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3           **Management Component Transport Protocol (MCTP)**  
4                   **Overview**  
5                   **White Paper**  
6

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36 **Abstract**

37 The Management Component Transport Protocol (MCTP) is a protocol defined by the DMTF Platform  
38 Management Component Intercommunications sub-team of the DMTF Pre-OS Workgroup. MCTP is  
39 designed to support communications between different intelligent hardware components that make up a  
40 platform management subsystem that is provides monitoring and control functions inside a managed sys-  
41 tem.

42 This document provides an overview of the architectural goals and general operation of MCTP.

43



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# 71 1 Introduction

72 The lack of standard interfaces among platform management components impedes the ability for  
73 platform developers to be able quickly and economically develop and deploy platform manage-  
74 ment subsystems that can be accessed using DMTF Common Information Model (CIM) Profiles  
75 and access protocols. The DMTF Platform Management Component Intercommunications  
76 (PMCI) sub-team of the DMTF Pre-OS Workgroup seeks to address this problem by defining  
77 interfaces and data models that facilitate interoperability and interchangeability among platform  
78 management components, enabling devices from different vendors to be more readily linked to-  
79 gether into a cohesive manageability subsystem.

80 The Management Component Transport Protocol (MCTP) supports the PMCI goals by defining  
81 a media-independent transport protocol that enables communications between different intelli-  
82 gent hardware components that make up a platform management subsystem that provides moni-  
83 toring and control functions inside a managed system.

## 84 1.1 Target Audience

85 The intended target audience for this document is readers that develop or utilize platform man-  
86 agement subsystems that are formed using management controllers and intelligent management  
87 devices and are interested in obtaining an overview of the MCTP specifications that define a  
88 common intercommunication mechanism for those components.

## 89 1.2 Related Documents

- 90 [1] DMTF, [DSP0236](#), *Management Component Transport Protocol (MCTP) Base Specification*  
91 [2] DMTF, [DSP0237](#), *Management Component Transport Protocol (MCTP) SMBus / I<sup>2</sup>C*  
92 *Transporting Binding Specification*  
93 [3] DMTF, [DSP0238](#), *Management Component Transport Protocol (MCTP) PCIe VDM Trans-*  
94 *port Binding Specification*  
95 [4] DMTF, [DSP0239](#), *Management Component Transport Protocol (MCTP) IDs and Codes*  
96 [5] DMTF, [DSP2014](#), *Systems Management Architecture for Mobile and Desktop Hardware*  
97 *White Paper*

## 98 1.3 Terminology

99

Term	Definition
ATCA	Advanced Telecommunications Computing Architecture. ATCA is a specification effort PCI Industrial Computer Manufacturers Group (PICMG). Known as AdvancedTCA™ (also often abbreviated as ATCA), the official specification designation is PICMG 3.x. AdvancedTCA requirements of "carrier grade" communications computer systems. ATCA includes specifications for platform management subsystem elements within and between blades in a blade-based computer chassis.
I <sup>2</sup> C	Name of a multi-master, two-wire, serial bus originally developed by Philips Semiconductor.
In-Band	Management that operates with the support of hardware components that are critical to and used by the operating system

Term	Definition
Intelligent Management Device	A management device that is typically implemented using a microcontroller and accessed through a messaging protocol. Management parameter access provided by an IMD is typically accomplished using an abstracted interface and data model rather than through direct "register level" accesses.
IPMB	Intelligent Platform Management Bus. Name for the architecture, protocol, and implementation of an I2C bus that provides a communications path between "management controllers" in IPMI -based systems.
IPMI	A set of specifications defining interfaces and protocols originally developed for server platform management by the IPMI Promoters Group: Intel, Dell, HP, and NEC
Manageability Access Point (MAP)	A collection of services of a system that provides management in accordance to specifications published under the DMTF Server Management Architecture for Server Hardware initiative.
Management Controller	A microcontroller or processor that aggregates management parameters from one or more management devices and makes access to those parameters available to local or remote software, or to other management controllers, through one or more management data models. Management controllers may also interpret and process management-related data, and initiate management-related actions on management devices. While a native data model is defined for PMCI, it is designed to be capable of supporting other data models, such as CIM, IPMI, and vendor-specific data models. The microcontroller or processor that serves as a management controller can also incorporate the functions of a management device.
Managed Element	The finest granularity of addressing which can be the target of commands or messages, or a collection thereof.
Out-of-Band	Management that operates with hardware resources and components that are independent of the operating systems control
RMII	A reduced signal count MAC to PHY interface, based on the IEEE Media Independent Interface (MII), which was specified by the RMII Consortium (3Com Corporation; AMD Inc.; Bay Networks, Inc.; Broadcom Corp.; National Semiconductor Corp.; and Texas Instruments Inc.)
SMBus	Name of a multi-master, two-wire, serial bus specified by the Smart Battery Systems Implementer's Forum.

## 1.4 Acronyms and Abbreviations

100

101

Term	Definition
MAP	Manageability Access Point
MCTP	Management Component Transport Protocol
PCIe	PCI Express™
PMCI	Platform Management Component Intercommunications. The name of the sub-team of the DMTF Pre-OS Working Group that developed the MCTP and other platform management hardware -related specifications.
USB	Universal Serial Bus

## 2 MCTP Highlights

The Management Component Transport Protocol (MCTP) is a media-independent protocol for intercommunication among intelligent devices within the platform management subsystem of a managed computer system. This protocol is independent of the underlying physical bus properties, as well as the "data-link" layer messaging used on the bus.

The physical and data-link layer methods for MCTP communication across a given medium are defined by companion "transport binding" specifications, such as MCTP over PCIe® Vendor Defined Messaging and MCTP over SMBus/ I<sup>2</sup>C. This approach enables future transport bindings to be defined to support additional buses such as USB, RMI, and others, without affecting the base MCTP specification.

MCTP has been designed to carry multiple types of manageability-related traffic across a common medium. The base MCTP specifications define message types for supporting the initialization and configuration of MCTP itself, and to support vendor-specific messages over MCTP. Other message types, such as message types to support a Platform Level Data Model (PLDM), network controller sideband communications, and so on, are planned to be specified in the future by the DMTF PMCI workgroup.

An example of a basic platform management subsystem topology that utilizes MCTP is shown in Figure 1 on page 13.

### 2.1 Goals

MCTP has been designed to address the following goals:

- Provide efficient communications between the following parties in a platform management subsystem:
  - Management Controllers and Intelligent Management Devices
  - Management Controllers and other Management Controllers
  - Management Controllers and system firmware (e.g. BIOS)
  - Management Controllers and Network Controllers
- Support multiple media types: for example, SMBus/I<sup>2</sup>C, PCIe VDM, USB, and others.
- Support multiple message types on a common media.
- Be suitable for different classes of computer system such as server, desktop, mobile, and communications systems.
- Use compact, byte-efficient formats and simple protocols that are suitable for implementation using low-cost microcontrollers.
- Capture and integrate learning's from other management bus protocols such as IPMB, SMBus, ATCA, ASF, by providing:
  - Improved addressing
  - Simplified message routing
  - Support for device discovery and hot plug devices



- 142
- Be cleanly extensible and maintainable
- 143
- Provide clear points in the specifications and protocol for supporting new messages types, media types, protocol version information, and so on.
- 144
- Provide support for Vendor-specific message types to allow value-added functions to use MCTP as a framework without conflicting with base MCTP messaging.
- 145
- 146
- 147

## 148 **2.2 MCTP Specification Documents**

149 MCTP is defined through a set of DMTF specifications. The following documents make up the  
150 MCTP specifications:

### 151 **2.2.1 Common Specifications**

152 These documents are the generic documents for the MCTP.

153 [DSP0236](#), *Management Component Transport Protocol (MCTP) Base Specification*

154 This document describes the aspects of the MCTP, message routing, and MCTP initialization that are common across all MCTP implementations. The specification consists of three main sections: MCTP base protocol, MCTP Control Protocol, and  
155 MCTP Control Commands.  
156  
157

158 [DSP0239](#), *Management Component Transport Protocol (MCTP) IDs and Codes*

159 This document presents a collection of IDs and codes that are used across the Management Component Transport Protocol (MCTP) and transport binding specifications.  
160  
161

### 162 **2.2.2 Transport Binding Specifications**

163 These documents describe how MCTP is implemented on a particular physical medium. There  
164 are two transport binding specifications as of this writing:

165 [DSP0237](#), *Management Component Transport Protocol (MCTP) SMBus / I<sup>2</sup>C Transport Binding Specification*

166 This document defines how MCTP is carried using SMBus or I<sup>2</sup>C as the transport  
167 medium.  
168

169 [DSP0238](#), *Management Component Transport Protocol (MCTP) PCIe VDM Transport Binding Specification*

170 This document defines how MCTP is carried using PCI Express™ Vendor Defined  
171 Messages (VDMs) as the transport medium.  
172

### 173 **2.2.3 Message Type Specifications**

174 MCTP Message Type specifications define how a particular class of payload is carried using  
175 MCTP. As of this writing, only MCTP Control and Vendor Defined message types are specified.  
176 The specification of these message types is incorporated in the MCTP Base Specification rather  
177 than as separate documents. In the future, message types for carrying traffic such as the PMCI  
178 Platform Level Data Model will be defined and provided as companion specifications to the present  
179 MCTP specification documents.

## 180 **3 MCTP Technology Overview**

181 This section provides a more detailed overview of the elements and operation of MCTP.

### 182 **3.1 MCTP Base Protocol**

183 The basic unit of data transfer in MCTP is the “MCTP packet”. One or more MCTP packets are  
184 used to transfer an “MCTP message”. The base protocol defines the common fields for MCTP  
185 packets and how they are used. This includes defining fields such as source and destination ad-  
186 dress fields, fields that identify which packets belong to a particular MCTP message, and fields  
187 that define what type of communication traffic is being carried in the MCTP message. The base  
188 protocol also defines the processes used for assembling MCTP messages, routing MCTP packets,  
189 and handling error conditions such as dropped or missing packets.

### 190 **3.2 MCTP Endpoints and EIDs**

191 An endpoint is the function within a device that terminates the communication protocol of  
192 MCTP and handles MCTP Control commands. MCTP uses a logical address called the endpoint  
193 ID (EID) for addressing and routing MCTP packets to and from endpoints.

### 194 **3.3 MCTP Busses**

195 In MCTP a bus is defined as an interconnect between platform components that share a common  
196 physical layer address space. A bus may be made up of multiple segments. A bus segment is a  
197 portion of a bus that is electrically separated from other segments that form a bus, but still shares  
198 a common physical address space with other segments.

### 199 **3.4 MCTP Bus Owners and Bridges**

200 Each MCTP bus has a bus owner. Bus Owners are responsible for assigning EIDs to any MCTP  
201 devices on that bus. A bus owner may also have additional media-specific responsibilities, such  
202 as device discovery and assignment of physical addresses.

203  
204 MCTP Bridges are devices that connect to two or more MCTP busses and are responsible for  
205 routing MCTP packets between those busses. A Bridge will typically also be the bus owner for at  
206 least one of the busses to which it connects.

207  
208 MCTP allows multiple bridges, busses, and bus owners to be interconnected to form an “MCTP  
209 network”. Because bus owners are responsible for assigning EIDs to any devices that are on the  
210 bus that it owns, MCTP provides a mechanism that enables bus owners to be allocated a pool of  
211 endpoint IDs that can subsequently be assigned or allocated to other devices. The ultimate source  
212 of EIDs for the entire MCTP network comes from what is referred to as the “topmost bus  
213 owner”.

214  
215 MCTP bus owners and bridges are also responsible for providing a service that enables resolving  
216 EIDs into physical addresses so that the originator of an MCTP packet knows what destination  
217 physical address needs to be used to route a message to a given EID.

### 218 **3.5 MCTP Packet Routing**

219 MCTP packets are routed based on their EIDs. MCTP bridges maintain a set of information re-  
220 ferred to as the “routing table” that tracks the relationship between the physical addresses and

221 bus with which an EID is associated. When an incoming packet is received, this information is  
222 used to route the packet to the appropriate bus. If the source and target busses use different  
223 physical media the bridge is also responsible for translating the physical layer formatting of the  
224 packet as required by the target medium.

225  
226 The information in the routing table is also used for handling requests to resolve an EID into a  
227 physical address and to support a capability to query individual bridges and bus owners for their  
228 routing information. This latter capability provides a way to obtain a snapshot of the MCTP net-  
229 work's routing configuration.

230  
231 The MCTP bridging function simply forwards packets based on endpoint addressing information  
232 on a per packet basis. Otherwise, bridging does not interpret message content, or handle message  
233 type-specific protocol behavior for routed packets. Bridging does not do intermediate assembly  
234 or disassembly of routed packets. Message assembly and disassembly is handled solely by the  
235 destination and source endpoints, respectively.

236  
237 MCTP packet routing between busses does not include a broadcast capability, although individ-  
238 ual busses may support broadcast as required by the particular medium to support device discov-  
239 ery. This eliminates the complexity of having bridges replicate and transmit packets across mul-  
240 tiple busses.

### 241 **3.6 Message Types**

242 The type of communication payload in an MCTP Message is identified by an enumeration called  
243 the "MCTP Message Type". MCTP is designed to be able to carry packets for multiple message  
244 types across a common communications medium. The MCTP base protocol specification in-  
245 cludes definition of a message type for MCTP Control messages and message types that support  
246 Vendor-defined MCTP messages. Other message types, such as a future message type to support  
247 Platform Level Data Model (PLDM) are defined in separate specifications.

248  
249 Different message types are identified by a message type field that is carried in the header of an  
250 MCTP message. The value in this field is specified in the specification that defines the message  
251 type. In addition, DSP0239, the Management Component Transport Protocol (MCTP) IDs and  
252 Codes specification, provides a centralized collection of the message types values defined for  
253 MCTP.

### 254 **3.7 MCTP Control Messages and Control Protocol**

255 The MCTP Base Specification includes the definition of a message type for "MCTP control mes-  
256 sages". These messages are used by bus owners to initialize and maintain the addressing and  
257 routing used in an MCTP network. MCTP control messages also include messages to help de-  
258 termine the basic MCTP messaging capabilities of an endpoint, such as what MCTP version and  
259 message types it supports. Control messages that initiate or request an action are also referred to  
260 as "commands".

261  
262 The MCTP Control Protocol defines the format of MCTP control messages and how they are  
263 delivered and acknowledged. Almost all control messages are delivered using a request / re-  
264 sponse mechanism where a request message is delivered to a target or "responder" endpoint us-  
265 ing an MCTP message transfer, and then later the responder delivers a response message back to

266 the requester. Response messages provide a positive acknowledgement of the receipt and han-  
267 dling of the request and return parametric data (if any) according to the request.

268  
269 The control protocol also supports delivering messages as unacknowledged “datagrams” and as  
270 broadcasts on the bus. These mechanisms are made available to support control messages that  
271 can be used for device discovery as required by the medium.

272  
273 The control protocol includes a retry mechanism to help ensure reliable delivery of requests, and  
274 to cover cases where a responder may be briefly off-line. The control protocol defines fields that  
275 are used to identify requests and responses, to identify whether a message is a datagram, and to  
276 identify new instances of requests from retried instances.

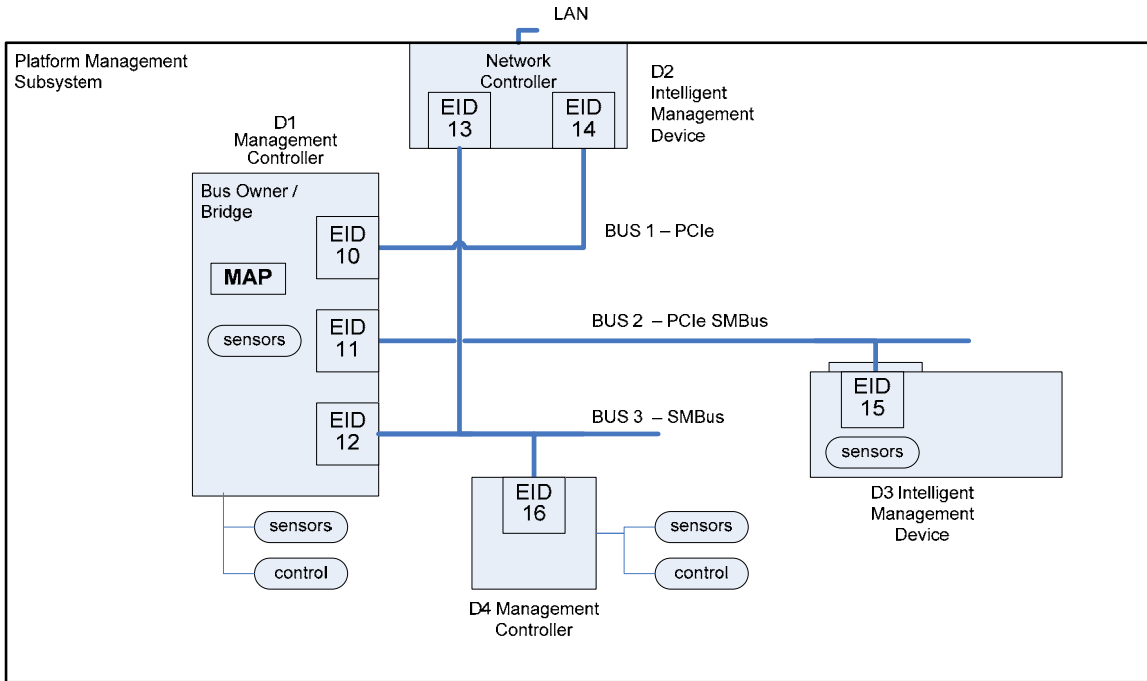
### 277 **3.8 Transport Binding Specifications**

278 The Transport Binding specifications are documents that describe how MCTP is implemented on  
279 a particular physical medium. This includes the definition of MCTP packet formatting for the  
280 medium, source and destination physical addressing handling, physical layer data integrity, and  
281 medium-specific timing parameters.

282  
283 The transport binding specifications include the definition of physical layer retry mechanisms for  
284 MCTP packets (if any).

285 **4 Example MCTP Topology**

286 The following example illustrates how MCTP can be used within a hypothetical platform man-  
 287 agement subsystem implementation. More complex topologies, with multi-levels of bridges and  
 288 greater numbers of busses and devices can be readily supported by MCTP as required.  
 289



290

291 **Figure 1 - Example MCTP Topology**

292

293 The following table describes the hardware elements that make up the subsystem shown in  
 294 Figure 1.

295

Element	Description
Bus 1	a PCIe bus that provides a high bandwidth connection between Management Controller D1 and Network Controller D2
Bus 2	an SMBus that connects to the PCI Express slots in the system
Bus 3	an SMBus that provides a separate connection for use by D2 and D4
D1	a microcontroller that provides MCTP bus owner and bridge functions for the motherboard and also provides the intelligence for a DMTF Management Access Point (MAP). (see <a href="#">DSP2014</a> )
D2	a network controller that contains a sideband interface function that enables network traffic to be transferred using MCTP over either bus 1 or bus 2
D3	a PCI Express add-in card that contains sensors (e.g. error status, temperature, and fan sensors)
D4	in this example, D4 represents a management controller that also provides the intelligence for a DMTF Management Access Point (MAP). (see <a href="#">DSP2014</a> )

296

297 In this example, D1 is a management controller that serves as intelligence for a DMTF MAP that  
 298 enables system sensors and control functions such as temperature, voltages, fan speeds, power  
 299 on/off/reset, etc. to be accessed using DMTF CIM data models. Network controller D2 provides

300 the network sideband interface that is used to transfer packets between D1 and a local area net-  
301 work.

302  
303 Network controller D2 has two connections: an SMBus connection via bus 3 and a PCIe connec-  
304 tion via bus 1. The SMBus connection is a low-power connection that is available in all system  
305 power states, but is low-bandwidth (< ~100kbps) while the PCIe connection is higher bandwidth,  
306 but is only available when the system is fully powered and after the BIOS/OS have initialized  
307 PCIe. The SMBus connection thus provides a way to communicate with the MAP while the sys-  
308 tem is powered down or in a sleep state, and the PCIe connection provides a connection that can  
309 deliver performance for functions such as media redirection, firmware updates, and so on, when  
310 the system is powered up.

311  
312 D3 represents a PCIe add-in card that is connected to an SMBus, bus 2, that is routed across the  
313 PCIe connectors in the system. In this example, bus 2 is separated from bus 3 in order to prevent  
314 any possibility that erroneous traffic or hardware errors on bus 2 will affect the SMBus commu-  
315 nication between D4, D2, and D1.

316  
317 D4 represents a management controller that is dedicated to monitoring and control functions that  
318 are related to thermal management of the system. It uses the MCTP connections to access tem-  
319 perature sensors and fan speed data maintained by D1, D3, and itself.  
320

321 **5 Conclusion**

322 MCTP provides a common, flexible, media-independent, and byte-efficient protocol to enable  
323 the interconnection of devices from multiple vendors within a platform management subsystem.

324 MCTP supports message types that will be defined by the DMTF PMCI workgroup to provide  
325 common access and abstraction of the low-level monitoring and control functions within the  
326 platform management subsystem that will in turn support the representation and access of plat-  
327 form manageability functions via higher level DMTF CIM data models, transports, and profiles.