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5 **Management Component Transport Protocol**  
6 **(MCTP) Base Specification**  
7 **Includes MCTP Control Command Specifications**

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165

## Foreword

166 The *Management Component Transport Protocol (MCTP) Base Specification* (DSP0236) was prepared  
167 by the PMCI Subgroup of the Pre-OS Working Group.

168 DMTF is a not-for-profit association of industry members dedicated to promoting enterprise and systems  
169 management and interoperability.

170

## Introduction

171 The Management Component Transport Protocol (MCTP) defines a communication model intended to  
172 facilitate communication between:

- 173 • Management controllers and other management controllers
- 174 • Management controllers and management devices

175 The communication model includes a message format, transport description, message exchange  
176 patterns, and configuration and initialization messages.

177 MCTP is designed so that it can potentially be used on many bus types. The protocol is intended to be  
178 used for intercommunication between elements of platform management subsystems used in computer  
179 systems, and is suitable for use in mobile, desktop, workstation, and server platforms. Management  
180 controllers such as a baseboard management controller (BMC) can use this protocol for communication  
181 between one another, as well as for accessing management devices within the platform.

182 Management controllers can use this protocol to send and receive MCTP-formatted messages across the  
183 different bus types that are used to access management devices and other management controllers.  
184 Management devices in a system need to provide an implementation of the message format to facilitate  
185 actions performed by management controllers.

186 It is intended that different types of devices in a management system may need to implement different  
187 portions of the complete capabilities defined by this protocol. Where relevant, this is called out in the  
188 individual requirements.





# 189 Management Component Transport Protocol (MCTP) Base 190 Specification

## 191 1 Scope

192 The *MCTP Base Specification* describes the command protocol, requirements, and use cases of a  
193 transport protocol for communication between discrete management controllers on a platform, as well as  
194 between management controllers and the devices they manage.

195 This document is intended to meet the following objectives:

- 196 • Describe the MCTP Base transport protocol
- 197 • Describe the MCTP control message protocol

198 The MCTP specifies a transport protocol format. This protocol is independent of the underlying physical  
199 bus properties, as well as the "data-link" layer messaging used on the bus. The physical and data-link  
200 layer methods for MCTP communication across a given medium are defined by companion "transport  
201 binding" specifications, such as MCTP over PCIe® Vendor Defined Messaging and MCTP over SMBus/  
202 I<sup>2</sup>C. This approach enables future transport bindings to be defined to support additional buses such as  
203 USB, RMI, and others, without affecting the base MCTP specification.

## 204 2 Normative References

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

### 208 2.1 Approved References

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## 229 **3 Terms and Definitions**

230 For the purposes of this document, the following terms and definitions apply.

### 231 **3.1 Requirement Term Definitions**

232 This clause defines key phrases and words that denote requirement levels in this specification.

#### 233 **3.1.1**

##### 234 **can**

235 used for statements of possibility and capability, whether material, physical, or causal

#### 236 **3.1.2**

##### 237 **cannot**

238 used for statements of possibility and capability, whether material, physical or causal

#### 239 **3.1.3**

##### 240 **conditional**

241 indicates requirements to be followed strictly to conform to the document when the specified conditions  
242 are met

#### 243 **3.1.4**

##### 244 **deprecated**

245 indicates that an element or profile behavior has been outdated by newer constructs

#### 246 **3.1.5**

##### 247 **mandatory**

248 indicates requirements to be followed strictly to conform to the document and from which no deviation is  
249 permitted

#### 250 **3.1.6**

##### 251 **may**

252 indicates a course of action permissible within the limits of the document

253 NOTE: An implementation that does *not* include a particular option shall be prepared to interoperate with another  
254 implementation that *does* include the option, although perhaps with reduced functionality. An implementation that  
255 *does* include a particular option shall be prepared to interoperate with another implementation that does *not* include  
256 the option (except for the feature that the option provides).

#### 257 **3.1.7**

##### 258 **may not**

259 indicates flexibility of choice with no implied preference

- 260 **3.1.8**  
261 **need not**  
262 indicates a course of action permissible within the limits of the document
- 263 **3.1.9**  
264 **not recommended**  
265 indicates that valid reasons may exist in particular circumstances when the particular behavior is  
266 acceptable or even useful, but the full implications should be understood and carefully weighed before  
267 implementing any behavior described with this label
- 268 **3.1.10**  
269 **obsolete**  
270 indicates that an item was defined in prior specifications but has been removed from this specification
- 271 **3.1.11**  
272 **optional**  
273 indicates a course of action permissible within the limits of the document
- 274 **3.1.12**  
275 **recommended**  
276 indicates that valid reasons may exist in particular circumstances to ignore a particular item, but the full  
277 implications should be understood and carefully weighed before choosing a different course
- 278 **3.1.13**  
279 **required**  
280 indicates that the item is an absolute requirement of the specification
- 281 **3.1.14**  
282 **shall**  
283 indicates requirements to be followed strictly to conform to the document and from which no deviation is  
284 permitted
- 285 **3.1.15**  
286 **shall not**  
287 indicates requirements to be followed strictly to conform to the document and from which no deviation is  
288 permitted
- 289 **3.1.16**  
290 **should**  
291 indicates that among several possibilities, one is recommended as particularly suitable, without  
292 mentioning or excluding others, or that a certain course of action is preferred but not necessarily required
- 293 **3.1.17**  
294 **should not**  
295 indicates that a certain possibility or course of action is deprecated but not prohibited

## 296 3.2 MCTP Term Definitions

297 For the purposes of this document, the following terms and definitions apply.

### 298 3.2.1

#### 299 Address Resolution Protocol

##### 300 ARP

301 refers to the procedure used to dynamically determine the addresses of devices on a shared  
302 communication medium

### 303 3.2.2

#### 304 baseline transmission unit

305 the required common denominator size of a transmission unit for packet payloads that are carried in an  
306 MCTP packet. Baseline Transmission Unit-sized packets are guaranteed to be routable within an MCTP  
307 network.

### 308 3.2.3

#### 309 baseboard management controller

##### 310 BMC

311 a term coined by the IPMI specifications for the main management controller in an IPMI-based platform  
312 management subsystem. Also sometimes used as a generic name for a motherboard resident  
313 management controller that provides motherboard-specific hardware monitoring and control functions for  
314 the platform management subsystem.

### 315 3.2.4

#### 316 binary-coded decimal

##### 317 BCD

318 indicates a particular binary encoding for decimal numbers where each four bits (*nibble*) in a binary  
319 number is used to represent a single decimal digit, and with the least significant four bits of the binary  
320 number corresponding to the least significant decimal digit. The binary values 0000b through 1001b  
321 represent decimal values 0 through 9, respectively. For example, with BCD encoding a byte can  
322 represent a two-digit decimal number where the most significant nibble (bits 7:4) of the byte contains the  
323 encoding for the most significant decimal digit and the least significant nibble (bits 3:0) contains the  
324 encoding for the least significant decimal digit (for example, 0010\_1001b in BCD encoding corresponds to  
325 the decimal number 29).

### 326 3.2.5

#### 327 bridge

328 generically, the circuitry and logic that connects one computer bus or interconnect to another, allowing an  
329 agent on one to access the other. Within this document, the term *bridge* shall refer to MCTP bridge,  
330 unless otherwise indicated.

### 331 3.2.6

#### 332 bus

333 a physical addressing domain shared between one or more platform components that share a common  
334 physical layer address space

### 335 3.2.7

#### 336 bus owner

337 the party responsible for managing address assignments (can be logical or physical addresses) on a bus  
338 (for example, in MCTP, the bus owner is the party responsible for managing EID assignments for a given

339 bus). A bus owner may also have additional media-specific responsibilities, such as assignment of  
340 physical addresses.

341 **3.2.8**

342 **byte**

343 an 8-bit quantity. Also referred to as an *octet*.

344 NOTE: PMCI specifications shall use the term *byte*, not *octet*.

345 **3.2.9**

346 **endpoint**

347 see [MCTP endpoint](#)

348 **3.2.10**

349 **endpoint ID**

350 **EID**

351 see [MCTP endpoint ID](#)

352 **3.2.11**

353 **Globally Unique Identifier**

354 **GUID**

355 see [UUID](#)

356 **3.2.12**

357 **Inter-Integrated Circuit**

358 **I<sup>2</sup>C**

359 a multi-master, two-wire, serial bus originally developed by Philips Semiconductor

360 **3.2.13**

361 **intelligent management device**

362 **IMD**

363 a management device that is typically implemented using a microcontroller and accessed through a  
364 messaging protocol. Management parameter access provided by an IMD is typically accomplished using  
365 an abstracted interface and data model rather than through direct "register level" accesses.

366 **3.2.14**

367 **Intelligent Platform Management Bus**

368 **IPMB**

369 name for the architecture, protocol, and implementation of an I<sup>2</sup>C bus that provides a communications  
370 path between "management controllers" in IPMI -based systems

371 **3.2.15**

372 **Intelligent Platform Management Interface**

373 **IPMI**

374 a set of specifications defining interfaces and protocols originally developed for server platform  
375 management by the IPMI Promoters Group: Intel, Dell, HP, and NEC

376 **3.2.16**377 **managed entity**

378 the physical or logical entity that is being managed through management parameters. Examples of  
379 *physical* entities include fans, processors, power supplies, circuit cards, chassis, and so on. Examples of  
380 *logical* entities include virtual processors, cooling domains, system security states, and so on.

381 **3.2.17**382 **Management Component Transport Protocol**383 **MCTP**

384 The protocol defined in this specification.

385 **3.2.18**386 **management controller**

387 a microcontroller or processor that aggregates management parameters from one or more management  
388 devices and makes access to those parameters available to local or remote software, or to other  
389 management controllers, through one or more management data models. Management controllers may  
390 also interpret and process management-related data, and initiate management-related actions on  
391 management devices. While a native data model is defined for PMCI, it is designed to be capable of  
392 supporting other data models, such as CIM, IPMI, and vendor-specific data models. The microcontroller  
393 or processor that serves as a management controller can also incorporate the functions of a management  
394 device.

395 **3.2.19**396 **management device**

397 any physical device that provides protocol terminus for accessing one or more management parameters.  
398 A management device responds to management requests, but does not initiate or aggregate  
399 management operations except in conjunction with a management controller (that is, it is a *satellite*  
400 device that is subsidiary to one or more management controllers). An example of a simple management  
401 device would be a temperature sensor chip. A management controller that has I/O pins or built-in analog-  
402 to-digital converters that monitor state and voltages for a managed entity would also be a management  
403 device.

404 **3.2.20**405 **management parameter**

406 a particular datum representing a characteristic, capability, status, or control point associated with a  
407 managed entity. Example management parameters include temperature, speed, volts, on/off, link state,  
408 uncorrectable error count, device power state, and so on.

409 **3.2.21**410 **MCTP bridge**

411 an MCTP endpoint that can route MCTP messages not destined for itself that it receives on one  
412 interconnect onto another without interpreting them. The ingress and egress media at the bridge may be  
413 either homogeneous or heterogeneous. Also referred to in this document as a "bridge".

414 **3.2.22**415 **MCTP bus owner**

416 responsible for EID assignment for MCTP or translation on the buses that it is a master of. The MCTP bus  
417 owner may also be responsible for physical address assignment. For example, for SMBus bus segments,  
418 the MCTP bus owner is also the ARP master. This means the bus owner assigns dynamic SMBus  
419 addresses to those devices requiring it.

420 **3.2.23**421 **MCTP control command**

422 commands defined under the MCTP *control* message type that are used for the initialization and  
423 management of MCTP communications (for example, commands to assign EIDs, discover device MCTP  
424 capabilities, and so on)

425 **3.2.24**426 **MCTP endpoint**

427 an MCTP communication terminus. An MCTP endpoint is a terminus or origin of MCTP packets or  
428 messages. That is, the combined functionality within a physical device that communicates using the  
429 MCTP transport protocol and handles MCTP control commands. This includes MCTP-capable  
430 management controllers and management devices. Also referred to in this document as an "endpoint".

431 **3.2.25**432 **MCTP endpoint ID**

433 the logical address used to route MCTP messages to a specific MCTP endpoint. A numeric handle  
434 (logical address) that uniquely identifies a particular MCTP endpoint within a system for MCTP  
435 communication and message routing purposes. Endpoint IDs are unique among MCTP endpoints that  
436 comprise an MCTP communication network within a system. MCTP EIDs are only unique within a  
437 particular MCTP network. That is, they can be duplicated or overlap from one MCTP network to the next.  
438 Also referred to in this document as "endpoint ID" and abbreviated "EID".

439 **3.2.26**440 **MCTP management controller**

441 a management controller that is an MCTP endpoint. Unless otherwise indicated, the term "management  
442 controller" refers to an "MCTP management controller" in this document.

443 **3.2.27**444 **MCTP management device**

445 a management device that is an MCTP endpoint. Unless otherwise indicated, the term "management  
446 device" refers to an "MCTP management device" in this document.

447 **3.2.28**448 **MCTP message**

449 a unit of communication based on the message type that is relayed through the MCTP Network using one  
450 or more MCTP packets

451 **3.2.29**452 **MCTP network**

453 a collection of MCTP endpoints that communicate using MCTP and share a common MCTP endpoint ID  
454 space

455 **3.2.30**456 **MCTP packet**

457 the unit of data transfer used for MCTP communication on a given physical medium

458 **3.2.31**459 **MCTP packet payload**

460 refers to the portion of the message body of an MCTP message that is carried in a single MCTP packet

- 461 **3.2.32**  
462 **message**  
463 see [MCTP message](#)
- 464 **3.2.33**  
465 **message assembly**  
466 the process of receiving and linking together two or more MCTP packets that belong to a given MCTP  
467 message to allow the entire message header and message data (payload) to be extracted
- 468 **3.2.34**  
469 **message body**  
470 the portion of an MCTP message that carries the message type field and any message type-specific data  
471 associated with the message. An MCTP message spans multiple MCTP packets when the message body  
472 needs is larger than what can fit in a single MCTP packet. Thus, the message body portion of an MCTP  
473 message can span multiple MCTP packets.
- 474 **3.2.35**  
475 **message disassembly**  
476 the process of taking an MCTP message where the message's header and data (payload) cannot be  
477 carried in a single MCTP packet and generating the sequence of two or more packets required to deliver  
478 that message content within the MCTP network
- 479 **3.2.36**  
480 **message originator**  
481 the original transmitter (source) of a message targeted to a particular message terminus
- 482 **3.2.37**  
483 **message terminus**  
484 the name for a triplet of fields called the MCTP Source Endpoint ID, Tag Owner bit value, and Message  
485 Tag value. Together, these fields identify the packets for an MCTP message within an MCTP network for  
486 the purpose of message assembly. The message terminus itself can be thought of as identifying a set of  
487 resources within the recipient endpoint that is handling the assembly of a particular message.
- 488 **3.2.38**  
489 **most significant byte**  
490 **MSB**  
491 refers to the highest order byte in a number consisting of multiple bytes
- 492 **3.2.39**  
493 **nibble**  
494 the computer term for a four-bit aggregation, or half of a byte
- 495 **3.2.40**  
496 **packet**  
497 see [MCTP packet](#)
- 498 **3.2.41**  
499 **packet payload**  
500 see [MCTP packet payload](#)



- 501 **3.2.42**  
502 **pass-through traffic/message/packets**  
503 non-control packets passed between the external network and the management controller through the  
504 network controller
- 505 **3.2.43**  
506 **payload**  
507 refers to the information bearing fields of a message. This is separate from those fields and elements that  
508 are used to transport the message from one point to another, such as address fields, framing bits,  
509 checksums, and so on. In some instances, a given field may be both a payload field and a transport field.
- 510 **3.2.44**  
511 **physical transport binding**  
512 refers to specifications that define how the MCTP base protocol and MCTP control commands are  
513 implemented on a particular physical transport type and medium, such as SMBus/I<sup>2</sup>C, PCI Express™  
514 Vendor Defined Messaging, and so on.
- 515 **3.2.45**  
516 **Platform Management Component Intercommunications**  
517 **PMCI**  
518 name for a working group under the Distributed Management Task Force's Pre-OS Workgroup that is  
519 chartered to define standardized communication protocols, low level data models, and transport  
520 definitions that support communications with and between management controllers and management  
521 devices that form a platform management subsystem within a managed computer system
- 522 **3.2.46**  
523 **point-to-point**  
524 refers to the case where only two physical communication devices are interconnected through a physical  
525 communication medium. The devices may be in a master/slave relationship, or could be peers.
- 526 **3.2.47**  
527 **Reduced Media Independent Interface**  
528 **RMII**  
529 a reduced signal count MAC to PHY interface, based on the IEEE Media Independent Interface (MII),  
530 which was specified by the RMII Consortium (3Com Corporation; AMD Inc.; Bay Networks, Inc.;  
531 Broadcom Corp.; National Semiconductor Corp.; and Texas Instruments Inc.)
- 532 **3.2.48**  
533 **simple endpoint**  
534 an MCTP endpoint that is not associated with either the functions of an MCTP bus owner or an MCTP  
535 bridge
- 536 **3.2.49**  
537 **Transmission Unit**  
538 refers to the size of the portion of the MCTP packet payload, which is the portion of the message body  
539 carried in an MCTP packet
- 540 **3.2.50**  
541 **transport binding**  
542 see [physical transport binding](#)

543 **3.2.51**544 **Universally Unique Identifier**545 **UUID**

546 refers to an identifier originally standardized by the Open Software Foundation (OSF) as part of the  
547 Distributed Computing Environment (DCE). UUIDs are created using a set of algorithms that enables  
548 them to be independently generated by different parties without requiring that the parties coordinate to  
549 ensure that generated IDs do not overlap. In this specification, [rfc4122](#) is used as the base specification  
550 describing the format and generation of UUIDs. Also sometimes referred to as a globally unique identifier  
551 (GUID).

552 **4 Symbols and Abbreviated Terms**

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

554 **4.1**555 **ACPI**

556 Advanced Configuration and Power Interface

557 **4.2**558 **ARP**

559 Address Resolution Protocol

560 **4.3**561 **BCD**

562 binary-coded decimal

563 **4.4**564 **BMC**

565 baseboard management controller

566 **4.5**567 **CIM**

568 Common Information Model

569 **4.6**570 **EID**

571 endpoint identifier

572 **4.7**573 **FIFO**

574 first-in first-out

575 **4.8**576 **GUID**

577 Globally Unique Identifier

578 **4.9**579 **I<sup>2</sup>C**

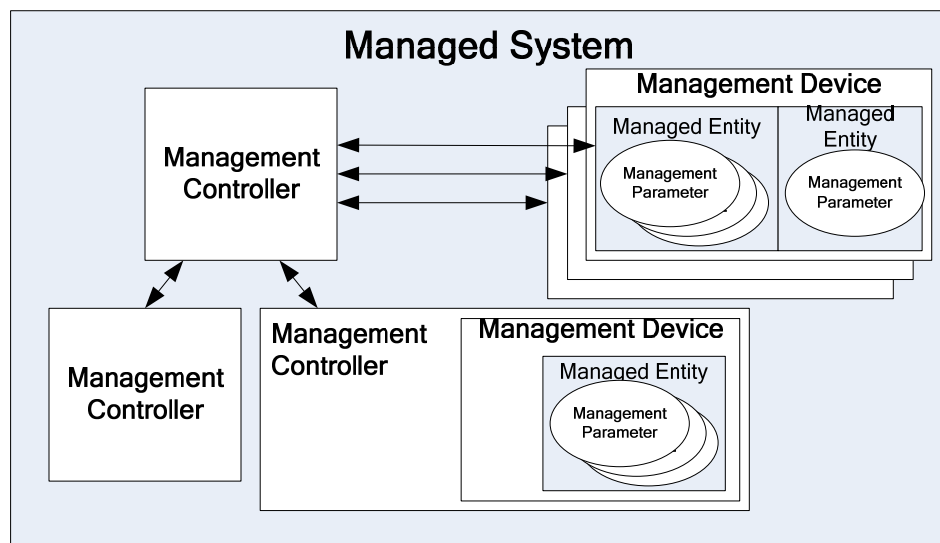
580 Inter-Integrated Circuit

581	<b>4.10</b>
582	<b>IANA</b>
583	Internet Assigned Numbers Authority
584	<b>4.11</b>
585	<b>IMD</b>
586	intelligent management device
587	<b>4.12</b>
588	<b>IP</b>
589	Internet Protocol
590	<b>4.13</b>
591	<b>IPMB</b>
592	Intelligent platform management bus
593	<b>4.14</b>
594	<b>IPMI</b>
595	Intelligent platform management interface
596	<b>4.15</b>
597	<b>ISO/IEC</b>
598	International Organization for Standardization/International Engineering Consortium
599	<b>4.16</b>
600	<b>MCTP</b>
601	Management Component Transport Protocol
602	<b>4.17</b>
603	<b>MSB</b>
604	most significant byte
605	<b>4.18</b>
606	<b>PCIe</b>
607	Peripheral Component Interconnect (PCI) Express
608	<b>4.19</b>
609	<b>PMCI</b>
610	Platform Management Component Intercommunications
611	<b>4.20</b>
612	<b>RMI</b>
613	Reduced Media Independent Interface
614	<b>4.21</b>
615	<b>SMBus</b>
616	System Management Bus
617	<b>4.22</b>
618	<b>TCP/IP</b>
619	Transmission Control Protocol/Internet Protocol

- 620 **4.23**  
 621 **USB**  
 622 Universal Serial Bus  
 623 **4.24**  
 624 **UUID**  
 625 Universally Unique Identifier  
 626 **4.25**  
 627 **VDM**  
 628 Vendor Defined Message

## 629 5 Management Component Relationships

- 630 Figure 1 illustrates the relationship between devices, management controllers, management devices, and  
 631 managed entities, which are described in 3.2.



632

633 **Figure 1 – Management Component Relationships**

## 634 6 Conventions

- 635 The conventions described in the following clauses apply to this specification.

### 636 6.1 Byte Ordering

- 637 Unless otherwise specified, byte ordering of multi-byte numeric fields or bit fields is "Big Endian" (that is,  
 638 the lower byte offset holds the most significant byte, and higher offsets hold lesser significant bytes).

### 639 6.2 Reserved Fields

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

642 Unless otherwise specified, numeric or bit fields that are designated as reserved shall be written as 0  
 643 (zero) and ignored when read.

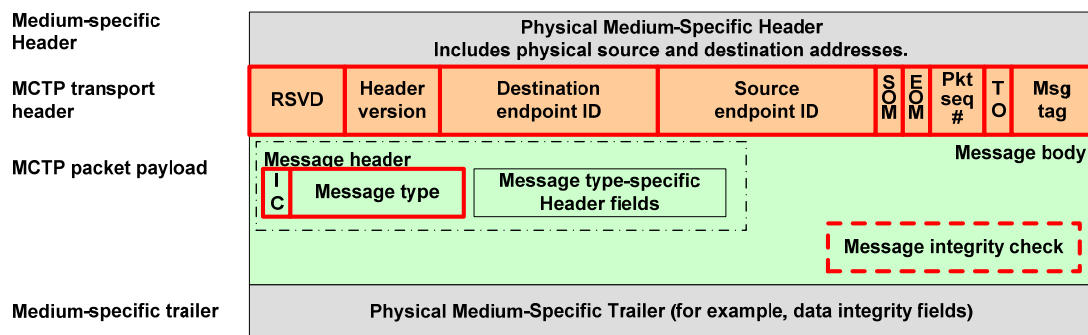
644 **7 MCTP Base Protocol**

645 The MCTP base protocol defines the common fields for MCTP packets and messages and their usage.

646 Though there are medium-specific packet header fields and trailer fields, the fields for the base protocol  
 647 are common for all media. These common fields support the routing and transport of messages between  
 648 MCTP endpoints and the assembly and disassembly of large messages from and into multiple MCTP  
 649 packets, respectively. The base protocol’s common fields include a message type field that identifies what  
 650 particular higher layer class of message is being carried using the MCTP base protocol.

651 **7.1 MCTP Packet Fields**

652 Figure 2 shows the fields that constitute a generic MCTP packet.



653

654 **Figure 2 – Generic Message Fields**

655 Table 1 defines the base protocol common fields.

656 **Table 1 – MCTP Base Protocol Common Fields**

Field Name	Field Size	Description
Medium-specific header	see description	This field represents the physical addressing and framing information that is used for transferring MCTP packets between devices on a particular physical medium. The size and type of any sub-fields or data within this field are defined by the corresponding transport binding specification for MCTP messaging on a given medium (for example, MCTP over SMBus, MCTP over PCIe, and so on).
Medium-specific trailer	see description	This field represents any additional medium-specific trailer fields (if any) that are required for transferring MCTP packets between devices on a particular physical medium. A typical use of this field would be to hold per-packet data integrity fields (for example CRC, checksum, and so on) that would be specified for the particular medium.

Field Name	Field Size	Description
MCTP transport header	32 bits	The MCTP transport header is part of each MCTP packet and provides version and addressing information for the packet as well as flags and a "Message Tag" field that, in conjunction with the source EID, is used to identify packets that constitute an MCTP message. The MCTP transport header fields are common fields that are always present regardless of the physical medium over which MCTP is being used.  Note: The positioning of the sub-fields of the MCTP transport header may vary based on the physical medium binding.
RSVD	4 bits	(Reserved) Reserved for future definition by the MCTP base specification.
Hdr version	4 bits	(Header version) Identifies the format, physical framing, and data integrity mechanism used to transfer the MCTP common fields in messages on a given physical medium. The value is defined in the specifications for the particular medium.  Note: The value in this field can vary between different transport bindings.
Destination endpoint ID	8 bits	The EID for the endpoint to receive the MCTP packet.  A few EID values are reserved for specific routing.  See Table 2 – Special Endpoint IDs.
Source endpoint ID	8 bits	The EID of the originator of the MCTP packet. See Table 2 – Special Endpoint IDs.
SOM	1 bit	(Start Of Message) Set to 1b if this packet is the first packet of a message.
EOM	1 bit	(End Of Message) Set to 1b if this packet is the last packet of a message.
Pkt Seq #	2 bits	(Packet sequence number) For messages that span multiple packets, the packet sequence number increments modulo 4 on each successive packet. This allows the receiver to detect up to three successive missing packets between the start and end of a message. Though the packet sequence number can be any value (0-3) if the SOM bit is set, it is recommended that it is an increment modulo 4 from the prior packet with an EOM bit set. After the SOM packet, the packet sequence number shall increment modulo 4 for each subsequent packet belonging to a given message up through the packet containing the EOM flag.
Msg tag	3 bits	(Message tag) Field that, along with the Source Endpoint IDs and the Tag Owner (TO) field, identifies a unique message at the MCTP transport level. Whether other elements, such as portions of the MCTP Message Data field, are also used for uniquely identifying instances or tracking retries of a message is dependent on the message type.  A source endpoint is allowed to interleave packets from multiple messages to the same destination endpoint concurrently, provided that each of the messages has a unique message tag.  For messages that are split up into multiple packets, the Tag Owner (TO) and Message Tag bits remain the same for all packets from the SOM through the EOM.
TO	1 bit	The TO (Tag Owner) bit identifies whether the message tag was originated by the endpoint that is the source of the message or by the endpoint that is the destination of the message. The Message Tag field is generated and tracked independently for each value of the Tag Owner bit. MCTP message types may overlay this bit with additional meaning, for example using it to differentiate between "request" messages and "response" messages.  Set to 1b to indicate that the source of the message originated the message tag.
Message body	See description	The message body represents the payload of an MCTP message. The message body can span multiple MCTP packets.

Field Name	Field Size	Description
IC	1 bit	(MCTP integrity check bit) Indicates whether the MCTP message is covered by an overall MCTP message payload integrity check. This field is required to be the most significant bit of the first byte of the message body in the first packet of a message along with the message type bits.  0b = No MCTP message integrity check 1b = MCTP message integrity check is present
Message type	7 bits	Defines the type of payload contained in the message data portion of the MCTP message. This field is required to be contained in the least-significant bits of the first byte of the message body in the first packet of a message. Like the fields in the MCTP transport header, the message type field is one of the common MCTP fields that are present independent of the transport over which MCTP is being used. Unlike the MCTP transport header, however, the message type field is only required to be present in the first packet of a particular MCTP message, whereas the MCTP transport header fields are present in every MCTP packet.
Message header	0 to M bytes	Additional header information associated with a particular message type, if any. This will typically only be contained in the first packet of a message, but a given message type definition can define header fields as required for any packet.
Message data	0 to N bytes	Data associated with the particular message type. Defined according to the specifications for the message type.
MCTP packet payload	See description	The packet payload is the portion of the message body that is carried in a given MCTP packet. The packet payload is limited according to the rules governing packet payload and transfer unit sizes. See 7.3, Packet Payload and Transmission Unit Sizes, for more information.
Msg integrity check	Message type-specific	(MCTP message integrity check) This field represents the optional presence of a message type-specific integrity check over the contents of the message body. If present, the Message integrity check field shall be carried in the last bytes of the message body. The particular message type definition will specify whether this is required, optional, or not to be used, the field size, and what algorithm is to be used to generate the field. The MCTP base protocol does not specify whether this field is required on single packet messages (potentially dependent on transmission unit size) or is only required on multiple packet messages. This is left to the message type specification.

657 **7.2 Special Endpoint IDs**

658 The following table lists EID values that are reserved or assigned to specific functions for MCTP.

659 **Table 2 – Special Endpoint IDs**

Value	Description
Destination endpoint ID 0	<b>Null Destination EID.</b> This value indicates that the destination EID value is to be ignored and that only physical addressing is used to route the message to the destination on the given bus. This enables communication with devices that have not been assigned an EID. Because the physical addresses between buses are not guaranteed to be unique, MCTP does not support bridging messages with a null destination EID between different buses.
Source endpoint ID 0	<b>Null Source EID.</b> This value indicates a message is coming from an endpoint that is using physical addressing only. This would typically be used for messages that are delivered from an endpoint that has not been assigned an EID. Because the physical addresses between buses are not guaranteed to be unique, MCTP does not support bridging messages with a null source EID between different buses.

Endpoint IDs 1 through 7	Reserved for future definition.
Endpoint ID 0xFF	<b>Broadcast EID.</b> Reserved for use as a broadcast EID on a given bus. MCTP network-wide broadcasts are not supported. Primarily for use by the MCTP control message type.
All other values	Available for assignment and allocation to endpoints.

### 660 7.3 Packet Payload and Transmission Unit Sizes

661 For MCTP, the size of a transmission unit is defined as the size of the packet payload that is carried in an  
662 MCTP packet.

#### 663 7.3.1 Baseline Transmission Unit

664 The following are key information points regarding baseline transmission unit:

- 665 • The baseline transmission unit (minimum transmission unit) size for MCTP is 64 bytes.
- 666 • A message terminus that supports MCTP control messages shall always accept valid packets  
667 that have a transmission unit equal to or less than the baseline transmission unit. The message  
668 terminus is also allowed to support larger transmission units.
- 669 • The transmission unit of all packets in a given message shall be the same size, except for the  
670 transmission unit in the last packet (packet with EOM bit = 1b). Except for the last packet, this  
671 size shall be at least the baseline transmission unit size.
- 672 • The size of the transmission unit in the last packet shall be less than or equal to the  
673 transmission unit size used for the other packets (if any).
- 674 • If a transmission unit size larger than the baseline transmission unit is negotiated, the  
675 transmission unit of all packets shall be less than or equal to the negotiated transmission unit  
676 size. (The negotiation mechanism for larger transmission units between endpoints is message  
677 type-specific and is not addressed in this specification.)
- 678 • A given endpoint may negotiate additional restrictions on packet sizes for communication with  
679 another endpoint, as long as the requirements of this clause are met.
- 680 • All message types shall include support for being delivered using packets that have a  
681 transmission unit that is no larger than the baseline transmission unit. This is required to support  
682 bridging those messages in implementations where there are MCTP bridges that only support  
683 the baseline transmission unit.

### 684 7.4 Maximum Message Body Sizes

685 The Message Body can span multiple packets. Limitations on message body sizes are message type-  
686 specific and are documented in the specifications for each message type.

### 687 7.5 Message Assembly

688 The following fields (and *only* these fields) are collectively used to identify the packets that belong to a  
689 given message for the purpose of message assembly on a particular destination endpoint.

- 690 • Msg Tag (Message Tag)
- 691 • TO (Tag Owner)
- 692 • Source Endpoint ID



693 As described in 3.2, together these values identify the message terminus on the destination endpoint. For  
694 a given message terminus, only one message assembly is allowed to be in process at a time.

## 695 7.6 Dropped Packets

696 Individual packets are dropped (silently discarded) by an endpoint under the following conditions. These  
697 packets are discarded before being checked for acceptance or rejection for message assembly.  
698 Therefore, these packets will *not* cause a message assembly to be started or terminated.

### 699 • Unexpected "middle" packet or "end" packet

700 A "middle" packet (SOM flag = 0 and EOM flag = 0) or "end" packet (SOM flag = 0 and EOM  
701 flag = 1) for a multiple-packet message is received for a given message terminus without first  
702 having received a corresponding "start" packet (where the "start" packet has SOM flag = 1 and  
703 EOM flag = 0) for the message.

### 704 • Bad packet data integrity or other physical layer error

705 A packet is dropped at the physical data-link layer because a data integrity check on the packet  
706 at that layer was invalid. Other possible physical layer errors may include framing errors, byte  
707 alignment errors, packet sizes that do not meet the physical layer requirements, and so on.

### 708 • Bad, unexpected, or expired message tag

709 A message with TO bit = 0 was received, indicating that the destination endpoint was the  
710 originator of the tag value, but the destination endpoint did not originate that value, or is no  
711 longer expecting it. (MCTP bridges do not check message tag or TO bit values for messages  
712 that are not addressed to the bridge's EID, or to the bridge's physical address if null-source or  
713 destination-EID physical addressing is used.)

### 714 • Unknown destination EID

715 A packet is received at the physical address of the device, but the destination EID does not  
716 match the EID for the device or the EID is un-routable.

### 717 • Un-routable EID

718 An MCTP bridge receives an EID that the bridge is not able to route (for example, because the  
719 bridge did not have a routing table entry for the given endpoint).

### 720 • Bad header version

721 The MCTP header version (Hdr Version) value is not a value that the endpoint supports.

### 722 • Unsupported transmission unit

723 The transmission unit size is not supported by the endpoint that is receiving the packet.

## 724 7.7 Starting Message Assembly

725 Multiple-packet message assembly begins when the endpoint corresponding to the destination EID in the  
726 packet receives a valid "start" packet (packet with SOM = 1b and EOM = 0b).

727 A packet with both SOM = 1b and EOM = 1b is considered to be a single-packet message, and is not  
728 assembled per se.

729 Both multiple- and single-packet messages are subject to being terminated or dropped based on  
730 conditions listed in 7.8.

## 731 7.8 Terminating Message Assembly/Dropped Messages

732 Message assembly is terminated at the destination endpoint and messages are accepted or dropped  
733 under the following conditions:

- 734 • **Receipt of the "end" packet for the given message**

735 Receiving an "end" packet (packet with EOM = 1b) for a message that is in the process of being  
736 assembled on a given message terminus will cause the message assembly to be completed  
737 (provided that the message has not been terminated for any of the reasons listed below). This is  
738 normal termination. The message is considered to be accepted at the MCTP base protocol  
739 level.

- 740 • **Receipt of a new "start" packet**

741 Receiving a new "start" packet (packet with SOM = 1b) for a message to the same message  
742 terminus as a message assembly already in progress will cause the message assembly in  
743 process to be terminated. All data for the message assembly that was in progress is dropped.  
744 The newly received start packet is not dropped, but instead it begins a new message assembly.  
745 This is considered an error condition.

- 746 • **Timeout waiting for a packet**

747 Too much time occurred between packets of a given multiple-packet message. The timeout  
748 interval is specific to a particular medium. All data for the message assembly that was in  
749 progress are dropped. This is considered an error condition.

- 750 • **Out-of-sequence packet sequence number**

751 For packets comprising a given multiple-packet message, the packet sequence number for the  
752 most recently received packet is not a mod 4 increment of the previously received packet's  
753 sequence number. All data for the message assembly that was in progress is dropped. This is  
754 considered an error condition.

- 755 • **Incorrect transmission unit**

756 An implementation may terminate message assembly if it receives a "middle" packet (SOM =  
757 0b and EOM = 0b) where the MCTP packet payload size does not match the MCTP packet  
758 payload size for the start packet (SOM = 1b and EOM bit = 0b). This is considered an error  
759 condition.

- 760 • **Bad message integrity check**

761 For single- or multiple-packet messages that use a message integrity check, a mismatch with  
762 the message integrity check value can cause the message assembly to be terminated and the  
763 entire message to be dropped, unless it is overridden by the specification for a particular  
764 message type.

765 NOTE: The message integrity check is considered to be at the message-type level error condition rather  
766 than an error at the MCTP base protocol level.

## 767 7.9 Dropped Messages

768 An endpoint may drop a message if the message type is not supported by the endpoint. This can happen  
769 in any one of the following ways:

- 770 • The endpoint can elect to not start message assembly upon detecting the invalid message type  
771 in the first packet.

- 772 • The endpoint can elect to terminate message assembly in process.
- 773 • The endpoint can elect to drop the message after it has been assembled.

774 **7.10 MCTP Versioning and Message Type Support**

775 There are three types of versioning information that can be retrieved using MCTP control messages:

- 776 • MCTP base specification version information
- 777 • MCTP packet header version information
- 778 • Message type version information

779 The version of the MCTP base specification that is supported by a given endpoint is obtained through the  
 780 Get MCTP Version Support command. This command can also be used to discover whether a particular  
 781 message type is supported on an endpoint, and if so, what versions of that message type are supported.

782 The Header Version field in MCTP packets identifies the media-specific formatting used for MCTP  
 783 packets. It can also indicate a level of current and backward compatibility with versions of the base  
 784 specification, as specified by the header version definition in each medium-specific transport binding  
 785 specification.

786 **7.10.1 Compatibility with Future Versions of MCTP**

787 An Endpoint may choose to support only certain versions of MCTP. The command structure along with  
 788 the Get MCTP Version Support command allows endpoints to detect and restrict the versions of MCTP  
 789 used by other communication endpoints. To support this, all endpoints on a given medium are required to  
 790 implement MCTP Version 1.0 control commands for initialization and version support discovery.

791 **7.11 MCTP Message Types**

792 Table 3 defines the values for the Message Type field for different message types transported through  
 793 MCTP. The MCTP control message type is specified within this document. Baseline requirements for the  
 794 Vendor Defined – PCI and Vendor Defined – IANA message types are also specified within this  
 795 document. All other message types are specified in the [MCTP ID](#) companion document to this  
 796 specification.

797 NOTE: A device that supports a given message type may not support that message type equally across all buses  
 798 that connect to the device.

799 **Table 3 – MCTP Message Types Used in this Specification**

Message Type	Message Type Code	Description
MCTP control	0x00	Messages used to support initialization and configuration of MCTP communication within an MCTP network. The messages and functions for this message type are defined within this specification.
Vendor Defined – PCI	0x7E	Message type used to support VDMs where the vendor is identified using a PCI-based vendor ID. The specification of the initial message header bytes for this message type is provided within this specification. Otherwise, the message body content is specified by the vendor, company, or organization identified by the given vendor ID.
Vendor Defined – IANA	0x7F	Message type used to support VDMs where the vendor is identified using an IANA-based vendor ID. (This format uses an "enterprise number" that is assigned and maintained by the Internet Assigned Numbers Authority, <a href="http://www.iana.org">www.iana.org</a> , as the means of identifying a

	particular vendor, company, or organization.) The specification of the initial message header bytes for this message type is provided within this specification. Otherwise, the message body content is specified by the vendor, company, or organization identified by the given vendor ID.
--	--

## 800 7.12 Security

801 The basic premise of MCTP is that higher layer protocols will fulfill security requirements (for example,  
802 confidentiality and authentication) for communication of management data. This means that the data  
803 models carried by MCTP are used to fulfill the security requirements of a given management transaction.  
804 The MCTP protocol itself will not define any additional security mechanisms.

## 805 7.13 Limitations

806 MCTP has been optimized for communications that occur within a single computer system platform. It has  
807 not been designed to handle problems that can typically occur in a more generic inter-system networking  
808 environment. In particular, compared to networking protocols such as IP and TCP/IP, MCTP has the  
809 following limitations:

- 810 • MCTP has limited logical addressing. MCTP been optimized for the small number of endpoints  
811 that are expected to be utilized within the platform. The 8-bit range of EIDs is limited compared  
812 to the ranges available for IP addresses.
- 813 • MCTP assumes an MCTP network implementation that does not include loops. There is no  
814 mechanism defined in MCTP to detect or reconcile implementations that have connections that  
815 form routing loops.
- 816 • MCTP assumes a network topology where all packets belonging to a given message will be  
817 delivered through the same route (that is, MCTP does not generally support some packets for a  
818 message arriving by one route, while other packets for the message arrive by a different route).
- 819 • MCTP does not support out-of-order packets for message assembly.
- 820 • The MCTP base protocol does not address flow control or congestion control. These behaviors,  
821 if required, are specified at the physical transport binding level or at the message type or higher  
822 level.
- 823 • MCTP is not specified to handle duplicate packets at the base protocol message assembly  
824 level. If a duplicate packet is received and passed on to MCTP message assembly, it can cause  
825 the entire message assembly to be terminated.

826 NOTE: Transport bindings are not precluded from including mechanisms for handling duplicate packets  
827 at the physical transport level.

## 828 7.14 MCTP Discovery and Addressing

829 This clause describes how MCTP endpoints and their capabilities are discovered by one another, and  
830 how MCTP endpoints are provisioned with the addresses necessary for MCTP communication.

831 MCTP discovery occurs over the course of several discrete, ordered steps:

- 832 1) Bus enumeration
- 833 2) Bus address assignment
- 834 3) MCTP capability discovery
- 835 4) Endpoint ID assignment
- 836 5) Distribution and use of routing information

837 This clause gives an overview of the methods used for accomplishing each of these steps in various  
838 operational scenarios. Clause 9 gives details on the messages used to implement these operations.

#### 839 **7.14.1 Bus Enumeration**

840 This step represents existing bus enumeration. (The actions taken in this step are specific to a given  
841 medium.) Because enumeration of devices on the physical bus is medium-specific, this information is  
842 provided in the transport binding specification for the medium.

#### 843 **7.14.2 Bus Address Assignment**

844 MCTP endpoints require a bus address that is unique to a given bus segment. This step deals with  
845 assignment of these addresses. Some bus types (such as PCIe) have built-in mechanisms to effectively  
846 deal with this. Others (such as SMBus) require some additional consideration. Because bus address  
847 assignment is medium-specific, this information is provided in the transport binding specification for the  
848 medium.

#### 849 **7.14.3 MCTP Capability Discovery**

850 Capability discovery deals with the discovery of the characteristics of individual MCTP endpoints.  
851 Capabilities that can be discovered include what message types are supported by an endpoint and what  
852 message type versions are supported. See 7.10 for a description of the methods used to accomplish  
853 capability discovery.

#### 854 **7.14.4 Endpoint ID Assignment**

855 Endpoint IDs are system-wide unique IDs for identifying a specific MCTP endpoint. They can be  
856 dynamically assigned at system startup or hot-plug insertion. See 7.17 for a description of the methods  
857 used to accomplish EID assignment.

#### 858 **7.14.5 Distribution and Use of Routing Information**

859 Bridging-capable MCTP endpoints need routing information to identify the next hop to forward a message  
860 to its final destination. See 7.19 for a description of how routing information is conveyed between MCTP  
861 endpoints.

### 862 **7.15 Devices with Multiple Media Interfaces**

863 MCTP fully supports management controllers or management devices that have interfaces on more than  
864 one type of bus. For example, a device could have both a PCI Express (PCIe) and an SMBus interface. In  
865 this scenario, the device will typically have a different EID for each interface. (Bridges can include  
866 instantiations that have an endpoint shared across multiple interfaces; see 7.19.2 for more information.)

867 This concept can be useful in different operational scenarios of the managed system. For example,  
868 typically a PCIe interface will be used during [ACPI](#) "S0" power states (when the system is fully powered  
869 up), which will provide significantly higher bandwidths, whereas the SMBus interface could be used for  
870 "S3–S5" low-power sleep states.

871 The baseline transmission unit is specified to be common across all media, enabling packets to be routed  
872 between different media without requiring bridges to do intermediate assembly and disassembly  
873 operations to handle differences in packet payload sizes between different media.

### 874 **7.16 Peer Transactions**

875 Endpoints can intercommunicate in a peer-to-peer manner using the physical addressing on a given bus.

876 A special value for the EID is used in cases when the physical address is known, but the EID is not  
877 known. This capability is used primarily to support device discovery and EID assignment. A device that  
878 does not yet have an EID assignment is not addressed using an EID. Rather, the device gets its EID  
879 assigned using an MCTP control command, Set Endpoint ID, which uses physical addressing only.

880 Similarly, depending on the transport binding, a device can also announce its presence by sending an  
881 MCTP message to a well-known physical address for the bus owner (for example, for PCIe VDM, this  
882 would be the root complex; for SMBus, the host slave address, and so on).

883 It is important to note that in cases where two endpoints are on the same bus, they do not need to go  
884 through a bridge to communicate with each other. Devices use the Resolve Endpoint ID command to ask  
885 the bus owner what physical address should be used to route messages to a given EID. Depending on  
886 the bus implementation, the bus owner can either return the physical address of the bridge that the  
887 message should be delivered to, or it can return the physical address of the peer on the bus.

## 888 7.17 Endpoint ID Assignment and Endpoint ID Pools

889 MCTP EIDs are the system-wide unique IDs used by the MCTP infrastructure to address endpoints and  
890 for routing messages across multiple buses in the system. There is one EID assigned to a given physical  
891 address. Most intelligent management devices (IMDs) or management controllers will connect to just a  
892 single bus and have a single EID. A non-bridge device that is connected to multiple different buses will  
893 have one EID for each bus it is attached to.

894 Bus owners are MCTP devices that are responsible for issuing EIDs to devices on a bus segment. These  
895 EIDs come from a pool of EIDs maintained by the bus owner.

896 With the exception of the topmost bus owner (see 7.17.1), a given bus owner's pool of EIDs is  
897 dynamically allocated at run-time by the bus owner of the bus above it in the hierarchy. Hot-plug devices  
898 shall have their EID pools dynamically allocated.

899 Once EIDs are assigned to MCTP endpoints, it is necessary for MCTP devices involved in a transaction  
900 to understand something about the route a given message will traverse. Clause 7.19 describes how this  
901 routing information is shared among participants along a message's route.

### 902 7.17.1 Topmost Bus Owner

903 The topmost bus owner is the ultimate source of the EID pool from which all EIDs are drawn for a given  
904 MCTP network.

905 This is illustrated in Figure 3, in which the arrows are used to identify the role of bus ownership. The  
906 arrows point outward from the bus owner for the particular bus and inward to a device that is "owned" on  
907 the bus.

908 In Figure 3, device X in diagram A and bridge X in diagram B are examples of topmost bus owners.  
909 Diagram A shows a device that connects to a single bus and is the topmost bus owner for the overall  
910 MCTP network. Diagram B shows that a bridge can simultaneously be the topmost bus owner, as well as  
911 the bus owner for more than one bus. The different colors represent examples of different media.

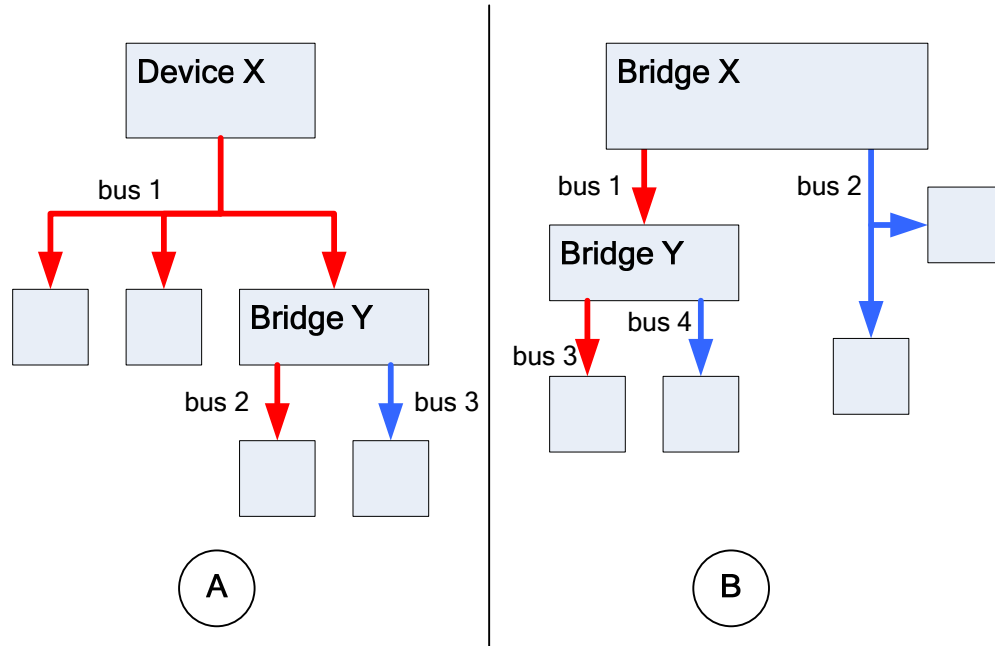


Figure 3 – Topmost Bus Owners

912

913

914 **7.17.2 Use of Static EIDs and Static EID Pools**

915 In general, the only device that will require a static (pre-configured) EID assignment will be the topmost  
 916 bus owner. It needs a static EID because there is no other party to assign it an EID through MCTP.  
 917 Otherwise, all other devices will have their EIDs assigned to them by a bus owner.

918 The same principle applies if the device functions as an MCTP bridge. If the device is the highest device  
 919 in the MCTP bus hierarchy, it will require a static pool of EIDs to be assigned to it as part of the system  
 920 design. Otherwise, the device will be dynamically allocated a pool of EIDs from a higher bus owner.

921 An MCTP network implementation is allowed to use static EIDs for devices other than the topmost bus  
 922 owner. Typically, this would only be done for very simple MCTP networks. Other key EID assignment  
 923 considerations follow:

- 924 • Endpoints that support the option of being configured for one or more static EIDs shall also  
 925 support being configured to be dynamically assigned EIDs.
- 926 • No mechanism is defined in the MCTP base specification for a bridge or bus owner to discover  
 927 and incorporate a static EID into its routing information. Thus, a simple endpoint that is  
 928 configured with a static EID needs to also be used with a bus owner that is configured to  
 929 support the static EIDs for the endpoint.
- 930 • All bus owners/bridges in the hierarchy, from the topmost bus owner to the endpoint, shall have  
 931 their routing configurable to support static EID routing information.
- 932 • Although an endpoint that uses a static EID needs to be used with a bus owner that supports  
 933 static EIDs, the reverse is not true. A bus owner that uses static EIDs does not need to require  
 934 that the devices on the buses it owns be configured with static EIDs.
- 935 • How the configuration of static EIDs occurs is outside the scope of this specification.

- 936 • No specified mechanism exists to "force" an override of a bridge's or bus owner's routing table  
937 entries for static EIDs. That is, commands such as Allocate Endpoint IDs and Routing  
938 Information Update only affect entries that are associated with dynamic EIDs.
- 939 • MCTP does not define a mechanism for keeping routing tables updated if static EIDs are used  
940 with dynamic physical addresses. That is, static EIDs are not supported for use with dynamic  
941 physical addresses.
- 942 • Bridges can have a mix of both static and dynamic EID pools. That is, the routing table can  
943 have both static and dynamic entries and can allocate from static and dynamic EID pools. Only  
944 the dynamic EID pool is given to the bridge by the bus owner using the Allocate Endpoint IDs  
945 command. There is no specification for how a static EID pool gets configured or how a bridge  
946 decides whether to give an endpoint an EID from a static or dynamically obtained EID pool.  
947 There is also no MCTP-defined mechanism to read the static EID pool setting from the bridge.
- 948 • MCTP bridges and bus owners (except the topmost bus owner) are not required to include  
949 support for static EIDs.
- 950 • MCTP does not define a mechanism for allocating EID pools that take static EID assignments  
951 into account. That is, a bridge cannot request a particular set of EIDs to be allocated to it.
- 952 • MCTP bridges/bus owners may be configurable to use only static EIDs.

### 953 7.17.3 Use of Static Physical Addresses

954 In many simple topologies, it is desirable to use devices that have statically configured physical  
955 addresses. This can simplify the implementation of the device. For example, an SMBus device that is not  
956 used in a hot-plug application would not need to support the SMBus address assignment (SMBus ARP)  
957 protocol. Fixed addresses can also aid in identifying the location and use of an MCTP device in a system.  
958 For example, if a system has two otherwise identical MCTP devices, a system vendor will know that the  
959 device at address "X" is the one at the front of the motherboard, and the device at address "Y" is at the  
960 back, because that is how they assigned the addresses when the system was designed.

961 Therefore, MCTP transport bindings, such as for SMBus, are allowed to support devices being at static  
962 physical addresses without requiring the binding to define a mechanism that enables the bus owner to  
963 discover MCTP devices that are using static addresses.

964 In this case, the bridge or bus owner shall have prior knowledge of the addresses of those devices to be  
965 able to assign EIDs to those devices and to support routing services for those devices. To support this  
966 requirement, the following requirements and recommendations are given to device vendors:

- 967 • Devices that act as bus owners or bridges and are intended to support MCTP devices that use  
968 static physical addresses should provide a non-volatile configuration option that enables the  
969 system integrator to configure which device addresses are being used for devices on each bus  
970 that is owned by the bridge/bus owner.
- 971 • The mechanism by which this non-volatile configuration occurs is specific to the device vendor.  
972 In many cases, the physical address information will be kept in some type of non-volatile  
973 storage that is associated with the device and gets loaded when the device is manufactured or  
974 when the device is integrated into a system. In other cases, this information may be coded into  
975 a firmware build for the device.



#### 976 7.17.4 Endpoint ID Assignment Process for Bus Owners/Bridges

977 The bus owner/bridge shall get its own EID assignment, and a pool of EIDs, as follows. These steps only  
978 apply to bus owner/bridge devices that are not the topmost bus owner.

- 979 • Bus owners/bridges shall be pre-configured with non-volatile information that identifies which  
980 buses they own. (How this configuration is accomplished is device/vendor specific and is  
981 outside the scope of this specification.)
- 982 • The bus owner/bridge announces its presence on any buses *that it does not own* to get an EID  
983 assignment for that bus. The mechanism by which this announcement occurs is dependent on  
984 the particular physical transport binding and is defined as part of the binding specification.
- 985 • The bus owner/bridge waits until it gets its own EID assignment for one of those buses through  
986 the Set Endpoint ID command.
- 987 • The bus owner/bridge indicates the size of the EID pool it requires by returning that information  
988 in the response to the Set Endpoint ID command.
- 989 • For each bus where the bus owner/bridge is itself an "owned" device, the bus owner/bridge will  
990 be offered a pool of EIDs by being sent an Allocate Endpoint IDs command from the bus owner.
- 991 • The bus owner/bridge accepts allocations only from the bus of the "first" bus owner that gives it  
992 the allocation, as described in the Allocate Endpoint IDs command description in 9.10. If it gets  
993 allocations from other buses, they are rejected.

994 The bus owner can now begin to build a routing table for each of the buses that it owns, and accept  
995 routing information update information. Refer to 7.19 for more information.

#### 996 7.17.5 Reclaiming EIDs from Hot-Plug Devices

997 Bridges will typically have a limited pool of EIDs from which to assign and allocate to devices. (This also  
998 applies when a single bus owner supports hot-plug devices.) It is important for bridges to reclaim EIDs so  
999 that when a device is removed, the EID can later be re-assigned when a device is plugged in. Otherwise,  
1000 the EID pool could become depleted as devices are successively removed and added.

1001 EIDs for endpoints that use static addresses are not reclaimed.

1002 No mechanism is specified in the MCTP base protocol for detecting device removal when it occurs.  
1003 Therefore, the general approach to detecting whether a device has been removed is to re-enumerate the  
1004 bus when a new device is added and an EID or EID pool is being assigned to that device.

1005 The following approach can be used to detect removed hot-plug devices: The bus owner/bridge can  
1006 detect a removed device or devices by validating the EIDs that are presently allocated to endpoints that  
1007 are directly on the bus and identifying which EIDs are missing. It can do this by attempting to access each  
1008 endpoint that the bridge has listed in its routing table as being a device that is directly on the particular  
1009 bus. Attempting to access each endpoint can be accomplished by issuing the Get Endpoint ID command  
1010 to the physical address of each device and comparing the returned result to the existing entry in the  
1011 routing table. If there is no response to the command, or if there is a mismatch with the existing routing  
1012 information, the entry should be cleared and the corresponding EID or EID range should be returned to  
1013 the "pool" for re-assignment. The bus owner/bridge can then go through the normal steps for EID  
1014 assignment.

1015 This approach should work for all physical transport bindings, because it keeps the "removed EID"  
1016 detection processing separated from the address assignment process for the bus.

1017 In some cases, a hot-plug endpoint may temporarily go into a state where it does not respond to MCTP  
1018 control messages. Depending on the medium, it is possible that when the endpoint comes back on line, it  
1019 does not request a new EID assignment but instead continues using the EID it had originally assigned. If  
1020 this occurs while the bus owner is validating EIDs to see if any endpoints are no longer accessible, it is

1021 possible that the bus owner will assume that the endpoint was removed and reassign its EID to a newly  
1022 inserted endpoint, unless other steps are taken:

- 1023 • The bus owner shall wait at least  $T_{RECLAIM}$  seconds before reassigning a given EID (where  
1024  $T_{RECLAIM}$  is specified in the physical transport binding specification for the medium used to  
1025 access the endpoint).
- 1026 • Reclaimed EIDs shall only be reassigned after all unused EIDs in the EID pool have been  
1027 assigned to endpoints. Optionally, additional robustness can be achieved if the bus owner  
1028 maintains a short FIFO list of reclaimed EIDs (and their associated physical addresses) and  
1029 allocates the older EIDs first.
- 1030 • A bus owner shall confirm that an endpoint has been removed by attempting to access it after  
1031  $T_{RECLAIM}$  has expired. It can do this by issuing a Get Endpoint ID command to the endpoint to  
1032 verify that the endpoint is still non-responsive. It is recommended that this be done at least three  
1033 times, with a delay of at least  $1/2 * T_{RECLAIM}$  between tries if possible. If the endpoint continues  
1034 to be non-responsive, it can be assumed that it is safe to return its EID to the pool of EIDs  
1035 available for assignment.

### 1036 7.17.6 Additional Requirements for Hot-Plug Endpoints

1037 Devices that are hot-plug shall support the Get Endpoint UUID command. The purpose of this  
1038 requirement is to provide a common mechanism for identifying when devices have been changed.

1039 Endpoints that go into states where they temporarily do not respond to MCTP control messages shall re-  
1040 announce themselves and request a new EID assignment if they are "off line" for more than  $T_{RECLAIM}$   
1041 seconds, where  $T_{RECLAIM}$  is specified in the physical transport binding specification for the medium used  
1042 to access the endpoint.

### 1043 7.17.7 Additional Requirements for Devices with Multiple Endpoints

1044 A separate EID is utilized for each MCTP bus that a non-bridge device connects to. In many cases, it is  
1045 desirable to be able to identify that the same device is accessible through multiple EIDs.

1046 If an endpoint has multiple physical interfaces (ports), the interfaces can be correlated to the device by  
1047 using the MCTP Get Endpoint UUID command (see 9.5) to retrieve the unique system-wide identifier.

1048 Devices connected to multiple buses shall support the Get Endpoint UUID command for each endpoint  
1049 and return a common UUID value across all the endpoints. This is to enable identifying EIDs as belonging  
1050 to the same physical device.

## 1051 7.18 Handling Reassigned EIDs

1052 Though unlikely, it is still possible that during the course of operation of an MCTP network, a particular  
1053 EID could get reassigned from one endpoint to another. For example, this could occur if a newly hot-swap  
1054 inserted endpoint device gets assigned an EID that was previously assigned to a device that was  
1055 subsequently removed.

1056 Under this condition, it is possible that the endpoint could receive a message that was intended for the  
1057 previously installed device. This is not considered an issue for MCTP control messages because the  
1058 control messages are typically just used by bus owners and bridges for initializing and maintaining the  
1059 MCTP network. The bus owners and bridges are aware of the EIDs they have assigned to endpoints and  
1060 are thus intrinsically aware of any EID reassignment.

1061 Other endpoints, however, are not explicitly notified of the reassignment of EIDs. Therefore,  
1062 communication that occurs directly from one endpoint to another is subject to the possibility that the EID  
1063 could become assigned to a different device in the middle of communication. This shall be protected  
1064 against by protocols specific to the message type being used for the communication.

1065 In general, the approach to protecting against this will be that other message types will require some kind  
 1066 of "session" to be established between the intercommunicating endpoints. By default, devices would not  
 1067 start up with an active session. Thus, if a new device is added and it gets a reassigned EID, it will not  
 1068 have an active session with the other device and the other device will detect this when it tries to  
 1069 communicate.

1070 The act of having a new EID assigned to an existing device should have the same effect. That is, if a  
 1071 device gets a new EID assignment, it would "close" any active sessions for other message types.

1072 The mechanism by which other message types would establish and track communication sessions  
 1073 between devices is not specified in this document. It is up to the specification of the particular message  
 1074 type.

1075 **7.19 MCTP Bridging**

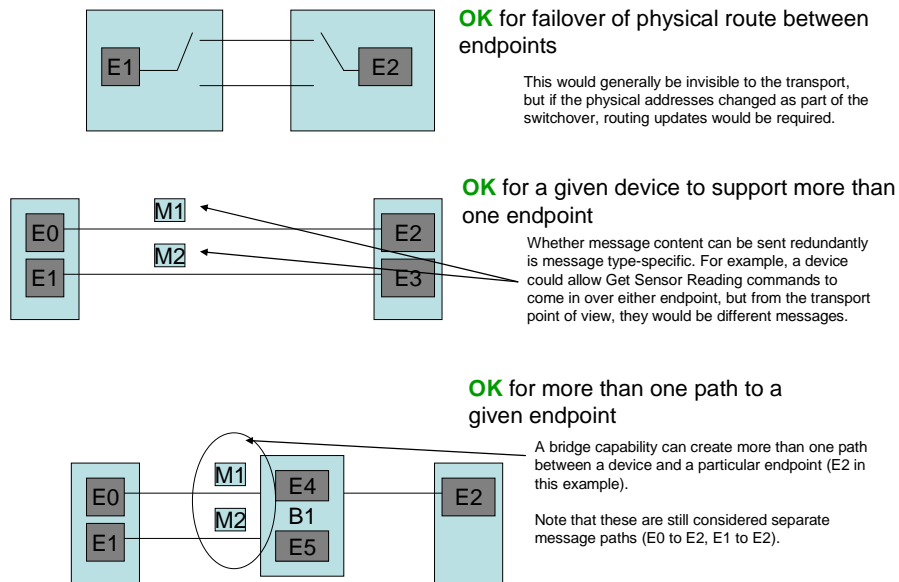
1076 One key capability provided by MCTP is its ability to route messages between multiple buses and  
 1077 between buses of different types. This clause describes how routing information is created, maintained,  
 1078 and used by MCTP bridges and MCTP endpoints. Keep the following key points in mind about MCTP  
 1079 bridges:

- 1080 • An MCTP bridge is responsible for routing MCTP packets between at least two buses.
- 1081 • An MCTP bridge is typically the bus owner for at least one of those buses.

1082 **7.19.1 Routing/Bridging Restrictions**

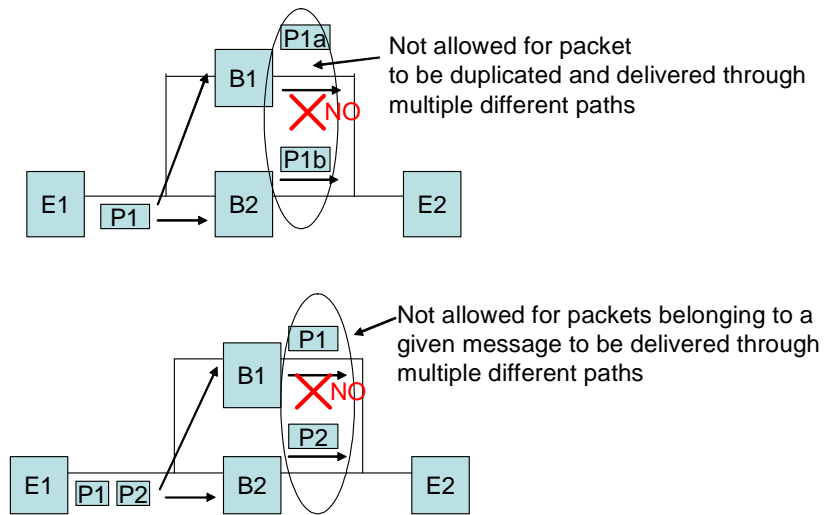
1083 Figure 4 and Figure 5 illustrate some of the supported and unsupported bridging topologies. As shown, it  
 1084 is acceptable for a given topology to have more than one path to get to a given EID. This can occur either  
 1085 because different media are used or because a redundant or failover communication path is desired in an  
 1086 implementation.

1087 A bridge shall not route or forward packets with a broadcast destination ID.



1088

1089 **Figure 4 – Acceptable Failover/Redundant Communication Topologies**



1090

1091

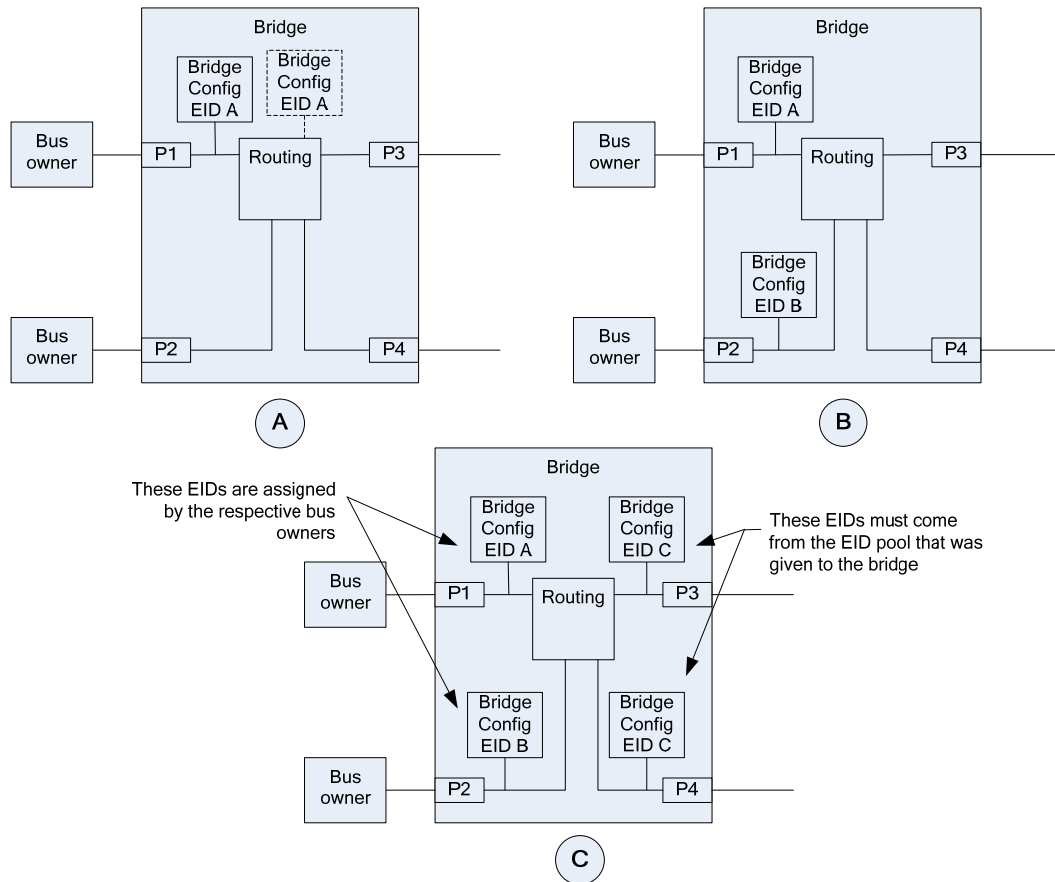
**Figure 5 – Routing/Bridging Restrictions**

### 1092 7.19.2 EID Options for MCTP Bridges

1093 An MCTP bridge that connects to multiple buses can have a single EID or multiple EIDs through which  
 1094 the bridge's routing configuration and endpoint functionality can be accessed through MCTP control  
 1095 commands. There are three general options:

- 1096 • The bridge uses a single MCTP endpoint.
- 1097 • The bridge uses an MCTP endpoint for each bus that connects to a bus owner.
- 1098 • The bridge uses an MCTP endpoint for every bus to which it connects.

1099 Examples of these different options are shown in Figure 6, and more detailed information on the options  
 1100 is provided following Figure 6.



1101

1102

**Figure 6 – EID Options for MCTP Bridges**

1103 A bridge has only one EID pool. To prevent issues with getting an EID pool allocation from multiple bus  
 1104 owners, a bridge that is accessible through multiple EIDs will only accept EID pool allocation from the first  
 1105 bus that allocation is received from using the Allocate Endpoint IDs command. This behavior is described  
 1106 in more detail in the specification of the Allocate Endpoint IDs command.

1107 If necessary, the Get Endpoint UUID command can be used to correlate that EIDs belong to the same  
 1108 MCTP bridge device. (This correlation is not required for normal initialization and operation of the MCTP  
 1109 network, but it may be useful when debugging.)

1110 The following is a more detailed description of the different EID options for bridges:

1111 • **Single endpoint**

1112 A single endpoint is used to access the bridge’s routing configuration and endpoint functionality.  
 1113 Referring to diagram (A) in Figure 6, an implementation may elect to either have the endpoint  
 1114 functionality be directly associated with a particular bus/port (for example, P1) or the  
 1115 functionality can be located on a "virtual bus" that is behind the routing function. In either case,  
 1116 the routing functionality ensures that the EID can be accessed through any of the buses to  
 1117 which the bridge connects.

1118 Although there is a single endpoint, the bridge shall report the need for EID assignment for that  
 1119 endpoint on each bus that is connected to a bus owner (for example, P1, P2). The multiple  
 1120 announcements provide a level of failover capability in the EID assignment process in case a  
 1121 particular bus owner becomes unavailable. The multiple announcements also help support a

1122 consistent EID assignment process across bus owners. To prevent issues with getting  
1123 conflicting EID assignments from multiple bus owners, the bridge will only accept EID pool  
1124 allocation from the first bus that an allocation is received from using the Set Endpoint ID  
1125 command. This behavior is described in more detail in the specification of the Set Endpoint ID  
1126 command. The bridge shall not report the need for EID assignment on any buses that the bridge  
1127 itself owns.

1128 • **Endpoint for each bus connection to a bus owner**

1129 The bridge has one endpoint for each bus connected to a bus owner. This is shown as diagram  
1130 (B) in Figure 6. There are no explicit endpoints associated with buses that are not connected to  
1131 a bus owner (for example, the buses connected to ports P3 and P4, respectively.) Because of  
1132 the way packet routing works, EID A and EID B can be accessed from any of the ports  
1133 connected to the bridge. Thus, the bridge's configuration functionality may be accessed through  
1134 multiple EIDs. Because a separate endpoint communication terminus is associated with each  
1135 port (P1, P2), the bridge can accept an EID assignment for each bus independently.

1136 The bridge shall only report the need for EID assignment on buses that connect to a bus owner,  
1137 and only for the particular MCTP control interface that is associated with the particular bus. For  
1138 example, the bridge would announce the need for EID assignment for the interface associated  
1139 with EID A only through P1, and the need for EID assignment for the interface associated with  
1140 EID B only through P2. The bridge shall not report the need for EID assignment on any buses  
1141 that the bridge itself owns.

1142 • **Endpoint for every bus connection**

1143 The bridge has one endpoint for each bus connected to it, as shown as diagram (C) in Figure 6.  
1144 This includes buses that connect to bus owners (for example, P1, P2) and buses for which the  
1145 bridge is the bus owner (for example, P3, P4). Because of the way packet routing works, any of  
1146 these EIDs can be accessed from any of the ports connected to the bridge.

1147 Because a separate endpoint communication terminus is associated with each owned port (P1,  
1148 P2), the bridge can accept an EID assignment for the bus owners of each bus independently.  
1149 The EIDs associated with the buses that the bridge itself owns (for example, P3, P4) shall be  
1150 taken out of the EID pool that is allocated to the bridge.

1151 The bridge shall only report the need for EID assignment on buses that connect to a bus owner,  
1152 and only for the particular MCTP control interface that is associated with the particular bus. For  
1153 example, the bridge would announce the need for EID assignment for the interface associated  
1154 with EID A only through P1, and the need for EID assignment for the interface associated with  
1155 EID B only through P2. The bridge shall not report the need for EID assignment on any buses  
1156 that the bridge itself owns.

1157 **7.19.3 Routing Table**

1158 An MCTP bridge maintains a routing table where each entry in the table associates either a single EID or  
1159 a range of EIDs with a single physical address and bus ID for devices that are on buses that are directly  
1160 connected to the bridge.

1161 If the device is a bridge, there will typically be a range of EIDs that are associated with the physical  
1162 address of the bridge. There may also be an entry with a single EID for the bridge itself.

1163 **7.19.4 Bridging Process Overview**

1164 When a bridge receives an MCTP packet, the following process occurs:

- 1165 1) The bridge checks to see whether the destination EID in the packet matches or falls within the  
1166 range of EIDs in the table.
- 1167 2) If the EID is for the bridge itself, the bridge internally consumes the packet.

- 1168 3) If there is a match with an entry in the routing table, the following steps happen:
- 1169 • The bridge changes the physical addresses in the packet and reformats the medium-
- 1170 specific header and trailer fields as needed for the destination bus.
- 1171 • The destination physical address from the source bus is replaced with the destination
- 1172 physical address for the destination bus obtained from the entry in the routing table.
- 1173 • The bridge replaces the source physical address in the packet it received with the bridge's
- 1174 own physical address on the target bus. This is necessary to enable messages to be
- 1175 routed back to the originator.
- 1176 • Packet-specific transport header and data integrity fields are updated as required by the
- 1177 particular transport binding.
- 1178 4) If there is no match, packets with EID values that are not in the routing table are silently
- 1179 discarded.

### 1180 7.19.5 Endpoint Operation with Bridging

1181 A bridge does not track the packet transmissions between endpoints. It simply takes packets that it

1182 receives and routes them on a per-packet basis based on the destination EID in the packet. It does not

1183 pay attention to message assembly or disassembly or message type-specific semantics, such as

1184 request/response semantics, for packets that it routes to other endpoints.

1185 Most simple MCTP endpoints will never need to know about bridges. Typically, another endpoint will

1186 initiate communication with them. The endpoint can then simply take the physical address and source

1187 EID information from the message and use that to send messages back to the message originator.

1188 An endpoint that needs to originate a "connection" to another MCTP endpoint does need to know what

1189 physical address should be used for messages to be delivered to that endpoint. To get this information, it

1190 needs to query the bus owner for it. An endpoint knows the physical address of the bus owner because it

1191 saved that information when it got its EID assignment.

1192 The Resolve Endpoint ID command requests a bus owner to return the physical address that is to be

1193 used to route packets to a given EID. (This is essentially the MCTP equivalent of the ARP protocol that is

1194 used to translate IP addresses to physical addresses.) The address that is returned in the Resolve

1195 Endpoint ID command response will either be the actual physical address for the device implementing the

1196 endpoint, or it will be the physical address for the bridge to be used to route packets to the desired

1197 endpoint.

1198 Because the physical address format is media-specific, the format of the physical address parameter is

1199 documented in the specifications for the particular media-specific physical transport binding for MCTP (for

1200 example, MCTP over SMBus, MCTP over PCIe, and so on).

1201 If endpoint A has received a message from another endpoint B, it does not need to issue a Resolve

1202 Endpoint ID command. Instead, it can extract the source EID and source physical address from the

1203 earlier message from endpoint B, and then use that as the destination EID and destination physical

1204 address for the message to Endpoint B.

### 1205 7.19.6 Routing Table Entries

1206 Each MCTP device that does bridging shall maintain a logical routing table. A bus owner shall also

1207 typically maintain a routing table if more than one MCTP device is connected to the bus that it owns. The

1208 routing table is required because the bus owner is also the party responsible for resolving EIDs to

1209 physical addresses.

1210 The internal format that a device uses for organizing the routing table is implementation dependent. From  
 1211 a logical point of view, each entry in a routing table will be comprised of at least three elements: An EID  
 1212 range, a bus identifier, and a bus address. This is illustrated in Figure 7.

EID Range	Bus ID	Bus Address
-----------	--------	-------------

1213 **Figure 7 – Basic Routing Table Entry Fields**

1214 The *EID range* specifies the set of EIDs that can be reached through a particular bus address on a given  
 1215 bus. Because the bus ID and bus address may correspond to a particular "port" on a bridge, it is possible  
 1216 that there can be multiple non-contiguous ranges (multiple routing table entries) that have the same bus  
 1217 ID/bus address pair route. EIDs and EID ranges can be categorized into three types: downstream,  
 1218 upstream, and local. "Downstream" refers to EIDs that are associated with routing table entries that are  
 1219 for buses that are owned by the bridge that is maintaining the routing table. "Upstream" refers to EIDs that  
 1220 are associated with routing table entries that route to buses that are not owned by the bridge that is  
 1221 maintaining the routing table.

1222 "Local" refers to the EIDs for routing table entries for endpoints that are on buses that are directly  
 1223 connected to the bridge that is maintaining the routing table. A particular characteristic of entries for local  
 1224 EIDs is that the Resolve Endpoint ID command is issued from the same bus that the endpoint is on. The  
 1225 bridge/bus owner delivers the physical address for that endpoint rather than the physical address  
 1226 associated with a routing function. This facilitates allowing endpoints on the same the bus to  
 1227 communicate without having to go through an MCTP routing function.

1228 A routing table entry may not be "local" even if two endpoints are located on the same bus. An  
 1229 implementation may require that different endpoints go through the routing function to intercommunicate  
 1230 even if the endpoints are part of the same bus.

1231 The *bus ID* is an internal identifier that allows the MCTP device to identify the bus that correlates to this  
 1232 route. MCTP does not require particular values to be used for identifying a given physical bus connection  
 1233 on a device. However, this value will typically be a 0-based numeric value.

1234 EXAMPLE: A device that had three buses would typically identify them as buses "0", "1", and "2".

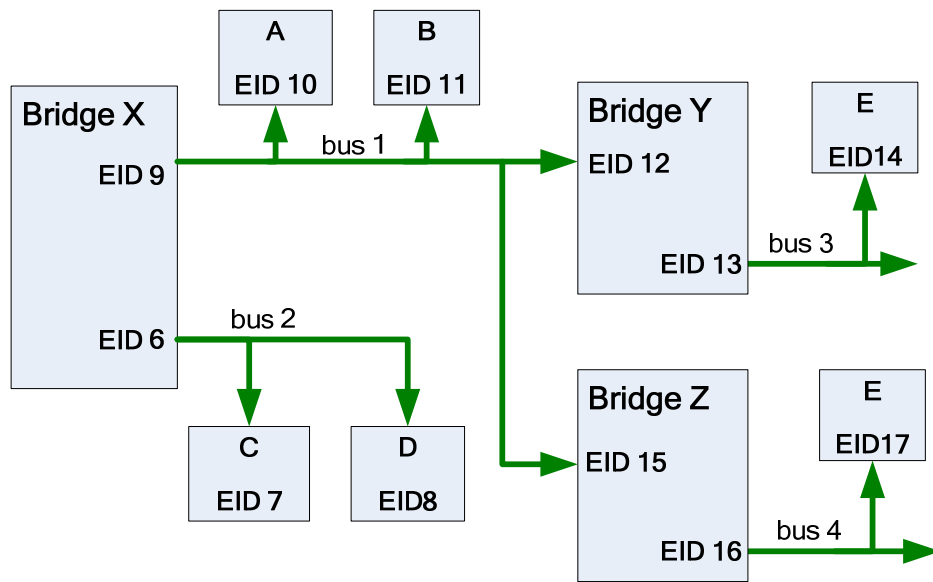
1235 The *bus address* is the physical address of a specific device on the bus through which the EIDs specified  
 1236 in the *EID range* can be reached. This can either be the physical address corresponding to the  
 1237 destination endpoint, or it can be the physical address of the next bridge in the path to the device. The  
 1238 format of this address is specific to the particular physical medium and is defined by the physical medium  
 1239 transport binding.

### 1240 **7.19.7 Routing Table Creation**

1241 This clause illustrates the types of routing information that a bridge requires, and where the information  
 1242 comes from. This clause also describes the steps that a bus owner shall use to convey that information  
 1243 for a given bus.

1244 Figure 8 helps illustrate the steps that are required to completely establish the routing information  
 1245 required by a bridge (bridge Y). The arrows in Figure 8 point outward from the bus owner and inward to  
 1246 "owned" endpoints on the bus.





1247

1248

Figure 8 – Routing Table Population

1249 **7.19.7.1 Routing Table Population Example**

1250 With reference to Figure 8, the following items describe the information that bridge Y will need for routing  
 1251 messages in the example topology shown:

- 1252 • It needs a set of EIDs allocated to it to use for itself and to allocate to other devices (for  
 1253 example, EIDs 12:14). These are allocated to it by the bus owner (bridge X).
- 1254 • It needs a routing table that has an entry that maps EID 14 to the physical address for device E  
 1255 on bus 3.
- 1256 • It needs routing table entries for the local devices on bus 1, which are: bridge X (EID 9), device  
 1257 A (EID 10), device B (EID 11), and bridge Z (EID 15), assuming that devices A and B are to be  
 1258 reached by bridge Y without having to go through bridge X. This information shall be given to it  
 1259 by the bus owner (bridge X).
- 1260 • It needs to know that EIDs 6:8 are accessed through bus owner/bridge X. Therefore, it needs a  
 1261 routing table entry that maps the EID range 6:8 to the physical address for bridge X on bus 1.  
 1262 This information shall also be given to it by the bus owner (bridge X).
- 1263 • It needs to know that EIDs 16:17 are accessed through bridge Z. Therefore, it needs a routing  
 1264 table entry that maps the EID range 16:17 to the physical address for bridge Z on bus 1.  
 1265 Because the bus owner (bridge X) allocated that range of EIDs to bridge Z in the first place, this  
 1266 information is also given to bridge Y by the bus owner (bridge X).

1267 **7.19.7.2 Bus Initialization Example**

1268 Starting with the description of what bridge Y requires, the following task list shows the steps that bridge  
 1269 X shall take to provide routing information for bus 1. Bridge X shall:

- 1270 1) Assign EIDs to devices A, B, C, D, bridge Y, and bridge Z. This is done using the Set Endpoint  
 1271 ID command. The response of the Set Endpoint ID command also indicates whether a device  
 1272 wants an additional pool of EIDs.

- 1273 2) Allocate EID pools to bridge Y and bridge Z. This is done using the Allocate Endpoint IDs  
1274 command.
- 1275 3) Tell bridge Y the physical addresses and EIDs for devices A and B, bridge X (itself), and bridge  
1276 Z on bus 1. This is done using the Routing Information Update command.
- 1277 4) Tell bridge Y that EIDs 16:17 are accessed through the physical address for bridge Z on bus 1.  
1278 This is also done using the Routing Information Update command. (Steps 3 and 4 can be  
1279 combined and covered with one instance of the command.)
- 1280 5) Tell bridge Z the physical addresses and EIDs for devices A and B, bridge X (itself), and bridge  
1281 Y on bus 1. This is also done using the Routing Information Update command.
- 1282 6) Tell bridge Z that EIDs 13:14 are accessed through the physical address for bridge Y on bus 1.  
1283 This is also done using the Routing Information Update command. (Steps 5 and 6 can be  
1284 combined and covered with one instance of the command.)
- 1285 7) Tell bridge Y and bridge Z that EIDs 6:8 are accessed through bridge X on bus 1. This is also  
1286 done using the Routing Information Update command. This step could also be combined with  
1287 steps 3 and 4 for bridge Y and steps 5 and 6 for bridge Z.

### 1288 **7.19.8 Routing Table Updates Responsibility for Bus Owners**

1289 After it is initialized for all bridges, routing table information does not typically require updating during  
1290 operation. However, updating may be required if a bridge is added as a hot-plug device. In this case,  
1291 when the bridge is added to the system, it will trigger the need for the bus owner to assign it an EID,  
1292 which will subsequently cause the request for EID pool allocations, and so on. At this time, the bus owner  
1293 can simply elect to re-run the steps for bus initialization as described in 7.19.7.2.

### 1294 **7.19.9 Consolidating Routing Table Entries**

1295 MCTP requires that when an EID pool is allocated to a device, the range of EIDs is contiguous and  
1296 follows the EID for the bridge itself. Thus, a bridge can elect to consolidate routing table information into  
1297 one entry when it recognizes that it has received an EID or EID range that is contiguous with an existing  
1298 entry for the same physical address and bus. (The reason that EID allocation and routing information  
1299 updates are not done as one range using the same command is because of the possibility that a device  
1300 may have already received an allocation from a different bus owner.)

## 1301 **7.20 Bridge and Routing Table Examples**

1302 The following examples illustrate different bridge and MCTP network configurations and the  
1303 corresponding information that shall be retained by the bridge for MCTP packet routing and to support  
1304 commands such as Resolve Endpoint ID and Query Hop.

1305 The following clauses (including Table 4 through Table 6) illustrate possible topologies and ways to  
1306 organize the information that the bridge retains. Implementations may elect to organize and store the  
1307 same information in different ways. The important aspect of the examples is to show what information is  
1308 kept for each EID, to show what actions cause an entry to be created, and to show how an EID or EID  
1309 range can in some cases map to more than one physical address.

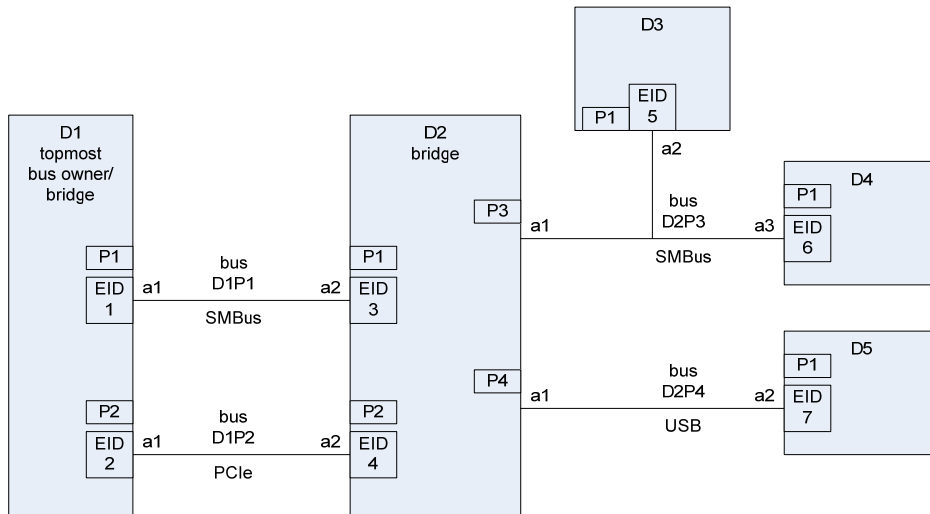
1310 The examples show a possible time order in which the entries of the table are created. Note that a given  
1311 implementation of the same example topology could have the entries populated in a different order. For  
1312 example, if there are two bus owners connected to a bridge, there is no fixed order that the bus owners  
1313 would be required to initialize a downstream bridge. Additionally, there is no requirement that bus owners  
1314 perform EID assignment or EID pool allocation in a particular order. One implementation may elect to  
1315 allocate EID pools to individual bridges right after it has assigned the bridge its EID. Another  
1316 implementation may elect to assign all the EIDs to devices first, and then allocate the EID pools to  
1317 bridges.

1318 **7.20.1 Example 1: Bridge D2 with an EID per "Owned" Port**

1319 Figure 9 shows the routing table in a bridge (D2), where D2 has an EID associated with each bus  
 1320 connected to a bus owner. In this example, D1 is not implementing any internal bridging between its P1  
 1321 and P2. Consequently, EID2 cannot be reached by bridging through EID1 and vice versa (see Table 4).

1322 NOTE: If there was internal bridging, D1 would need to provide routing information that indicated that EID2 was  
 1323 reachable by going through EID1 and vice versa. In this case, D1 would provide routing information that EID range  
 1324 (EID1...EID2) would be accessed through D1P1a1 on SMBus and D1P1a2 on PCIe.

1325 **Key: D = device, P = port, a = physical address**



1326

1327

**Figure 9 – Example 1 Routing Topology**

1328

**Table 4 – Example 1 Routing Table for D2**

Time	EID	EID Access Port	Medium Type	Access Physical Address	Device/Entry Type	Entry Was Created and Populated By
↓	EID 3	P1	SMBus	D1P1a2	Bridge, Self	Self when EID was assigned by D1
	EID 4	P2	PCIe	D1P2a2	Bridge, Self	Self when EID was assigned by D1
	EID 5	P3	SMBus	D2P3a2	Endpoint	Self after D1 assigned EID pool (typically the entry will not be created until after the bridge D2 assigns EID 5 to D3)
	EID 6	P3	SMBus	D2P3a3	Endpoint	Self after D1 assigned EID pool (typically the entry will not be created until after the bridge D2 assigns EID 6 to D4)
	EID 7	P4	USB	D2P4a2	Endpoint	Self after D1 assigned EID pool (typically the entry will not be created until after the bridge D2 assigns EID 7 to D5)
	EID 1	P1	SMBus	D1P1a1	Bridge	D1 through Routing Information Update command
	EID 2	P2	PCIe	D1P2a1	Bridge	D1 through Routing Information Update command

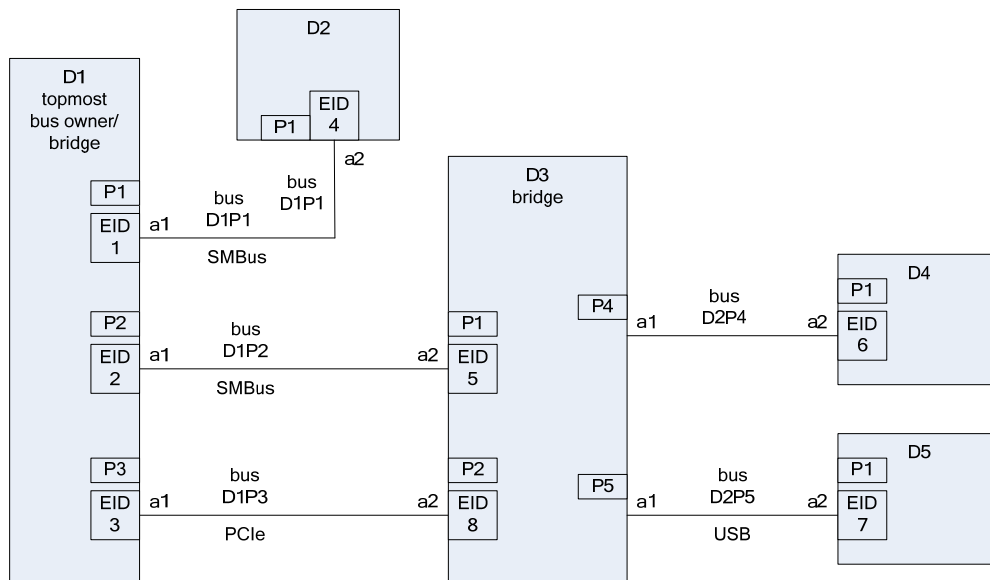
1329 **7.20.2 Example 2: Topmost Bus Owner D1**

1330 Figure 10 assumes the following:

- 1331 • D1 assigns its internal EIDs first.
- 1332 • The buses are handled in the order D1P1, D1P2, D1P3.
- 1333 • D1 allocates the EID pool to bridges right after it has assigned the EID to the device.

1334 Similar to Example 1 (see 7.20.1), this example assumes that there is no internal bridging within D1  
 1335 between P1, P2, and P3. This scenario is reflected in Table 5.

1336 **Key: D = device, P = port, a = physical address**



1337

1338

**Figure 10 – Example 2 Routing Topology**

1339

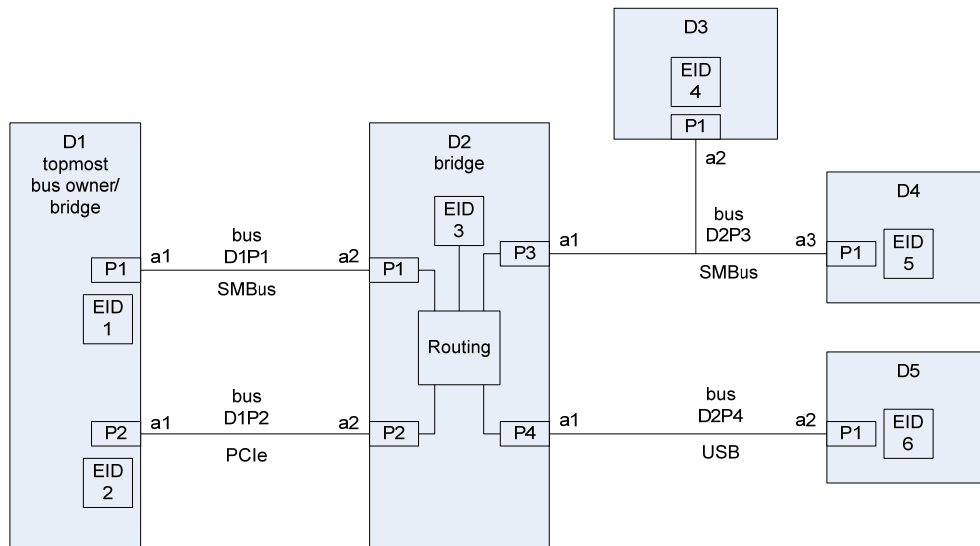
**Table 5 – Example 2 Routing Table for D1**

EID	EID Access Port	Medium Type	Access Physical Address	Device/Entry Type	Entry Was Created and Populated By
EID 1	P1	SMBus	D1P1a1	Bridge, self	Self
EID 2	P2	SMBus	D1P2a1	Bridge, self	Self
EID 3	P3	PCIe	D1P3a1	Bridge, self	Self
EID 4	P1	SMBus	D1P1a2	Endpoint	Self upon assigning EID to device D2
EID 5	P2	SMBus	D1P2a2	Bridge	Self upon assigning EID 5 to bridge D3
EID 6:7	P2	SMBus	D1P2a2	Bridge pool	Self upon assigning EID pool to bridge D3
EID 8	P3	PCIe	D1P3a2	Bridge	Self upon assigning EID 8 to bridge D3
EID 6:7	P3	PCIe	D1P3a2	Bridge pool	Self upon issuing an Allocate Endpoint IDs command and finding that bridge D3 already has an assigned pool, D1 creates this entry by extracting the EIDs for this entry from the response to the Allocate Endpoint IDs command

1340 **7.20.3 Example 3: Bridge D2 with Single EID**

1341 Figure 11 assumes that bridge D2 has a single EID and gets its EID assignment and EID allocation  
 1342 through bus D1P1 first, and that bus D1P2 later gets initialized. This scenario is reflected in Table 6.

1343 **Key: D = device, P = port, a = physical address**



1344

1345

**Figure 11 – Example 3 Routing Topology**

1346

**Table 6 – Example 3 Routing Table for D2**

Target EID	Target Endpoint Access Port	Target EID Access Physical Address	Device/Entry Type	Entry Was Created and Populated By
EID 3	P1	D1P1a2	Bridge, self	All four entries created by self (bridge) upon receiving initial EID assignment from D1 through P1
EID 3	P2	D1P2a2	Bridge, self	
EID 3	P3	D2P3a1	Bridge, self	
EID 3	P4	D2P4a1	Bridge, self	
EID 4	P3	D2P3a2	Endpoint	Self after D1 allocated EID pool (typically the entry will not be created until after the bridge D2 assigns EID 4 to D3)
EID 5	P3	D2P3a3	Endpoint	Self after D1 allocated EID pool (typically the entry will not be created until after the bridge D2 assigns EID 5 to D4)
EID 6	P3	D2P4a2	Endpoint	Self after D1 allocated EID pool (typically the entry will not be created until after the bridge D2 assigns EID 6 to D5)
EID 1:2	P1	D1P1a1	Bridge	D1 through Routing Information Update command
EID 1:2	P2	D1P2a1	Bridge	D1 through Routing Information Update command

1347 **7.20.4 Additional Information Tracked by Bridges**

1348 In addition to the information required to route messages between different ports, a bridge has to track  
 1349 information to handle MCTP control commands related to the configuration and operation of bridging  
 1350 (shown in Table 7).

1351 **Table 7 – Additional Information Tracked by Bridges**

What	Why
Which buses are connected to a bus owner	This information tells the bridge from which buses it should request EID assignment. This will typically be accomplished as a non-volatile configuration or hardware-strapping option for the bridge.
Which bus the bridge received its EID assignment through the Set Endpoint ID command	If the bridge uses a single EID that is shared across multiple "owned" buses, this information is used to track which bus the request came in on, so that the bridge can reject EID assignment requests from other buses.
Which bus it received the Routing Information Update command from for creating a particular routing table entry	This information is required so that if a future Routing Information Update command is received, the bridge will update only the entries corresponding to that bus.
Which bus it received its EID pool allocation from through the Allocate Endpoint IDs command	This information is used to track which bus the request came in on so that the bridge can reject EID pool allocations from other buses.
The physical medium and physical addressing format used for each port	This information is used to provide the correctly formatted response to commands such as Resolve Endpoint ID and for bridging MCTP packets between the different buses that the bridge supports. Because this is related to the physical ports and hardware of the bridge, this information will typically be "hard coded" into the bridge.

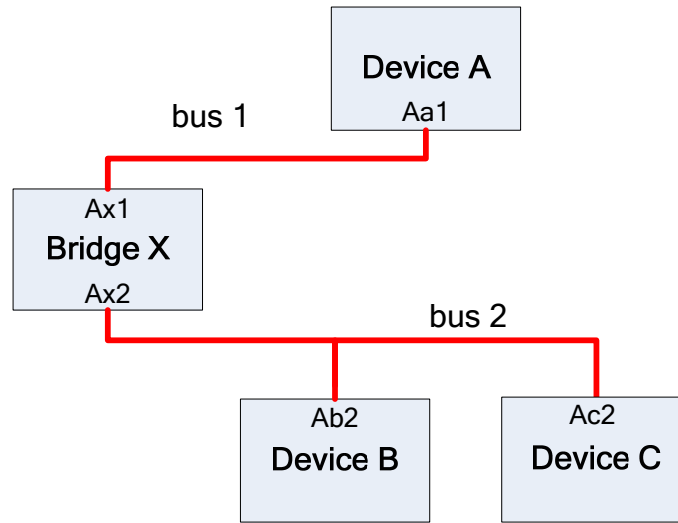
1352 **7.21 Endpoint ID Resolution**

1353 When a device uses the Resolve Endpoint ID command to request the resolution of a given endpoint to a  
 1354 physical address, the bridge shall respond based on which bus the request came in on.

1355 For example, consider Figure 12. If device A wishes to get the physical address needed to send a  
 1356 message to device C, it sends a Resolve Endpoint ID command to bus owner bridge X through address  
 1357 Ax1. Because device A shall go through bridge X to get to device C, bridge X responds with its physical  
 1358 address Ax1.

1359 When device B wishes to know the address to use to communicate with device C, it sends a Resolve  
 1360 Endpoint ID request to bridge X through address Ax2. In this case, bridge X can respond by giving device  
 1361 B the direct physical address of device C on bus 2, Ac2.

1362 Thus, the Resolve Endpoint ID command can return a different response based on the bus from which  
 1363 the Resolve Endpoint ID command was received.



notation:  
 Ab2 = physical Address of device b on bus 2.

1364

1365

**Figure 12 – Endpoint ID Resolution**

1366 **7.21.1 Resolving Multiple Paths**

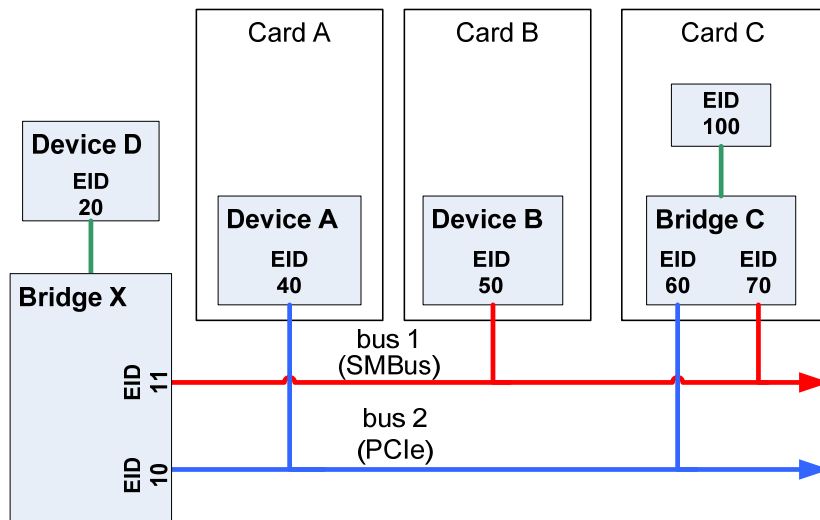
1367 Cases can occur where there can be more than one possible path to a given EID. A likely scenario is  
 1368 shown in Figure 13. In Figure 13, assume that the system topology supports cards that connect to either  
 1369 SMBus, PCIe, or both. Bridge X is the bus owner for both buses.

1370 NOTE: This is a logical representation of MCTP buses. Physically, the buses may be formed of multiple physical  
 1371 segments, as would be the case if one of the MCTP buses was built using PCIe.

1372 As shown, card C contains a bridge that connects to both buses. Thus, the device with EID 100 can be  
 1373 reached either from bus 1 or bus 2.

1374 If device D wishes to send a message to EID 100, bridge X can choose to route that message either  
 1375 through bus 1 or bus 2. MCTP does not have a requirement on how this is accomplished. The general  
 1376 recommendation is that the bridge preferentially selects the faster available medium. In this example, that  
 1377 would be PCIe.

1378 NOTE: There are possible topologies where that simple rule may not yield the preferred path to a device. However,  
 1379 in most common implementations in PC systems, this approach should be effective. A vendor making a bridge device  
 1380 may consider providing configuration options to enable alternative policies.



1381

1382

Figure 13 – Resolving Multiple Paths

## 1383 7.22 Bridge and Bus Owner Implementation Recommendations

1384 This clause provides recommendations on EID pool and routing table sizes for devices that implement  
1385 bridge and bus owner functionality.

### 1386 7.22.1 Endpoint ID Pool Recommendations

1387 The system design should seek to minimize the number of devices that need to allocate EID pools to hot-  
1388 plug devices or add-in cards. If feasible, the system design should have all busses that support hot-plug  
1389 devices/add-in cards owned by a single device.

1390 If only one device handles the hot-plug devices and add-in cards, it will be simpler for the system  
1391 integrator to configure devices and allocate EID pools. Because any other bridges in the system that do  
1392 not handle hot-plug devices only need to handle a fixed number of MCTP devices, it will be known at  
1393 design time how large an EID pool will be required. The remaining number of EIDs can then simply be  
1394 allocated to the single device that handles the hot-plug devices and add-in cards.

1395 To support this, it is recommended that devices that operate as bridges include a non-volatile  
1396 configuration option that enables the system integrator to configure the size of the EID pool they request.

### 1397 7.22.2 Routing Table Size Recommendations

1398 This clause provides some initial recommendations and approaches on how to determine what target  
1399 routing table entry support to provide in a device.

- 1400 • **PCIe slots**

1401 To provide entries to support devices that plug into PCIe slots, assume that each slot may  
1402 support both PCIe and SMBus endpoints and provide support for at least two endpoints per bus  
1403 type.

1404 This means providing support for at least four directly connected endpoints per card. (Other  
1405 endpoints may be behind bridges on the card, but this does not affect the routing table size for  
1406 the bus owner.) This implies at least four routing table entries per PCIe slot. Thus, a device that



1407 was designed to support system implementations with eight PCIe slots should have support for  
 1408 32 routing table entries.

1409 • **Planar PCIe devices**

1410 In most PC systems, PCIe would be typically implemented as a single MCTP bus owned by a  
 1411 single device as the bus owner. Thus, the number of static devices should be proportional to the  
 1412 number of PCIe devices that are built into the motherboard.

1413 Typically, this is fewer than eight devices. Thus it is recommended to support at least eight  
 1414 entries for static PCIe devices.

1415 • **Static SMBus MCTP devices**

1416 The routing table should also be sized to support an additional number of "static" devices on  
 1417 owned buses. At this time, it is considered unlikely that more than a few MCTP devices would  
 1418 be used on a given SMBus. Most devices would be non-intelligent sensor and I/O devices  
 1419 instead. Conservatively, it is recommended that at least four entries be provided for each  
 1420 SMBus that the device owns.

1421 Example 1: "client" capable device

1422	Four PCIe slots	→ 16 routing table entries
1423	Two owned SMBus	→ +8 entries
1424	<u>Static PCIe device support</u>	<u>→ +8 entries</u>
1425		~32 entries or more

1426 Example 2: volume server capable

1427	Eight PCIe slots	→ 32 routing table entries
1428	Four owned SMBus	→ +16 entries
1429	<u>Static PCIe device support</u>	<u>→ +8 entries</u>
1430		~56 entries or more

1431 **7.23 Path and Transmission Unit Discovery**

1432 The transmission unit is defined as the size of the MCTP packet payload that is supported for use in  
 1433 MCTP message assembly for a given message. The supported transmission unit sizes are allowed to  
 1434 vary on a per-message type basis.

1435 Intermediate bridges and physical media can limit the transmission unit sizes between endpoints.  
 1436 Therefore, the MCTP control protocol specifies a mechanism for discovering the transmission unit support  
 1437 for the path between endpoints when one or more bridges exist in the path between the endpoints.

1438 The mechanism for path transmission unit discovery also enables the discovery of the bridges and  
 1439 number of "hops" that are used to route an MCTP packet from one endpoint to another.

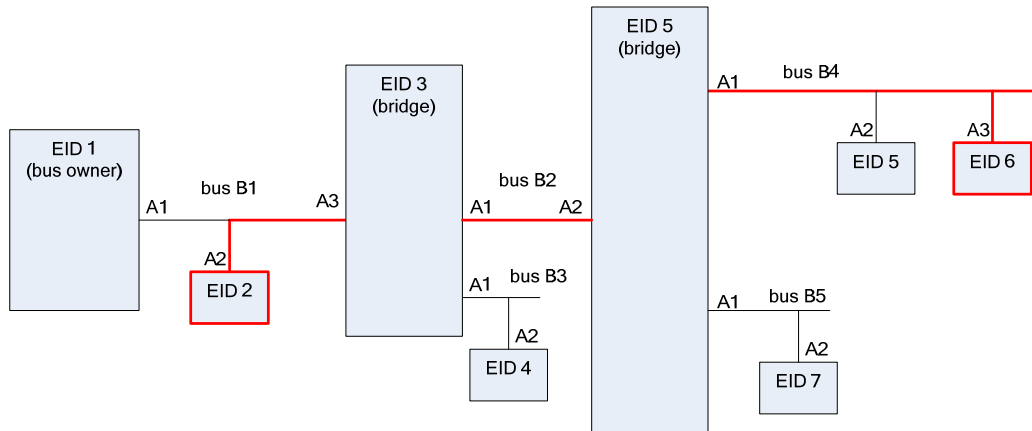
1440 **7.23.1 Path Transmission Unit Negotiation**

1441 The MCTP control protocol only specifies how to discover what the path transmission unit size is for the  
 1442 path between endpoints. The MCTP control protocol does not specify a generic mechanism for  
 1443 discovering what transmission unit sizes a particular endpoint supports for a given message type.  
 1444 Discovery and negotiation of transmission unit sizes for endpoints, if supported, is specified by the  
 1445 definition of the particular message type.

1446 **7.23.2 Path Transmission Unit Discovery Process Overview**

1447 This clause describes the process used for path transmission unit discovery. The discovery process  
 1448 described here is designed to enable one endpoint to discover the path and transmission unit support for

1449 accessing a particular "target" endpoint. It does not define a general mechanism for enabling an endpoint  
 1450 to discover the path between any two arbitrary endpoints. For example, referring to  
 1451 Figure 14, the process defines a way for the endpoint at EID 2 to discover the path/transmission unit  
 1452 support on the route to endpoint at EID 6, but this process does not define a process for EID 2 to discover  
 1453 the path/transmission unit support between EID 4 and EID 6.



1454

1455

**Figure 14 – Example Path Routing Topology**

1456 The following example provides an overview of the path/transmission unit discovery process. The  
 1457 example presumes that the MCTP network has already been initialized. Referring to  
 1458 Figure 14, the endpoint with EID 2 wishes to discover the path used to access the endpoint with EID 6.  
 1459 This discovery is accomplished using just two commands, Resolve Endpoint ID and Query Hop, as  
 1460 follows:

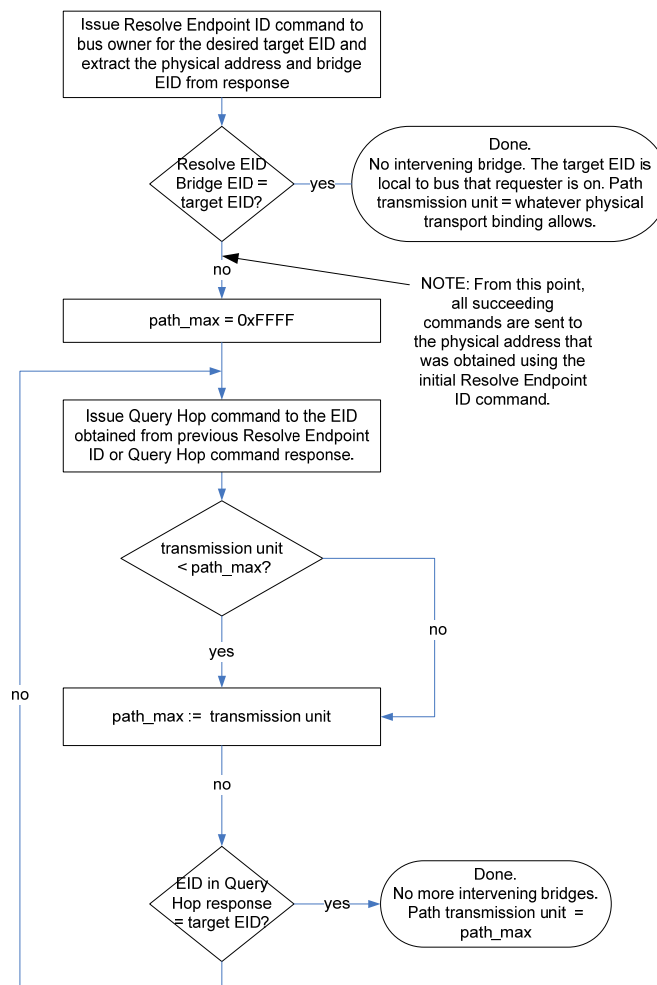
- 1461 1) EID 2 first issues a Resolve Endpoint ID command to the bus owner, EID 1, with EID 6 as the  
 1462 EID to resolve.
- 1463 2) EID 1 returns the physical address and EID of the bridge, EID 3 in the Resolve Endpoint ID  
 1464 command response.
- 1465 3) EID 2 queries the bridge, EID 3, using a Query Hop command with EID 6 (the "target" EID) as  
 1466 the request parameter. Note that EID 2 does not need to do another Resolve Endpoint ID  
 1467 command because it already received the physical address of EID 3 from the original Resolve  
 1468 Endpoint ID command.
- 1469 4) Bridge EID 3 responds to the Query Hop command by returning EID 5, which is the EID of the  
 1470 next bridge required to access EID 6. The bridge EID 3 also returns the transmission unit  
 1471 support that it offers for routing to the target EID.
- 1472 5) EID 2 then sends a Query Hop command to the bridge at EID 5. Note that EID 2 does not need  
 1473 to do another Resolve Endpoint ID command because it already received the physical address  
 1474 of EID 5 from the original Resolve Endpoint ID command.
- 1475 6) Bridge EID 5 responds to the Query Hop command by returning EID 6, which, because it is the  
 1476 EID of the target endpoint, tells EID2 that bridge EID 5 was the last "hop" in the path to EID 6.  
 1477 The bridge EID 5 also returns the transmission unit support that it offers for routing to the target  
 1478 EID.
- 1479 7) At this point, the bridges in the path to EID 6 have subsequently been discovered and their  
 1480 respective transmission unit support returned. The effective transmission unit support for the

1481 path to EID 6 will be the lesser of the transmission unit support values returned by the two  
 1482 bridges.

1483 **7.23.3 Path Transmission Unit Discovery Process Flowchart**

1484 Figure 15 shows a generic algorithm for discovering the bridges in the path from one endpoint to a given  
 1485 target endpoint and the path transmission unit support. The flowchart has been intentionally simplified.  
 1486 Note that while the Query Hop command actually supports returning separate transmission unit sizes for  
 1487 the transmit and receive paths, the flowchart is simplified for illustration purposes and just refers to a  
 1488 single transmission unit for both transmit and receive.

1489 Additionally, Figure 15 does not show any explicit steps for error handling nor the process of handling  
 1490 command retries. In general, errors are most likely due to either an invalid EID being sent to the bridge  
 1491 (perhaps due to a programming error at the requester) or the EID not being present in the bridge's routing  
 1492 table. The latter condition could occur under normal operation if the requester did not realize that a  
 1493 routing table update had occurred because of a hot-plug update, for example. This error condition would  
 1494 be indicated by the bridge responding with an `ERROR_INVALID_DATA` completion code.



1495

1496 **Figure 15 – Path Transmission Unit Discovery Flowchart**

## 1497 7.24 Path Transmission Unit Requirements for Bridges

1498 An MCTP bridge routes packets between different buses, but it does not typically interpret the packet  
 1499 payload contents nor does it do assembly of those packets. Exceptions to this are when the bridge is  
 1500 handling packets addressed to its own EID, receives a Broadcast EID, and if the bridge supports different  
 1501 transmission units based on message type. See Table 31 for more information.

## 1502 8 MCTP Control Protocol

1503 MCTP control messages are used for the setup and initialization of MCTP communications within an  
 1504 MCTP network. This clause defines the protocol and formatting used for MCTP control messages over  
 1505 MCTP.

### 1506 8.1 Terminology

1507 The terms shown in Table 8 are used when describing the MCTP control protocol.

1508 **Table 8 – MCTP Control Protocol Terminology**

Term	Description
Requester	The term "requester" is used to refer to the endpoint that originates an MCTP control Request message.
Responder	The term "responder" is used to refer to the endpoint that originates an MCTP control response message (that is, an endpoint that returns the response to an MCTP control Request message).
Originator or Source	The term "originator" or "source" is used to refer to the endpoint that originates any MCTP control message: Request, Response, or Datagram.
Target or Destination	The term "target" or "destination" is used to refer to the endpoint that is the intended recipient of any MCTP control message: Request, Response, or Datagram.
Asynchronous Notification	The term "asynchronous notification" is used to refer to the condition when an MCTP endpoint issues an un-requested Datagram to another MCTP endpoint.
Broadcast	The term "broadcast" is used when an MCTP control Datagram is sent out onto the bus using the broadcast EID.

### 1509 8.1.1 Control Message Classes

1510 The different types of messages shown in Table 9 are used under the MCTP control message type.

1511 **Table 9 – MCTP Control Message Types**

Type	Description
Request	This class of control message requests that an endpoint perform a specific MCTP control operation. All MCTP control Request messages are acknowledged with a corresponding Response message. (Within this specification, the term "command" and "request" are used interchangeably as shorthand to refer to MCTP control Request messages.)
Response	This class of MCTP control message is sent in response to an MCTP control Request message. The message includes a "Completion Code" field that indicates whether the response completed normally. The response can also return additional data dependent on the particular MCTP control Request that was issued.

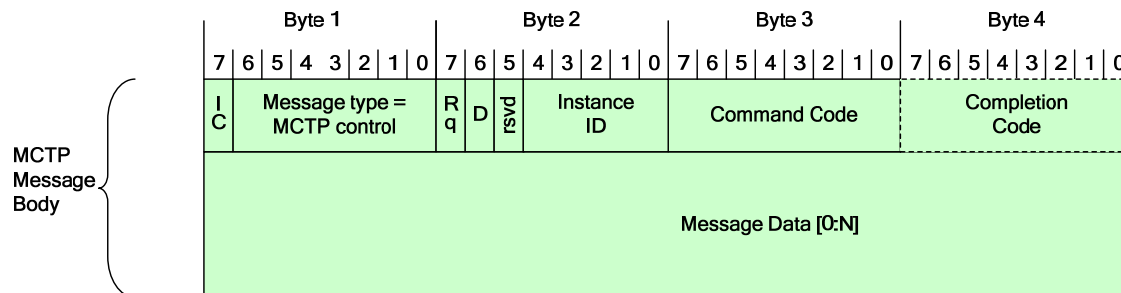
Type	Description
Datagram	Datagrams are "unacknowledged" messages (that is, Datagrams do not have corresponding Response messages). This class of MCTP control message is used to transfer messages when an MCTP control Response message is neither required nor desirable.
Broadcast Request	A broadcast message is a special type of Request that is targeted to all endpoints on a given bus. All endpoints that receive the message are expected to interpret the Request.
Broadcast Datagram	A Datagram that is broadcast to all endpoints on the bus. Broadcast Datagrams are "unacknowledged" messages (that is, broadcast Datagrams do not have corresponding Response messages).

1512 **8.2 MCTP Control Message Format**

1513 MCTP control messages use the MCTP control message type (see Table 3). Any message sent with this  
 1514 message type will correspond to the definitions set forth in this clause. The basic format of an MCTP  
 1515 control message is shown in Figure 16. Note that the byte offsets shown in Figure 16 are relative to the  
 1516 start of the MCTP message body rather than the start of the physical packet.

1517 **8.2.1 Use of Message Integrity Check**

1518 MCTP control messages do not use a Message Integrity Check field. Therefore, the IC bit in MCTP  
 1519 control messages shall always be 0b.



1520

1521 **Figure 16 – MCTP Control Message Format**

1522 **8.3 MCTP Control Message Fields**

1523 Table 10 lists the common fields for MCTP control messages.

1524 **Table 10 – MCTP Control Message Fields**

Field Name	Description
IC*	Message Integrity Check bit = 0b. MCTP control messages do not include an overall Message Integrity check field.
Message Type*	MCTP control = 0x00 (000_0000b). This field identifies the MCTP message as being an MCTP control message.
Rq bit	Request bit. This bit is used to help differentiate between MCTP control Request messages and other message classes. Refer to 8.5.

Field Name	Description
D-bit	Datagram bit. This bit is used to indicate whether the Instance ID field is being used for tracking and matching requests and responses, or is just being used to identify a retransmitted message. Refer to 8.5.
Instance ID	The Instance ID field is used to identify new instances of an MCTP control Request or Datagram to differentiate new requests or datagrams that are sent to a given message terminus from retried messages that are sent to the same message terminus. The Instance ID field is also used to match up a particular instance of an MCTP Response message with the corresponding instance of an MCTP Request message.
Command Code	For Request messages, this field is a command code indicating the type of MCTP operation the packet is requesting. Command code values are defined in Table 12. The format and definition of request and response parameters for the commands is given in Clause 9. The Command Code that is sent in a Request shall be returned in the corresponding Response.
Completion Code	This field is only present in Response messages. This field contains a value that indicates whether the response completed normally. If the command did not complete normally, the value can provide additional information regarding the error condition. The values for completion codes are specified in Table 13.
Message Data	Zero or more bytes of parameter data that is specific to the particular Command Code and whether the message is a Request or Datagram, or a Response.
* These fields are MCTP base protocol fields.	

#### 1525 8.4 MCTP Control Message Transmission Unit Size

1526 All MCTP control messages are required to have a packet payload that is no larger than the baseline  
1527 transmission unit size of 64 bytes.

1528 MCTP control messages are carried in a single MCTP packet. Multiple messages are used if an operation  
1529 requires more data to be transferred than can be carried in a single message.

#### 1530 8.5 Tag Owner (TO), Request (Rq), and Datagram (D) Bit Usage

1531 For MCTP control messages, the Rq bit is set to 1b if the message is a "command" or Request message  
1532 and 0b if the message is a Response message. For Datagram and Broadcast messages, the Rq bit is  
1533 always 1b.

1534 For the present specification, Requests and Datagrams are required to be issued from tag owners  
1535 (TO bit = 1b). Provision has been left for the definition of possible future Datagrams that are not issued  
1536 from tag owners (see Table 11).

1537 **Table 11 – Tag Owner (TO), Request (Rq) and Datagram (D) Bit Usage**

MCTP Control Message Class	Destination EID Value	Tag Owner (TO) bit	Request (Rq) bit	Datagram (D) bit
Command/Request Responses are expected and tracked by Instance ID at the requester.	Target EID	1b	1b	0b
Response	Target EID	0b	0b	0b

MCTP Control Message Class	Destination EID Value	Tag Owner (TO) bit	Request (Rq) bit	Datagram (D) bit
Broadcast Request Responses are expected and tracked by Instance ID at the requester.	Broadcast EID	1b	1b	0b
Datagram Unacknowledged Request – Responses are neither expected nor tracked by Instance ID at the requester. Duplicate packets are handled the same as retried Command/Request packets.	Target EID	1b	1b	1b
Broadcast Datagram (unacknowledged control command that is broadcast.)	Broadcast EID	1b	1b	1b
Reserved for future definition	all other			

1538 **8.6 Concurrent Command Processing**

1539 This clause describes the specifications and requirements for handling concurrent overlapping MCTP  
1540 control requests by endpoints.

1541 **8.6.1 Requirements for Responders**

1542 An endpoint is not required to process more than one request at a time (that is, it can be "single threaded"  
1543 and does not have to accept and act on new requests until it has finished responding to any previous  
1544 request).

1545 A responder that is not ready to accept a new request can either silently discard the request, or it can  
1546 respond with an `ERROR_NOT_READY` message completion code.

1547 **8.6.2 Requirements for Requesters**

1548 An endpoint that issues MCTP control Requests to another endpoint shall wait until it gets the response  
1549 to the particular request, or times out waiting for the response, before issuing a new request, Datagram,  
1550 or Broadcast Datagram.

1551 An endpoint that issues MCTP control Requests is allowed to have multiple requests outstanding  
1552 simultaneously to *different* responder endpoints.

1553 An endpoint that issues MCTP control Requests should be prepared to handle responses that may not  
1554 match the request (that is, it should not automatically assume that a response that it receives is for a  
1555 particular request). It should check to see that the command code and source EID values in the response  
1556 match up with a corresponding outstanding command before acting on any parameters returned in the  
1557 response.

1558 **8.6.3 Additional Requirements for Bridges**

1559 The packets that are routed *through* a bridge's routing functionality are not interpreted by the bridge and  
1560 therefore are not considered to constitute concurrent requests.

1561 A bridge shall support at least one outstanding MCTP control request for each bus connection (port)  
1562 through which MCTP control messages can be used to access the bridge's configuration and control  
1563 functionality.

1564 Bridges shall retain temporal ordering of packets forwarded from one message terminus to another.

## 1565 9 MCTP Control Messages

1566 This clause contains detailed descriptions for each MCTP control message. The byte offsets for the  
1567 Request and Response parameter information given in the tables for the commands indicates the byte  
1568 offset for the message data starting with the byte following the Command field.

### 1569 9.1 MCTP Control Message Command Codes

1570 Table 12 lists the MCTP control messages and their corresponding command code values. The  
1571 commands and their associated parameters are specified later in this clause. For bridges, the  
1572 requirements apply equally to all endpoints within the bridge device that are used to configure and control  
1573 the bridges routing functionality.

1574 **Table 12 – MCTP Control Command Numbers**

Command Code	Command Name	General Description	OMC		Clause
			E	B	
0x00	Reserved	Reserved	–	–	–
0x01	Set Endpoint ID	Assigns an EID to the endpoint at the given physical address	Ma Ng	Ca <sup>1</sup> Mg	9.3
0x02	Get Endpoint ID	Returns the EID presently assigned to an endpoint. Also returns information about what type the endpoint is and its level of use of static EIDs.	Ma Og	Ma Og	9.4
0x03	Get Endpoint UUID	Retrieves a per-device unique UUID associated with the endpoint	Ca <sup>2</sup> Og	Ca <sup>2</sup> Og	9.5
0x04	Get MCTP Version Support	Lists which versions of the MCTP control protocol are supported on an endpoint	Ma Og	Ma Og <sup>5</sup>	9.6
0x05	Get Message Type Support	Lists the message types that an endpoint supports	Ma Og	Ma Og	9.7
0x06	Get Vendor Defined Message Support	Used to discover an MCTP endpoint's vendor-specific MCTP extensions and capabilities	Oa Og	Oa Og	9.8
0x07	Resolve Endpoint ID	Used to get the physical address associated with a given EID	Na Og	Ma Og	9.9
0x08	Allocate Endpoint IDs	Used by the bus owner to allocate a pool of EIDs to an MCTP bridge	Na Ng	Ma <sup>6</sup> Mg <sup>6</sup>	9.10
0x09	Routing Information Update	Used by the bus owner to extend or update the routing information that is maintained by an MCTP bridge	Na Ng	Ma <sup>4</sup> Mg <sup>4</sup>	9.11
0x0A	Get Routing Table Entries	Used to request an MCTP bridge to return data corresponding to its present routing table entries	Na Og	Ma Og	9.12
0x0B	Prepare for Endpoint Discovery	Used to direct endpoints to clear their "discovered" flags to enable them to respond to the Endpoint Discovery command	Ca <sup>3</sup> Ng	Ca <sup>3</sup> Cg <sup>3</sup>	9.13
0x0C	Endpoint Discovery	Used to discover MCTP-capable devices on a bus, provided that another discovery mechanism is not defined for the particular physical medium	Ca <sup>3</sup> Cg <sup>3</sup>	Ca <sup>3</sup> Cg <sup>3</sup>	9.14
0x0D	Discovery Notify	Used to notify the bus owner that an MCTP device has become available on the bus	Na Cg <sup>3</sup>	Ca <sup>3</sup> Cg <sup>3</sup>	9.15
0x0E	Reserved	Reserved	–	–	–



Command Code	Command Name	General Description	OMC		Clause
			E	B	
0x0F	Query Hop	Used to discover what bridges, if any, are in the path to a given target endpoint and what transmission unit sizes the bridges will pass for a given message type when routing to the target endpoint	Na Og	Ma Og	9.16
0xF0 – 0xFF	Transport Specific	This range of control command numbers is reserved for definition by individual MCTP Transport binding specifications. Transport specific commands are intended to be used as needed for setup and configuration of MCTP on a given media. A particular transport specific command number may have different definitions depending on the binding specification. Transport specific commands should not be bridged to different media.	-	-	9.17
<p><b>Key for OMC (optional / mandatory / conditional) column:</b></p> <p>E = non-bridge, non-bus owner endpoint (simple endpoint)                      B = bridge / bus-owner endpoint                      Ma = mandatory (required) to accept. The request shall be accepted by the endpoint and a response generated per the following command descriptions.                      Mg = mandatory to generate. The endpoint shall generate this request as part of its responsibilities for MCTP operation.                      Oa = optional to accept                      Og = optional to generate                      Ca = conditional to accept (see notes)                      Cg = conditional to generate (see notes)                      Na = not applicable to accept. This command is not applicable to the device type and shall not be accepted                      Ng = not applicable to generate. This command is used for MCTP configuration and initialization and should not be generated.</p>					
<ol style="list-style-type: none"> <li>1. The topmost bus owner is not required to support the Set Endpoint ID command.</li> <li>2. Hot-plug and add-in devices are required to support the Get Endpoint UUID command.</li> <li>3. Mandatory on a per-bus basis to support endpoint discovery if required by the physical transport binding used for the particular bus type. Refer to the appropriate MCTP physical transport binding specification.</li> <li>4. The topmost bus owner is not required to accept this command. The command is required to be generated when downstream bridges require dynamic routing information from bus owners that they are connected to. Some implementations may be configured where all routing information has been statically configured into the bridge and no dynamically provided information is required, In this case, it is not required to support the command while the endpoints are configured in that manner.</li> <li>5. Bridges should use this command to verify that they are initializing devices that are compatible with their MCTP control protocol version.</li> <li>6. The endpoint is required to accept this command if it indicated support for a dynamic EID pool. The command shall be generated by the endpoint if the configuration requires the endpoint to support allocating EID pools to downstream bridges.</li> </ol>					

1575 **9.2 MCTP Control Message Completion Codes**

1576 The command/result code field is used to return management operation results for response messages. If  
 1577 a `SUCCESS` completion code is returned then the specified response parameters (if any) shall also be  
 1578 returned in the response. If an error completion code is received (not `SUCCESS`) an MCTP endpoint  
 1579 receives an error completion code, unless otherwise specified, the responder shall not return any  
 1580 additional parametric data and the requester shall ignore any additional parameter data provided in the  
 1581 response (if any). See Table 13 for the completion codes.

1582

Table 13 – MCTP Control Message Completion Codes

Value	Name	Description
0x00	SUCCESS	The Request was accepted and completed normally.
0x01	ERROR	This is a generic failure message. (It should not be used when a more specific result code applies.)
0x02	ERROR_INVALID_DATA	The packet payload contained invalid data or an illegal parameter value.
0x03	ERROR_INVALID_LENGTH	The message length was invalid. (The Message body was larger or smaller than expected for the particular request.)
0x04	ERROR_NOT_READY	The Receiver is in a transient state where it is not ready to receive the corresponding message.
0x05	ERROR_UNSUPPORTED_CMD	The command field in the control type of the received message is unspecified or not supported on this endpoint. This completion code shall be returned for any unsupported command values received in MCTP control Request messages.
0x80– 0xFF	COMMAND_SPECIFIC	This range of completion code values is reserved for values that are specific to a particular MCTP control message. The particular values (if any) and their definition is provided in the specification for the particular command.
all other	Reserved	Reserved

### 1583 9.3 Set Endpoint ID

1584 The Set Endpoint ID command assigns an EID to an endpoint. This command is typically issued only by a  
 1585 bus owner to assign an EID to an endpoint at a particular physical address. Thus, the destination EID in  
 1586 the message will typically be set to the special null destination EID value.

1587 An MCTP bridge may elect to have a single EID for its functionality, rather than using an EID for each port  
 1588 (bus connection) that is connected to a different bus owner. See 7.19.2 for more information. In this case,  
 1589 the bridge will accept its EID assignment from the "first" bus to deliver the Set Endpoint ID request to the  
 1590 bridge.

1591 It is recognized that different internal processing delays within a bridge can cause the temporal ordering  
 1592 of requests to be switched if overlapping requests are received over more than one bus. Therefore, which  
 1593 request is accepted by an implementation is not necessarily tied to the request that is first received at the  
 1594 bridge, but instead will be based on which request is the first to be processed by the bridge.

1595 If an EID has already been assigned and the Set Endpoint ID command is issued from a different bus  
 1596 without forcing an EID assignment, the command shall return a `SUCCESSFUL` completion code, but the  
 1597 response parameters shall return an EID assignment status of "EID rejected".

1598 The Set Endpoint ID command functions in the same manner regardless of whether the endpoint uses a  
 1599 static EID. The only difference is that if an endpoint has a static EID, it uses that EID as its initial "default"  
 1600 EID value. The endpoint does not treat this initial EID as if it were assigned to it by a different bus owner.  
 1601 That is, the endpoint shall accept the EID assignment from the first bus that the command is received  
 1602 from, and shall track that bus as the originating bus for the EID for subsequent instances of Set Endpoint  
 1603 ID command. See 7.17.2 for more information. The request and response parameters are specified in  
 1604 Table 14.

1605

**Table 14 – Set Endpoint ID Message**

	Byte	Description
Request data	1	<p>Operation</p> <p>[7:3] – reserved</p> <p>[1:0] – Operation:</p> <p>00b Set EID. Submit an EID for assignment. The given EID will be accepted conditional upon which bus the device received the EID from (see preceding text). A device where the endpoint is only reached through one bus shall always accept this operation (provided the EID value is legal).</p> <p>01b Force EID. Force EID assignment. The given EID will be accepted regardless of whether the EID was already assigned through another bus. Note that if the endpoint is forcing, the EID assignment changes which bus is being tracked as the originator of the Set Endpoint ID command. A device where the endpoint is only reached through one bus shall always accept this operation (provided the EID value is legal), in which case the Set EID and Force EID operations are equivalent.</p> <p>10b Reset EID (optional). This option only applies to endpoints that support static EIDs. If supported, the endpoint shall set the EID to the statically configured EID value. The EID value in byte 2 shall be ignored. An <code>ERROR_INVALID_DATA</code> completion code shall be returned if this operation is not supported.</p> <p>11b Set Discovered Flag. Set Discovered flag to the "discovered" state only. Do not change present EID setting. The EID value in byte 2 shall be ignored. Note that Discovered flag is only used for some physical transport bindings. An <code>ERROR_INVALID_DATA</code> completion code shall be returned if this operation is selected and the particular transport binding does not support a Discovered flag.</p>
	2	<p>Endpoint ID.</p> <p>0xFF, 0x00 = illegal. Endpoints are not allowed to be assigned the broadcast or null EIDs. It is recommended that the endpoint return an <code>ERROR_INVALID_DATA</code> completion code if it receives either of these values.</p>
Response data	1	Completion code
	2	<p>[7:6] – reserved</p> <p>[5:4] – EID assignment status:</p> <p>00b = EID assignment accepted.</p> <p>01b = EID assignment rejected. EID has already been assigned by another bus owner and assignment was not forced.</p> <p>10b = reserved.</p> <p>11b = reserved.</p> <p>[3:2] – reserved.</p> <p>[1:0] – Endpoint ID allocation status (see 9.10 for additional information):</p> <p>00b = Device does not use an EID pool.</p> <p>01b = Endpoint requires EID pool allocation.</p>

	Byte	Description
		10b = Endpoint uses an EID pool and has already received an allocation for that pool.  11b = reserved
	3	EID Setting.  If the EID setting was accepted, this value will match the EID passed in the request. Otherwise, this value returns the present EID setting.
	4	EID Pool Size.  This is the size of the dynamic EID pool that the bridge can use to assign EIDs or EID pools to other endpoints or bridges. It does not include the count of any additional static EIDs that the bridge may maintain. See 7.17.2 for more information. Note that a bridge always returns its pool size regardless of whether it has already received an allocation.  0x00 = no dynamic EID pool.

#### 1606 9.4 Get Endpoint ID

1607 The Get Endpoint ID command returns the EID for an endpoint. This command is typically issued only by  
 1608 a bus owner to retrieve the EID that was assigned to a particular physical address. Thus, the destination  
 1609 EID in the message will typically be set to the special Physical Addressing Only EID value. The request  
 1610 and response parameters are specified in Table 15.

1611 **Table 15 – Get Endpoint ID Message**

	Byte	Description
Request data	–	–
Response data	1	Completion Code.
	2	Endpoint ID.  0x00 = EID not yet assigned.
	3	Endpoint Type.  [7:6] = reserved  [5:4] = Endpoint Type:  00b = simple endpoint 01b = bus owner/bridge 10b = reserved 11b = reserved  [2:0] = reserved  [1:0] = Endpoint ID Type:  00b = dynamic EID.  The endpoint uses a dynamic EID only.  01b = static EID supported.  The endpoint was configured with a static EID. The EID returned by this command reflects the present setting and may or may not match the static EID value.

	Byte	Description
		<p>The following two status return values are optional. If provided, they shall be supported as a pair in place of the static EID support status return. It is recommended that this be implemented if the Reset EID option in the Set Endpoint ID command is supported.</p> <p>10b = static EID supported.</p> <p>Present EID matches static EID.</p> <p>The endpoint has been configured with a static EID. The present value is the same as the static value.</p> <p>11b = static EID supported. Present EID does not match static EID. Endpoint has been configured with a static EID. The present value is different than the static value.</p> <p>See 7.17.2 for more information.</p>
	4	<p>Medium-Specific Information.</p> <p>This byte can hold additional information about optional configuration of the endpoint on the given medium, such as whether certain types of timing or arbitration are supported. This should only be used to report static information.</p> <p>This byte shall be returned as 0x00 unless otherwise specified by the transport binding.</p>

1612 **9.5 Get Endpoint UUID Command**

1613 The Get Endpoint UUID command returns a universally unique identifier (UUID), also referred to as a  
 1614 globally unique ID (GUID), for the management controller or management device. The command can be  
 1615 used to correlate a device with one or more EIDs. The format of the ID follows the byte (octet) format  
 1616 specified in [RFC4122](#). [RFC4122](#) specifies four different versions of UUID formats and generation  
 1617 algorithms suitable for use for a device UUID in MCTP. These are version 1 (0001b) "time based", and  
 1618 three "name-based" versions: version 3 (0011b) "MD5 hash", version 4 (0100b) "Pseudo-random", and  
 1619 version 5 "SHA1 hash". The version 1 format is recommended. However, versions 3, 4, or 5 formats are  
 1620 also allowed. A device UUID should never change over the lifetime of the device. The request and  
 1621 response parameters are specified in Table 16.

1622 **Table 16 – Get Device UUID Message Format**

	Byte	Description
Request data	–	–
Response data	1	Completion Code
	2:17	UUID bytes 1:16, respectively (see Table 17)

1623 The individual fields within the UUID are stored most-significant byte (MSB) first per the convention  
 1624 described in [RFC4122](#). See Table 17 for an example format.

1625

Table 17 – Example UUID Format

Field	UUID Byte	MSB
time low	1	MSB
	2	
	3	
	4	
time mid	5	MSB
	6	
time high and version	7	MSB
	8	
clock seq and reserved	9	MSB
	10	
node	11	MSB
	12	
	13	
	14	
	15	
	16	

## 1626 9.6 Get MCTP Version Support

1627 This command can be used to retrieve the MCTP base specification versions that the endpoint supports,  
 1628 and also the message type specification versions supported for each message type. The format of the  
 1629 request and response parameters for this message is given in Table 18.

1630 More than one version number can be returned for a given message type by the Get MCTP Version  
 1631 Support command. This enables the command to be used for reporting different levels of compatibility  
 1632 and backward compatibility with different specification versions. The individual specifications for the given  
 1633 message type define the requirements for which versions number values should be used for that  
 1634 message type. Those documents define which earlier version numbers, if any, shall also be listed.

1635 The command returns a completion code that indicates whether the message type number passed in the  
 1636 request is supported or not. This enables the command to also be used to query the endpoint for whether  
 1637 it supports a given message type.

1638

Table 18 – Get MCTP Version Support Message

	Byte	Description
Request data	1	Message Type Number The Message Type Number to retrieve version information for: 0xFF = return MCTP base specification version information. 0x00 = return MCTP control protocol message version information. other = return version information for a given message type. See <a href="#">MCTP ID</a> and Table 3 for message type numbers.

	Byte	Description
Response data	1	Completion Code 0x80 = message type number not supported
	2	Version Number Entry count One-based count of 32-bit version numbers being returned in this response. Numerically lower version numbers are returned first.
	3:6	Version Number entry 1: [31:24] = major version number [23:16] = minor version number [15:8] = update version number [7:0] = "alpha" byte The encoding of the version number and alpha fields is provided in 9.6.1.
	(7:X)	Version Number Entries 2 through N. Additional 32-bit major/minor version numbers, if any.

1639 **9.6.1 Version Field Encoding**

1640 The version field is comprised of four bytes referred to as the "major", "minor", "update", and "alpha"  
1641 bytes. These bytes shall be encoded as follows:

1642 The "major", "minor", and "update" bytes are BCD-encoded, and each byte holds two BCD digits. The  
1643 "alpha" byte holds an optional alphanumeric character extension that is encoded using the ISO/IEC 8859-  
1644 1 Character Set. The semantics of these fields are specified in [DSP4004](#).

1645 The value 0x00 in the alpha field means that the alpha field is not used. Software or utilities that display  
1646 the version number should not display any characters for this field.

1647 The value 0xF in the most-significant nibble of a BCD-encoded value indicates that the most-significant  
1648 nibble should be ignored and the overall field treated as a single-digit value. Software or utilities that  
1649 display the number should only display a single digit and should not put in a leading "0" when displaying  
1650 the number.

1651 A value of 0xFF in the "update" field indicates that the entire field is not present. 0xFF is not allowed as a  
1652 value for the "major" or "minor" fields. Software or utilities that display the version number should not  
1653 display any characters for this field.

1654 EXAMPLE:

1655 Version 3.7.10a → 0xF3F71061

1656 Version 10.01.7 → 0x1001F700

1657 Version 3.1 → 0xF3F1FF00

1658 Version 1.0a → 0xF1F0FF61

1659 **9.6.2 MCTP Base Specification Version Number**

1660 The version of the MCTP base specification for this specification shall be:

1661 **1.0** [Major version 1, minor version 0, no update version number, no alpha]

1662 This is reported using the encoding as: 0xF1F0FF00

### 1663 9.6.3 MCTP Control Message Type Version Number

1664 The version of the MCTP control protocol message type for this specification shall be:

1665 **1.0** [Major version 1, minor version 0, no update version number, no alpha]

1666 This is reported using the encoding as: 0xF1F0FF00

## 1667 9.7 Get Message Type Support

1668 The Get Message Type Support command enables management controllers to discover the MCTP  
1669 control protocol capabilities supported by other MCTP endpoints, and get a list of the MCTP message  
1670 types that are supported by the endpoint. The request and response parameters for this message are  
1671 listed in Table 19.

1672 The response to this command may be specific according to which bus the request was received over  
1673 (that is, a device that supports a given message type may not support that message type equally across  
1674 all buses that connect to the device).

1675 **Table 19 – Get Message Type Support Message**

	Byte	Description
Request data	–	–
Response data	1	Completion Code.
	2	MCTP Message Type Count. One-based. Number of message types in addition to the MCTP control message type that is supported by this endpoint
	(3:N)	List of Message Type numbers. One byte per number. See Table 3 and <a href="#">MCTP ID</a> .

## 1676 9.8 Get Vendor Defined Message Support

1677 The Get Vendor Defined Message Support operation enables management controllers to discover  
1678 whether the endpoint supports vendor-defined messages, and, if so, the vendors or organizations that  
1679 defined those messages. The format and definition of the request and response parameters for this  
1680 message is given in Table 20.

1681 **Table 20 – Get Vendor Defined Message Support Message**

	Byte	Description
Request data	1	Vendor ID Set Selector Indicates the specific capability set requested. Indices start at 0x00 and increase monotonically by 1. If the responding endpoint has one or more capability sets with indices greater than the requested index, it increments the requested index by 1 and returns the resulting value in the response message. The requesting endpoint uses the returned value to request the next capability set.
	1	Completion Code
Response data	1	Completion Code
	2	Vendor ID Set Selector 0xFF = no more capability sets.

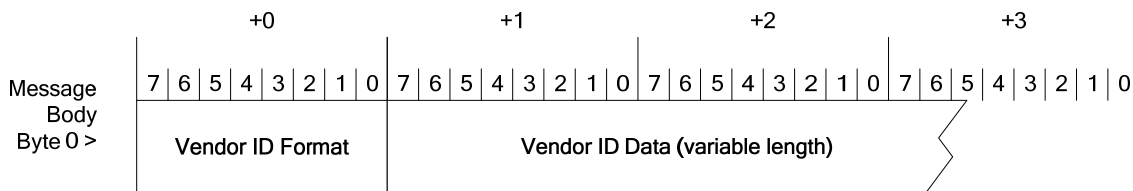


	Byte	Description
	var	Vendor ID A structured field of variable length that identifies the vendor ID format (presently PCI or IANA) and the ID of the vendor that defined the capability set. The structure of this field is specified in Figure 17.
	2 bytes	16-bit numeric value or bit field, as specified by the vendor or organization identified by the vendor ID. This value is typically used to identify a particular command set type or major version under the given vendor ID.

1682 **9.8.1 Vendor ID Formats**

1683 Figure 17 shows the general structure of Vendor ID fields used in this specification. The first byte of the  
 1684 field contains the Vendor ID Format, a numeric value that indicates the definition space and format of the  
 1685 ID. The remainder of the field holds the Vendor ID Data with content and format as specified in Table 21.

1686 The MCTP management controller or management device can pick which format is best suited for the  
 1687 device. In general, if the device does not already have an existing vendor ID that matches one of the  
 1688 specified formats, it is recommended that the IANA enterprise number format be used.



1689

1690 **Figure 17 – Structure of Vendor ID Field for Get Vendor Defined Capabilities Message**

1691

**Table 21 – Vendor ID Formats**

Vendor ID Format Name	Vendor ID Format	Vendor ID Data Length	Description
PCI Vendor ID	0x00	2	<b>16-bit Unsigned Integer.</b> The PCI 2.3 specifications state the following about the PCI vendor ID: "This field identifies the manufacturer of the device. Valid vendor identifiers are allocated by the PCI SIG to ensure uniqueness. 0xFFFF is an invalid value for the Vendor ID." However, for MCTP this value may be used for identifying aspects other than the manufacturer of the device, such as its use in the Vendor Defined - PCI message type, where it identifies the vendor or organization that defined a particular set of vendor-defined messages. Thus, in some uses, the ID may or may not correspond to the PCI ID for the manufacturer of the device.

Vendor ID Format Name	Vendor ID Format	Vendor ID Data Length	Description
IANA Enterprise Number	0x01	4	<b>32-bit Unsigned Integer.</b> The IANA enterprise number for the organization or vendor expressed as a 32-bit unsigned binary number. For example, the enterprise ID for the DMTF is 412 (decimal) or 0x0000_019C expressed as a 32-bit hexadecimal number. The enterprise number is assigned and maintained by the Internet Assigned Numbers Authority, www.iana.org, as a means of identifying a particular vendor, company, or organization.

## 1692 9.9 Resolve Endpoint ID

1693 This command is sent to the bus owner to resolve an EID into the physical address that shall be used to  
 1694 deliver MCTP messages to the target endpoint. The command takes an EID as an input parameter in the  
 1695 request and returns the EID and the physical address for routing to that EID (if any) in the response. The  
 1696 response data will also indicate if no mapping was available.

1697 An endpoint knows the physical address of the bus owner by keeping track of which physical address  
 1698 was used when the endpoint received its EID assignment through the Set Endpoint ID command. The  
 1699 endpoint can send this command to the bus owner using the null destination EID value. This eliminates  
 1700 the need for the endpoint to also keep track of the EID of the bus owner. The request and response  
 1701 parameters are specified in Table 22.

1702 **Table 22 – Resolve Endpoint ID Message**

	Byte	Description
Request data	1	Target Endpoint ID This is the EID that the bus owner is being asked to resolve.
Response data	1	Completion Code
	2	Bridge Endpoint ID This is the EID for the endpoint that is providing the bridging server (if any) that is required to access the target endpoint.  If the EID being returned matches the same value as the target EID, it indicates that there is no bridging function that is required to access the target endpoint (that is, the target EID is local to the bus that the Resolve Endpoint ID request was issued over).
	3:N	Physical Address. The size of this field is dependent on the particular MCTP physical transport binding used for the bus that this data is being provided for. The size and format of this field is defined as part of the corresponding physical transport binding specification.

## 1703 9.10 Allocate Endpoint IDs

1704 Bus owners are responsible for allocating pools of EIDs to MCTP bridges that are lower in the bus  
 1705 hierarchy. This is done using the Allocate Endpoint IDs command. The EID for the bridge itself is  
 1706 assigned separately and is *not* part of the pool given with this command.

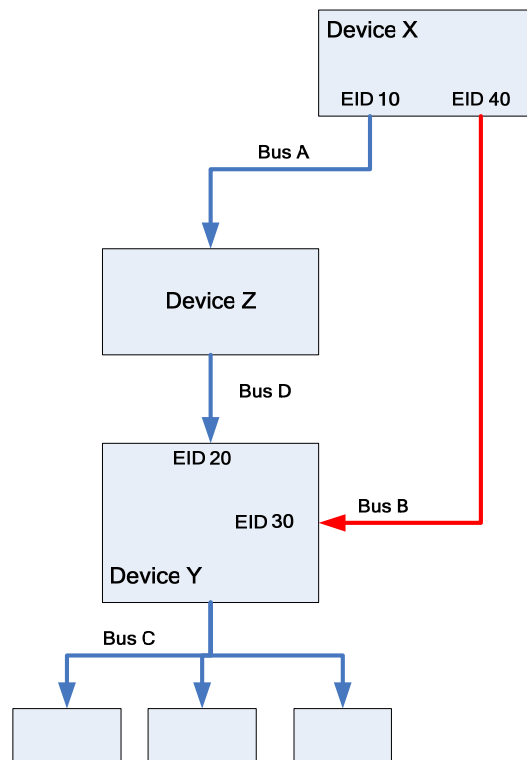
1707 The bus owner will typically use this command as part of the EID assignment process for a bus. When a  
 1708 device has been assigned an EID using the Set Endpoint ID command, the response to that command  
 1709 indicates whether the endpoint supports an EID pool. If the device indicates that it supports an EID pool,  
 1710 the bus owner can then issue the Allocate Endpoint IDs command to supply the pool of EIDs to the  
 1711 device.

1712 NOTE: The Allocate Endpoint IDs command can also cause a bridge to rebuild its routing table. See 9.11.2 for  
 1713 more information.

1714 When an EID or EID pool that was previously allocated becomes unused (for example, due to a hot-swap  
 1715 removal), the bus owner shall reclaim the endpoint's EID or EID pool allocation. See 7.17 for additional  
 1716 details.

1717 Referring to Figure 18, there is a potential race condition with handling EID allocation. In the scenario  
 1718 shown in this figure, it is possible that device X and device Z might both be assigning EIDs to device Y at  
 1719 the same time. This also means that, unless steps are taken, device Z could allocate endpoints to device  
 1720 Y only to have this overwritten by a set of endpoints assigned by device X.

1721 To prevent this, the Allocate Endpoint IDs command is only accepted from the "first" bus that provides the  
 1722 EID pool to the device. If another bus owner attempts to deliver an EID pool through another bus, the  
 1723 request will be rejected unless an intentional over-ride is done.



1724

1725

Figure 18 – EID Pools from Multiple Bus Owners

1726 The Allocate Endpoint IDs message fields are described in Table 23.

1727

**Table 23 – Allocate Endpoint IDs Message**

	Byte	Description
Request data	1	<p>Operation Flags:</p> <p>[7:1] – reserved.</p> <p>[1:0] – Operation:</p> <p>00b = allocate EIDs. Submit an EID pool allocation. Do not force allocation. This enables the allocation to be rejected if the bridge has already received its EID pool from another bus. (See additional information in the following clauses.)</p> <p>01b = Force allocation. Force bridge to accept this EID pool regardless of whether it has already received its EID pool from another bus. This shall also cause a bridge to rebuild its routing tables. See 9.11.2 for more information.</p> <p>10b = Get allocation information Return the response parameters without changing the present allocation. This can be used to query information on the dynamic pool of EIDs presently allocated to the Endpoint, if any. If this operation is selected, the Number of Endpoint IDs and Starting Endpoint ID parameters in the request shall be ignored.</p> <p>11b = Reserved</p>
	2	<p>Number of Endpoint IDs</p> <p>Specifies the number of EIDs in the pool being made available to this Endpoint</p>
	3	<p>Starting Endpoint ID</p> <p>Specifies the starting EID for the range of EIDs being allocated in the pool. When multiple EIDs are provided, the IDs are sequential starting with this value as the first EID in the range.</p>
Response data	1	<p>Completion Code</p> <p>An error completion code shall be returned if the number of EIDs assigned does not match the pool size. (This error condition does not apply to when the number of endpoint IDs passed in the request is 0xFF or 0x00.)</p>
	2	<p>[7:2] – reserved</p> <p>[1:0] – 00b = Allocation was accepted</p> <p>01b = Allocation was rejected. The Allocate Endpoint IDs command is accepted only from the "first" bus that provides the EID pool to the device. If another bus owner attempts to deliver an EID pool through another bus, the request will be rejected unless an intentional over-ride is done. (The rationale for this behavior is explained in the text of this clause.)</p> <p>10b, 11b = reserved</p>
	3	<p>Endpoint ID Pool Size</p> <p>This value is the size of the EID pool used by this endpoint. This is the size of the dynamic EID pool that the bridge can use to assign EIDs or EID pools to other endpoints or bridges. It does not include the count of any additional static EIDs that the bridge may maintain. See 7.17.2 for more information.</p>
	4	<p>First Endpoint ID</p> <p>This field specifies the first EID assigned to the pool for this endpoint. The value is 0x00 if there are no EIDs assigned to the pool.</p>

1728 **9.11 Routing Information Update**

1729 The Routing Information Update message is used by a bus owner to give routing information to a bridge  
 1730 for the bus on which the message is being received.

1731 Because the physical address format is based on the bus over which the request is delivered, the bus  
 1732 owner shall use the medium-specific physical address format for the addresses sent using this command.

1733 An MCTP bridge may be sent more than one instance of this command to transfer the update information.  
 1734 An integral number of routing information update entries shall be provided in the command (that is,  
 1735 routing information update entries cannot be split across instances of the command).

1736 **9.11.1 Adding and Replacing Entries**

1737 The recipient of this command shall check to see whether the information in the request corresponds to  
 1738 the EID for an existing entry for the bus over which the command was received. If so, it shall replace that  
 1739 entry with the new information. If an entry for a given EID or EID range does not already exist, it shall  
 1740 create new entries for the given EIDs. In some cases this may require the bridge to split existing entries  
 1741 into multiple entries.

1742 NOTE: A bus owner is only allowed to update entries that correspond to its bus. For each routing table entry that  
 1743 was created or updated through the Routing Information Update message, the bridge shall keep track of which bus it  
 1744 received the Routing Information Update from. This is necessary so that when a Routing Information Update is  
 1745 received from a particular bus, the bridge only updates entries that correspond to entries that were originally given to  
 1746 it from that bus.

1747 **9.11.2 Rebuilding Routing Tables**

1748 A bridge that receives and accepts the Allocate Endpoint IDs command with the "Force Allocation" bit set  
 1749 (1b) shall clear out and rebuild its routing table information. The bridge shall issue commands to reassign  
 1750 EIDs and re-allocate EID pools to all downstream devices. The request and response parameters are  
 1751 specified in Table 24, and format information is provided in Table 25.

1752 **Table 24 – Routing Information Update Message**

	Byte	Description
Request data	1	Count of update entries (1-based)
	see text	One or more update entries, based on the given count, as illustrated in Table 25
Response data	1	Completion Code  0x80 = Insufficient space to add requested entries to internal routing table

1753 **Table 25 – Routing Information Update Entry Format**

Byte	Description
1	[7:4] - reserved  [3:0] - Entry Type:  00b = entry corresponds to a single endpoint that is not serving as an MCTP bridge  01b = entry reflects an EID range for a bridge where the starting EID is the EID of the bridge itself and additional EIDs in the range are routed by the bridge

Byte	Description
	<p>10b = entry is for a single endpoint that is serving as an MCTP bridge</p> <p>11b = entry is an EID range for a bridge, but does not include the EID of the bridge itself</p>
2	[7:0] Size of EID Range. The count of EIDs in the range.
3	<p>First EID in EID Range.</p> <p>The EID Range is sequential (for example, if the size of the EID Range is 3 and the First EID value given in this parameter is 21, the Entry covers EIDs 21, 22, and 23).</p>
4:N	Physical Address. The size and format of this field is defined as part of the corresponding physical transport binding specification for the bus that this data is being provided for.

## 1754 9.12 Get Routing Table Entries

1755 This command can be used to request an MCTP bridge to return data corresponding to its present routing  
 1756 table entries. This data is used to enable troubleshooting the configuration of routing tables and to enable  
 1757 software to draw a logical picture of the MCTP network. More than one instance of this command will  
 1758 typically need to be issued to transfer the entire routing table content.

1759 An integral number of routing table entries shall be provided in the response to this command (that is,  
 1760 routing table entries cannot be split across instances of the command). The request and response  
 1761 parameters are specified in Table 26, and format information is provided in Table 27.

1762

**Table 26 – Get Routing Table Entries Message**

	Byte	Description
Request data	1	Entry Handle (0x00 to access first entries in table)
Response data	1	Completion Code
	2	<p>Next Entry Handle (Use this value to request the next set of entries, if any.)            If the routing table data exceeds what can be carried in a single MCTP control response.            0xFF = No more entries</p>
	3	Number of routing table entries being returned in this response
	4:N	One or more routing table entries, formatted per Table 27. This field will be absent if the number of routing table entries is 0x00.

1763

**Table 27 – Routing Table Entry Format**

Byte	Description
1	Size of EID range associated with this entry
2	Starting EID
3	<p>Entry Type/Port Number</p> <p>[7:6] – Entry Type:            00b = entry corresponds to a single endpoint that does not operate as an MCTP bridge</p>

Byte	Description
	<p>01b = entry reflects an EID range for a bridge where the starting EID is the EID of the bridge itself and additional EIDs in the range are routed by the bridge</p> <p>10b = entry is for a single endpoint that serves as an MCTP bridge</p> <p>11b = entry is an EID range for a bridge, but does not include the EID of the bridge itself</p> <p>[5] – Dynamic/Static Entry.</p> <p>Indicates whether the entry was dynamically created or statically configured. Note that statically configured routing information shall not be merged with dynamic information when reporting entry information using this command. While an implementation may internally organize its data that way, dynamic and statically configured routing shall be reported as separate entries. Dynamically created entries include entries that were generated from the Routing Information Update command as well as entries that were created as a result of the bridge doing EID assignment and EID pool allocation as a bus owner.</p> <p>0b = Entry was dynamically created</p> <p>1b = Entry was statically configured</p> <p>[4:0] – Port number</p> <p>This value is chosen by the bridge device vendor and is used to identify a particular bus connection that the physical address for the entry is defined under. In some cases, this number may correspond to an internal "logical" bus that is not directly connected to an external physical bus. Port numbers are required to be static.</p> <p>It is recommended, but not required, that the ports (bus connections) on the bridge be numbered sequentially starting from 0x00. This specification does not define any requirements or recommendations on how port numbers are assigned to corresponding physical connections on a device.</p>
4	Physical Transport Binding Type Identifier, according to <a href="#">MCTP ID</a>
5	Physical Media Type Identifier, according to <a href="#">MCTP ID</a> . This value is used to indicate what format the following physical address data is given in.
6	Physical Address Size. The size in bytes of the following Physical Address field
7 :N	<p>Physical Address.</p> <p>The size and format of this field is defined as part of the corresponding physical transport binding specification.</p> <p>The information given in this field is given MSB first. Any unused bits should be set to 0b.</p>

1764 **9.13 Prepare for Endpoint Discovery**

1765 The Endpoint Discovery message is used to determine if devices on a bus communicate MCTP (see  
 1766 Table 28). Whether this message is required depends on the particular medium. Currently, this message  
 1767 may be required only by a particular transport binding, such as PCI Express (PCIe) VDM, because other  
 1768 bindings such as SMBus may use other mechanisms for determining this information.

1769 Each endpoint (except the bus owner) on the bus maintains an internal flag called the "Discovered" flag.

1770 The Prepare for Endpoint Discovery command is issued as a broadcast Request message on a given bus  
 1771 that causes each endpoint on the bus to set their respective Discovered flag to the "undiscovered" state.  
 1772 The flag is subsequently set to the "discovered" state when the Set Endpoint ID command is received by  
 1773 the endpoint.

- 1774 An endpoint also sets the flag to the "undiscovered" state at the following times:
- 1775 • Whenever the physical address associated with the endpoint changes or is assigned
  - 1776 • Whenever an endpoint first appears on the bus and requires an EID assignment
  - 1777 • During operation if an endpoint enters a state that requires its EID to be reassigned
  - 1778 • For hot-plug endpoints: After exiting any temporary state where the hot-plug endpoint was  
1779 unable to respond to MCTP control requests for more than  $T_{RECLAIM}$  seconds (where  $T_{RECLAIM}$  is  
1780 specified in the physical transport binding specification for the medium used to access the  
1781 endpoint). See 7.17.5 for additional information.

1782 Only endpoints that have their Discovered flag set to "undiscovered" will respond to the Endpoint  
1783 Discovery message. Endpoints that have the flag set to "discovered" will not respond.

1784 The destination EID for the Prepare for Endpoint Discovery message is set to the Broadcast EID value  
1785 (see Table 2) in the request message to indicate that this is a broadcast message. The response  
1786 message sets the destination EID to be the ID of the source of the request message, which is typically the  
1787 EID of the bus owner. The request and response parameters are specified in Table 28.

1788 **Table 28 – Prepare for Endpoint Discovery Message**

	Byte	Description
Request data	–	–
Response data	1	Completion Code

## 1789 **9.14 Endpoint Discovery**

1790 This command is used to discover endpoints that have their Discovered flag set to "undiscovered". Only  
1791 endpoints that have their Discovered flag set to "undiscovered" will respond to this message. Endpoints  
1792 that have the flag set to "discovered" will not respond.

1793 This message is typically sent as a Broadcast Request message by the bus owner using the Broadcast  
1794 EID as the destination EID, though for testing purposes endpoints shall also accept and handle this  
1795 command as a non-broadcast Request. Additionally, the request may be sent as a datagram, depending  
1796 on the transport binding requirements. The request and response (if any) parameters are specified in  
1797 Table 29.

1798 **Table 29 – Endpoint Discovery Message**

	Byte	Description
Request data	–	–
Response data	1	Completion Code

## 1799 **9.15 Discovery Notify**

1800 This message is available for use as a common message for enabling an endpoint to announce its  
1801 presence to the bus owner. This will typically be used as part of the endpoint discovery process when an  
1802 MCTP device is hot-plugged onto or becomes powered up on an MCTP bus.

1803 Whether and how this message is used for endpoint discovery depends on the particular physical  
1804 transport binding specification. For example, the SMBus transport binding does not use this message for  
1805 an endpoint to announce itself because it takes advantage of mechanisms that are already defined for  
1806 SMBus.



1807 This message should only be sent from endpoints to the bus owner for the bus that the endpoint is on so  
 1808 it can notify the bus owner that the endpoint has come online and may require an EID assignment or  
 1809 update. Additionally, the request may be sent as a datagram, depending on the transport binding  
 1810 requirements. The request and response (if any) parameters are specified in Table 30.

1811 **Table 30 – Discovery Notify Message**

	Byte	Description
Request data	–	–
Response data	1	Completion Code

1812 **9.16 Query Hop**

1813 This command can be used to query a bridge to find out whether a given EID shall be accessed by going  
 1814 through that bridge, and if so, whether yet another bridge shall be passed through in the path to the  
 1815 endpoint, or if the endpoint is on a bus that is directly connected to the bridge.

1816 The command also returns the information about the transmission unit information that the bridge  
 1817 supports in routing to the given target endpoint from the bus that the request was received over. See 7.23  
 1818 for more information.

1819 NOTE: The physical transport binding for MCTP may place additional requirements on the physical packet sizes  
 1820 that can be used to transfer MCTP packet payloads, such as requiring that physical packet sizes be in 32-byte or 64-  
 1821 byte increments, or particular power of 2 increments (for example, 128, 256, 512, and so on).

1822 The request and response parameters are specified in Table 31.

1823 **Table 31 – Query Hop Message**

	Byte	Description
Request data	1	Target Endpoint ID  0x00, 0xFF = reserved. (An ERROR_INVALID_DATA completion code shall be returned.)
	2	Message type for which transmission unit information is being requested. Use the MCTP control message type number unless another message type is of interest.
Response data	1	Completion Code  An ERROR_INVALID_DATA completion code shall be returned if the target EID is not covered by any entry in the bridge's routing table.
	2	EID of the next bridge that is used to access the target endpoint, if any  Note: This response depends on which bus port the Query Hop request is received over.  If this EID is 00h:  The EID is covered by the bridge's routing table, but the target EID does not require access by <i>going through</i> this bridge from the port the request was received over. This response will be returned if the target EID is already local to the bus over which the request is being received. This response is also returned when the target EID is an EID for the bridge itself.  If this EID is non-zero <i>and</i> is different than the target EID passed in request:  The EID being provided is the EID of the "next bridge" in the path to the

	Byte	Description
		target EID. If this EID is equal to the target EID passed in request: The target EID is accessed by going through this bridge and no additional bridges shall be gone through to reach the target.
	3	Message Type. This value either returns the message type that was given in the request, or it returns 0xFF to indicate that the information is applicable to all message types that are supported by the bridge.
	4:5	Maximum supported incoming transmission unit size in increments of 16 bytes, starting from the baseline transmission unit size (0x0000 = 64 bytes, 0x0001 = 80 bytes, and so on).
	5:6	Maximum supported outgoing transmission unit size in increments of 16 bytes, starting from the baseline transmission unit (0x0000 = 64 bytes, 0x0001 = 80 bytes, and so on). The responder will return whether this transmission unit size is supported for MCTP packets that it transmits for the given message type.

## 1824 9.17 Transport Specific

1825 Transport Specific commands are a range of commands that are available for use by transport binding  
1826 specifications in order to perform additional MCTP Control functions that are defined by a particular  
1827 transport binding.

1828 The request and response parameters are specified in Table 32.

1829 **Table 32 – Transport Specific Message**

	Byte	Description
Request data	1	MCTP Physical Transport Binding Identifier The ID of the Physical Transport specification that defines the transport specific message. This ID is defined in the <a href="#">MCTP ID</a> companion document to this specification.
	2	MCTP Physical Media Identifier The ID of the physical medium that the message is targeted for. This ID is defined in the <a href="#">MCTP ID</a> companion document to this specification.
	3:N	Transport specific command data. Defined by the transport binding specification identified by the MCTP Physical Transport Binding Identifier given in byte 1. If the Physical Transport Binding Identifier = Vendor Defined: The first four bytes of data shall be the IANA Enterprise ID for the Vendor. MSB first. See 9.8.1 for the information on the IANA Enterprise ID as used in this specification.
Response data	1	Completion Code

## 1830 10 Vendor Defined – PCI and Vendor Defined – IANA Messages

1831 The Vendor Defined – PCI and Vendor Defined – IANA message types provide a mechanism for  
1832 providing an MCTP message namespace for vendor-specific messages over MCTP.

1833 The PCI and IANA designations refer to the mechanism that is used to identify the vendor or organization  
 1834 this is specifying the message’s functionality and any parametric data or other fields provided in the  
 1835 message body.

1836 Note that this specification only defines the initial bytes in the message body of these messages, and sets  
 1837 the requirement that these messages shall follow the requirements set by the MCTP base protocol and  
 1838 any additional requirements necessary to meet the transport of these messages over a particular  
 1839 medium, such as path transmission unit limitations.

1840 Otherwise, any other field definitions and higher level message behavior such as retries, error/completion  
 1841 codes, and so on, is message type-specific and thus is vendor-specific.

1842 **10.1 Vendor Defined – PCI Message Format**

1843 For these messages, the MCTP message type is set to the value for "Vendor Defined – PCI" as defined in  
 1844 Table 3. The request and response parameters are specified in Table 33.

1845 **Table 33 – Vendor Defined – PCI Message Format**

	Byte	Description
Request data	1:2	PCI/PCIe Vendor ID. Refer to <a href="#">PCIe</a> . MSB first. This value is formatted per the Vendor Data Field for the PCI Express vendor ID format. See 9.8.1".  NOTE: Because the vendor ID format is implied by the command, the Vendor ID Format bytes are not part of this field.
	(3:N)	Vendor-Defined Message Body. 0 to N bytes.
Response data	1:2	PCI/PCIe Vendor ID. Refer to <a href="#">PCIe</a> . MSB first.
	(3:M)	Vendor-Defined Message Body. 0 to M bytes.

1846 **10.2 Vendor Defined – IANA Message Format**

1847 For these messages, the MCTP message type is set to the value for "Vendor Defined – IANA" as defined  
 1848 in Table 3. The request and response parameters are specified in Table 34.

1849 **Table 34 – Vendor Defined – IANA Message Format**

	Byte	Description
Request data	1:4	IANA Enterprise ID for Vendor. MSB first. This value is formatted per the Vendor Data Field for the IANA enterprise vendor ID format. See 9.8.1.  NOTE: Because the vendor ID format is implied by the command, the Vendor ID Format bytes are not part of this field.
	(5:N)	Vendor-Defined Message Body. 0 to N bytes.
Response data	1:4	IANA Enterprise ID for the Vendor. MSB first.
	(5:M)	Vendor-Defined Message Body. 0 to M bytes.

1850

## Annex A (informative)

### Notation

1851  
1852  
1853  
1854

#### 1855 A.1 Notations

1856 Examples of notations used in this document are as follows:

- 1857 • 2:N In field descriptions, this will typically be used to represent a range of byte offsets  
1858 starting from byte two and continuing to and including byte N. The lowest offset is on  
1859 the left, and the highest is on the right.
- 1860 • (6) Parentheses around a single number can be used in message field descriptions to  
1861 indicate a byte field that may be present or absent.
- 1862 • (3:6) Parentheses around a field consisting of a range of bytes indicates the entire range  
1863 may be present or absent. The lowest offset is on the left, and the highest is on the  
1864 right.
- 1865 • PCIe Underlined, blue text is typically used to indicate a reference to a document or  
1866 specification called out in 2, "Normative References", or to items hyperlinked within  
1867 the document.
- 1868 • rsvd Abbreviation for Reserved. Case insensitive.
- 1869 • [4] Square brackets around a number are typically used to indicate a bit offset. Bit offsets  
1870 are given as zero-based values (that is, the least significant bit [LSb] offset = 0).
- 1871 • [7:5] A range of bit offsets. The most-significant is on the left, and the least-significant is on  
1872 the right.
- 1873 • 1b The lower case "b" following a number consisting of 0s and 1s is used to indicate the  
1874 number is being given in binary format.
- 1875 • 0x12A A leading "0x" is used to indicate a number given in hexadecimal format.

1876

**Annex B**  
(informative)

**Change Log**

1877  
1878  
1879  
1880  
1881

Version	Date	Author	Description
1.0.0	07/28/09		DMTF Standard Release

1882

1883

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1886