U.S. Patent No. 7,856,520 ("'520 Patent")

Accused Products

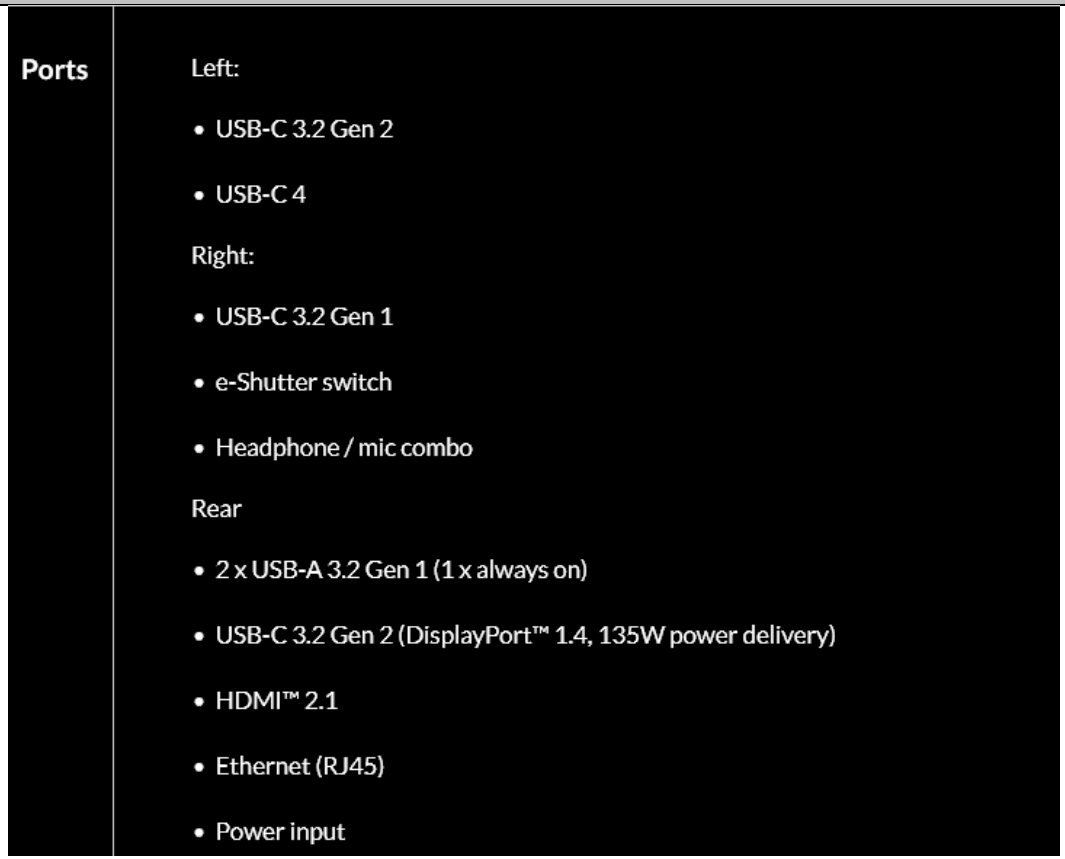
Lenovo products (laptops, desktops, monitors, docking stations, and USB-C to DP/HDMI adapters) made, used, sold, offered for sale, or imported into the United States by Lenovo that support DisplayPort Alt Mode on USB Type-C Version 1.0 and later or HDMI Alt Mode for USB-C, such as the ThinkPad T16 Gen 2 (AMD) Laptop and Legion 7 Gen 7 Laptop ("Accused Products"), infringe at least Claim 12 of the '520 Patent without limitation.

Claim 12

Claim 12	Exemplary Infringement Evidence
[12pre] A transmitting device comprising:	To the extent the preamble is limiting, each Accused Product comprises a transmitting device. For example, the exemplary Lenovo Legion 7 Gen 7 Laptop comprises a transmitting device having a USB Type-C port with DisplayPort 1.4 over USB-C. DisplayPort 1.4 data is transmitted over one of the USB-C ports via a USB-C to DisplayPort connection to a receiver with a standard DP port. *See, e.g.*: Legion 7 Gen 7 (16" AMD) Gaming Laptop ★★★★★ 4.2 (110)

Claim 12	Exemplary Infringement Evidence
	

Claim 12	Exemplary Infringement Evidence



Ports	Left: • USB-C 3.2 Gen 2 • USB-C 4 Right: • USB-C 3.2 Gen 1 • e-Shutter switch • Headphone / mic combo Rear • 2 x USB-A 3.2 Gen 1 (1 x always on) • USB-C 3.2 Gen 2 (DisplayPort™ 1.4, 135W power delivery) • HDMI™ 2.1 • Ethernet (RJ45) • Power input

https://www.lenovo.com/us/en/p/laptops/legion-laptops/legion-7-series/legion-slim-7-gen-7-(16-inch-amd)/len101g0019#tech_specs

Lenovo USB-C to DisplayPort Adapter

Claim 12	Exemplary Infringement Evidence
	 https://support.lenovo.com/us/en/accessories/acc100310-lenovo-usb-c-to-displayport-adapter-overview-and-service-parts For example, a Lenovo ThinkPad Universal USB-C Dock provides USB-C Alternate Mode connections for a Lenovo laptop to a Lenovo DisplayPort or HDMI monitor. ThinkPad UNIVERSAL USB-C DOCK 

Claim 12	Exemplary Infringement Evidence
	SPECIFICATIONS PERFORMANCE **Docking Interface** USB-C **Docking Cable Length** 1 m USB-C Cable **Video Ports** 2 x DisplayPort™ 1.4 1 x HDMI™ 2.0 **USB Ports** 2 x USB-A 2.0 3 x USB-A 3.1 Gen 2[2] (10 Gbps, 1 with Always-On Charging) 1 x USB-C (10 Gbps, 5V / 3A) **System Charging** 65W with 90W Power Adapter attached; Max 100W with 135W Power Adapter attached https://www.lenovo.com/content/dam/lenovo/pcsd/global/en/products/accessories/docking-/thinkpad-universal-usb-c-dock/datasheet/ThinkPad%20Universal%20USB-C%20Dock_DS.pdf?refId=57bb3c67-09b5-4ce0-b91d-4c5cd0807c3d
[12a] a connection to a single first control bus, the first control bus being a bi-directional, single-line bus, wherein the transmitting device is operable for coupling with a receiving device via the first control bus;	Each Accused Product comprises a connection to a single first control bus, the first control bus being a bi-directional, single-line bus, wherein the transmitting device is operable for coupling with a receiving device via the first control bus. For example, the exemplary Lenovo Legion 7 Gen 7 Laptop with a USB-C Port comprises a transmitter that has a connection to a bi-directional, single-line control bus (CC bus). The transimtter couples with a receiving device via the control bus. *See, e.g.*,

Claim 12	Exemplary Infringement Evidence

E.2.1 Alternate Mode Pin Reassignment

Figure E-1 illustrates the only pins that shall be available for functional reconfiguration in a full-featured cable. The pins highlighted in yellow are the only pins that shall be reconfigured.

Figure E-1 Pins Available for Reconfiguration over the Full-Featured Cable

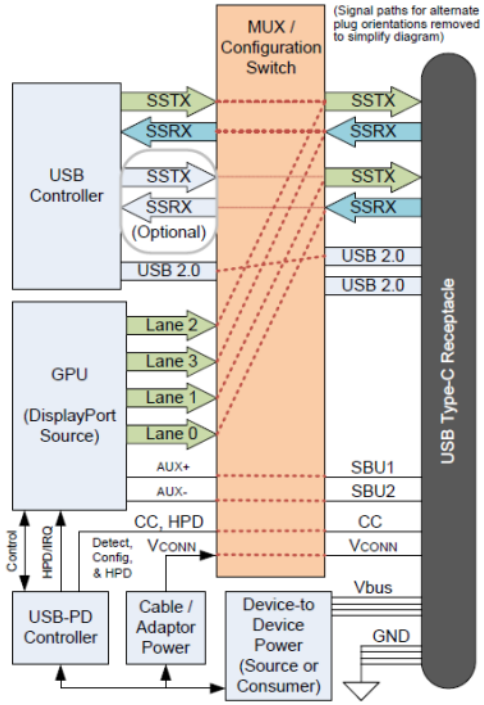
A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2−	VBUS	SBU1	D−	D+	CC	VBUS	TX1−	TX1+	GND
GND	TX2+	TX2−	VBUS	VCONN			SBU2	VBUS	RX1−	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

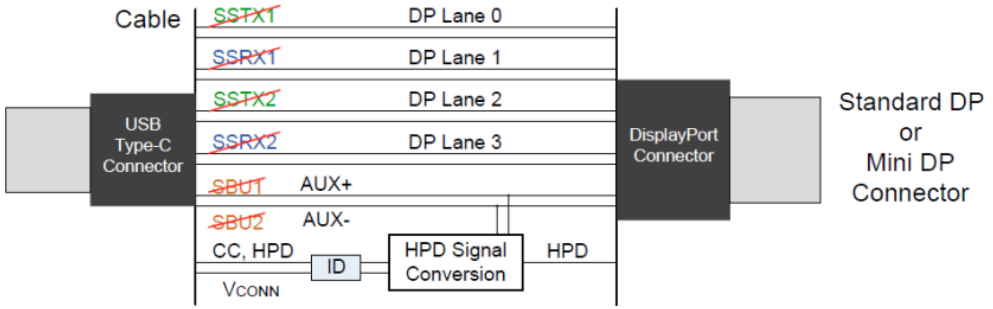
Figure E-2 illustrates the only pins that shall be available for functional reconfiguration in direct connect applications such as a cradle dock, captive cable or a detachable notebook. The pins highlighted in yellow are the only pins that shall be reconfigured. Five additional pins are available because this configuration is not limited by the cable wiring.

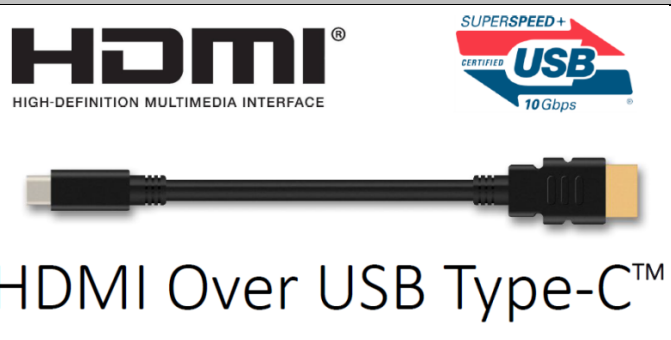
Figure E-2 Pins Available for Reconfiguration for Direct Connect Applications

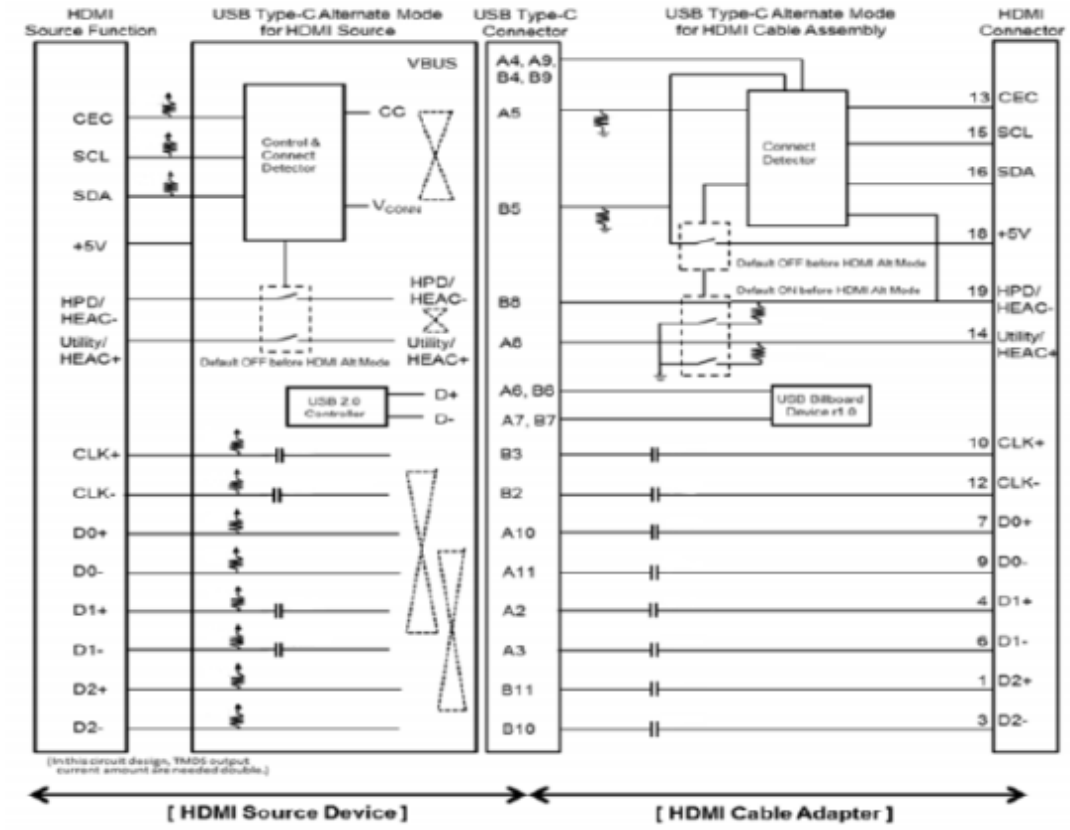
A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2−	VBUS	SBU1	D−	D+	CC	VBUS	TX1−	TX1+	GND
GND	TX2+	TX2−	VBUS	VCONN			SBU2	VBUS	RX1−	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

USB Type-C Cable and Connector Specification, Release 2.0, Section E, pg. 351.

Claim 12	Exemplary Infringement Evidence
	

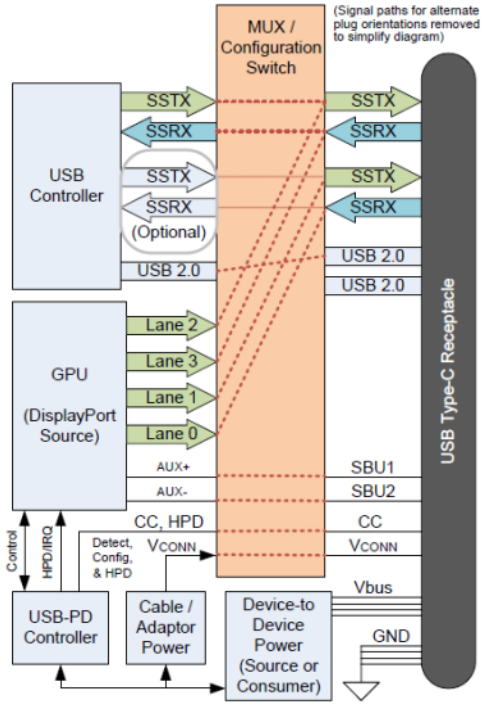
Claim 12	Exemplary Infringement Evidence
	 http://www.vesa.org/wp-content/uploads/2014/09/DP-Alt-Mode-Overview-for-VESA-v1.pdf USB-C to DP cables must include logic to support USB PD and DP connection detect protocols.  https://www.vesa.org/wp-content/uploads/2016/10/USB-DevDays-DisplayPort-Alternate-Mode-2016-final4.pdf

Claim 12	Exemplary Infringement Evidence
	

Claim 12	Exemplary Infringement Evidence
	 *See* HDMI Over USB Type-C Specification, HDMI Licensing, LLC 2016, https://kipdf.com/hdmi-over-usb-type-c-tm_5b3984b7097c47a8348b4620.html

Claim 12	Exemplary Infringement Evidence
[12b] logic to convert each of one or more control signals into a data packet, each of the one or more control signals being one of a plurality of different types of control signals for a standard protocol, each data packet including a plurality of bits to be transmitted;	Each Accused Product comprises logic to convert each of one or more control signals into a data packet, each of the one or more control signals being one of a plurality of different types of control signals for a standard protocol, each data packet including a plurality of bits to be transmitted. For example, the Alternate PHY (e.g., Display/HDMI Alt mode) logic converts control signals of DisplayPort/HDMI standard into data packets (e.g., USB PD Structured VDMs). One or more control signals belongs to DisplyPort/HDMI control signals (e.g., Discovery, Configuration and Entry/Exit DisplayPort signals, SDA signals for HDMI). Each data packet of USB PD Structured VDMs includes multiple bits to be transmitted. *See, e.g.*, *See* VESA DisplayPort (DP) Standard Version 1.3, Figure 1-1, pg. 51.

Claim 12	Exemplary Infringement Evidence



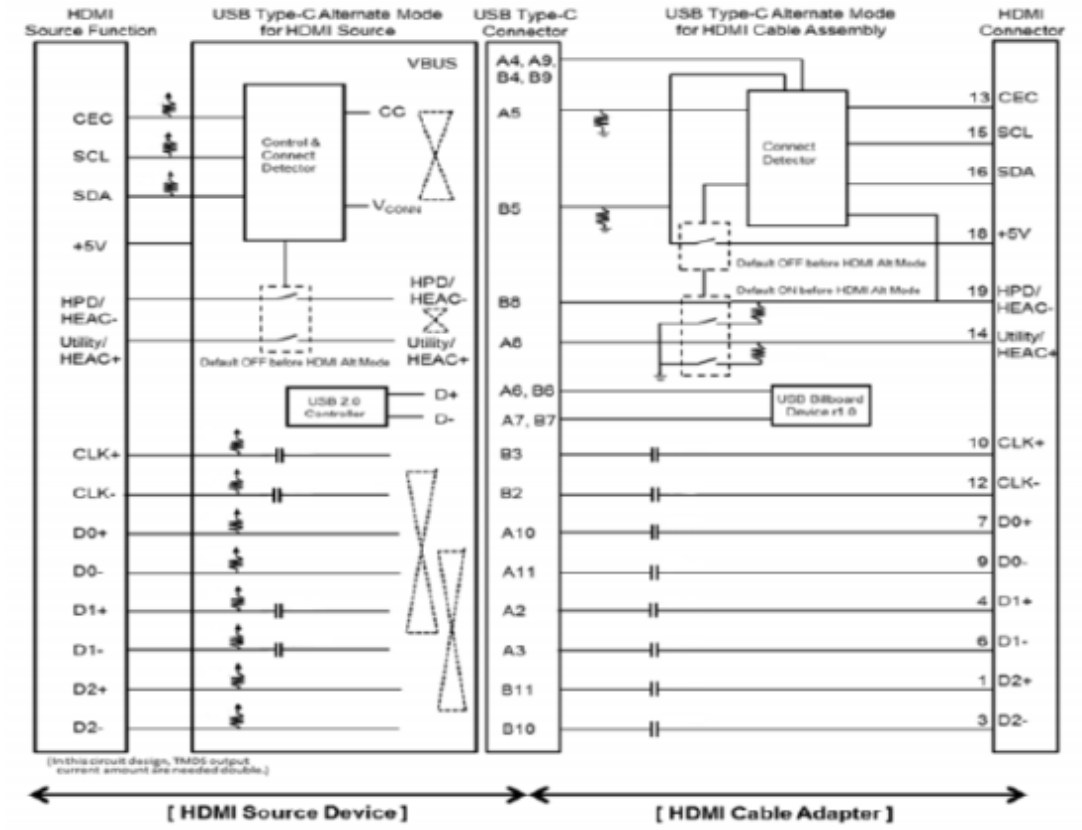
http://www.vesa.org/wp-content/uploads/2014/09/DP-Alt-Mode-Overview-for-VESA-v1.pdf

USB-C to DP cables must include logic to support USB PD and DP connection detect protocols.

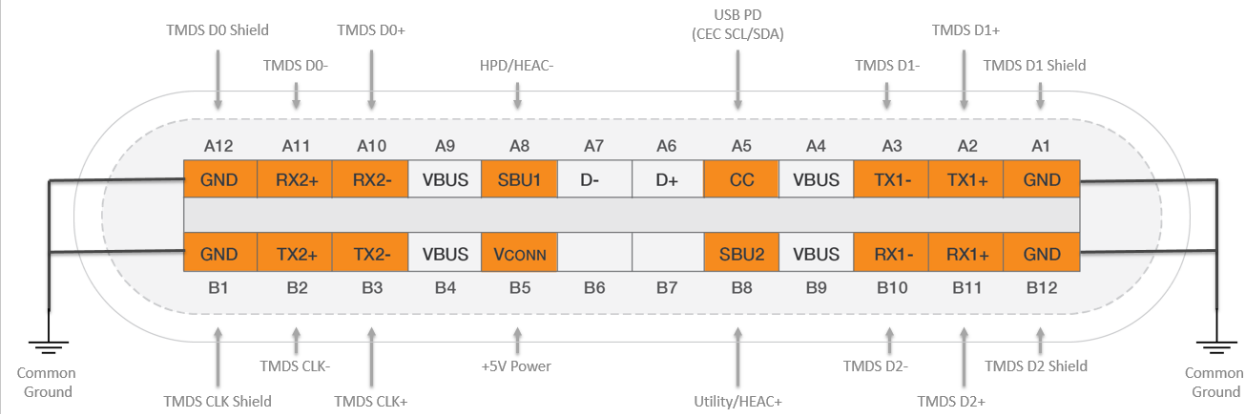


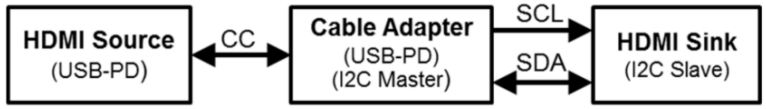
Claim 12	Exemplary Infringement Evidence
	https://www.vesa.org/wp-content/uploads/2016/10/USB-DevDays-DisplayPort-Alternate-Mode-2016-final4.pdf *See* Proposed VESA DisplayPort Alt Mode on USB Type-C, V1, d3, pg. 39. **E Alternate Modes** All hosts and devices (except chargers and clearly marked charge-through ports) using a USB Type-C® receptacle shall expose a USB interface (minimally *USB 2.0*). In the case where the host or device optionally supports Alternate Modes: • The host and device shall use *USB Power Delivery* Structured Vendor Defined Messages (Structured VDMs) to discover, configure and enter/exit modes to enable Alternate Modes. USB Type-C Cable and Connector Specification, Release 2.0, Section E, pg. 350; or USB Type-C Cable and Connector Specification, Release 1.0, Section 5.1, pg. 157

Claim 12	Exemplary Infringement Evidence
	E.1 Alternate Mode Architecture The *USB Power Delivery* Structured VDMs are defined to extend the functionality a device exposes. Only Structured VDMs shall be used to alter the USB functionality or reconfigure the pins the USB Type-C Connector exposes. Structured VDMs provide a standard method to identify the modes a device supports and to command the device to enter and exit a mode. The use of Structured VDMs are in addition to the normal *USB PD* messages used to manage power. Structured VDMs may be interspersed within the normal *USB PD* messaging stream, however they shall not be inserted in the middle of an ongoing PD power negotiation. The Structured VDMs consist of a request followed by a response. The response is either a successful completion of the request (ACK), an indication that the device needs time before it can service a request (BUSY), or a rejection of the request (NAK). A host and device do not enter a mode when either a NAK or BUSY is returned. Multiple modes may exist and/or function concurrently. For example, a Structured VDM may be used to manage an active cable at the same time that another Structured VDM is used to manage the device so that both the cable and device are operating in a compatible mode. USB Type-C Cable and Connector Specification, Release 2.0, Section E, pg. 350. *See* Proposed VESA DisplayPort Alt Mode on USB Type-C, V1, d3, pg. 57-63.

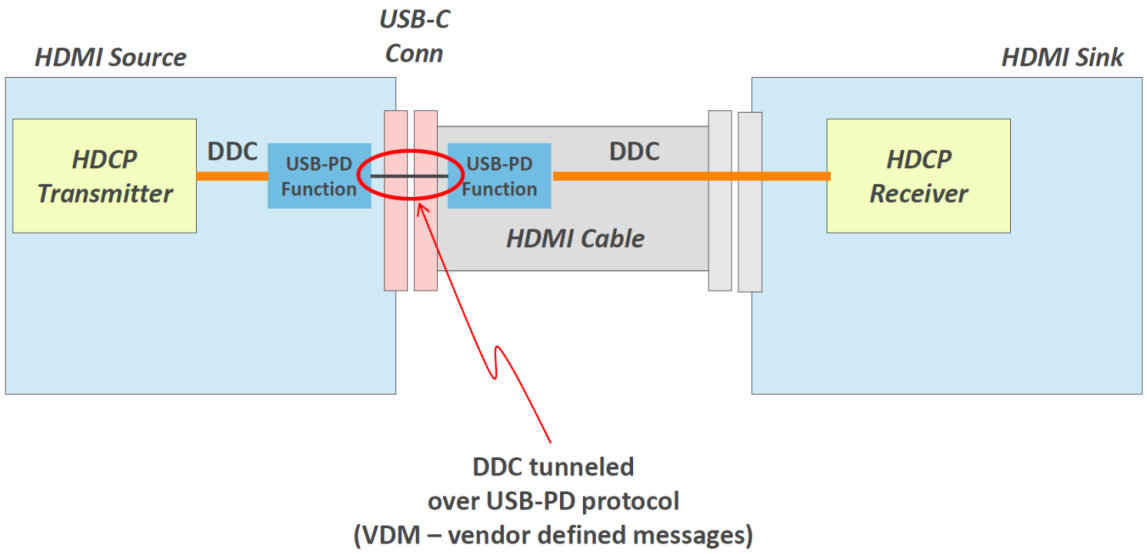
Claim 12	Exemplary Infringement Evidence
	

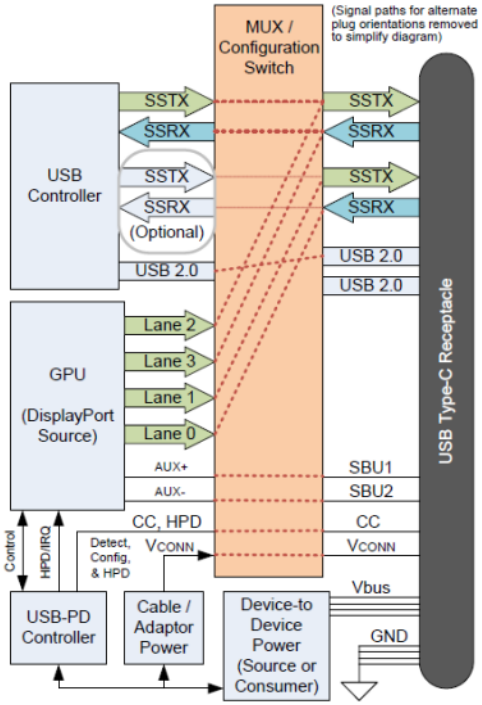
Claim 12	Exemplary Infringement Evidence

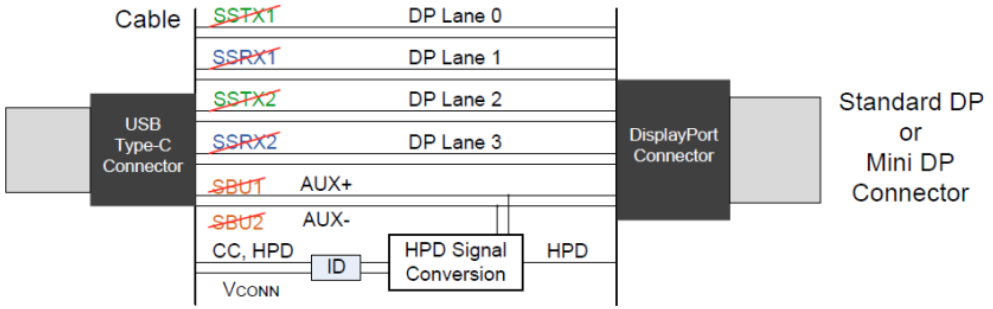


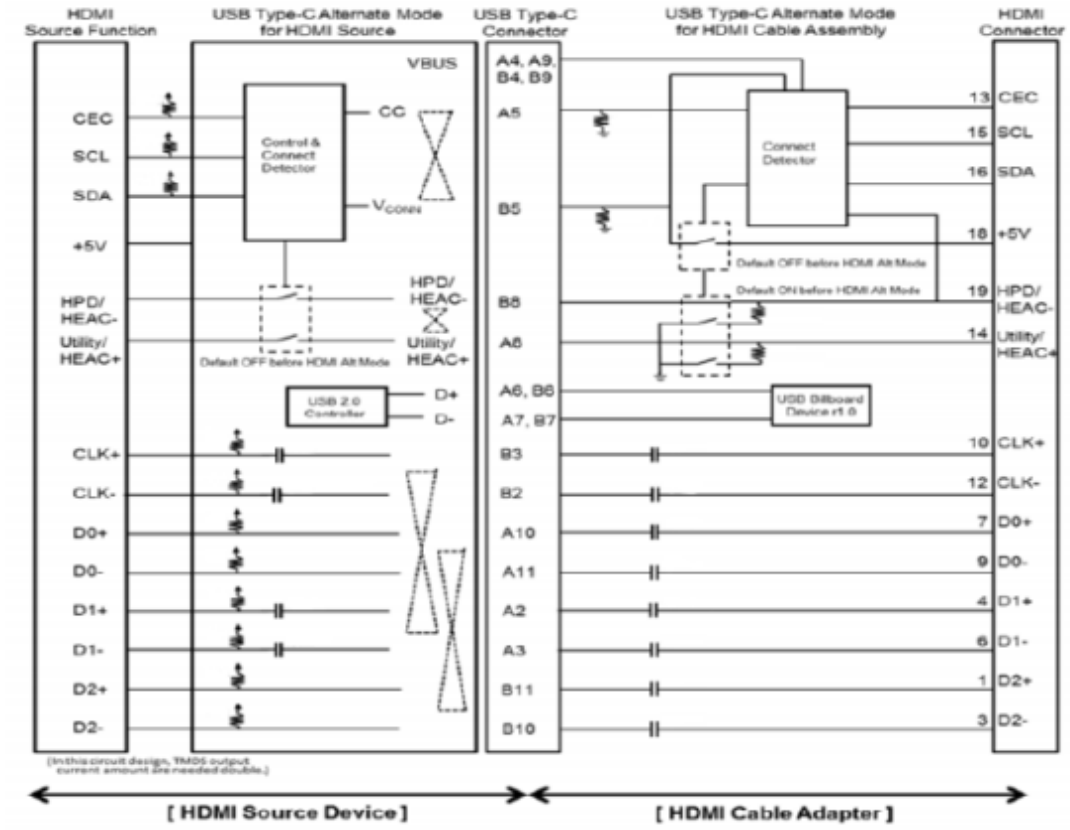


- The HDMI USB Type-C cable will act as the USB-PD node and handle all read/write messages from the HDMI Source
- The HDMI USB Type-C cable will also act as the DDC master and relay the USB-PD command it received from the HDMI Source to the HDMI Sink

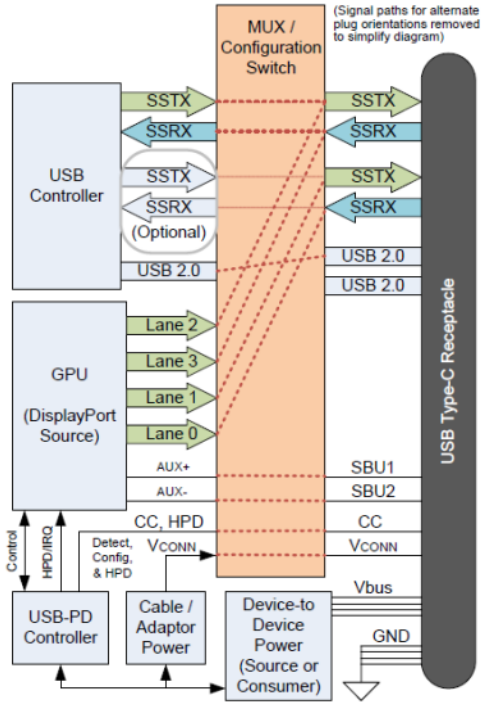
Claim 12	Exemplary Infringement Evidence
	 **DDC** – Display Data Channel based on I2C specification – Used for EDID data, Metadata/InfoFrame, and HDCP communications **CEC** – Consumer Electronics Control is a single wire bidirectional bus that allows remote control of other CEC enabled devices over the HDMI connection HDMI Over USB Type-C Specification, HDMI Licensing, LLC 2016; *see also* https://kipdf.com/hdmi-over-usb-type-c-tm_5b3984b7097c47a8348b4620.html
[12c] a transmitter, the transmitter to transmit the data	Each Accused Product comprises a transmitter to transmit the data packets to the receiving device on the first control bus.

Claim 12	Exemplary Infringement Evidence
packets to the receiving device on the first control bus; and	For example, the USB-C port transmits the data packets (e.g., USB PD Structured VDMs) to the receiver on the CC bus. *See, e.g.*, 

Claim 12	Exemplary Infringement Evidence
	 http://www.vesa.org/wp-content/uploads/2014/09/DP-Alt-Mode-Overview-for-VESA-v1.pdf

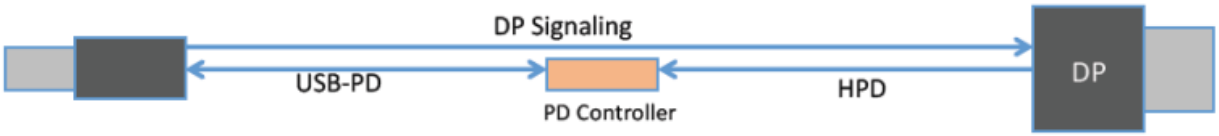
Claim 12	Exemplary Infringement Evidence
	 HDMI Over USB Type-C Specification, HDMI Licensing, LLC 2016; *see also* https://kipdf.com/hdmi-over-usb-type-c-tm_5b3984b7097c47a8348b4620.html
[12d] logic to arbitrate use of the first control bus, the logic	Each Accused product comprises logic to arbitrate use of the first control bus.

Claim 12	Exemplary Infringement Evidence
to arbitrate use being operable to:	For example, the USB PD controller in the Alternate Mode cable/adapter (e.g., USB-PD in the DP/HDMI over USB-C cable as the bus directional arbitrator) arbirates use of the CC bus. *See, e.g.*, **5.7 Collision Avoidance** The PHY Layer shall monitor the channel for data transmission and only initiate transmissions when V_{BUS} or CC is idle. If the bus idle condition is present, it shall be considered safe to start a transmission provided the conditions detailed in Section 5.8.1.4 are met. The bus idle condition shall be checked immediately prior to transmission. If transmission cannot be initiated then the packet shall be ***Discarded***. If the packet is ***Discarded*** because V_{BUS} or CC is not idle, the PHY Layer shall signal to the protocol layer that it has ***Discarded*** the Message as soon as V_{BUS} or CC becomes idle. See Section 5.8.2.6.4 for the definition of idle V_{BUS} and Section 5.8.3.6.1 for the definition of idle CC. USB Power Delivery Specification, Release 2.0, V1.2, pg. 117. 5.8.3.6.1 Definition of Idle BMC packet collision is avoided by the detection of signal transitions at the receiver. This is the equivalent of squelch for FSK modulation. Detection is active when ***nTransitionCount*** transitions occur at the receiver within a time window of ***tTransitionWindow***. After waiting ***tTransitionWindow*** without detecting ***nTransitionCount*** transitions the bus shall be declared idle. Refer to Section 5.8.1.4 for details of when transmissions may start. USB Power Delivery Specification, Release 2.0, V1.2, pg. 140.

Claim 12	Exemplary Infringement Evidence
	 http://www.vesa.org/wp-content/uploads/2014/09/DP-Alt-Mode-Overview-for-VESA-v1.pdf

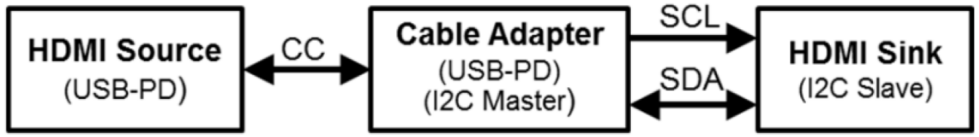
Claim 12	Exemplary Infringement Evidence

USB-C to DP cables must include logic to support USB PD and DP connection detect protocols.



https://www.vesa.org/wp-content/uploads/2016/10/USB-DevDays-DisplayPort-Alternate-Mode-2016-final4.pdf

See VESA DisplayPort 1.3 Specification, Section 2.3.2.

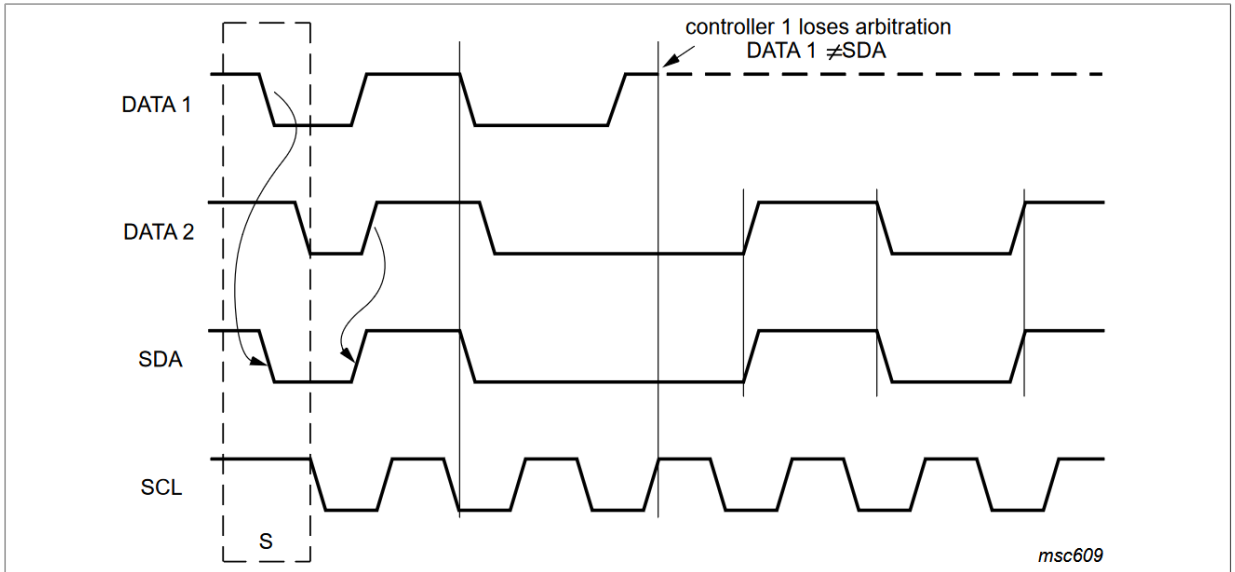


- The HDMI USB Type-C cable will act as the USB-PD node and handle all read/write messages from the HDMI Source
- The HDMI USB Type-C cable will also act as the DDC master and relay the USB-PD command it received from the HDMI Source to the HDMI Sink

<table>
<tr><th>Claim 12</th><th>Exemplary Infringement Evidence</th></tr>
<tr><td></td><td>HDMI Over USB Type-C Specification, HDMI Licensing, LLC 2016; see also https://kipdf.com/hdmi-over-usb-type-c-tm_5b3984b7097c47a8348b4620.html

Table 2. Definition of I²C-bus terminology
<table><tr><th>Term</th><th>Description</th></tr><tr><td>Transmitter</td><td>the device which sends data to the bus</td></tr><tr><td>Receiver</td><td>the device which receives data from the bus</td></tr><tr><td>Controller</td><td>the device which initiates a transfer, generates clock signals and terminates a transfer</td></tr><tr><td>Target</td><td>the device addressed by a controller</td></tr><tr><td>Multi-controller</td><td>more than one controller can attempt to control the bus at the same time without corrupting the message</td></tr><tr><td>Arbitration</td><td>procedure to ensure that, if more than one controller simultaneously tries to control the bus, only one is allowed to do so and the winning message is not corrupted</td></tr><tr><td>Synchronization</td><td>procedure to synchronize the clock signals of two or more devices</td></tr></table></td></tr>
</table>

Claim 12	Exemplary Infringement Evidence
	3.1.8 Arbitration Arbitration, like synchronization, refers to a portion of the protocol required only if more than one controller is used in the system. Targets are not involved in the arbitration procedure. A controller may start a transfer only if the bus is free. Two controllers may generate a START condition within the minimum hold time ($t_{HD;STA}$) of the START condition which results in a valid START condition on the bus. Arbitration is then required to determine which controller will complete its transmission. Arbitration proceeds bit by bit. During every bit, while SCL is HIGH, each controller checks to see if the SDA level matches what it has sent. This process may take many bits. Two controllers can actually complete an entire transaction without error, as long as the transmissions are identical. The first time a controller tries to send a HIGH, but detects that the SDA level is LOW, the controller knows that it has lost the arbitration and turns off its SDA output driver. The other controller goes on to complete its transaction. Figure 8 shows the arbitration procedure for two controllers. More may be involved depending on how many controllers are connected to the bus. The moment there is a difference between the internal data level of the controller generating DATA1 and the actual level on the SDA line, the DATA1 output is switched off. This does not affect the data transfer initiated by the winning controller.

Claim 12	Exemplary Infringement Evidence
	 **Figure 8. Arbitration procedure of two controllers** I2C-bus specification and user manual https://www.pololu.com/file/0J435/UM10204.pdf
[10e] determine whether the control bus is in use by the receiving device, and	Each Accused product comprises logic to arbitrate use, operable to determine whether the control bus is in use by the receiving device. For example, the USB PD controller in the Alternate Mode over USB-C cable/adapter arbitrates use of the CC control bus operable to determine whether the control bus is in use by the receiving device (e.g., whether the receiver uses the bus to send PD message, e.g. HPD, or SDA signals). *See, e.g.*,

Claim 12	Exemplary Infringement Evidence

5.7 Collision Avoidance

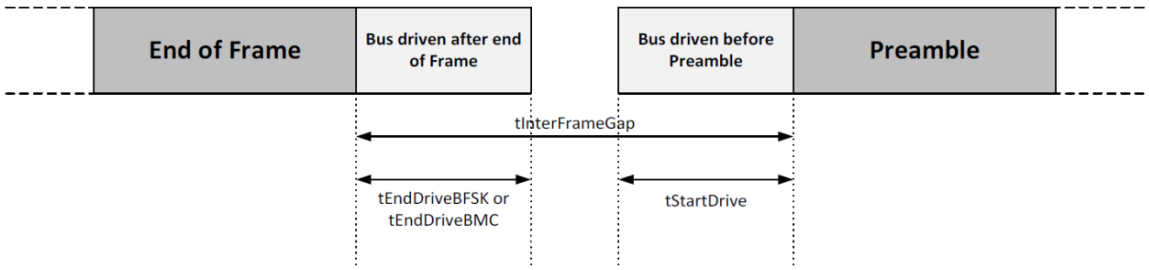
The PHY Layer shall monitor the channel for data transmission and only initiate transmissions when V_{BUS} or CC is idle. If the bus idle condition is present, it shall be considered safe to start a transmission provided the conditions detailed in Section 5.8.1.4 are met. The bus idle condition shall be checked immediately prior to transmission. If transmission cannot be initiated then the packet shall be ***Discarded***. If the packet is ***Discarded*** because V_{BUS} or CC is not idle, the PHY Layer shall signal to the protocol layer that it has ***Discarded*** the Message as soon as V_{BUS} or CC becomes idle. See Section 5.8.2.6.4 for the definition of idle V_{BUS} and Section 5.8.3.6.1 for the definition of idle CC.

USB Power Delivery Specification, Release 2.0, V1.2, pg. 117.

5.8.1.4 Inter-Frame Gap

Figure 5-7 illustrates the inter-Frame gap timings.

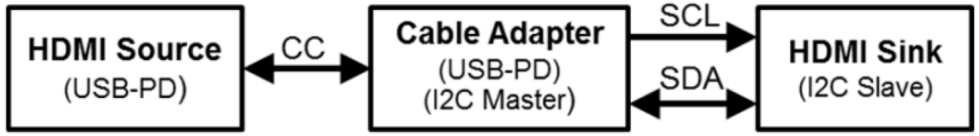
Figure 5-7 Inter-Frame Gap Timings

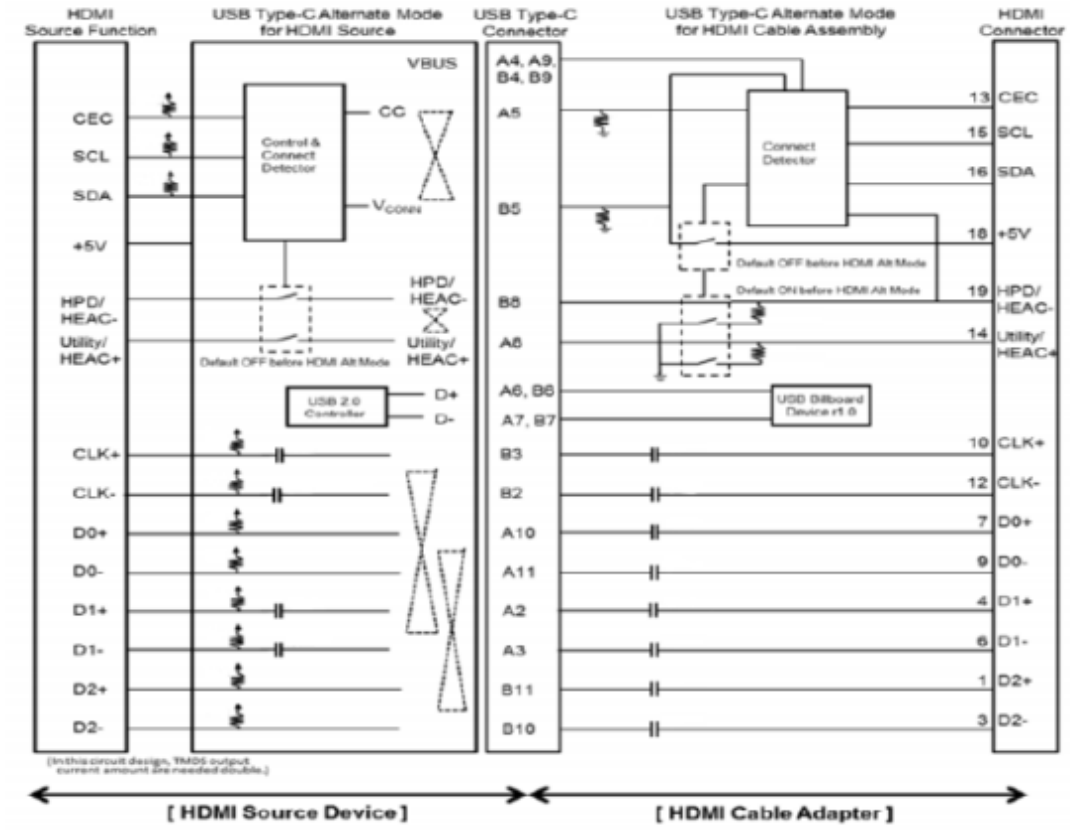


The transmitter shall drive the bus for no longer than ***tEndDriveBFSK*** or ***tEndDriveBMC*** (as appropriate) after transmitting the final bit of the Frame. Detailed requirements for terminating the Frame and ceasing to drive the bus are given separately for BFSK and BMC.

USB Power Delivery Specification, Release 2.0, V1.2, pg. 119.

Claim 12	Exemplary Infringement Evidence
	5.8.3.6.1 Definition of Idle BMC packet collision is avoided by the detection of signal transitions at the receiver. This is the equivalent of squelch for FSK modulation. Detection is active when ***nTransitionCount*** transitions occur at the receiver within a time window of ***tTransitionWindow***. After waiting ***tTransitionWindow*** without detecting ***nTransitionCount*** transitions the bus shall be declared idle. Refer to Section 5.8.1.4 for details of when transmissions may start. USB Power Delivery Specification, Release 2.0, V1.2, pg. 140. USB-C to DP cables must include logic to support USB PD and DP connection detect protocols.  https://www.vesa.org/wp-content/uploads/2016/10/USB-DevDays-DisplayPort-Alternate-Mode-2016-final4.pdf *See* VESA DisplayPort 1.3 Specification, Section 2.3.2.

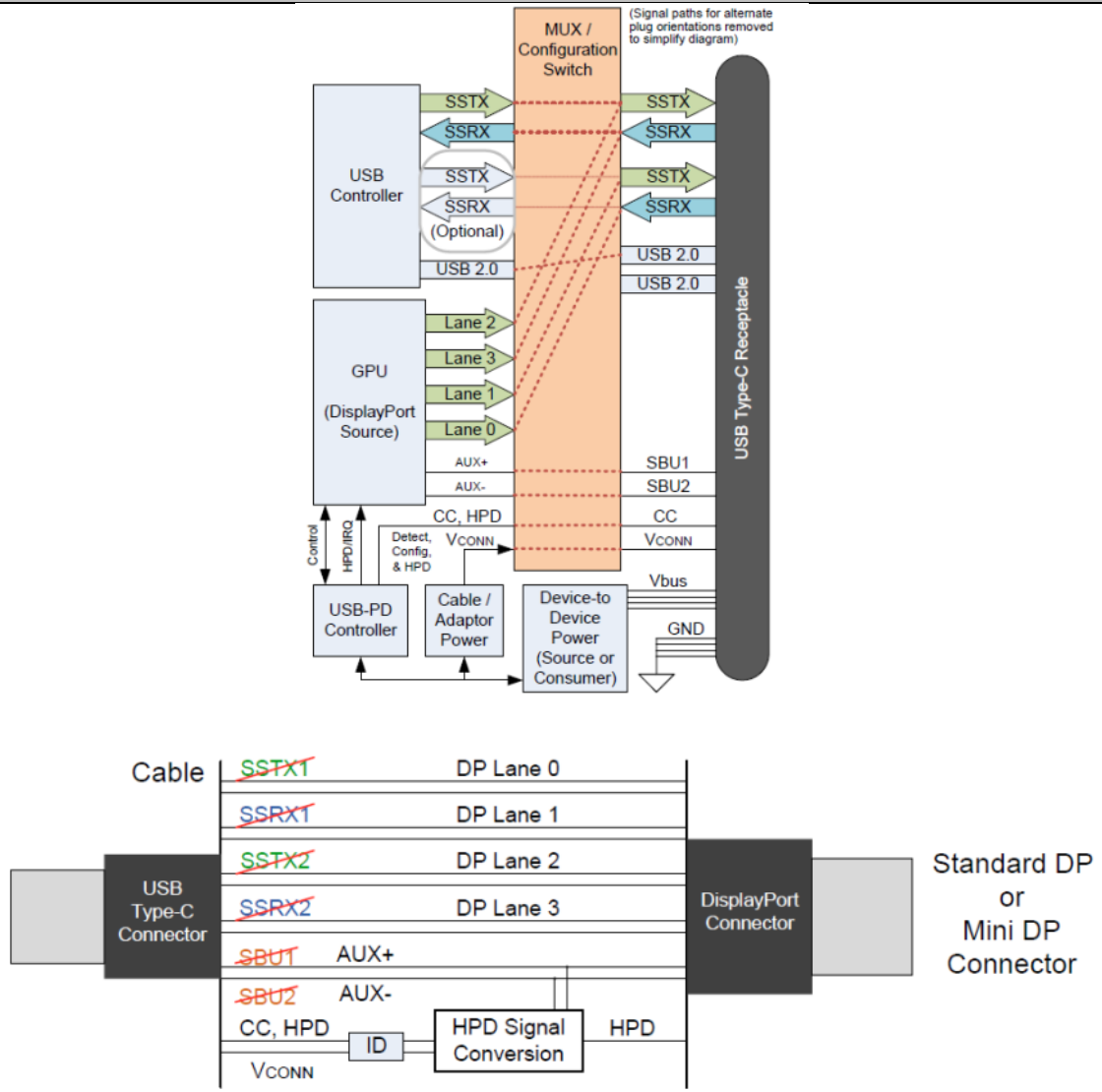
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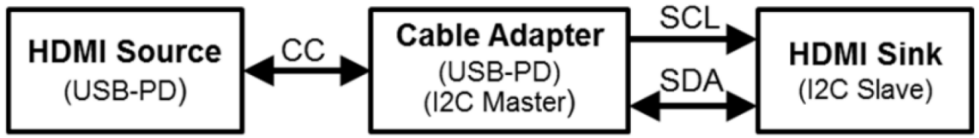
Claim 12	Exemplary Infringement Evidence
	 HDMI Over USB Type-C Specification, HDMI Licensing, LLC 2016; *see also* https://kipdf.com/hdmi-over-usb-type-c-tm_5b3984b7097c47a8348b4620.html

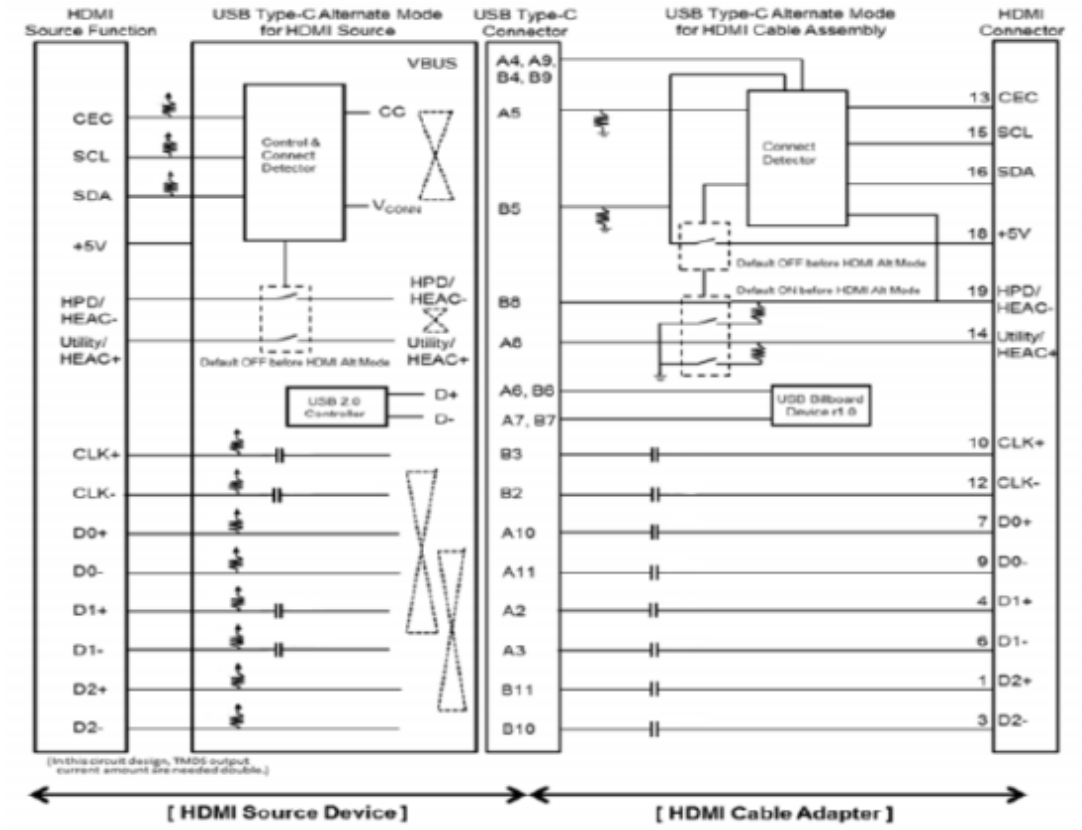
<table>
<tr><th>Claim 12</th><th>Exemplary Infringement Evidence</th></tr>
<tr><td></td><td>Table 2. Definition of I²C-bus terminology
<table><tr><th>Term</th><th>Description</th></tr><tr><td>Arbitration</td><td>procedure to ensure that, if more than one controller simultaneously tries to control the bus, only one is allowed to do so and the winning message is not corrupted</td></tr></table>
I2C-bus specification and user manual https://www.pololu.com/file/0J435/UM10204.pdf</td></tr>
<tr><td>[12f] if the first control bus is not in use by the receiving device, conduct arbitration for control of the first control bus, and wherein the receiving device is a device utilizing the standard protocol and the transmitting device is a mobile device utilizing a modified protocol, the modified protocol being a modification of the standard protocol that is not included in the standard protocol.</td><td>Each Accused product comprises logic to arbitrate use, operable to if the first control bus is not in use by the receiving device, conduct arbitration for control of the first control bus, and wherein the receiving device is a device utilizing the standard protocol and the transmitting device is a mobile device utilizing a modified protocol, the modified protocol being a modification of the standard protocol that is not included in the standard protocol.

For example, when the CC bus is not in use by the receiver, the USB-PD control logic conducts arbitration for control of the CC bus. The transmitter is a mobile device utilizing a modified protocol, which is a modification of the standard protocol that is not included in the standard protocol.

See, e.g.,</td></tr>
</table>

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	http://www.vesa.org/wp-content/uploads/2014/09/DP-Alt-Mode-Overview-for-VESA-v1.pdf USB-C to DP cables must include logic to support USB PD and DP connection detect protocols.  https://www.vesa.org/wp-content/uploads/2016/10/USB-DevDays-DisplayPort-Alternate-Mode-2016-final4.pdf  • The HDMI USB Type-C cable will act as the USB-PD node and handle all read/write messages from the HDMI Source • The HDMI USB Type-C cable will also act as the DDC master and relay the USB-PD command it received from the HDMI Source to the HDMI Sink

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	 HDMI Over USB Type-C Specification, HDMI Licensing, LLC 2016; *see also* https://kipdf.com/hdmi-over-usb-type-c-tm_5b3984b7097c47a8348b4620.html Legion 7 Gen 7 (16" AMD) Gaming Laptop 4.2 (110)  https://www.lenovo.com/us/en/p/laptops/legion-laptops/legion-7-series/legion-7-gen-7-(16-inch-amd)/len101g0017#tech_specs