..03	MC ID	Header Revision	Reserved	IID
04..07	Control Packet Type	Ch. ID	Flags	Payload Length
08..11	Reserved			
12..15	Reserved			

222 To build an NC-SI packet from a *Test* Request message, the Test Service (and the Control Plane hosting the Test Service) may take the following steps (refer to DSP0222). Implementers are reminded that NC-SI is a Big Endian protocol and that the bytes column of the preceding diagram represents the order of transmission.

1. The Test Service shall ensure that the Protocol type is set to NC-SI Control, even though this message will not be going over MCTP. If the Protocol type is not set to NC-SI control, the Test Service shall return an `INVALID_PROTOCOL` message response code to the Test Client.

2. The Ethernet frame header is populated by the Control Plane.
3. The NC-SI Control Packet Header must be included as part of the Upper-layer Protocol Request Message coming from the Test Client. However, the Control Plane and Test Service may validate or re-write certain fields as follows:
    i. The Management Controller ID shall be filled in by the Test Service using the DUT Connection ID. Typically, this value will be `0x00`.
    ii. The Header Revision must be set to `0x01` by the Test Service.
    iii. The Instance ID must be re-written by the Control Plane or Test Service to ensure that it is monotonically increasing, as required in DSP0222. The Instance ID that was requested by the Test Client must be remembered so that it may be re-written into the *Test* response. It is possible that even Instance IDs sent from the Test Service will not be monotonically increasing, since the Control Plane may need to send its own NC-SI messages for critical operations such as thermal monitoring, and therefore the Test Service must maintain a bi-directional mapping of the requested Instance ID and the sent/received Instance ID.
    iv. The Control Packet Type, Flags, and Payload Length is provided by the Test Client as part of the Upper-layer Protocol Request.
    v. The Channel ID is provided by the Test Client as part of the Upper-layer Protocol Request, based on the `NC-SIInfo` section of the System Inventory. Implementers are encouraged to review the NC-SI Considerations section of this document related to the Channel ID.
4. The Control Packet payload will follow the Control Packet Header in the Upper-layer Protocol Request from the Test Client, and may be copied directly into the NC-SI over RBT packet. However, the Test Service or Control Plane may have to modify the Payload Pad as required by DSP0222.
5. Once the entire RBT message is constructed and sent to the DUT, the Test Service must start a timer to capture the elapsed request-to-response time in a *Test* response. If the timer exceeds the Maximum Wait Time from the Test Client, the Test Service shall respond with a `TIMEOUT` Message Response Code.

223 Likewise, the Test Service may handle an NC-SI Response packet or AEN packet received from the DUT in this way:

1. If the Test Service receives an NC-SI packet that cannot be interpreted as an AEN packet or a Response packet correlated to a Request message, the Test Service should send a *Log Event* message with Reason Code `CorruptMessage` to the Test Client with relevant information, and then continue waiting for a response if appropriate. It is possible that the Test Service will eventually exceed the Maximum Wait Time in this scenario, in which case a `TIMEOUT` Message Response code should be sent.
2. If the packet is valid, the Ethernet frame header shall be removed by the Test Service or Control Plane. If the packet is not valid, it is appropriate to send a `TRANSPORT_ERROR` message response code to the Test Client.
3. The Test Service shall construct a *Test* Response message with:
    i. The Test Service Wrapper with the Protocol type set to NC-SI Control (even though this was not an MCTP message) and the TS → TC Response bits set.

ii. The DUT Connection ID appropriate value for the device and physical interface.
iii. For NC-SI Response packets, the Elapsed Time shall be filled in using the timer that was started during the *Test* request.
iv. The appropriate Message response code (typically, `SUCCESS` if a valid NC-SI message was received).
v. For NC-SI Response packets, the requested Instance ID from the Test Client shall replace the received Instance ID from the DUT so that the Test Client may match up the request and response NC-SI messages. For AEN packets, the Instance ID field is set to 0.
vi. The Control Packet header (with the updated Instance ID), followed by the unmodified Response packet payload, as the Upper-layer Protocol Response Message.

224 11 ANNEX A SystemInventory Example (informative) and Schema (normative)

225 11.1 SystemInventory Example

226 The following is an example of System Inventory that might be returned from the *GetSystemInventory* message:

```
{
    "SchemaDefinition": "SystemInventory.v1_0_0",
    "ControlPlane": {
        "Manufacturer": "Contoso",
        "Model": "ContoBMC",
        "FirmwareVersions": [
            {
                "Name": "name1",
                "Version": "version1"
            },
            {
                "Name": "name2",
                "Version": "version2"
            },
            {
                "Name": "name3",
                "Version": "version3"
            }
        ],
        "Interfaces": [
            {
                "Interface": "I2C",
                "MessageInitiationSupport": "ControlPlaneRequestorOnly"
            },
            {
                "Interface": "PCIeVDM",
                "MessageInitiationSupport": "AnyRequestor"
            },
            {
                "Interface": "RBT",
                "MessageInitiationSupport": "ControlPlaneRequestorOnly"
            }
        ]
    },
    "Devices": [
        {
            "Manufacturer": "ContosoAdapters",
            "Location": "Slot 3",
            "GeneralDeviceIdentifier": 3180,
            "PCI-ID": {
                "DID": "0x1234",
                "SDID": "0x5678",
                "VID": "0x9ABC",
                "SVID": "0xDEF0"
            },
            "FirmwareVersions": [
                {
                    "Name": "Management",
                    "Version": "2.7.3"
                },
                {
                    "Name": "Ethernet",
                    "Version": "4.8.1"
                },
                {
                    "Name": "Security",
                    "Version": "1.3.7a"
                }
            ],
            "Interfaces": [
                {
                    "Interface": "I2C",
                    "InterfaceIdentifier": 3187,
                    "ParentDeviceIdentifier": 0,
                    "ProtocolSupport": [
                        {
                            "Protocol": "MCTP",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "MCTP Base",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 1,
                                    "Name": "PLDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 2,
                                    "Name": "NC-SI over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 3,
                                    "Name": "Ethernet over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 4,
                                    "Name": "NVM Express Management Messages over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 5,
                                    "Name": "SPDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 126,
                                    "Name": "Vendor Defined - PCI",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 127,
                                    "Name": "Vendor Defined - IANA",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        },
                        {
                            "Protocol": "PLDM",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "PLDM Base",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 2,
                                    "Name": "PLDM for Platform Monitoring and Control",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                }
                            ]
                        }
                    ]
            },
            {
                "Interface": "PCIeVDM",
                "InterfaceIdentifier": 3188,
                "ParentDeviceIdentifier": 0,
                "ProtocolSupport": [
                        {
                            "Protocol": "MCTP",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "MCTP Base",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 1,
                                    "Name": "PLDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        },
                        {
                            "Protocol": "PLDM",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "PLDM Base",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 2,
                                    "Name": "PLDM for Platform Monitoring and Control",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 5,
                                    "Name": "PLDM for Firmware Update",
                                    "Versions": [
                                        "1.1.0"
                                    ]
                                },
                                {
                                    "Type": 6,
                                    "Name": "PLDM for Redfish Device Enablement",
                                    "Versions": [
                                        "1.0.1",
                                        "1.1.0"
                                    ]
                                }
                            ]
                        }
                    ]
                },
                {
                    "Interface": "RBT",
                    "InterfaceIdentifier": 3189,
                    "ParentDeviceIdentifier": 0,
                    "ProtocolSupport": [
                        {
                            "Protocol": "NC-SI",
                            "Types":[
                                {
                                    "Type": 0,
                                    "Name": "NC-SI",
                                    "Versions": [
                                        "1.1.1"
                                    ]
                                }
                            ],
                            "NC-SIInfo": [
                                {
                                    "ChannelID": "0x01",
                                    "Pass-through": "Enabled"
                                },
                                {
                                    "ChannelID": "0x02",
                                    "Pass-through": "Disabled"
                                }
                            ]
                        }
                    ]
                }
            ]
        },
        {
            "Manufacturer": "ContosoBridge",
            "Location": "Slot 5",
            "GeneralDeviceIdentifier": 6450,
            "PCI-ID": {
                "DID": "0x0867",
                "SDID": "0x5309",
                "VID": "0x9ABC",
                "SVID": "0xDEF0"
            },
            "FirmwareVersions": [
                {
                    "Management": "1.6a"
                }
            ],
            "Interfaces": [
                {
                    "Interface": "I2C",
                    "PathDeviceIdentifier": 6457,
                    "ParentDeviceIdentifier": 0,
                    "ProtocolSupport": [
                        {
                            "Protocol":"MCTP",
                            "Types":[
                                {
                                    "Type": 0,
                                    "Name": "MCTP Base",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 1,
                                    "Name": "PLDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        },
                        {
                            "Protocol": "PLDM",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "PLDM Base",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        }
                    ]
                },
                {
                    "Interface": "PCIeVDM",
                    "PathDeviceIdentifier": 6458,
                    "ParentDeviceIdentifier": 0,
                    "ProtocolSupport": [
                        {
                            "Protocol": "MCTP",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "MCTP Base",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 1,
                                    "Name": "PLDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        },
                        {
                            "Protocol": "PLDM",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "PLDM Base",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        }
                    ]
                }
            ]
        },
        {
            "Manufacturer": "ContosoBackendDrive",
            "Location": "Bridge Slot 1",
            "GeneralDeviceIdentifier": 1240,
            "UniqueID": "0x45237789056AB781",
            "PCI-ID":{
                "DID": "0x2468",
                "SDID": "0x1357",
                "VID": "0x9ABC",
                "SVID": "0xDEF0"
            },
            "FirmwareVersions": [
                {
                    "Management": "1.0.1",
                    "NVMe": "12.3.45"
                }
            ],
            "Interfaces": [
                {
                    "Interface": "I2C",
                    "PathDeviceIdentifier": 1247,
                    "ParentDeviceIdentifier": 6450,
                    "ProtocolSupport": [
                        {
                            "Protocol": "MCTP",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "MCTP Base",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 1,
                                    "Name": "PLDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        },
                        {
                            "Protocol": "PLDM",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "PLDM Base",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        }
                    ]
                },
                {
                    "Interface": "PCIeVDM",
                    "PathDeviceIdentifier": 1248,
                    "ParentDeviceIdentifier": 6450,
                    "ProtocolSupport": [
                        {
                            "Protocol": "MCTP",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "MCTP Base",
                                    "Versions": [
                                        "1.2.0"
                                    ]
                                },
                                {
                                    "Type": 1,
                                    "Name": "PLDM over MCTP",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                }
                            ]
                        },
                        {
                            "Protocol": "PLDM",
                            "Types": [
                                {
                                    "Type": 0,
                                    "Name": "PLDM Base",
                                    "Versions": [
                                        "1.0.0"
                                    ]
                                },
                                {
                                    "Type": 5,
                                    "Name": "PLDM for Firmware Update",
                                    "Versions": [
                                        "1.1.0"
                                    ]
                                }
                            ]
                        }
                    ]
                }
            ]
        }
    ]
}
```

227 11.2 SystemInventory Schema

228 The following Schema dictates the contents of the System Inventory document returned from the GetSystemInventory message:

```
{
    "$id": "http://pmci.dmtf.org/tools/SystemInventory.v1_0_0.json",
    "$schema": "http://json-schema.org/draft-07/schema#",
    "description": "A system-level representation of the hardware devices and their
  connections.",
    "copyright": "Copyright 2021 DMTF. For the full DMTF copyright policy, see
  http://www.dmtf.org/about/policies/copyright",
    "type": "object",
    "additionalProperties": false,
    "properties": {
        "SchemaDefinition": {
            "type": "string",
            "description": "The JSON schema that defines this SystemInventory document and can
  be used to validate its contents."
        },
        "ControlPlane": {
            "type": "object",
            "description": "Information on the Control Plane with which the test service
  interacts.",
            "properties": {
                "Manufacturer": {
                    "type": "string",
                    "description": "The name of the organization that manufactures this Control
  Plane."
                },
                "Model": {
                    "type": "string",
                    "description": "The model name of this Control Plane."
                },
                "FirmwareVersions": {
                    "type": "array",
                    "items": {
                        "$ref": "#/definitions/FWVersion"
                    }
                },
                "Interfaces": {
                    "type": "array",
                    "items": {
                        "$ref": "#/definitions/ControlPlaneInterface"
                    }
                }
            }
        },
        "Devices": {
            "type": "array",
            "items": {
                "$ref": "#/definitions/Device"
            }
        }
    },
    "definitions": {
        "Interface": {
            "type": "string",
            "enum": ["I2C", "I3C", "PCIeVDM", "RBT", "Serial", "Proprietary"],
            "enumDescriptions": {
                "I2C": "I2C or SMBus",
                "I3C": "I3C",
                "PCIeVDM": "PCIe supported via vendor defined messages",
                "RBT": "RBT/RMII used for NC-SI communications",
                "Serial": "Serial",
                "Proprietary": "Vendor-specific proprietary interface not otherwise listed here"
            },
            "description": "The name of the interface"
        },
        "Device": {
            "type": "object",
            "description": "Information about hardware device",
            "properties": {
                "Manufacturer": {
                    "type": "string",
                    "description": "The name of the organization that manufactures this Device."
                },
                "Location": {
                    "type": "string",
                    "description": "The physical location (slot, etc.) for this device."
                },
                "GeneralDeviceIdentifier": {
                    "type": "number",
                    "description": "A numeric identifier assigned by the testing service for
this device."
                },
                "UniqueID": {
                    "type": "string",
                    "description": "An idempotent identifier unique to the device ."
                },
                "PCI-ID": {
                    "type": "object",
                    "description": "The PCI identifier for this device",
                    "properties": {
                        "DID": {
                            "type": "string",
                            "description": "The four hexadecimal digit device identifier for
this device, prefixed with 0x"
                        },
                        "SDID": {
                            "type": "string",
                            "description": "The four hexadecimal digit subdevice identifier for
this device, prefixed with 0x"
                        },
                        "VID": {
                            "type": "string",
                            "description": "The four hexadecimal digit vendor identifier for
this device, prefixed with 0x"
                        },
                        "SVID": {
                            "type": "string",
                            "description": "The four hexadecimal digit subvendor identifier for
this device, prefixed with 0x"
                        }
                    }
                },
                "FirmwareVersions": {
                    "type": "array",
                    "items": {
                        "$ref": "#/definitions/FWVersion"
                    }
                },
                "Interfaces": {
                    "type": "array",
                    "items": {
                        "$ref": "#/definitions/DeviceInterfaceInfo"
                    }
                }
            }
        },
        "DeviceInterfaceInfo": {
            "type": "object",
            "description": "Information about a specific interface for a hardware device",
            "properties": {
                "Interface": {
                    "$ref": "#/definitions/Interface"
                },
                "PathDeviceIdentifier": {
                    "type": "number",
                    "description": "A numeric identifier assigned by the testing service for
this device as connected to via this interface."
                },
                "ParentDeviceIdentifier": {
                    "type": "number",
                    "description": "The testing service-assigned numeric identifier for the
bridge to which this device is attached on this interface, or zero if the device is directly
connected to the host system's Control Plane."
                },
                "ProtocolSupport": {
                    "type": "array",
                    "items": {
                        "$ref": "#/definitions/ProtocolInfo"
                    }
                }
            }
        },
        "FWVersion": {
            "type": "object",
            "description": "Information about a firmware version for the Control Plane",
            "properties": {
                "Name": {
                    "type": "string",
                    "description": "The name of the firmware component"
                },
                "Version": {
                    "type": "string",
                    "description": "The version string for the firmware component"
                }
            }
        },
        "ControlPlaneInterface": {
            "type": "object",
            "description": "Information about an interface supported by the Control Plane",
            "properties": {
                "Interface": {
                    "$ref": "#/definitions/Interface"
                },
                "MessageInitiationSupport": {
                    "type": "string",
                    "enum": [
                        "AnyRequestor",
                        "ControlPlaneRequestorOnly",
                        "DeviceRequestorOnly"
                    ],
                    "enumDescriptions": {
                        "AnyRequestor": "Either the Control Plane or the device may initiate
messages",
                        "ControlPlaneRequestorOnly": "Only the Control Plane may initiate
messages",
                        "DeviceRequestorOnly": "Only the device may initiate messages"
                    },
                    "description": "An indication of the directions from which messages may be
initiated on this interface"
                }
            }
        },
        "ProtocolInfo": {
            "type": "object",
            "description": "Information about a protocol family supported by a device.",
            "properties": {
                "Protocol": {
                    "type": "string",
                    "enum": [
                        "MCTP",
                        "PLDM",
                        "NC-SI",
                        "NVMe",
                        "OEM"
                    ],
                    "enumDescriptions": {
                        "MCTP": "Management Control Transfer Protocol",
                        "PLDM": "Platform Layer Data Model",
                        "NC-SI": "Network Controller Sideband Interface",
                        "NVMe": "Non-Volatile Memory Express",
                        "OEM": "Original Equipment Manufacturer (proprietary)"
                    }
                },
                "Types": {
                    "type": "array",
                    "items": {
                        "$ref": "#/definitions/ProtocolTypeSupport"
                    }
                }
            }
        },
        "ProtocolTypeSupport": {
            "type": "object",
            "description": "Information about the types supported within a protocol family for
a device.",
            "properties": {
                "Type": {
                    "type": "number",
                    "description": "The numeric identifier for the protocol type."
                },
                "Name": {
                    "type": "string",
                    "description": "The name of the protocol"
                },
                "Versions": {
                    "type": "array",
                    "items": {
                        "patternProperties": {
                            "^.*$": {
                                "description": "A version of the protocol type supported by the
device"
                            }
                        }
                    }
                }
            }
        },
        "NC-SIAuxInfo": {
            "type": "object",
            "description": "Information about the NC-SI implementation on the network controller",
            "properties": {
                "ChannelID": {
                    "type": "string",
                    "description": "Network Controller Channel ID to address the Network Controller Channel."
                },
                "Pass-through": {
                    "type": "string",
                    "description": "The status of the channel to allow Pass-through packets.",
                    "enum": [
                        "Enabled",
                        "Disabled"
                    ],
                    "enumDescriptions": {
                        "Enabled": "Pass-through enabled on channel",
                        "Disabled": "Pass-through disabled on channel"
                    }
                }
            }
        }
    }
}
```

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12 ANNEX B (informative) Change log

Version	Date	Description
1.0.0	2022-07-07	Initial Version

13 Bibliography

DMTF DSP4014, *DMTF Process for Working Bodies 2.6*.