USB Type-C ENGINEERING CHANGE NOTICE
Title: USB4™ VDO Response Clarification
Applied to: USB Type-C® Specification Release 2.1, May 2021

Brief description of the functional changes proposed:

Adds clarification to help implementers to know that for the USB4 discovery flow managed by the DFP, a response from the UFP (port partner) with either UFP or DFP VDO are intended to be used to establish if the port partner is USB4 capable.

Also added is a new appendix that provides guidance on the intended use of UFP/DFP Product Types and VDOs.

Benefits as a result of the proposed changes:

Prior to this clarification, an implementer might only look for UFP VDO from its UFP port partner to make the USB4 capability determination which could therefore result in a USB4-capable host connected as a UFP during this process to be ignored if it only responds Discover_ID(SOP) with a DFP VDO.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:

Unless existing products are updated, they may continue to not recognize certain USB4-capable hosts, these being hosts that are not DRD and therefore do not respond to Discover_ID(SOP) with UFP VDO.

An analysis of the hardware implications:

For products that don't currently examine received DFP VDOs to determine USB4 capabilities, updates to the USB Type-C port controller logic and USB PD firmware will need to be updated.

An analysis of the software implications:

Presumed that this will not impact software.

An analysis of the compliance testing implications:

Believe that existing certification test procedures will not need to be changed because of this clarification. Some products may be failing the Enter_USB4 testing and once they align with this update, these failures may be reduced.

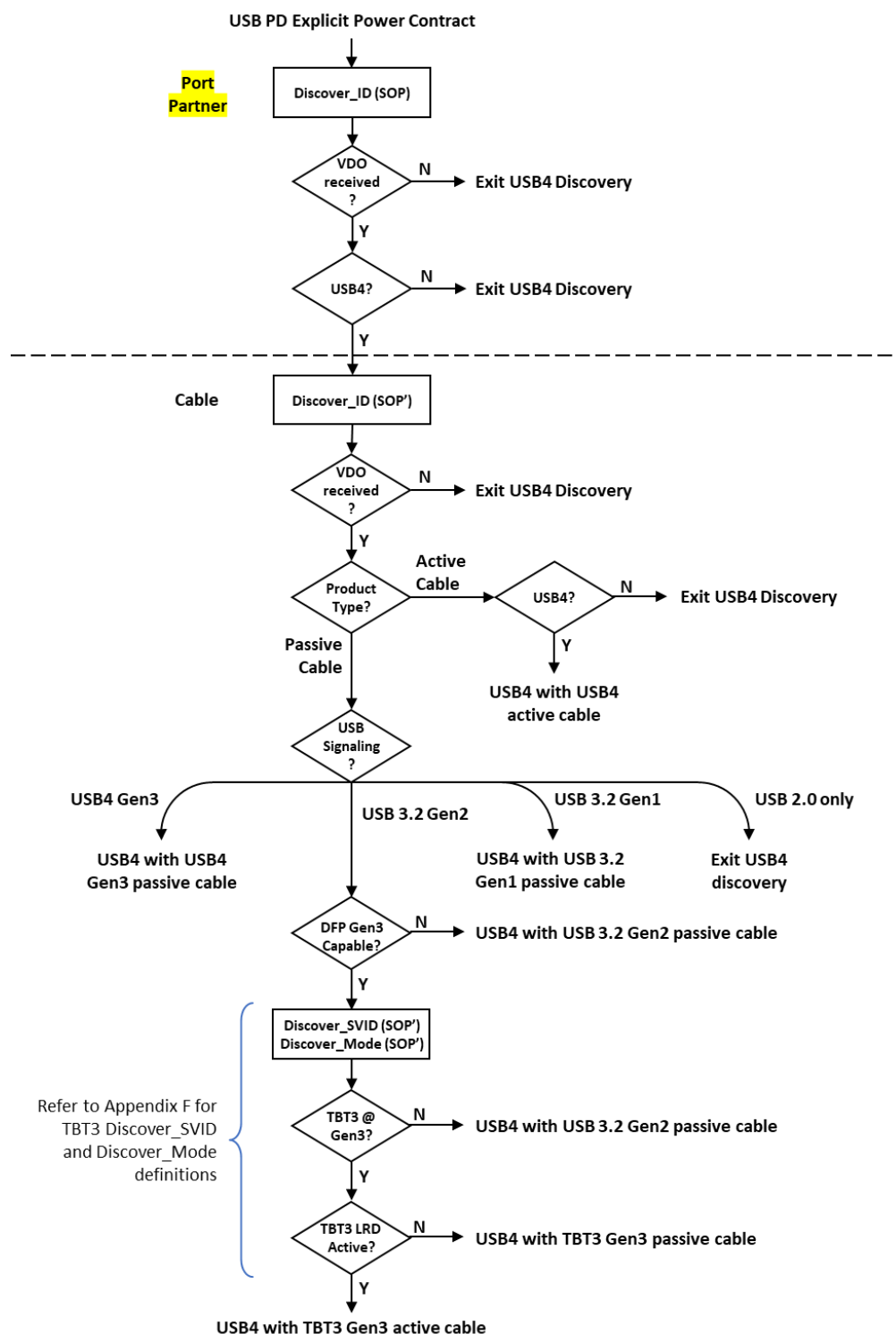# USB Type-C ENGINEERING CHANGE NOTICE

Actual Change Requested

Changes <mark>highlighted</mark> in modified text and figures

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5.4.3   USB4 Discovery and Entry Flow

Figure 5-1 illustrates the basic flow model for *USB4* discovery and entry.

Figure 5-1 USB4 Discovery and Entry Flow Model

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5.4.3.1　　USB4 Port Partner Discovery (SOP)

USB4 port partner discovery shall occur only after having a negotiated USB PD Explicit Contract.

USB4 port partner discovery involves the use of the USB PD Discover ID process between the DFP and its port partner (SOP).

The USB4 port partner to be discovered can be any data-capable product presenting itself as the UFP port partner during the discovery process. Depending on the type and capabilities of the port partner, either or both UFP and DFP VDOs may be returned in response to the DFP's USB PD Discover_ID(SOP) command. As long as at least one of those VDOs are received, then the DFP should proceed to assess its port partner's ability to support USB4 operation based on the content of the VDOs received. For a received UFP VDO, this is based on the Device Capability Field (B27…24) and for a received DFP VDO, this is based on the Host Capability Field (B26…24).

Refer to Appendix I for more information and guidance on the use of UFP and DFP Product Types and VDOs.

Add new Appendix I as follows:

I　　USB PD Encoding Guidelines for USB Type-C Product Types

This appendix provides guidance for the use of the UFP and DFP product types and UFP and DFP VDO responses for USB Type-C product examples. Refer to Section 6.4.4.3.1 (Discover Identity) in the USB Power Delivery specification for more information.

I.1　　USB Type-C Product Type Definitions and USB PD Encodings

When establishing a USB Type-C connection, the Discover Identity command may be received over the link between the two products being connected. It should be noted that an Explicit Contract must already exist between the port partners before the Discover Identity command may be initiated by either product.

The product that receives a Discover Identity Command responds with a Discover Identity Command ACK which will contain multiple pieces of information including the Product Types for its UFP, DFP or both (depending on applicability) and its UFP VDO, DFP VDO or both (depending on applicability). The encoding information described below and used in the tables that follow is only a portion of the overall Command ACK response – refer to the USB PD specification for the complete Discover Identity Command ACK response requirements.

When a product has multiple USB Type-C ports, these definitions are specific to the port that is being queried by its port partner. Typically, a product with multiple ports will expose the same functionality across all of its ports but there are some situations where this isn't the case, for example, a hub will describe its upstream port differently than its collection of downstream ports. In some cases, a port may have a special purpose that is not equivalent to the other exposed ports, for example, a user-identifiable port dedicated to charging a product whereas the other port or ports have data capabilities.

In this appendix, the following Discover Identity Command ACK response items are included.

- **UFP Product Types** (Ref. USB PD Section 6.4.4.3.1.1.3)
  - **Undefined** (000b) – The responding port is not a UFP, i.e., it has no device function or device controller connected to this port. This port also does not consume power although it may connect as a Sink for the purpose of establishing a functional relationship with a Source.
  - **PDUSB Hub** (001b) – The responding port has only upstream hub functionality connected to this port. No other device function or device controller is connected to this port. *The response needs to also include a UFP VDO.*

- o **PDUSB Peripheral** (010b) – The responding port has at least one device function or device controller connected to this port. *The response needs to also include a UFP VDO.*
- o **PSD** (011b) – The responding port has no data functionality but does consume power via this port.

- **DFP Product Types** (Ref. *USB PD* Section 6.4.4.3.1.1.6)
  - o **Undefined** (000b) – The responding port is not a DFP, i.e., it had no host controller or hub downstream functionality connected to this port. This port also does not supply power to its port partner.
  - o **PDUSB Hub** (001b) – The responding port has downstream hub functionality. *The response needs to also include a DFP VDO.*
  - o **PDUSB Host** (010b) – The responding port has a host controller connected to this port. *The response needs to also include a DFP VDO.*
  - o **Power Brick** (011b) – The responding port has no data functionality but does supply power via this port. *The response needs to also include a DFP VDO.*

- **UFP VDO – Device Capability** (Ref. *USB PD* Section 6.4.4.3.1.4)
  - o **USB 2.0 Device Capable** – The responding port has at least one *USB 2.0* device function or device controller. This bit is specific to all device function types except a *USB 2.0* Billboard Device Class function. When the *USB 3.2* Device Capable bit is set, this bit is required to be set as well. When the *USB4* Device Capable bit is set, this bit may or may not be set depending on if at least one of the *USB4* Device Capable functions maps to a *USB 2.0* Device Class function.
  - o **USB 2.0 Billboard only** – this bit is specific to the presence or not of a *USB 2.0* Billboard Device Class function. Other *USB 2.0* Device Capable functions may or may not exist, and if such a function does exist, the *USB 2.0* Device Capable bit will be used to indicate this.
  - o **USB 3.2 Device Capable** – The responding port has at least one *USB 3.2* device function or device controller. When the *USB4* Device Capable bit is set, this bit may or may not be set depending on if at least one of the *USB4* Device Capable functions maps to a *USB 3.2* Device Class function.
  - o **USB4 Device Capable** – The responding port is connected to the upstream port of a USB4 device router with one or more *USB4* peripheral functions (i.e., *USB3*, DisplayPort or PCIe).

- **UFP VDO – Highest Speed** (Ref. *USB PD* Section 6.4.4.3.1.4)
  - o 000b = **USB 2.0 only**, no SuperSpeed USB support.
  - o 001b = **USB 3.2 Gen1** – *USB 2.0* is also supported.
  - o 010b = **USB 3.2 Gen2 / USB4 Gen2** – *USB 2.0* and *USB 3.2* Gen1 are also supported. This encoding is used both for *USB 3.2* Gen2 or *USB4* Gen2 products, and if for a *USB4* Gen2 product, USB 3.2 Gen2 is also supported.
  - o 011b = **USB4 Gen3** – *USB 2.0*, *USB 3.2* Gen1, *USB 3.2* Gen2 and *USB4* Gen2 are also supported.

- **DFP VDO – Host Capability** (Ref. *USB PD* Section 6.4.4.3.1.5)
  - o **USB 2.0 Host Capable** – The responding port is connected to the downstream side of a *USB 2.0* host controller. When either the *USB 3.2* Host Capable or *USB4* Host Capable bits are set, this bit is required to be set as well.
  - o **USB 3.2 Host Capable** – The responding port is connected to the downstream side of a *USB 3.2* host controller. When the *USB4* Host Capable bit is set, this bit is required to be set as well.
  - o **USB4 Host Capable** – The responding port is connected to the downstream side of a *USB4* host or device router.

I.2 USB PD Encoding Guideline Tables

Table I-1 lists examples of USB Type-C-based products and provides brief clarifying notes for each. All of the included product examples implement *USB PD* as either a Source, Sink or both, and will use *USB PD* for other functional configuration (*USB4*, Alternate Modes, etc.) as appropriate to the product. This list of examples is not exhaustive and other valid combinations of features can also be described by the available *USB PD* encodings. Products that don't implement *USB PD* are not relevant to these guidelines.

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Table I-2 lists the same examples (in the same order as **Table I-1**) and provides the recommended _USB PD_ encoding information for the UFP and DFP Product Types along with the UFP and DFP VDOs fields associated with those product types.

Notes for these tables:

1. DC = USB Device Controller. This controller provides access to either _USB 2.0_, _USB 3.2_ or _USB4_ peripheral functionality when the port is operating in its UFP data role.

2. Upstream and Downstream are in reference to the physical port locations on either a hub or dock product. By definition, a hub has only one identifiable upstream port and will have one or more downstream ports. Docks included here are hubs with extended functionality.

3. For product types: PSDs are power sinks only and don't support a UFP data connection; Power Bricks are power sources only and don't support a DFP data connection.

Table I-1 USB Type-C Product Example Clarifying Notes

Product Example	Notes
USB 3.2 Host – no DC (e.g., Desktop PC)	Typical of a Desktop PC that provides power to attached peripherals. This product has no UFP device controller functionality nor does it consume power via the port.
USB 3.2 Host – no DC – power consumer	Typical of a notebook PC that can provide power to attached peripherals but also can consume power over this port from either a hub, dock or charger. This product has no UFP device controller functionality.
USB 3.2 Host – USB 2.0 DC	This product has user-visible _USB 2.0_-based UFP device controller functionality. This product may or may not consume power over this port from either a hub, dock or charger.
USB 3.2 Host – USB 3.2 DC	This product has user-visible _USB 3.2_-based UFP device controller functionality that also will function over a _USB 2.0_ connection. This product may or may not consume power over this port from either a hub, dock or charger.
USB4 Host – no DC (e.g., Desktop PC)	Typical of a Desktop PC that provides power to attached peripherals. This product has no UFP device controller functionality nor does it receive power via the port. Even though this host does not consume power, it will still behave as a DRP in order to be able to establish a _USB4_ data connection with another _USB4_ Host.
USB4 Host – no DC – power consumer	Typical of a notebook PC that can provide power to attached peripherals but also can consume power over this port from either a hub, dock or charger. This product has no UFP device controller functionality.
USB4 Host – USB 2.0 DC	This product has user-visible _USB 2.0_-based UFP device controller functionality. This product may or may not consume power over this port from either a hub, dock or charger.
USB4 Host – USB 3.2 DC	This product has user-visible _USB 3.2_-based UFP device controller functionality that also will function over a _USB 2.0_ connection. This product may or may not consume power over this port from either a hub, dock or charger.
USB4 Host – USB4 DC	This product has user-visible _USB4_-based UFP device router functionality and that functionally is also available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. This product may or may not consume power over this port from either a hub, dock or charger.

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Product Example	Notes
USB4 Host – USB4 DC – partial USB equiv.	This product has user-visible _USB4_-based UFP device router functionality and that only a portion of this functionally is available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. This product may or may not consume power over this port from either a hub, dock or charger.
USB4 Host – USB4 DC – no USB equiv.	This product has user-visible _USB4_-based UFP device router functionality and that none of this functionally is available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. This product may or may not consume power over this port from either a hub, dock or charger.
USB 3.2 Peripheral	This product provides one or more user-visible functions. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection. This product is not capable of supplying power to the other product.
USB 3.2 Peripheral – power provider	This product provides one or more user-visible functions. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection. This product is also capable of supplying power to the other product.
USB4 Peripheral	This product provides one or more user-visible functions and that functionally is also available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection. This product is not capable of supplying power to the other product.
USB4 Peripheral – power provider	This product provides one or more user-visible functions and that functionally is also available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection. This product is also capable of supplying power to the other product.
USB4 Peripheral – partial USB equiv.	This product provides one or more user-visible functions and that only a portion of this functionally is available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection. This product is not capable of supplying power to the other product.
USB4 Peripheral – no USB equiv.	This product provides one or more user-visible functions and that none of this functionally is available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection. This product is not capable of supplying power to the other product.
USB 3.2 Hub (Upstream)	This is the dedicated upstream port of a _USB 3.2_ hub.
USB 3.2 Hub (Upstream) – power provider	This is the dedicated upstream port of a _USB 3.2_ hub. This port can also supply power.
USB 3.2 Hub (Downstream)	This is one of the downstream ports of a _USB 3.2_ hub.
USB 3.2 Hub (Downstream) – power consumer	This is one of the downstream ports of a _USB 3.2_ hub. This port can also consume power.
USB4 Hub (Upstream)	This is the dedicated upstream port of a _USB4_ hub.
USB4 Hub (Upstream) – power provider	This is the dedicated upstream port of a _USB4_ hub. This port can also supply power.

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Product Example	Notes
USB4 Hub (Downstream)	This is one of the downstream ports of a *USB4* hub.
USB4 Hub (Downstream) – power consumer	This is one of the downstream ports of a *USB4* hub. This port can also consume power.
USB4 Dock (Upstream)	This is the dedicated upstream port of a *USB4*-based dock that includes a *USB4* hub with one or more downstream USB Type-C ports. This product provides one or more user-visible functions and that functionally is also available when the port is operating in either a *USB 2.0* or *USB 3.2* connection.
USB4 Dock (Upstream) – power provider	This is the dedicated upstream port of a *USB4*-based dock that includes a *USB4* hub with one or more downstream USB Type-C ports. This product provides one or more user-visible functions and that functionally is also available when the port is operating in either a *USB 2.0* or *USB 3.2* connection. This port can also supply power.
USB4 Dock (Upstream) – partial USB equiv.	This is the dedicated upstream port of a *USB4*-based dock that includes a *USB4* hub with one or more downstream USB Type-C ports. This product provides one or more user-visible functions and that only a portion of this functionally is available when the port is operating in either a *USB 2.0* or *USB 3.2* connection.
USB4 Dock (Upstream) – power provider - partial USB equiv.	This is the dedicated upstream port of a *USB4*-based dock that includes a *USB4* hub with one or more downstream USB Type-C ports. This product provides one or more user-visible functions and that only a portion of this functionally is available when the port is operating in either a *USB 2.0* or *USB 3.2* connection. This port can also supply power.
USB4 Dock (Upstream) – no USB equiv.	This is the dedicated upstream port of a *USB4*-based dock that includes a *USB4* hub with one or more downstream USB Type-C ports. This product provides one or more user-visible functions and that none of this functionally is available when the port is operating in either a *USB 2.0* or *USB 3.2* connection.
USB4 Dock (Upstream) – power provider – no USB equiv.	This is the dedicated upstream port of a *USB4*-based dock that includes a *USB4* hub with one or more downstream USB Type-C ports. This product provides one or more user-visible functions and that none of this functionally is available when the port is operating in either a *USB 2.0* or *USB 3.2* connection. This port can also supply power.
USB4 Dock (Downstream)	This is one of the downstream ports of a *USB4* dock that includes a *USB4* hub.
USB4 Dock (Downstream) – power consumer	This is one of the downstream ports of a *USB4* dock that includes a *USB4* hub. This port can also supply power.
USB Type-C Charger	This product's only function is to be a *USB PD* power source.
USB Type-C Power Bank	This product's primary function is to be a *USB PD* power source using an internal battery as its source of power. The product also consumes power to charge its internal battery or pass power through to another port of the product.
USB PD-based Power Sinking Device	This product has no USB data functionality and only uses power supplied over a *USB PD* connection for its non-USB purpose.

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Table I-2 USB PD Encoding Guidelines for Example Products

Notes:
1. DC = USB Device Controller (UFP)
2. Upstream and Downstream are in reference to the physical port locations.
3. For product types: PSDs are power sinks only; Power Bricks are power sources only.

Highest Speed encoding: 000b = USB 2.0 only, 001b = Gen1, 010b = Gen2, 011b = Gen3, 100b...111b = Reserved

Product Examples	UFP Product Type — Type	UFP VDO Required	DFP Product Type — Type	DFP VDO Required	USB4 Device	USB 3.2 Device	USB 2.0 Billboard	USB 2.0 Device	Highest Speed	USB 2.0 Host	USB 3.2 Host	USB4 Host
USB 3.2 Host – no DC (e.g., Desktop PC)	Undefined	None	PDUSB Host	DFP VDO						1	1	0
USB 3.2 Host – no DC – power consumer	PSD	None	PDUSB Host	DFP VDO						1	1	0
USB 3.2 Host – USB 2.0 DC	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	0	0	0	1	000b	1	1	0
USB 3.2 Host – USB 3.2 DC	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	0	1	0	1	001b or 010b	1	1	0
USB4 Host – no DC (e.g., Desktop PC)	Undefined	None	PDUSB Host	DFP VDO						1	1	1
USB4 Host – no DC – power consumer	PSD	None	PDUSB Host	DFP VDO						1	1	1
USB4 Host – USB 2.0 DC	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	0	0	0	1	000b	1	1	1
USB4 Host – USB 3.2 DC	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	0	1	0	1	001b or 010b	1	1	1
USB4 Host – USB4 DC	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	1	1	0	1	010b or 011b	1	1	1
USB4 Host – USB4 DC – partial USB equiv.	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	1	0	0	1	010b or 011b	1	1	1
USB4 Host – USB4 DC – no USB equiv.	PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO	1	0	1	0	010b or 011b	1	1	1
USB 3.2 Peripheral	PDUSB Peripheral	UFP VDO	Undefined	None	0	1	0	1	001b or 010b			
USB 3.2 Peripheral – power provider	PDUSB Peripheral	UFP VDO	Power Brick	DFP VDO	0	1	0	1	001b or 010b	0	0	0
USB4 Peripheral	PDUSB Peripheral	UFP VDO	Undefined	None	1	1	0	1	010b or 011b			
USB4 Peripheral – power provider	PDUSB Peripheral	UFP VDO	Power Brick	DFP VDO	1	1	0	1	010b or 011b	0	0	0
USB4 Peripheral – partial USB equiv.	PDUSB Peripheral	UFP VDO	Undefined	None	1	0	0	1	010b or 011b			
USB4 Peripheral – no USB equiv.	PDUSB Peripheral	UFP VDO	Undefined	None	1	0	1	0	010b or 011b			

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Table I-2 USB PD Encoding Guidelines for Example Products, cont.

Notes:
1. DC = USB Device Controller (UFP)
2. Upstream and Downstream are in reference to the physical port locations.
3. For product types: PSDs are power sinks only; Power Bricks are power sources only.

UFP Product Type – VDO Required legend: Undefined = None; PDUSB Hub = UFP VDO; PDUSB Peripheral = None; PSD = None

DFP Product Type – VDO Required legend: Undefined = None; PDUSB Hub = DFP VDO; PDUSB Host = DFP VDO; Power Brick = DFP VDO

UFP Device Cap and Highest Speed codes: 000b = USB 2.0 only; 001b = Gen1; 010b = Gen2; 011b = Gen3; 100b…111b = Reserved

Product Examples	UFP Product Type – Type	UFP VDO Required	DFP Product Type – Type	DFP VDO Required	UFP Dev Cap: USB 2.0 Device	USB 2.0 Billboard	USB 3.2 Device	USB4 Device	Highest Speed	DFP Host: USB 2.0 Host	USB 3.2 Host	USB4 Host
USB 3.2 Hub (Upstream)	PDUSB Hub	UFP VDO	Undefined	None	1	0	1	0	001b or 010b			
USB 3.2 Hub (Upstream) – power provider	PDUSB Hub	UFP VDO	Power Brick	DFP VDO	1	0	1	0	001b or 010b	0	0	0
USB 3.2 Hub (Downstream)	Undefined	None	PDUSB Hub	DFP VDO						1	1	0
USB 3.2 Hub (Downstream) – power consumer	PSD	None	PDUSB Hub	DFP VDO	1	0	1	0		1	1	0
USB4 Hub (Upstream)	PDUSB Hub	UFP VDO	Undefined	None	1	0	1	1	010b or 011b			
USB4 Hub (Upstream) – power provider	PDUSB Hub	UFP VDO	Power Brick	DFP VDO	1	0	1	1	010b or 011b	0	0	0
USB4 Hub (Downstream)	Undefined	None	PDUSB Hub	DFP VDO						1	1	1
USB4 Hub (Downstream) – power consumer	PSD	None	PDUSB Hub	DFP VDO						1	1	1
USB4 Dock (Upstream)	PDUSB Peripheral	None	Undefined	None	1	0	1	1	010b or 011b			
USB4 Dock (Upstream) – power provider	PDUSB Peripheral	None	Power Brick	DFP VDO	1	0	1	1	010b or 011b	0	0	0
USB4 Dock (Upstream) – partial USB equiv.	PDUSB Peripheral	None	Undefined	None	1	0	1	1	010b or 011b			
USB4 Dock (Upstream) – power provider - partial USB equiv.	PDUSB Peripheral	None	Power Brick	DFP VDO	1	0	1	1	010b or 011b	0	0	0
USB4 Dock (Upstream) – no USB equiv.	PDUSB Peripheral	None	Undefined	None	0	1	0	1	010b or 011b			
USB4 Dock (Upstream) – power provider – no USB equiv.	PDUSB Peripheral	None	Power Brick	DFP VDO	0	1	0	1	010b or 011b	0	0	0
USB4 Dock (Downstream)	Undefined	None	PDUSB Hub	DFP VDO						1	1	1
USB4 Dock (Downstream) – power consumer	PSD	None	PDUSB Hub	DFP VDO						1	1	1

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Table I-2 USB PD Encoding Guidelines for Example Products, cont.

Notes:
1. DC = USB Device Controller (UFP)
2. Upstream and Downstream are in reference to the physical port locations.
3. For product types: PSDs are power sinks only; Power Bricks are power sources only.

UFP Device Cap and Highest Speed:
- 000b = USB 2.0 only
- 001b = Gen1
- 010b = Gen2
- 011b = Gen3
- 100b...111b = Reserved

UFP Device categories: USB4 Device, USB 3.2 Device, USB 2.0 Billboard, USB 2.0 Device

UFP Product Type Type	UFP VDO Required	DFP Product Type Type	DFP VDO Required
Undefined	None	Undefined	None
PDUSB Hub	UFP VDO	PDUSB Hub	DFP VDO
PDUSB Peripheral	UFP VDO	PDUSB Host	DFP VDO
PSD	None	Power Brick	DFP VDO

Product Examples

Product Examples	UFP Product Type	DFP Product Type	USB 2.0 Host	USB 3.2 Host	USB4 Host
USB Type-C Charger	Undefined	Power Brick	0	0	0
USB Type-C Power Bank	PSD	Power Brick	0	0	0
USB PD-based Power Sinking Device	PSD	Undefined			

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I.3   Detailed Examples

This section includes a number of detailed examples drawn from the list of product examples listed in **Table I-1** and using the guidance provided by **Table I-2**. This set of examples was chosen to provide additional explanatory comments and for pointing out some notable characteristics.

All of the product examples fall into one of the following USB Type-C power and data role categories:

1. **Sink / UFP** – this product can only consume power and be a UFP in a data connection.

2. **Source / DFP** – this product can only supply power and be a DFP in a data connection.

3. **DRP (Source or Sink) / Not DRD (UFP)** – this product can supply or consume power and only be a UFP in a data connection.

4. **DRP (Source or Sink) / Not DRD (DFP)** – this product can supply or consume power and only be a DFP in a data connection.

5. **DRP (Source or Sink) / DRD** – this product can supply or consume power and be either a UFP or DFP in a data connection.

I.3.1   USB 3.2 Host – no DC – power consumer : DRP (Source or Sink) / Not DRD (DFP)

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

	USB 3.2 Host – no DC – power consumer	
	DRP (Source or Sink)	**Not DRD (DFP)**
Sink / UFP	Source	DFP
Source / DFP	Sink	No connect
DRP / Not DRD (UFP)	Source or Sink	DFP
DRP / Not DRD (DFP)	Source or Sink	No connect
DRP / DRD	Source or Sink	DFP

This _USB 3.2_ host is typical of a notebook PC that when connected to a charger or power-sourcing hub, dock or peripheral, can sink power using USB PD. As this product has no UFP device controller functionality, it will not establish a data connection to any other product that isn't in a UFP data role.

As this host can sink power, the UFP Product Type is set to PSD and no UFP VDO is needed.

The DFP Product Type is set to PDUSB Host and the DFP VDO indicates that is supports _USB 2.0_ and _USB 3.2_ Host Capabilities.

I.3.2   USB 3.2 Peripheral – power provider : DRP (Source or Sink) / Not DRD (UFP)

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

	USB 3.2 Peripheral – power provider	
	DRP (Source or Sink)	**Not DRD (UFP)**
Sink / UFP	Source	No connect
Source / DFP	Sink	UFP
DRP / Not DRD (UFP)	Source or Sink	No connect
DRP / Not DRD (DFP)	Source or Sink	UFP
DRP / DRD	Source or Sink	UFP

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This _USB 3.2_ peripheral is unusual in that goes beyond a traditional peripheral by being able to supply power to a connected host, hub or dock that is capable of consuming power over the connection. An example might be a _USB 3.2_-based dock where all of its functional capabilities connect in the UFP role after the Source/Sink relationship with its port partner are established via USB Type-C and USB PD connection protocol. If this peripheral ends up in the Source power role, the use of a _USB PD_ Data Role Swap will be used to correctly establish the UFP data role of the peripheral's port.

The UFP Product Type is set to PDUSB Peripheral and the UFP VDO indicates _USB 2.0_ and _USB 3.2_ device capabilities and the highest _USB 3.2_ speed of either Gen1 (001b) or Gen2 (010b).

As this peripheral can supply power, the DFP Product Type is set to Power Brick and the DFP VDO indicates no support for any of the USB Host Capabilities (_USB 2.0_, _USB 3.2_ or _USB4_).

I.3.3   USB4 Host – Power Consumer : DRP (Source or Sink) / Not DRD (DFP)

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

	USB4 Host – no DC – power consumer	
	DRP (Source or Sink)	Not DRD (DFP)
Sink / UFP	Source	DFP
Source / DFP	Sink	No connect or _USB4_*
DRP / Not DRD (UFP)	Source or Sink	DFP
DRP / Not DRD (DFP)	Source or Sink	No connect or _USB4_*
DRP / DRD	Source or Sink	DFP

* If the port partner is also a _USB4_ DFP.

This _USB4_ host is similar to the _USB 3.2_ host described earlier (see I.3.1) but differs with regard to how it works with other hosts, hubs or docks depending on the data capabilities of those other products. Both host examples do not include UFP data role support but the _USB4_ host is capable of communicating with another _USB4_ host as an inter-domain link even as it does not include any USB device controller functionality.

To enable two _USB4_ DFPs to discover and establish the _USB4_ data connection, the _USB4_ discovery and entry process of the Source will discover the DFP VDO of the Sink which will indicate _USB4_ Host Capability and as long as the cable also supports _USB4_, the _USB4_ data connection will be enabled. Following that, the _USB4_ Connection Manager of each host will discover the inter-domain link and enable the host-to-host data connections supported by the application layer.

As this host can sink power, the UFP Product Type is set to PSD and no UFP VDO is needed.

The DFP Product Type is set to PDUSB Host and the DFP VDO indicates that is supports _USB 2.0_, _USB 3.2_ and _USB4_ Host Capabilities.

I.3.4   USB4 Host – USB4 DC – partial or no USB equivalent : DRP (Source or Sink) / DRD

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

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	USB4 Host – USB4 DC	
	DRP (Source or Sink)	DRD
Sink / UFP	Source	DFP
Source / DFP	Sink	UFP
DRP / Not DRD (UFP)	Source or Sink	DFP
DRP / Not DRD (DFP)	Source or Sink	UFP
DRP / DRD	Source or Sink	DFP or UFP

This _USB4_ host differs from the _USB4_ host described earlier (see I.3.3) in that it does include some _USB4_-based UFP device functionality and therefore is a DRD. This specific example is included here to illustrate what is needed if only a portion of this device functionally is available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection.

When this example host is connected to another _USB4_ host, its device functionality is fully available to the other host via functions that are connected to one or more of the available _USB4_ tunneling protocols (USB, DisplayPort or PCIe). But when this host is connected to either a _USB 2.0_ or _USB 3.2_ host, some or all of the _USB4_-based device functionality is not available because it doesn't map to one of the existing USB Device Classes – in this case, the example host is required to expose a Billboard Device Class function specific to the missing functionality on the _USB 2.0_ interface when in the UFP data role.

As this host has device controller functionality in a UFP data role, the UFP Product Type is set to PDUSB Peripheral and the UFP VDO indicates _USB4_ device capabilities and the highest _USB4_ speed of either Gen2 (010b) or Gen3 (011b).

Additionally, since this host supports only partial or no USB equivalent functionality when connected to a non-_USB4_ host, the UFP VDO will indicate what USB equivalent functionality is supported (_USB 2.0_ or _USB 3.2_) along with providing a _USB 2.0_ Billboard, or indicate only the presence of a _USB 2.0_ Billboard. The following lists the possible UFP VDO Device Capabilities combinations for this example.

USB 2.0 Device	USB 2.0 Billboard	USB 3.2 Device	USB4 Device	Interpretation of the USB4 host's UFP Device Capabilities
0	1	0	1	None of the _USB4_ device functionality maps to either _USB 2.0_ or _USB 3.2_ Device Class equivalents.
1	0	0	1	At least some of the _USB4_ device functionality maps to _USB 2.0_ Device Class equivalents but none maps to _USB 3.2_ Device Class equivalents.
1	0	1	1	At least some of the _USB4_ device functionality maps to _USB 2.0_ and _USB 3.2_ equivalents.

The DFP Product Type is set to PDUSB Host and the DFP VDO indicates that is supports _USB 2.0_, _USB 3.2_ and _USB4_ Host Capabilities.

I.3.5   USB4 Peripheral : UFP (Sink)

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

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	USB4 Peripheral	
	Sink	**UFP**
Sink / UFP	No connect	No connect
Source / DFP	Sink	UFP
DRP / Not DRD (UFP)	Sink	No connect
DRP / Not DRD (DFP)	Sink	UFP
DRP / DRD	Sink	UFP

This _USB4_ peripheral provides one or more user-visible functions and that functionally is also available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. Power for this product is provided either over the USB Type-C connection or by a separate power supply not associated with the USB connection.

The UFP Product Type is set to PDUSB Peripheral and the UFP VDO indicates _USB 2.0_, _USB 3.2_ and _USB4_ device capabilities and the highest _USB4_ speed of either Gen2 (010b) or Gen3 (011b).

As this peripheral can only sink power and has no DFP data functionality, the DFP Product Type is set to Undefined and no DFP VDO is needed.

I.3.6 USB4 Dock (Upstream) – power provider : DRP (Source or Sink) / Not DRD (UFP)

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

	USB4 Dock (Upstream) – power provider	
	DRP (Source or Sink)	**Not DRD (UFP)**
Sink / UFP	Source	No connect
Source / DFP	Sink	UFP
DRP / Not DRD (UFP)	Source or Sink	No connect
DRP / Not DRD (DFP)	Source or Sink	UFP
DRP / DRD	Source or Sink	UFP

This is the dedicated upstream port of a _USB4_-based dock that includes a _USB4_ hub with one or more downstream USB Type-C ports along with one or more user-visible functions and that functionally is also available when the port is operating in either a _USB 2.0_ or _USB 3.2_ connection. This upstream port can also supply power.

This dock's upstream port UFP Product Type is set to PDUSB Peripheral and the UFP VDO indicates _USB 2.0_, _USB 3.2_ and _USB4_ device capabilities and the highest _USB4_ speed of either Gen2 (010b) or Gen3 (011b).

Since this dock's upstream port can also source power but has no DFP data role functionality, its DFP Product Type is Power Brick and the DFP VDO indicates no support for any of the USB Host Capabilities (_USB 2.0_, _USB 3.2_ or _USB4_).

I.3.7 USB4 Hub (Downstream) : DFP (Source)

The following summarizes the connection results for connecting this product to any of the five distinct product power/data role combinations:

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	USB4 Hub (Downstream) – power provider	
	Source	**DFP**
Sink / UFP	Source	DFP
Source / DFP	No connect	No connect
DRP / Not DRD (UFP)	Source	DFP
DRP / Not DRD (DFP)	Source	No connect or USB4*
DRP / DRD	Source	DFP

* If the port partner is also a *USB4* DFP.

This is one of the downstream ports of a *USB4* hub.

When a USB host product is connected to a *USB4* hub downstream port, it functions similarly to *USB 2.0* and *USB 3.2* hub downstream ports by not establishing a data connection when that host is only *USB 2.0* or *USB 3.2* capable. If that USB host product is capable of *USB4*, the *USB4* hub will use its *USB4* discovery and entry process to discover the DFP VDO of the attached *USB4* host and as long as the cable also supports *USB4*, the *USB4* data connection will be enabled.

To enable two *USB4* DFPs to discover and establish the *USB4* data connection, the. Following that, the *USB4* Connection Manager of each host will discover the inter-domain link and enable the host-to-host data connections supported by the application layer

Since this hub's downstream port does not support receiving power nor does it offer any UFP data functionality in a UFP data role, the UFP Product Type is set to Undefined.

This hub's downstream port DPF Product Type is set to PDUSB Hub and the DFP VDO indicates support for all USB Host Capabilities (*USB 2.0*, *USB 3.2* and *USB4*).