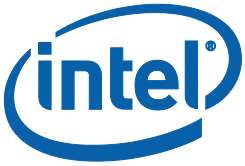

USB Type-C™ Connector System Software Interface [UCSI]

Requirements Specification

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1 Introduction

1.1 Scope

The USB Type-C Connector System Software Interface (UCSI) describes the registers and data structures used to interface with the USB Type-C connectors on a system. The system software component is referred to as the OS Policy Manager (OPM) in this specification.

This specification is intended for hardware component designers, system builders and device driver (software) developers. The reader is expected to be familiar with [USBTYPEC] and [USBPD]. In spite of due diligence, there may exist conflicts between this specification and either one or both of the above mentioned specifications. In such cases the [USBTYPEC] and [USBPD] take precedence.

The combination of hardware and firmware and any vendor-provided OS software that provides the interface to all the USB Type-C connectors on the platform is referred to as the Platform Policy Manager (PPM) in this specification. In addition, there may be individual policy managers for each USB Type-C connector on the platform. The individual policy managers are referred to as Local Policy Managers (LPM) in this specification.

This specification does not define the method to use (PCIe*/ACPI/I2C/etc.) in order to interface with the PPM. It is left to individual system manufacturers to determine what bus/protocol they use to expose the PPM.

1.2 Purpose

The purpose of this document is to describe the minimum registers and data structures that a PPM shall support. These registers and data structures shall be used to communicate with the PPM. They shall be used to send commands to and retrieve capabilities and status from the PPM.

1.3 Related Documents

- [USB2.0] – Universal Serial Bus Specification, Revision 2.0, (including errata and ECNs through August 11, 2014) (referred to in this document as the USB 2.0 Specification) (available at: http://www.usb.org/documents).
- [USB3.1] – Universal Serial Bus 3.1 Specification, Revision 1.0, (including errata and ECNs through February 14, 2017) (referred to in this document as the USB 3.1 Specification) (available at: http://www.usb.org/documents).
- [USBPD] – USB Power Delivery Specification Rev. 3.0, Version 2.0, August 29, 2019 (referred to in this document as the USB PD Specification) (available at: http://www.usb.org/documents).

- [USBTYPEC] – USB Type-C™ Cable and Connector Specification Revision 2.0, August 2019 (referred to in this document as the USB Type-C Specification) (available at: http://www.usb.org/developers/docs.)

1.4 Terms and Abbreviations

This section defines terms and abbreviations used throughout this document. For additional terms and abbreviations that pertain to the Universal Serial Bus, Refer to Chapter 2, "Terms and Abbreviations," in [USB2.0] and [USB3.1], Section 1.5 in [USBTYPEC] and Section 1.6 in [USBPD].

Table 1-1: Terms and Abbreviations

Term	Description
Connector	A USB Type-C connector that is attached to the platform.
LPM	Local Policy Manager. Hardware/firmware that manages an individual USB Type-C connector.
OPM	OS Policy Manager. Operating Software that interfaces with the PPM.
PPM	Platform Policy Manager. Hardware/firmware that manages all the USB Type-C connectors on the platform.

1.5 Conventions and Notations

1.5.1 Precedence

If there is a conflict between text, figures, and tables, the precedence shall be tables, figures, and then text.

1.5.2 Keywords

The following keywords differentiate between the levels of requirements and options.

1.5.2.1 Informative

Informative is a keyword that describes information with this specification that intends to discuss and clarify requirements and features as opposed to mandating them.

1.5.2.2 May

May is a keyword that indicates a choice with no implied preference.

1.5.2.3 N/A

N/A is a keyword that indicates that a field or value is not applicable and has no defined value and shall not be checked or used by the recipient.

1.5.2.4 Normative

Normative is a keyword that describes features that are mandated by this specification.

1.5.2.5 Optional

Optional is a keyword that describes features not mandated by this specification. However, if an optional feature is implemented, the feature shall be implemented as defined by this specification (optional normative).

1.5.2.6 Reserved

Reserved is a keyword indicating reserved bits, bytes, words, fields, and code values that are set-aside for future standardization. Their use and interpretation may be specified by future extensions to this specification and, unless otherwise stated, shall not be utilized or adapted by vendor implementation. A reserved bit, byte, word, or field shall be set to zero by the sender and shall be ignored by the receiver. Reserved field values shall not be sent by the sender and, if received, shall be ignored by the receiver.

1.5.2.7 Shall

Shall is a keyword indicating a mandatory (normative) requirement. Designers are mandated to implement all such requirements to ensure interoperability with other compliant Devices.

1.5.2.8 Should

Should is a keyword indicating flexibility of choice with a preferred alternative. Equivalent to the phrase "it is recommended that".

1.5.3 Numbering

Numbers that are immediately followed by a lowercase "b" (e.g., 01b) are binary values. Numbers that are immediately followed by an uppercase "B" are byte values. Numbers that are immediately followed by a lowercase "h" (e.g., 3Ah) are hexadecimal values. Numbers not immediately followed by either a "b", "B", or "h" are decimal values.

1.5.4 Byte Ordering

All multiple byte fields in this specification are interpreted as and moved over the bus in little-endian order, i.e., LSB to MSB unless otherwise specified.

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2 Management Overview

This specification defines the various commands and notifications to manage a platform that exposes one or more USB Type-C connectors. It details the initialization sequence to determine the number of ports on the system and capabilities of the system and each of the connectors on the platform.

The data structures are defined in Chapter 3 and the Operational Model, State Machines and Commands are defined in Chapter 4.

Note: This specification does not define the policy that the OPM is required to implement.

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3 Data Structures

This section defines the structure of the memory locations used to pass information between the OPM and PPM. The table below lists the direction in which each memory location is used. OPM->PPM indicates that the OPM uses the memory location to pass information to the PPM. The location is Read Only (RO) as far as the PPM is concerned. Similarly PPM->OPM indicates that the PPM uses the memory location to pass information to the OPM. The location is RO as far as the OPM is concerned.

Table 3-1: Data Structures

Offset (Bytes)	Mnemonic	Memory Location Name	Direction	Size (bits)
0	VERSION	UCSI Version Number	PPM->OPM	16
2	RESERVED	Reserved	N/A	16
4	CCI	USB Type-C Command Status and Connector Change Indication	PPM->OPM	32
8	CONTROL	USB Type-C Control	OPM->PPM	64
16	MESSAGE IN	USB Type-C Message In	PPM->OPM	128
32	MESSAGE OUT	USB Type-C Message Out	OPM->PPM	128

3.1 VERSION – USB Type-C Interface Version Number

The Version Data Structure contains the BCD version of the UCSI specification that the PPM is compliant to. The OPM shall only read from this Data Structure. The PPM shall update this Data Structure right after Power On or after a Reset. The value of the Version Data Structure is 0xJJMN for version JJ.M.N (JJ – major version number, M – minor version number, N – sub-minor version number), e.g. version 2.1.3 is represented with value 0x0213 and version 3.0 is represented with a value of 0x0300.

3.2 CCI – USB Type-C Command Status and Connector Change Indication

Table 3-2: Command Status and Connector Change Indication Data Structure

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	The PPM shall use this field to indicate the connector number that a change occurred on.

Offset (Bits)	Field	Size (Bits)	Description
			Valid values are 0 to the maximum number of connectors supported on the platform. If this field is set to zero, then no change occurred on any of the connectors.
8	Data Length	8	Length of valid data in bytes. If this value is greater than zero then the MESSAGE IN Data Structure contents are valid. The value in this register shall be less than or equal to MAX_DATA_LENGTH.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	The PPM shall set this field to one when it wants to indicate that it does not currently support a command. This field shall only be valid when the Command Completed Indicator field is set to one.
26	Cancel Completed Indicator	1	The PPM shall set this field to one when it has completed a CANCEL command. This field shall only be valid when the Command Completed Indicator field is set to one.
27	Reset Completed Indicator	1	The PPM shall set this field to one when it has completed a PPM_RESET command. If this field is set to one, then no other bits in this Data Structure shall be set by the PPM. The PPM shall clear this field on reception of the next command (not PPM_RESET) from the OPM.
28	Busy Indicator	1	The PPM shall set this field to one when it wants to indicate that the PPM is currently busy and will complete the command sent to it by the OPM at a later time. If this field is set to one, then no other bits in this Data Structure shall be set by the PPM. When the PPM completes the command sent to it, it shall set this field to zero and update the other fields in this Data Structure appropriately before notifying the OPM.
29	Acknowledge Command Indicator	1	The PPM shall set this field to one when it completes the ACK_CC_CI (Acknowledge Command Completion and/or Change Indication) command. The PPM shall automatically reset this bit when it receives the next command from the OPM. If this field is set to one, then the only other field that can be set is the Connector Change Indicator field.
30	Error Indicator	1	The PPM shall set this field to one when it encounters an error when executing the command sent to it by the OPM. This field shall only be valid when the Command Completed Indicator field is set to one.
31	Command Completed Indicator	1	The PPM shall set this field to one when it wants to indicate that it completed the command sent to it by the OPM.

When the OPM is notified it shall read this Data Structure to determine the reason for the notification.

3.3 CONTROL – USB Type-C Control

The CONTROL Data Structure indicates the command to be executed by the PPM. Depending on the command type, some fields in this Data Structure need to be interpreted differently. This section defines the high level structure of the fields that are static and the fields that change based on the command. Subsequent sections define the structure of the CONTROL Data Structure for each type of command.

Table 3-3: USB Type-C Control Data Structure

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	The value in this field determines the command that OPM wants the PPM to execute. Bits 16-63 shall contain any parameters specific to this command.
8	Data Length	8	Length of valid data in bytes. If this value is greater than zero then the MESSAGE OUT Data Structure contents are valid. The value in this field shall be less than or equal to MAX_DATA_LENGTH.
16	Command Specific	48	The definition of these bits is different for each command that can be sent to the PPM.

Section 4.5 describes the definition of the Command Specific field for each command that can be sent to a PPM.

The OPM is the only entity that can write to this Data Structure. The PPM shall only read from this Data Structure.

3.4 MESSAGE IN – USB Type-C Message In

The MESSAGE IN Data Structure contains the data that the PPM wants to send to the OPM. The format of this Data Structure is command specific. The OPM shall only read from this Data Structure when it gets a notification that the PPM has completed a command. The PPM shall only write to this Data Structure in response to a command (from the OPM) that requires data to be returned. If the PPM is required to return data it shall write to this Data Structure before notifying the OPM.

3.5 MESSAGE OUT – USB Type-C Message Out

The MESSAGE OUT Data Structure contains the data to be sent to the PPM. The format of this Data Structure is command specific. The OPM shall only write to this Data Structure when there is no active command being executed by the PPM. The PPM shall only read from this Data Structure if the command (from the OPM) sent to it defines that data shall be present in this Data Structure.

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4 Operational Model

The general operational model describes how the OPM shall interact with the PPM. It also defines all the commands that the OPM may send to the PPM. Some of the commands may be optional for the PPM to implement. This specification clearly states which commands are optional and which are mandatory.

The OPM shall send at most one command at a time to the PPM. The OPM shall wait until the PPM completes the current command before sending the next command. The PPM shall notify the OPM when it completes the command if the Command Completed notification is enabled. The only exceptions to the one command rule are CANCEL and PPM_RESET. A PPM_RESET command may be sent by the OPM at any time. The CANCEL command shall only be sent by the OPM when it wants to cancel an outstanding command that it had previously got a PPM Busy response for.

Note: If a command takes longer than MIN_TIME_TO_RESPOND_WITH_BUSY ms for the PPM (excluding PPM to OPM communication latency) to complete, then the PPM shall respond to the command by setting the CCI Busy Indicator and notify the OPM. Subsequently, when the PPM actually completes the command, the PPM shall notify the OPM of the outcome of the command via an asynchronous notification associated with that command.

The PPM shall send at most one Connection Change notification at a time to the OPM. The PPM shall wait until the OPM Acknowledges the notification (due to an asynchronous event) before sending the next notification. The PPM shall not set the Connector Change Indicator if the change on the connector occurred as a direct result of a command sent to that connector unless the PPM will require more time to process the command.

On reception of a command (neither CANCEL nor PPM_RESET), the PPM shall:

1. If the PPM is Busy or the PPM will take more than MIN_TIME_TO_RESPOND_WITH_BUSY ms to complete the command then it shall set the Busy Indicator in the CCI Data Structure. Go to step 4.
2. The PPM shall execute the command.
3. The PPM shall set the CCI Data Structure and optionally update the STATUS and MESSAGE IN Data Structures as detailed in the sections for each command.
4. If the “Command Completed” notification was enabled by the OPM then the PPM shall notify the OPM.

On reception of a CANCEL command, the PPM shall:

1. If the PPM was not currently processing a command then go drop the CANCEL request.
2. Cancel the current operation(s) it was performing.
3. The PPM shall complete the CANCEL command successfully and update the CCI Data Structure with the “Cancel Completed Indicator” set to one.
4. If the “Command Completed” notification was enabled by the OPM then the PPM shall notify the OPM.

On reception of a PPM_RESET command, the PPM shall:

1. Disable all notifications.
2. The PPM shall transition to the "PPM Idle (Notifications Disabled)" state.
3. Reset itself and set the Reset Completed Indicator in the CCI Data Structure.
4. The OPM shall poll for the Reset Completed Indicator in the CCI Data Structure.

When an asynchronous event occurs on one or more of the connectors, then the PPM shall:

1. Update the CCI and STATUS Data Structures.
2. If the corresponding notification was enabled by the OPM, then notify the OPM.

Once the OPM is notified of either a command completion and/or an asynchronous event it shall:

1. Read the CCI and optionally the STATUS Data Structures.
2. It shall send any other commands it needs to get details on the event.
3. Acknowledge the notification via the ACK_CC_CI (Acknowledge Command Completion and/or Change Indication) command. The only notification that is not acknowledged by the OPM is the command completion notification for the ACK_CC_CI or the PPM_RESET command.

4.1 PPM State Machine

Figure 4-1: PPM State Machine (Core)

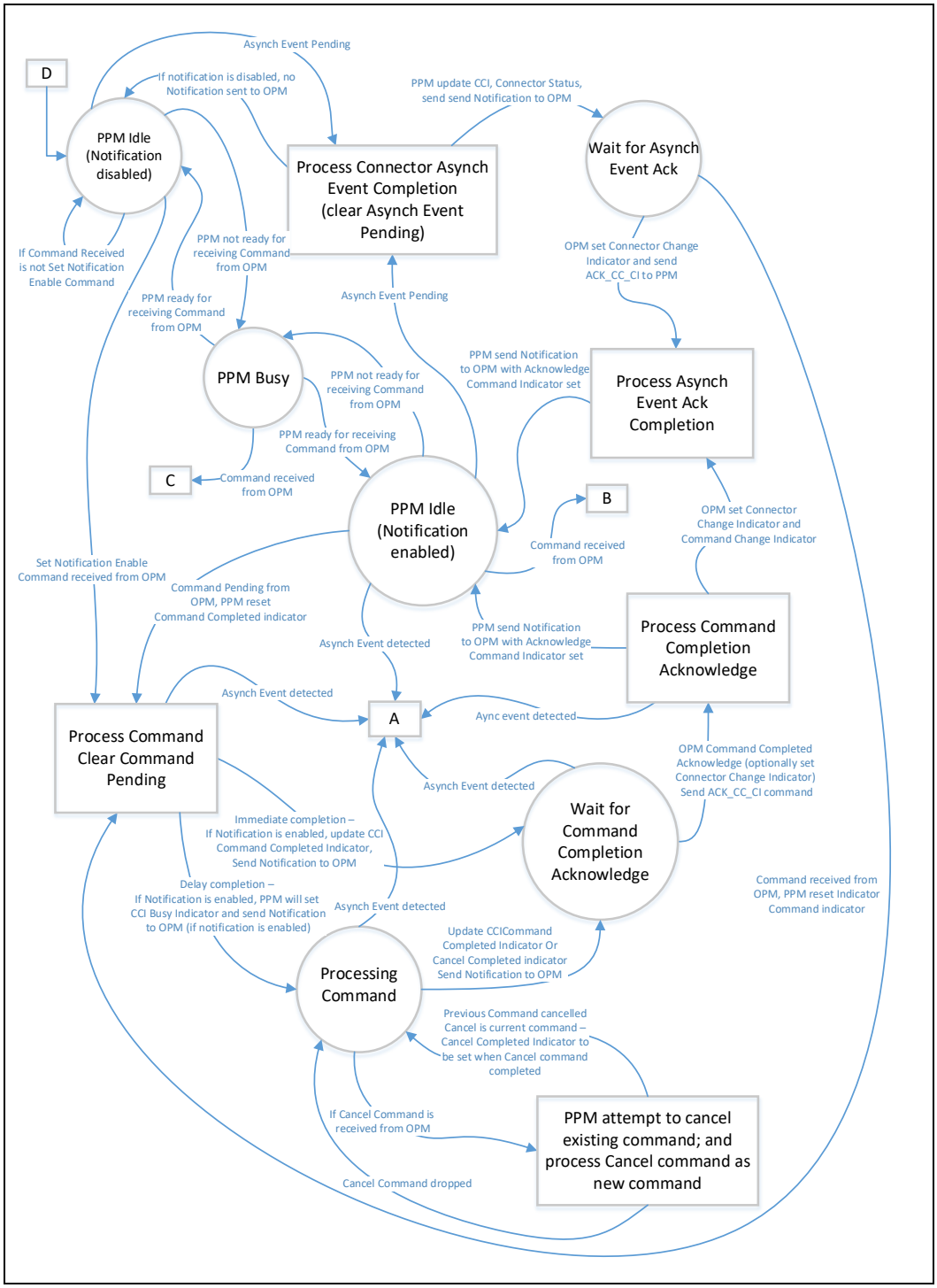
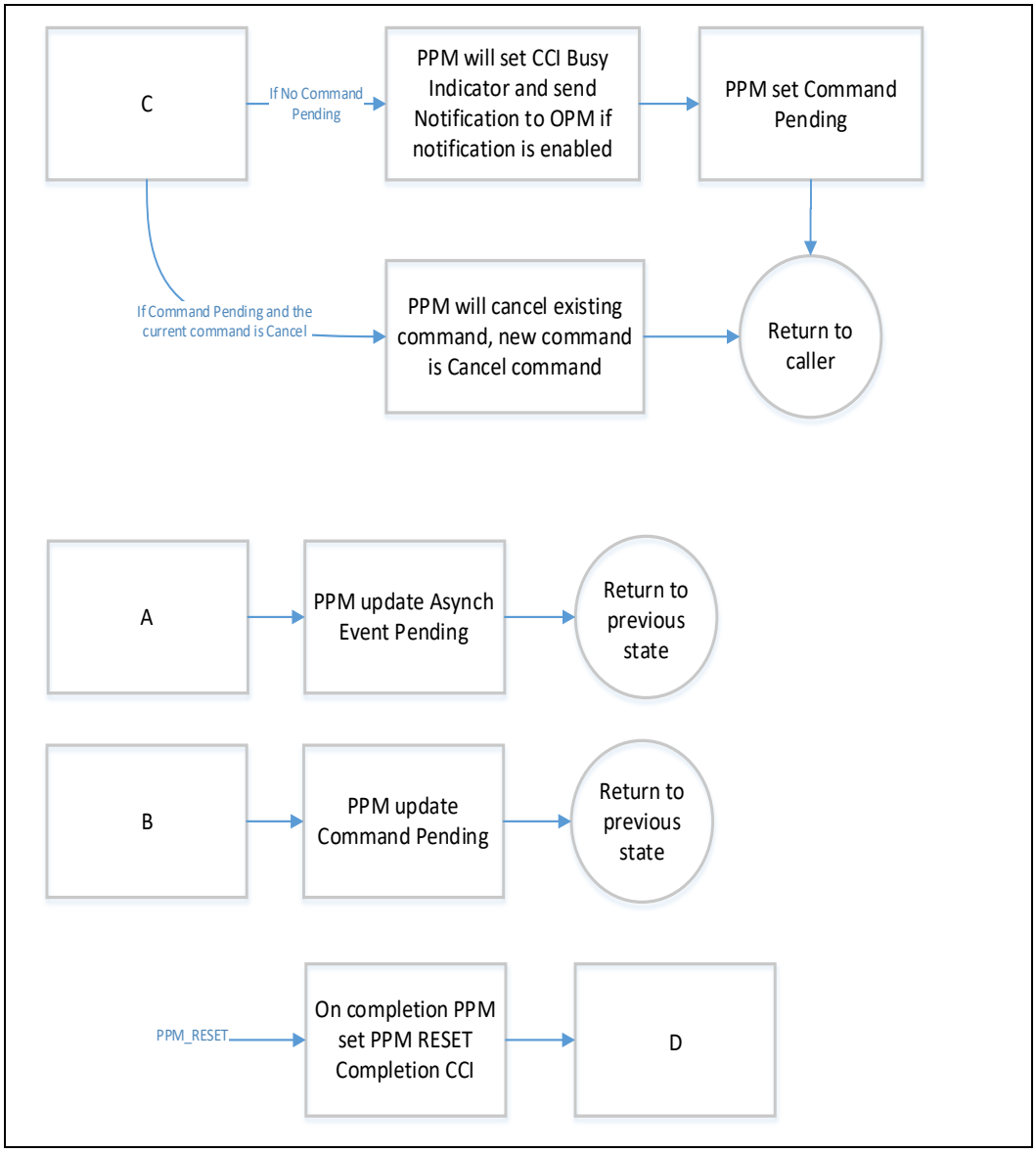
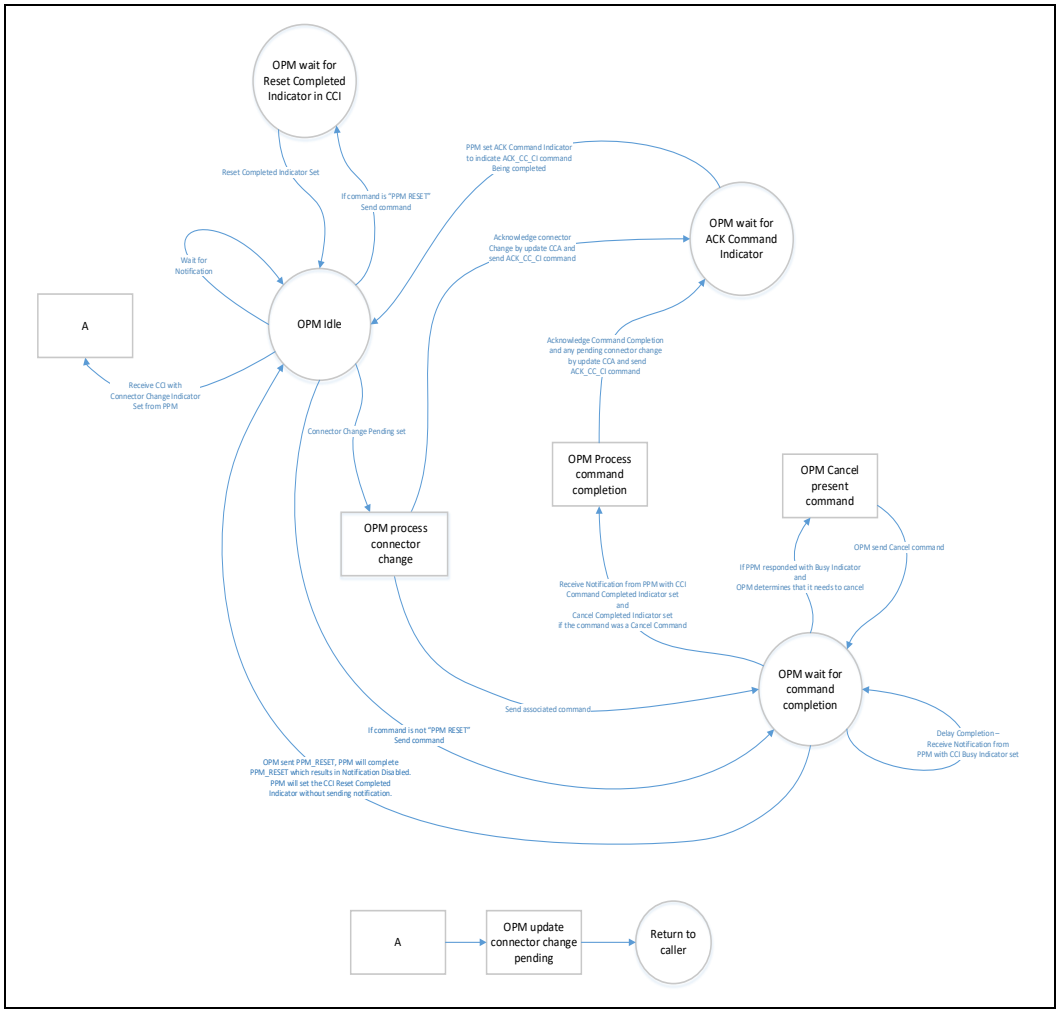


Figure 4-2: PPM State Machine (Extended)



4.2 OPM State Machine

Figure 4-3: OPM State Machine



4.3 PPM Initialization

The PPM is expected to function without any OS interaction. On completion of internal initialization the PPM shall be in the “PPM Idle (Notifications Disabled)/” state. The PPM shall not notify the OPM until the OPM enables one or more notifications via the SET_NOTIFICATION_ENABLE command. On successful completion of the SET_NOTIFICATION_ENABLE command the PPM shall transition to the “PPM Idle (Notifications Enabled)” state.

The only commands the PPM is required to process in the “PPM Idle (Notifications Disabled)” state are SET_NOTIFICATION_ENABLE and PPM_RESET.

Not all notifications are required to be supported by the PPM. Hence, the OPM shall first enable only the “Command Completed” notification, query the PPM for supported

notifications using the GET_CAPABILITY command, and then enable the rest of the supported notifications. Alternatively, the OPM may choose to enable only those notifications that this specification requires the PPM to support.

An example of the PPM Initialization flow is given below:

1. Optionally send a PPM_RESET.
2. Enable the "Command Completed" notification.
3. Determine platform capability by sending GET_CAPABILITY command.
    a. Indicates the number of connectors supported by the PPM.
    b. Indicates the notifications supported by the PPM.
4. Enable as many of the notifications supported by the PPM as needed by sending a SET_NOTIFICATION_ENABLE command.
5. For each of the connectors, the OPM sends GET_CONNECTOR_CAPABILITY command to determine the capabilities of each connector.
6. If Alternate Modes are supported by the Platform and the connector, the OPM can use the GET_ALTERNATE_MODES on each connector to determine the Alternate Modes supported by the PPM. Then, the OPM can use the GET_CAM_SUPPORTED to determine the Alternate Modes supported by each connector.
7. If there is a device connected (indicated by the Connector Change Indicator) on a connector, the OPM can use the GET_ALTERNATE_MODES (Recipient field equal to SOP', SOP'' and SOP) to determine the Alternate Modes supported by the cable and the connected device respectively.
8. If additional information about the cable is needed and the PPM supports it, OPM can use the GET_CABLE_PROPERTY command to determine the same.

Note: The Result of #5, #6, #7 and #8 can be used to create an Alternate Mode support bit map of the current system configuration (Platform/connector/cable/device)

9. The OPM can use the GET_CURRENT_CAM command to determine the current Alternate Mode that a connector is operating in.
10. The OPM can use the SET_NEW_CAM to set connector in new Alternate Mode, if needed and the PPM supports it.

4.4 PPM Suspend/Resume

This Suspend/Resume behavior is dependent on the underlying method (PCIe/ACPI/I2C etc) used to interface with the PPM and hence this specification does not define the behavior of the OPM/PPM during Suspend/Resume.

4.5 PPM Controller Commands

This section describes each of the commands that an OPM may send to the PPM and the requirements of the PPM when it receives the command. It also indicates in the title of the command whether support for the command is required or optional. An (R) at the end stands for "Required" and (O) stands for "Optional". Certain notifications and fields in the data structures are also optional, and are indicated similarly.

4.5.1 PPM RESET (R)

This command is used to reset the PPM. It may be sent at any time by the OPM to the PPM. Note that, if the OPM wants to reset the connectors on the PPM then it shall perform a CONNECTOR_RESET on each individual connector before sending the PPM a PPM_RESET. The format of the CONTROL Data Structure for this command is given in the table below.

Table 4-1: PPM_RESET Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to PPM_RESET.
8	Data Length	8	Set to 0x00.
16	Reserved	48	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-2: PPM_RESET Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	Set to 0x00.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 1b. The PPM shall clear this field on reception of the next command from the OPM.
28	Busy Indicator	1	Set to 0b.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	Set to 0b.
31	Command Completed Indicator	1	Set to 0b.

Note: The OPM shall poll this Data Structure to determine when the PPM completes the PPM_RESET command.

4.5.2 CANCEL (R)

This command is used to cancel a command previously sent to the PPM. The OPM shall only send this command if it received a response with the CCI Busy Indicator set for the previous command it sent. If the PPM has already completed the command by the time it received the CANCEL command, it shall drop the CANCEL command.

The format of the CONTROL Data Structure for this command is given in the Table below.

Table 4-3: CANCEL Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to CANCEL.
8	Data Length	8	Set to 0x00.
16	Reserved	48	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-4: CANCEL Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 1b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	Set to 0b.
31	Command Completed Indicator	1	Set to 1b.

4.5.3 Connector Reset (R)

This command is used to reset the connector specified in the command. The PPM shall send a command completion once it starts the Reset process and send an Asynchronous notification after the Reset process is completed on the connector. On successful completion of a Connect Reset, the connector shall go through a disconnect-connect sequence.

If a USB Type-C charger is connected to the connector being reset and if there is no other power source (e.g. Dead Battery condition), then the PPM shall fail the Connector Reset request. The OPM can determine the cause of the failure by reading Bit 5 of Get Error Status Command.

The format of the CONTROL Data Structure for this command is given in the table below.

Table 4-5: CONNECTOR_RESET Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to CONNECTOR_RESET.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector being reset.
23	Reserved	41	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-6: CONNECTOR_RESET Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge	1	Set to 0b.

Offset (Bits)	Field	Size (Bits)	Description
	Command Indicator		
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.4 Acknowledge Command Completion and/or Change Indication (R)

This command is used to acknowledge to the PPM that the OPM received and processed a Command Completion and/or a Connector Change Indication. The OPM acknowledges either the Command Completion or the Connector Change or both by setting the appropriate fields in the CONTROL Data Structure. The format of the CONTROL Data Structure for this command is given in the table below.

Table 4-7: ACK_CC_CI Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to ACK_CC_CI.
8	Data Length	8	Set to 0x00.
16	Connector Change Acknowledge	1	The OPM shall this field to a one to acknowledge a connector change that occurred on the connector indicated by the PPM in the CCI Data Structure.
17	Command Completed Acknowledge	1	The OPM shall set this field to a one to acknowledge that a command completed.
18	Reserved	46	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-8: ACK_CC_CI Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	Set to 0x00.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.

Offset (Bits)	Field	Size (Bits)	Description
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b.
29	Acknowledge Command Indicator	1	Set to 1b.
30	Error Indicator	1	Set to 0b.
31	Command Completed Indicator	1	Set to 0b.

4.5.5 Set Notification Enable (R)

This command is used to set the list of asynchronous events that the PPM may send notifications about to the OPM. The OPM may update the list at any time. The format of the CONTROL Data Structure for this command is given in the table below.

The OPM shall not attempt to enable any notifications that the PPM does not support. Table below indicates which notifications are required and which are optional using a convention similar to that used for commands in this specification.

Note: If any notification is enabled, it is imperative that the Command Completed notification is also enabled.

Table 4-9: SET_NOTIFICATION_ENABLE Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to SET_NOTIFICATION_ENABLE.
8	Data Length	8	Set to 0x00.
16	Notification Enable	16	The list of notifications that the OPM wants to Enable. Bit 0: Command Completed (R) Bit 1: External Supply Change (O) Bit 2: Power Operation Mode Change (R) Bit 3: Reserved and shall be set to zero Bit 4: Reserved and shall be set to zero

<table>
<tr><th>Offset (Bits)</th><th>Field</th><th>Size (Bits)</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Bit</th><th>Notification Enabled when set to 1</th></tr>
<tr><td>5</td><td>Supported Provider Capabilities Change (O)</td></tr>
<tr><td>6</td><td>Negotiated Power Level Change (O)</td></tr>
<tr><td>7</td><td>PD Reset Complete (O)</td></tr>
<tr><td>8</td><td>Supported CAM Change (O)</td></tr>
<tr><td>9</td><td>Battery Charging Status Change (R)</td></tr>
<tr><td>10</td><td>Reserved and shall be set to zero</td></tr>
<tr><td>11</td><td>Connector Partner Change (R)</td></tr>
<tr><td>12</td><td>Power Direction Change (R)</td></tr>
<tr><td>13</td><td>Reserved and shall be set to zero</td></tr>
<tr><td>14</td><td>Connect Change (R)</td></tr>
<tr><td>15</td><td>Error (R)</td></tr>
</table>
</td></tr>
<tr><td>32</td><td>Reserved</td><td>32</td><td>Reserved and shall be set to zero.</td></tr>
</table>

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-10: SET_NOTIFICATION_ENABLE Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.

Offset (Bits)	Field	Size (Bits)	Description
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.6 Get Capability (R)

This command is used to get the PPM capabilities. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-11: GET_CAPABILITY Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_CAPABILITY
8	Data Length	8	Set to 0x00.
16	Reserved	48	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-12: GET_CAPABILITY Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful set to 0x10 else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.

Offset (Bits)	Field	Size (Bits)	Description
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

Table 4-13: GET_CAPABILITY Data

Offset (Bits)	Field	Size (Bits)	Description
0	bmAttributes	32	Bitmap encoding of supported PPM features. Refer Table 4-14 for a description of each bit.
32	bNumConnectors	7	This field indicates the number of Connectors that this PPM supports. A value of zero is illegal in this field.
39	Reserved	1	Reserved and shall be set to zero.
40	bmOptionalFeatures	24	Bitmap encoding indicating which optional features are supported by the PPM. This field is described in the detail in Section 4.5.20
64	bNumAltModes	8	This field indicates the number of Alternate Modes that this PPM supports. A value of zero in this field indicates that the PPM does not support Alternate Modes. The complete list of Alternate Modes supported by the PPM can be obtained using the GET_ALTERNATE_MODE command. The maximum number of Alternate Modes a PPM can support is limited to MAX_NUM_ALT_MODE.
72	Reserved	8	Reserved and shall be set to zero.
80	bcdBCVersion	16	Battery Charging Specification Release Number in Binary-Coded Decimal (e.g., V1.20 is 120H). This field shall only be valid if the device indicates that it supports BC in the bmAttributes field.
96	bcdPDVersion	16	USB Power Delivery Specification Revision Number in Binary-Coded Decimal. Example, Revision 3.0 is 300h. This field shall only be valid if the device indicates that it supports PD in the bmAttributes field.
112	bcdUSBTypeCVersion	16	USB Type-C Specification Release Number in Binary-Coded Decimal. Example, Revision 2.0 is 200h This field shall only be valid if the device indicates that it supports USB Type-C in the bmAttributes field.

Table 4-14: bmAttributes Field Description

Bit	Description
0	**Disabled State Support** This bit shall be set to one to indicate this platform supports the Disabled State as defined in Section 4.5.2.2.1 in the [USBTYPEC]
1	**Battery Charging** This bit shall be set to one to indicate this platform supports the Battery Charging Specification as per the value reported in the bcdBCVersion field.
2	**USB Power Delivery** This bit shall be set to one to indicate this platform supports the USB Power Delivery Specification as per the value reported in the bcdPDVersion field.
5:3	**Reserved** Shall be set to zero.
6	**USB Type-C Current** This bit shall be set to one to indicate this platform supports power capabilities defined in the USB Type-C Specification as per the value reported in the bcdUSBTypeCVersion field.
7	**Reserved** Shall be set to zero.
15:8	**bmPowerSource** At least one of the following bits 8, 10 and 14 shall be set to indicate which power sources are supported. **Bit** / **Description** 8 – AC Supply 9 – Reserved and shall be set to zero. 10 – Other 13:11 – Reserved and shall be set to zero. 14 – Uses VBUS 15 – Reserved and shall be set to zero.
31:16	**Reserved** Shall be set to zero.

4.5.7 Get Connector Capability (R)

This command is used to get the capabilities of a connector. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-15: GET_CONNECTOR_CAPABILITY Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_CONNECTOR_CAPABILITY.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field indicates the connector whose capabilities are to be retrieved. A value of zero in this field is illegal.
23	Reserved	41	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-16: GET_CONNECTOR_CAPABILITY Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful set to 0x02 else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

Table 4-17: GET_CONNECTOR_CAPABILTY Data

<table>
<tr><th>Offset (Bits)</th><th>Field</th><th>Size (Bits)</th><th>Description</th></tr>
<tr><td>0</td><td>Operation Mode</td><td>8</td><td>This field shall indicate the mode that the connector can support.
<table>
<tr><th>Bit</th><th>Meaning</th></tr>
<tr><td>0</td><td>Rp only</td></tr>
<tr><td>1</td><td>Rd only</td></tr>
<tr><td>2</td><td>DRP (Rp/Rd)</td></tr>
<tr><td>3</td><td>Analog Audio Accessory Mode (Ra/Ra)</td></tr>
<tr><td>4</td><td>Debug Accessory Mode (Rd/Rd)</td></tr>
<tr><td>5</td><td>USB2</td></tr>
<tr><td>6</td><td>USB3</td></tr>
<tr><td>7</td><td>Alternate Mode</td></tr>
</table></td></tr>
<tr><td>8</td><td>Provider</td><td>1</td><td>This bit is valid only when the operation mode is DRP or Rp only. This bit shall be set to one if the connector is capable of providing power on this connector. [Either PD, USB Type-C Current or BC 1.2)</td></tr>
<tr><td>9</td><td>Consumer</td><td>1</td><td>This bit is valid only when the operation mode is DRP or Rd only. This bit shall be set to one if the connector is capable of consuming power on this connector. [Either PD, USB Type-C Current or BC 1.2)</td></tr>
<tr><td>10</td><td>Swap to DFP</td><td>1</td><td>This bit is valid only when the operation mode is DRP or Rp only or Rd only. This bit shall be set to one if the connector is capable of accepting swap to DFP</td></tr>
<tr><td>11</td><td>Swap to UFP</td><td>1</td><td>This bit is valid only when the operation mode is DRP or Rp only or Rd only. This bit shall be set to one if the connector is capable of accepting swap to UFP</td></tr>
<tr><td>12</td><td>Swap to SRC</td><td>1</td><td>This bit is valid only when the operation mode is DRP. This bit shall be set to one if the connector is capable of accepting swap to SRC</td></tr>
<tr><td>13</td><td>Swap to SNK</td><td>1</td><td>This bit is valid only when the operation mode is DRP. This bit shall be set to one if the connector is capable of accepting swap to SNK</td></tr>
<tr><td>14</td><td>Reserved</td><td>1</td><td>Reserved and shall be set to zero.</td></tr>
</table>

4.5.8 Set CC Operation Mode (O)

This command is used to set the CC operation mode that the OPM wants the connector to operate at. The CC operation mode set by the OPM shall be a subset of the supported operation modes that the PPM reported that the connector can operate at. The effect of this command is to change the USB Type-C state machine that the connector shall operate under.

The value set by this command gets reset when the PPM is reset. If the connector supports being a DRP, the default value on reset is DRP. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-18: SET_CCOM Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to SET_CCOM.
8	Data Length	8	This field shall be set to zero.
16	Connector Number	7	This field indicates the connector whose CC operational mode is to be modified. A value of zero in this field is illegal.
23	CC Operation Mode	3	<table><tr><th>Bit</th><th>Meaning</th></tr><tr><td>0</td><td>If this bit is set then the connector shall operate as Rp Only.</td></tr><tr><td>1</td><td>If this bit is set then the connector shall operate as Rd Only.</td></tr><tr><td>2</td><td>If this bit is set then the connector shall operate as a DRP.</td></tr></table>It is illegal for the OPM to set all these bits to zero. These bits are valid only if Get Connector Capability returns DRP.
26	Reserved	38	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-19: SET_CCOM Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.

Offset (Bits)	Field	Size (Bits)	Description
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.9 Set USB Operation Role (R)

This command is used to set the USB operation role that the OPM wants the connector to operate at, for the current connection. If the connector does not have an active connection, this command has no effect and the command should be failed. If the connector is already in the operation role that is being requested, the command should be completed successfully. If the connector does not support the role requested, this command has no effect and should be failed.

The USB operation role set by the OPM shall be compatible with the current operation mode. If the operation mode is DRP, bit 2 will denote whether connector will accept any data role swaps that may be initiated by the partner.

The execution of this command might require PPM to initiate a data role swap. The PPM might achieve the role swap by using the PD role swap mechanism. The successful completion of this command indicates that a successful connection was established in the new operation mode. If the change of the operation mode did not result in a successful connection, the command should return an error. If the command returns error for any reason, the CC operation mode should remain unchanged. Note that if the execution of the command resulted in a successful data role swap, it should not result in a connector status change notification.

The value set by this command gets reset when either PPM is reset or is power cycled or the remote device gets detached.

This command will return error in these cases – Port Partner rejected Swap, Hard reset occurred while performing this command, or PPM detects policy conflict and sets the Errors Information Field to PPM Policy Conflict.

The format of the CONTROL Data Structure for this command is given in the table below.

Table 4-20: SET_UOR Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to SET_UOR.
8	Data Length	8	This field shall be set to zero.
16	Connector Number	7	This field indicates the connector whose USB operational mode is to be modified. A value of zero in this field is illegal.
23	USB Operation Role	3	<table><tr><th>Bit</th><th>Meaning</th></tr><tr><td>0</td><td>If this bit is set then the connector shall initiate swap to DFP if not already operating in DFP mode.</td></tr><tr><td>1</td><td>If this bit is set then the connector shall initiate swap to UFP if not already operating in UFP mode.</td></tr><tr><td>2</td><td>If this bit is set then the connector shall accept role swap change requests from the port partner. If this bit is cleared then connector shall reject Role Swap change requests from the port partner.</td></tr></table> It is illegal for the OPM to set/clear Bit0 and Bit1 at the same time. This command is valid only if connector supports PD.
26	Reserved	38	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-21: SET_UOR Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.

Offset (Bits)	Field	Size (Bits)	Description
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.10 Set Power Direction Role (R)

This command is used to set the Power direction that the OPM wants the connector to operate at, for the current connection. If the connector does not have an active connection, or the partner is not PD-capable, this command has no effect and the command should be failed. If the power direction is already the one that is being requested the command should be completed successfully. If the connector does not support the role requested, this command has no effect and should be failed. The default behavior prior to execution of this command is to accept power swaps.

The execution of this command might require PPM to initiate a power role swap. If the power role swap fails for any reason, the command returns and error and the power direction should remain unchanged. Note that if the execution of the command resulted in a successful power role swap, it should not result in a connector status change notification.

The value set by this command gets reset when either PPM is reset or is power cycled or the remote device gets detached. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-22: SET_PDR Command

<table>
<tr><th>Offset (Bits)</th><th>Field</th><th>Size (Bits)</th><th>Description</th></tr>
<tr><td>0</td><td>Command</td><td>8</td><td>This field shall be set to SET_PDR.</td></tr>
<tr><td>8</td><td>Data Length</td><td>8</td><td>This field shall be set to zero.</td></tr>
<tr><td>16</td><td>Connector Number</td><td>7</td><td>This field indicates the connector whose Power Direction Role is to be modified.
A value of zero in this field is illegal.</td></tr>
<tr><td>23</td><td>Power Direction Role</td><td>3</td><td><table><tr><th>Bit</th><th>Meaning</th></tr><tr><td>0</td><td>If this bit is set then the connector shall initiate swap to Source, if not already operating as Source</td></tr><tr><td>1</td><td>If this bit is set then the connector shall initiate swap to Sink, if not already operating as Sink</td></tr></table></td></tr>
</table>

Offset (Bits)	Field	Size (Bits)	Description
			2 — If this bit is set then the connector shall accept power swap change requests from the port partner. If this bit is cleared then the connector shall reject power swap change requests from the port partner It is illegal for the OPM to set all these bits to zero.
26	Reserved	38	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-23: SET_PDR Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.11 Get Alternate Modes (O)

This command is used to get the Alternate Modes that the Connector/Cable/Attached Device is capable of supporting. If the Connector/Cable/Attached device does not support the number of Alternate Modes requested, starting from the value in the

Alternate Mode offset field, it shall return only (six times the number of Alternate Mode) bytes to report the number of Alternate Modes it supports.

The format of the CONTROL Data Structure for this command is given in the table belowTable 4-24: .

Example flow for a connector that supports three alternate modes:

1. OPM sends GET_ALTERNATE_MODES to the connector to query the first two alternate modes. Recipient = 0. Alternate Mode Offset = 0. Number of Alternate Modes = 1.
2. PPM returns SVID[0], MID[0], SVID[1], MID[1]. Data length = 0xC (96 bits in GET_ALTERNATE_MODES_DATA = 12 bytes)
3. OPM sends GET_ALTERNATE_MODES again to the connector to query the next two alternate modes. Recipient = 0. Alternate Mode Offset = 2. Number of Alternate Modes = 1.
4. PPM returns SVID[2], MID[2] and leaves the other data fields blank. Data length = 0x6 (48 bits in GET_ALTERNATE_MODES_DATA = 6 bytes).

Table 4-24: GET_ALTERNATE_MODES Command

<table>
<tr><th>Offset (Bits)</th><th>Field</th><th>Size (Bits)</th><th>Description</th></tr>
<tr><td>0</td><td>Command</td><td>8</td><td>This field shall be set to GET_ALTERNATE_MODES.</td></tr>
<tr><td>8</td><td>Data Length</td><td>8</td><td>Set to 0x00.</td></tr>
<tr><td>16</td><td>Recipient</td><td>3</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Connector</td></tr><tr><td>1</td><td>SOP</td></tr><tr><td>2</td><td>SOP’</td></tr><tr><td>3</td><td>SOP”</td></tr><tr><td>4-7</td><td>Reserved. Shall be set to zero.</td></tr></table></td></tr>
<tr><td>19</td><td>Reserved</td><td>5</td><td>Reserved and shall be set to zero.</td></tr>
<tr><td>24</td><td>Connector Number</td><td>7</td><td>This field shall be set to the connector being queried.</td></tr>
<tr><td>31</td><td>Reserved</td><td>1</td><td>Reserved and shall be set to zero.</td></tr>
<tr><td>32</td><td>Alternate Mode Offset</td><td>8</td><td>Starting offset of the first Alternate Mode to be returned.</td></tr>
<tr><td>40</td><td>Number of Alternate Modes</td><td>2</td><td>Number of Alternate Modes to return starting from the Alternate Mode Offset. The number of Alternate Modes to return is the value in this field plus 1. The maximum value of this field is 1.</td></tr>
<tr><td>42</td><td>Reserved</td><td>22</td><td>Reserved and shall be set to zero.</td></tr>
</table>

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-25: GET_ALTERNATE_MODES Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful, set to the number of bytes returned in GET_ALTERNATE_MODES Data up to MAX_DATA_LENGTH. Else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

Table 4-26: GET_ALTERNATE_MODES Data

Offset (Bits)	Field	Size (Bits)	Description
0	SVID[0]	16	Standard or Vendor ID.
16	MID[0]	32	Mode ID for associated with the above SVID.
48	SVID[1]	16	Standard or Vendor ID (If supported).
64	MID[1]	32	Mode ID for associated with the above SVID.

4.5.12 Get Connector Alternate Modes Supported (O)

This command is used to get the list of Alternate Modes that are currently supported on the connector identified by this command. This shall be a subset of the complete list of Alternate Modes that the Connector is capable of supporting if the Alternate Mode resources are being used by some other connector and are not available currently for this connector. The complete list of Alternate Modes that the Connector is capable of supporting is returned by GET_ALTERNATE_MODES with Connector as Recipient. For this command, the list is returned as a bit vector with one bit per Alternate Mode supported in the order that they were returned by the Connector in response to the GET_ALTERNATE_MODES commands.

The PPM shall return floor((Number of Alternate Modes + 7)/8) number of bytes to the OPM in response to this command. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-27: GET_CAM_SUPPORTED Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_CAM_SUPPORTED.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector being queried.
23	Reserved	41	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-28: GET_CAM_SUPPORTED Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful set to ((Number of Alternate Modes Mod 8) + 1) else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this

Offset (Bits)	Field	Size (Bits)	Description
			field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

4.5.13 Get Current Connector Alternate Mode (O)

This command is used to get the current Alternate Mode that the connector is operating in. The format of the CONTROL Data Structure for this command is given in the table below.

Table 4-29: GET_CAM Supported Data

Offset (Bits)	Field	Size (Bits)	Description
0	bmAlternateModeSupported	N	If an Alternate Mode is supported then that bit position shall be set to one. Else it shall be set to zero..
N	ZeroBits	M	If (N Mod 8 == 0) then M = 0, else M = (8 - (N Mod 8)). The PPM shall set these bits to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-30: GET_CURRENT_CAM Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful, set to the number of Alternate Modes that the connector is currently operating in. Else, set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.

Offset (Bits)	Field	Size (Bits)	Description
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

The GET_CURRENT CAM Data structure shall contain the same number of Current Alternate Mode offsets as given in the Data Length field of the GET_CURRENT_CAM Status.

Table 4-31: GET_CURRENT_CAM Data

Offset (Bits)	Field	Size (Bits)	Description
0	Current Alternate Mode[0]	8	First Offset into the list of Alternate Modes that the connector is currently operating in. This is an offset into the list of Alternate Modes supported by the PPM. If the connector is not operating in an alternate mode, the PPM shall set this field to 0xFF.
8	Current Alternate Mode[1]	8	Second offset into the list of Alternate Modes that the connector is currently operating in (if connector is currently operating in multiple Alternate Modes).
16	…	varies	…
N * 8	Current Alternate Mode[N]	8	Final offset into the list of Alternate Modes that the connector is currently operating in (if connector is currently operating in multiple Alternate Modes).

4.5.14 Set New Connector Alternate Mode (O)

This command is used to set the new Alternate Mode that the OPM wants the PPM to operate in. The PPM shall respond with "PPM Busy" on reception of this command if it will take longer than MIN_TIME_TO_RESPOND_WITH_BUSY ms to complete the same. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-32: SET_NEW_CAM Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to SET_NEW_CAM.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector being queried.
23	EnterOrExit	1	This field shall be set to one if the OPM wants to enter this Alternate Mode. This field shall be set to zero if the OPM wants to exit this Alternate Mode.
24	New CAM	8	This field shall be set to an offset into the list of Alternate Modes that the OPM wants the connector to operate in. This shall be an offset into the list of Alternate Modes supported by the PPM.
32	AMSpecific	32	This field shall be set by the OPM as per the requirements of the Standard or Vendor specific Alternate Mode. For example, if the Alternate Mode being changed is the DP Alternate Mode, then this field shall be a byte in length and shall contain the configuration within the DP Alternate Mode that the OPM wants the connector to operate in.

Note: A command to enter an Alternate Mode that has already been entered is not an error and similarly, a command to exit an Alternate Mode that has already been exited is not an error.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-33: SET_NEW_CAM Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.

Offset (Bits)	Field	Size (Bits)	Description
8	Data Length	8	Set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.15 Get PDOs (O)

This command is used to get the Sink or Source PDOs associated with the connector identified with the command. For the connector, this command can be used to get the Source PDOs/Capabilities as defined below:

- Maximum Supported Source Capabilities
- The Maximum Provider Capabilities that the Source can support. These wouldn't change for a connector.
- Current Supported Source capabilities
- The Provider Capabilities that the Source currently supports. These could change dynamically and could be lower than the Maximum Source Capabilities if the system is Reaching Power Budget Limit due to multiple connected Sinks or if the Power Budget has been lowered due to it being unplugged from external power supply.
- Advertised Source Capabilities
- The Provider Capabilities that are advertised by the Source during PD contract negotiation. These could be lower due to the Cable's current carrying capabilities. This is only valid when a port partner is present.

In addition, this command can be used to return the Sink or Source PDOs of the device that is connected to this connector. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-34: GET_PDOS Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_PDOS.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector being queried.
23	Partner PDO	1	This field shall be set to one if the OPM wants to retrieve the PDOS of the device attached to the connector.
24	PDO Offset	8	Starting offset of the first PDO to be returned. Valid values are 0 through 7. Values 8 through 255 shall not be used.
32	Number of PDOs	2	Number of PDOs to return starting from the PDO Offset. The number of PDOs to return is the value in this field plus 1.
34	Source or Sink PDOs	1	This field shall be set to one if the OPM wants to retrieve the Source PDOs otherwise it wants to retrieve the Sink PDOs.
35	Source Capabilities Type	2	This field indicates the type of Source Capabilities requested. This field is valid only if OPM sets Partner PDO to 0 and Source or Sink PDOs to 1. **Value** / **Meaning** 0 – Current Supported Source Capabilities 1 – Advertised Capabilities 2 – Maximum Supported Source Capabilities 3 – Not Used
37	Reserved	27	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-35: GET_PDOS Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to four times the number of PDOs returned up to a maximum of MAX_DATA_LENGTH. If not successful, shall be set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.

Offset (Bits)	Field	Size (Bits)	Description
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully and the Data Length field is not 0x00 then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

Table 4-36: GET_PDO Data

Offset (Bits)	Field	Size (Bits)	Description
0	PDO[0]	32	First PDO at PDO Offset.
32	PDO[1]	32	Next PDO (If present).
64	PDO[2]	32	Next PDO (If present).
96	PDO[3]	32	Next PDO (If present).

If the PPM receives an otherwise valid GET_PDOS Command for which the target cannot provide any PDOs, it shall set the Error Indicator to 0b in the GET_PDOS Status and shall set the Data Length field to 0. The PPM shall not return any GET_PDO data.

If the PPM receives a GET_PDOS Command in which the sum of the PDO Offset field and the Number of PDOs field is greater than 7, it shall set the Error Indicator to 1b in the GET_PDOS Status and shall set the Invalid Command Specific Parameters bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PDOS Command with the Partner PDO field set to 1 when no PD device is attached, it shall set the Error Indicator to 1b in the GET_PDOS Status and shall set the Incompatible Connector Partner bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PDOS command with the Partner PDO field set to 1 when no Connector partner is present, it shall set the Error Indicator to 1b in the GET_PDOS Status and shall set the CC Communication Error bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PDOS Command with the Partner PDOs field set to 0 that is inappropriate for the target (e.g. requesting Source PDOs from a Sink-only target), it shall set the Error Indicator to 1b in the GET_PDOS Status and shall set the Invalid Command Specific Parameters bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PDOS Command with the Partner PDOs field set to 1 that is inappropriate for the target (e.g. requesting Source PDOs from a Sink-only target), it shall set the Error Indicator to 1b in the GET_PDOS Status and shall set the Incompatible Connector Partner bit to 1b in the GET_ERROR_STATUS Data.

4.5.16 Get Cable Property (O)

This command is used to get the Cable properties on the connector identified by this command. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-37: GET_CABLE_PROPERTY Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_CABLE_PROPERTY.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector on which the cable is connected.
23	Reserved	41	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-38: GET_CABLE_PROPERTY Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful set to 0x05 else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.

29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below

Table 4-39: GET_CABLE_PROPERTY Data

<table>
<tr><th>Offset (Bits)</th><th>Field</th><th>Size (Bits)</th><th>Description</th></tr>
<tr><td>0</td><td>bmSpeedSupported</td><td>16</td><td>
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>1:0</td><td>Speed Exponent (SE). This field defines the base 10 exponent times 3, that shall be applied to the Speed Mantissa (SM) when calculating the maximum bit rate that this Cable supports.
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>Bits per second</td></tr>
<tr><td>1</td><td>Kb/s</td></tr>
<tr><td>2</td><td>Mb/s</td></tr>
<tr><td>3</td><td>Gb/s</td></tr>
</table></td></tr>
<tr><td>15:2</td><td>This field defines the mantissa that shall be applied to the SE when calculating the maximum bit rate.</td></tr>
</table>
</td></tr>
<tr><td>16</td><td>bCurrentCapability</td><td>8</td><td>Return the amount of current the cable is designed for in 50ma units.</td></tr>
<tr><td>24</td><td>VBUSInCable</td><td>1</td><td>The PPM shall set this field to a one if the cable has a VBUS connection from end to end.</td></tr>
<tr><td>25</td><td>CableType</td><td>1</td><td>The PPM shall set this field to one if the cable is an Active cable otherwise it shall set this field to zero if the cable is a Passive cable.</td></tr>
<tr><td>26</td><td>Directionality</td><td>1</td><td>The PPM shall set this field to one if the lane directionality is configurable else it shall set this field to zero if the lane directionality is fixed in the cable.</td></tr>
<tr><td>27</td><td>Plug End Type</td><td>2</td><td>
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>USB Type-A</td></tr>
<tr><td>1</td><td>USB Type-B</td></tr>
<tr><td>2</td><td>USB Type-C</td></tr>
<tr><td>3</td><td>Other (Not USB)</td></tr>
</table>
</td></tr>
</table>

Offset (Bits)	Field	Size (Bits)	Description
29	Mode Support	1	This field shall only be valid if the CableType field is set to one. This field shall indicate that the cable supports Alternate Modes. The OPM can use the GET_ALTERNATE_MODE command to get the list of modes this cable supports.
30	Reserved	2	Reserved and shall be set to zero.
32	Latency	4	Refer Table 6-28 in the [USBPD] for additional information on the contents of this field.
36	Reserved	4	Reserved and shall be set to zero.

4.5.17 Get Connector Status (R)

This command is used to get the current status of the connector identified by this command. The format of the CONTROL Data Structure for this command is given in table below.

Table 4-40: GET_CONNECTOR_STATUS Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_CONNECTOR_STATUS.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector on which the cable is connected.
23	Reserved	41	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-41: GET_CONNECTOR_STATUS Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	If successful set to 0x09 else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed	1	Set to 0b.

Offset (Bits)	Field	Size (Bits)	Description
	Indicator		
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

Table 4-42: GET_CONNECTOR_STATUS Data

Offset (Bits)	Field	Size (Bits)	Description
0	Connector Status Change	16	A bitmap indicating the types of status changes that have occurred on the connector. Refer to Table 4-43: Table 4-43 for a description of each bit.
16	Power Operation Mode	3	This field is only valid when the Connect Status field is set to one. This field shall indicate the current power operation mode of the connector. **Value** / **Meaning** 0 – Reserved 1 – USB Default Operation 2 – BC 3 – PD 4 – USB Type-C Current – 1.5A 5 – USB Type-C Current – 3A 6-7 – Reserved
19	Connect Status	1	This field indicates the current connect status of the connector. This field shall be set to one when a device is connected to this connector.
20	Power Direction	1	This field is only valid when the Connect Status field is set to one. The field shall indicate whether the connector is operating as a consumer or provider.

<table>
<tr><th>Offset (Bits)</th><th>Field</th><th>Size (Bits)</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>Connector is operating as a consumer</td></tr>
<tr><td>1</td><td>Connector is operating as a provider</td></tr>
</table>
</td></tr>
<tr><td>21</td><td>Connector Partner Flags</td><td>8</td><td>This field is only valid when the Connect Status field is set to one. This field indicates the current mode the connector is operating in.
<table>
<tr><th>Bit</th><th>Meaning</th></tr>
<tr><td>0</td><td>USB</td></tr>
<tr><td>1</td><td>Alternate Mode</td></tr>
<tr><td>2-7</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>29</td><td>Connector Partner Type</td><td>3</td><td>This field is only valid when the Connect Status field is set to one. This field indicates the type of connector partner detected on this connector.
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>Reserved</td></tr>
<tr><td>1</td><td>DFP attached</td></tr>
<tr><td>2</td><td>UFP attached</td></tr>
<tr><td>3</td><td>Powered cable/No UFP attached</td></tr>
<tr><td>4</td><td>Powered cable/UFP attached</td></tr>
<tr><td>5</td><td>Debug Accessory attached</td></tr>
<tr><td>6</td><td>Audio Adapter Accessory attached</td></tr>
<tr><td>7</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>32</td><td>Request Data Object (O)</td><td>32</td><td>This field is only valid when the Connect Status field is set to one and the Power Operation Mode field is set to PD. Additionally, this is an optional field, and is valid only if the PPM has indicated support for the appropriate feature, as described in the Section 4.5.6. This field shall return the currently negotiated power level. Refer Tables 6-13, 6-14, 6-15 and 6-16 in the in the [USBPD] for additional information on the contents of this data structure.</td></tr>
<tr><td>64</td><td>Battery Charging Capability Status</td><td>2</td><td>This field is only valid if the connector is operating as a Sink. Slow or very slow charging rate shall be indicated only if the PPM determines that the currently negotiated contract (or current level) is not sufficient for nominal charging rate.
As an example, if the nominal charging rate capability is 45 W:
Slow charging rate capability is indicated when the</td></tr>
</table>

Offset (Bits)	Field	Size (Bits)	Description
			negotiated power level is between 27W and 45W Very slow charging rate capability is indicated when the negotiated power level is between 15W and 27W No charging capability is indicated when the negotiated power level is less than 15W **Value** / **Meaning** 0 – Not charging 1 – Nominal charging rate 2 – Slow charging rate 3 – Very slow charging rate
66	Provider Capabilities Limited Reason	4	A bitmap indicating the reasons why the Provider capabilities of the connector have been limited. This field is only valid if the connector is operating as a provider. If the PPM has lowered the capabilities but the reason doesn't fall into any of the predefined categories, it can choose to not set any of these bits. Also if the Provider Capabilities change and are no longer limited, the PPM shall clear these bits. Refer [USBPD] for description of each bit.
70	bcdPDVersion Operation Mode	16	This field indicates the USB Power Delivery Specification Revision Number the connector uses during an Explicit Contract (as described in the [USBPD] and the format is in Binary-Coded Decimal Example, Revision 3.0 is 300H. This field shall only be valid if Power Operation Mode field is set to PD. Additionally, this is an optional field, and is valid only if the PPM has indicated support for the appropriate feature, as described in the Section 4.5.6.
86	Reserved	42	Reserved and shall be set to zero.

Table 4-43: Connector Status Change Field Description

Bit	Description
0	**Reserved** Shall be set to zero.
1	**External Supply Change** When set, the OPM can get the current status of the supply attached to the PPM by using the GET_PDO command.
2	**Power Operation Mode Change** When set the Power Operation Mode field in the STATUS Data Structure shall indicate the

Bit	Description
	current power operational mode of the connector.
3	**Reserved** Shall be set to zero.
4	**Reserved** Shall be set to zero.
5	**Supported Provider Capabilities Change** When set, the OPM shall get the updated Power Data Objects by using the GET_PDOS command. The Supported Provider Capabilities Limited Reason field shall indicate the reason if the provider capabilities are limited.
6	**Negotiated Power Level Change** When set, the Request Data Object field in the STATUS Data Structure shall indicate the newly negotiated power level. Note that this bit shall be set by the PPM whenever a Power contract is established or renegotiated.
7	**PD Reset Complete** This field shall be set when the PPM completes a PD Hard Reset requested by the connector partner.
8	**Supported CAM Change** When set, the OPM shall get the updated Alternate Modes supported by using the GET_CAM_SUPPORTED command.
9	**Battery Charging Status Change** This bit will be set when the Battery Charging status changes.
10	**Reserved** Shall be set to zero.
11	**Connector Partner Changed** This shall be set when the Connector Partner Type field or Connector Partner Flags change.
12	**Power Direction Changed** This shall be set when the PPM completes a Power Role Swap requested by the connector partner or due to the PPM autonomously performing a Power Role Swap or as a side effect of the OPM issuing a Data Role Swap command. The Power Direction field in the STATUS Data Structure shall indicate the new Power Role.
13	**Reserved** Shall be set to zero.
14	**Connect Change** When set, the Connect Status field in the STATUS Data Structure shall indicate whether a device is attached to the connector. In addition the Operation Mode field in the STATUS Data Structure shall indicate the current operational mode of the connector.
15	**Error** When set, this field shall indicate that an unknown error has occurred on the connector.

Table 4-44: Provider Capabilities Limited Reason Field Description

Bit	Description
0	**Power Budget Lowered** When set, indicates that the Power Budget for the PPM has been lowered due to it being unplugged from an External Supply.
1	**Reaching Power Budget Limit** When set, indicates that the PPM is reaching the Power Budget Limit due to too many connected Sink devices.
2	**Reserved** Shall bet set to zero.
3	**Reserved** Shall bet set to zero.

4.5.18 Get Error Status (R)

This command is used to get details about an error, if one is reported by the PPM. The OPM may send this command to get additional details on why a command failed, which is indicated by the PPM by completing the command with the Error Indicator set. The OPM may also send this command to get additional details on the error associated with a connector change event with the Error bit set. In either case, the PPM may clear the Error Status Data after the OPM has acknowledged the command completion or connector change notification, or after receiving a PPM_RESET Command but not before. The format of the CONTROL Data Structure for this command is given in the table below.

Table 4-45: GET_ERROR_STATUS Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to GET_ERROR_STATUS.
8	Data Length	8	Set to 0x00.
16	Reserved	48	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-46: GET_ERROR_STATUS Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.

Offset (Bits)	Field	Size (Bits)	Description
8	Data Length	8	If successful set to GET_ERROR_STATUS_DATA_LENGTH else set to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	Set to 0b.
31	Command Completed Indicator	1	Set this field to a 1b.

If the command completed successfully then the PPM shall set the MESSAGE IN Data Structure as described in the table below.

Table 4-47: GET_ERROR_STATUS Data

Offset (Bits)	Field	Size (Bits)	Description
0	Error Information	16	This field indicates the reason for the error reported by the PPM.

Bit	Meaning
0	Unrecognized command
1	Non-existent connector number
2	Invalid command specific parameters
3	Incompatible connector partner
4	CC communication error
5	Command unsuccessful due to dead battery condition
6	Contract negotiation failure
7	Overcurrent
8	Undefined
9	Port partner rejected swap
10	Hard Reset

Offset (Bits)	Field	Size (Bits)	Description
			Bit / Meaning 11 – PPM Policy Conflict 12 – Swap Rejected 15:13 – Reserved and shall be set to zero.
16	Vendor Defined	N	This contents of this filed are vendor specific.
16+N	Reserved	112-N	Reserved and shall be set to zero.

4.5.19 Set Power Level (O)

This command is used by the OPM to set the maximum negotiable power level of Sink or Source associated with the connector identified with the command, for the current connection. If the connector does not have an active connection, this command has no effect and the PPM shall set the Error Information field to indicate Invalid Command Specific Parameters. If the power direction of the current connection does not match the command, this command has no effect and the PPM shall set the Error Information field to indicate Invalid Command Specific Parameters. The default behavior prior to execution of this command is PPM determining the maximum negotiable power level of the connector.

If the PPM receives a SET_POWER_LEVEL command while there is an active connection, the PPM shall notify the OPM that it has completed the command and then renegotiate a power contract if necessary.

Note: If the PPM negotiates a new power contract after receiving a SET_POWER_LEVEL command and the new power contract is for a power level that is different than the previous power level, the PPM will send a Negotiated Power Level Change notification (if supported).

The format of the CONTROL Data Structure for this command is given in the table below. The port may offer other Type-C Current or PDO(s) with lower power capability than the maximum negotiable power level within this command.

The value set by this command is reset when one of the following occurs:

1. PPM is reset
2. PPM is power cycled
3. Connector is reset
4. Connector is detached

Setting the value of the “Max Power” field to 0xFF would disable this command and result in PPM determining the maximum negotiable power level of the connector. If the PPM detects a policy conflict (for example, the maximum negotiable power level identified within this command cannot be supported by the PPM), the PPM shall set the Error Information field to indicate PPM Policy Conflict.

Table 4-48: SET_POWER_LEVEL Command

Offset (Bits)	Field	Size (Bits)	Description
0	Command	8	This field shall be set to SET_POWER_LEVEL.
8	Data Length	8	Set to 0x00.
16	Connector Number	7	This field shall be set to the connector being queried. A value of zero in this field indicates USB PD Max Power field indicates the total power for all ports.
23	Source or Sink	1	This field shall be set to one if the OPM wants to set the Source power level otherwise it wants to set the Sink power level.
24	USB PD Max Power	8	This field shall indicate the maximum negotiable power level the connector shall advertise/request in 0.5W unit. This field shall only be valid for USB PD capable connectors. If this field is set to 0x00 then the PPM shall determine the maximum negotiable power level of the connector by itself.
32	USB Type-C Current	2	This field shall indicate the maximum current the connector shall advertise/consume. This field shall be set to zero when the Connector Number field is set to zero. **Value** / **Meaning** 0 – PPM defined default 1 – 3A 2 – 1.5A 3 – USB Type-C Default
34	Reserved	30	Reserved and shall be set to zero.

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-49: SET_POWER_LEVEL Status

Offset (Bits)	Field	Size (Bits)	Description
0	Reserved	1	Reserved and shall be set to zero.
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	Set to 0x00
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b.

Offset (Bits)	Field	Size (Bits)	Description
26	Cancel Completed Indicator	1	Set to 0b.
27	Reset Completed Indicator	1	Set to 0b.
28	Busy Indicator	1	Set to 0b. If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero.
29	Acknowledge Command Indicator	1	Set to 0b.
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b.
31	Command Completed Indicator	1	Set this field to a 1b.

4.5.20 Get PD Message (O)

This command is used by the OPM to retrieve the USB Power Delivery response message of the identified connector, the port partner, or the cable plug of the identified connector.

There are two scenarios of the OPM retrieving a USB PD response message from the PPM:

If the OPM wants to retrieve a USB PD response message from the port partner or the cable plug of the identified connector, the PPM requests data by sending the appropriate request message. For example, when the OPM sends a GET_PD_MESSAGE command with the Response Message Type field set to Sink_Capabilities_Extended and the Recipient field is set to 1, the PPM sends the Get_Sink_Cap_Extended to the port partner using SOP then returns the Sink_Capabilities_Extended response message. This process applies to the messages provided in the Response Message Type field in GET_PD_MESSAGE Command.

If the OPM wants to retrieve a USB PD response message from the identified connector, the PPM returns the response message that the platform would send upon receiving the corresponding request message from its port partner.

For example, when the OPM sends a GET_PD_MESSAGE command with the Response Message Type field set to Sink_Capabilities_Extended and the Recipient field is set to 0, the PPM returns the Sink Capabilities Extended response message that the platform would send upon receiving the Get_Sink_Cap_Extended. This process applies to the messages provided in the Response Message Type field in GET_PD_MESSAGE Command.

The following rules shall be followed when the OPM sends GET_PD_MESSAGE command with Recipient field set to 1, 2 or 3:

- When the OPM sends a GET_PD_MESSAGE command with the Message Offset field set to 0 and the Recipient field set to 1, 2 or 3, the PPM shall initiate sending a USB PD request message and return the new USB PD response message.

- The PPM shall return a cached response message when it receives GET_PD_MESSAGE Command with the Message Offset field set to non-zero value and Recipient field set to 1, 2 or 3. If the PPM does not have a cached response message (because the OPM has not sent GET_PD_MESSAGE command for the corresponding response message with Message Offset field set to 0), then the PPM shall set the Error Indicator bit to 1b in the GET_PD_MESSAGE Status and shall set the CC Communication Error bit to 1b in the GET_ERROR_STATUS Data.

Table 4-50: GET_PD_MESSAGE Command

Offset (bits)	Field	Size (bits)	Description
0	Command	8	This field shall be set to GET_PD_MSG
8	Data Length	8	Shall be set to 0x0
16	Connector Number	7	This field shall be set to the connector being queried
23	Recipient	3	This field shall be set to zero if the OPM wants to retrieve the USB PD response message from the identified connector. This field shall be set to 1, 2 or 3 if the OPM wants to retrieve the USB PD response message from either the port partner or the cable plug of the identified connector. This field shall provide a valid Start of Packet (SOP*) that matches the Response Message Type field as specified in Chapter 6 of [USBPD] (e.g. the only valid Recipient value, which is non-zero, for Sink_Capabilities_Extended response message is SOP). 0: Connector 1: SOP 2: SOP’ 3: SOP’’ 4-7: Reserved
26	Message Offset	8	This field indicates the starting offset (in bytes) of the message to be returned. If the response message is an Extended Message, then the valid values are less than the Data Size in the Extended Message header (as defined in [USBPD]). If the response message is a Data Message or a Structured VDM, then the valid values are multiples of four that are less than four times the Number of Data Objects in the message.
34	Number of Bytes	8	This field indicates the number of bytes to return starting from the offset. Valid values in this field are less than or equal to MAX_DATA_LENGTH. If the response message is a Data Message, then the valid values are non-zero multiples of four.

<table>
<tr><th>Offset (bits)</th><th>Field</th><th>Size (bits)</th><th>Description</th></tr>
<tr><td>42</td><td>Response Message Type</td><td>6</td><td>
<table>
<tr><th>Value</th><th>PD Response Message</th><th>Corresponding PD Request Message</th></tr>
<tr><td>0</td><td>Sink_Capabilities_Extended (Extended Message)</td><td>Get_Sink_Cap_Extended</td></tr>
<tr><td>1</td><td>Source_Capabilities_Extended (Extended Message)</td><td>Get_Source_Cap_Extended</td></tr>
<tr><td>2</td><td>Battery_Capabilities (Extended Message)</td><td>Get_Battery_Cap</td></tr>
<tr><td>3</td><td>Battery_Status (Data Message)</td><td>Get_Battery_Status</td></tr>
<tr><td>4</td><td>Discover Identity Response – ACK, NAK or BUSY (Structured VDM)</td><td>Discover Identity Request</td></tr>
<tr><td>5-63</td><td>Reserved</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>48</td><td>Reserved</td><td>16</td><td>Reserved and shall be set to zero.</td></tr>
</table>

On successful completion of the command the PPM shall set the CCI Data Structure as described in the table below.

Table 4-51: GET_PD_MESSAGE Status

Offset (bits)	Field	Size (bits)	Description
0	Reserved	1	Reserved and shall be set to zero
1	Connector Change Indicator	7	If an asynchronous event occurred on a connector then the PPM shall set this field to the connector number on which the change occurred.
8	Data Length	8	The PPM shall set this field to the number of bytes returned. This field shall not exceed the value in the Number of Bytes field in the GET_PD_MESSAGE command. When the value in this field is zero or less than the Number of Bytes field in the GET_PD_MESSAGE command, it indicates that the OPM has requested more data than the PPM can return. For example, if the OPM assumes a revision of [USBPD] that defines a larger data size. If the command was not successful or there isn't any data to be returned, the PPM shall set this field to 0x00.
16	Reserved	9	Reserved and shall be set to zero.
25	Not Supported Indicator	1	Set to 0b

Offset (bits)	Field	Size (bits)	Description
26	Cancel Completed Indicator	1	Set to 0b
27	Reset Completed Indicator	1	Set to 0b
28	Busy Indicator	1	If the PPM is Busy then the PPM shall set this field to a 1b and all other fields to zero. Otherwise, set to 0b.
29	Acknowledge Command Indicator	1	Set to 0b
30	Error Indicator	1	If the command was not successfully completed the PPM shall set this field to 1b
31	Command Completed Indicator	1	Set to 1b

If the command completed successfully and the Data Length field (in GET_PD_MESSAGE Status) is not 0x00 then the PPM shall return the entire Data Block of Extended Message, the Data Object(s) of Data Message, or the VDM Header and Object(s) of Structured VDM Command in the MESSAGE IN Data Structure. Note that the PPM shall not include Message Header and Extended Message Header (as defined by [USBPD]) in the MESSAGE IN Data Structure. The PPM shall return the entire Data Block of the Extended Message in one whole message in the MESSAGE IN Data Structure i.e. the PPM shall merge a Chunked Extended Message before returning as a PD response message.

Table 4-52 and Table 4-53 provide examples that assume the identified connector supports USB Power Delivery Rev3.0 Ver2.0 and the Data Size of *Sink Capabilities Extended* message is 21 bytes. If the PPM receives a GET_PD_MESSAGE Command in which the *Response Message Type* is Sink Capabilities Extended, the Message Offset is 0 and the Number of Bytes is 16, then the PPM sets the Data Length field (in GET_PD_MESSAGE Status) to 16 and the MESSAGE IN Data Structure as described in the [USBPD]. If the PPM receives a GET_PD_MESSAGE Command in which the Response Message Type is Sink Capabilities Extended, the Message Offset is 16 and the Number of Bytes is more than 5, then the PPM sets the Data Length field (in GET_PD_MESSAGE Status) to 5 and the MESSAGE IN Data Structure as described in the Table 4-53.

Table 4-52: GET_PD_MESSAGE Data (Example: 1st Part of Sink Capabilities Extended)

Offset (bits)	Field	Size (bits)	Description
0	VID	16	Refer to [USBPD]
16	PID	16	Refer to [USBPD]
32	XID	32	Refer to [USBPD]
64	FW Version	8	Refer to [USBPD]
72	HW Version	8	Refer to [USBPD]
80	SKEDB Version	8	Refer to [USBPD]

Offset (bits)	Field	Size (bits)	Description
88	Load Step	8	Refer to [USBPD]
96	Sink Load Characteristics	16	Refer to [USBPD]
112	Compliance	8	Refer to [USBPD]
120	Touch Temp	8	Refer to [USBPD]

Table 4-53: GET_PD_MESSAGE Data (Example: 2nd Part of Sink Capabilities Extended)

Offset (bits)	Field	Size (bits)	Description
0	Battery Info	8	Refer to [USBPD]
8	Sink Modes	8	Refer to [USBPD]
16	Sink Minimum PDP	8	Refer to [USBPD]
24	Sink Operational PDP	8	Refer to [USBPD]
32	Sink Maximum PDP	8	Refer to [USBPD]

If the PPM receives a GET_PD_MESSAGE Command with the Recipient field set to 1, 2 or 3 and a port partner is not present, it shall set the Error Indicator bit to 1b in the GET_PD_MESSAGE Status and shall set the CC Communication Error bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PD_MESSAGE Command with the Recipient field set to 1, 2 or 3 and the responder either responds with an Ignored Message (as defined in [USBPD]) or a Not Supported Message, then the PPM shall set the Error Indicator bit to 1b in the GET_PD_MESSAGE Status and shall set the Incompatible Connector Partner bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PD_MESSAGE Command with the Recipient field set to 0 and the USB PD request message is not supported by the connector, then the PPM shall set the Error Indicator bit to 1b in the GET_PD_MESSAGE Status and shall set the Invalid Command Specific Parameters bit to 1b in the GET_ERROR_STATUS Data.

If the PPM receives a GET_PD_MESSAGE Command with an invalid Start of Packet (SOP*) (as specified in Chapter 6 of [USBPD] in the Recipient field, then the PPM shall set the Error Indicator bit to 1b in the GET_PD_MESSAGE Status and shall set the Invalid Command Specific Parameters bit to 1b in the GET_ERROR_STATUS Data.

4.6 Optional Features

Features are groups of commands and/or notifications that the PPM may optionally support. The bmOptionalFeatures field in the GET_CAPABILITY Data indicates which optional features the PPM supports. This section lists the optional features, and the commands and/or notifications associated with each.

Table below describes each of the bits in the bmOptionalFeatures field in GET_CAPABILITY Data. Each bit corresponds to a Feature, which is described in the a subsequent section.

Table 4-54: bmOptionalFeatures Field Description

Bit	Description
0	SET_CCOM supported
1	SET_POWER_LEVEL supported
2	Alternate mode details supported
3	Alternate mode override supported
4	PDO details supported
5	Cable details supported
6	External supply notification supported
7	PD reset notification supported
8	GET_PD_MESSAGE supported

4.6.1 SET_CCOM Supported

This feature indicates that the PPM supports the SET_CCOM command.

If the SET_CCOM Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives a SET_CCOM command.

4.6.2 SET_POWER_LEVEL Supported

This feature indicates that the PPM supports the SET_POWER_LEVEL command.

If the SET_POWER_LEVEL Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives a SET_POWER_LEVEL command.

4.6.3 Alternate Mode Details Supported

This feature indicates that the PPM can report details about supported alternate modes to the OPM. The following commands may be used by the OPM:

- GET_ALTERNATE_MODES
- GET_CAM_SUPPORTED
- GET_CURRENT_CAM

The following notifications are also supported, and may be enabled by the OPM:

- Supported CAM Change

If the Alternate Mode Details Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives a GET_ALTERNATE_MODES, GET_CAM_SUPPORTED, or GET_CURRENT_CAM command.

4.6.4 Alternate Mode Override Supported

This feature indicates that the PPM allows the OPM to change the currently negotiated alternate mode using the SET_NEW_CAM command.

If the Alternate Mode Override Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives SET_NEW_CAM command.

4.6.5 PDO Details Supported

This feature indicates that the PPM can report details of Power Delivery Power Data Objects to the OPM. The following commands may be used by the OPM:

- GET_PDOS

If the PDO Details Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives GET_PDOS command.

The following notifications are also supported, and may be enabled by the OPM:

- Negotiated Power Level Change
- Supported Provider Capabilities Change

The Request Data Object field in the GET_CONNECTOR_STATUS Data will be valid.

4.6.6 Cable Details Supported

This feature indicates that the PPM supports the GET_CABLE_PROPERTY command. If the Cable Details Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives GET_CABLE_PROPERTY command.

4.6.7 External Supply Notification Supported

This feature indicates that the PPM supports the External Supply Change notification.

4.6.8 PD Reset Notification Supported

This feature indicates that the PPM supports the PD Reset notification.

4.6.9 GET_PD_MESSAGE Supported

This feature indicates that the PPM supports the GET_PD_MESSAGE command. If the GET_PD_MESSAGE Supported bit in the bmOptionalFeatures field is 0b, the PPM shall set the Not Supported Indicator in the CCI Data Structure if it receives GET_PD_MESSAGE command.

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Appendix A Values of Constants

A.1 Commands

Table A 1: Command Code

Command	Value
RESERVED	0x00
PPM_RESET	0x01
CANCEL	0x02
CONNECTOR_RESET	0x03
ACK_CC_CI	0x04
SET_NOTIFICATION_ENABLE	0x05
GET_CAPABILITY	0x06
GET_CONNECTOR_CAPABILITY	0x07
SET_UOM	0x08
SET_UOR	0x09
SET_PDM (obsolete)	0x0A
SET_PDR	0x0B
GET_ALTERNATE_MODES	0x0C
GET_CAM_SUPPORTED	0x0D
GET_CURRENT_CAM	0x0E
SET_NEW_CAM	0x0F
GET_PDOS	0x10
GET_CABLE_PROPERTY	0x11
GET_CONNECTOR_STATUS	0x12
GET_ERROR_STATUS	0x13

Table A 2: Parameter values

CONSTANT	Minimum Value	Maximum Value
MAX_DATA_LENGTH	N/A	0x10
MAX_NUM_ALT_MODE	N/A	0x80
MIN_TIME_TO_RESPOND_WITH_BUSY	0x0A	N/A
GET_ERROR_STATUS_DATA_LENGTH	N/A	0x10

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