U.S. Patent No. 7,746,798 ("'798 Patent")

Accused Products

Lenovo products (laptops[1], desktops[2], workstations[3], monitors[4], and docking stations[5]) made, used, sold, offered for sale, or imported into the United States by Lenovo that support USB 3.0 and later, such as the ThinkVision Ml4t USB-C Mobile Monitor, ThinkStation P620 Workstation, ThinkPad T14 Gen 3 Laptop, and Legion 7 Gen 6 & 7 Gaming Laptop ("Accused Products"), infringe at least Claims 1-4, 6-9, 11, 12, 14-22, 24-26, and 28 of the '798 Patent without limitation.

Claim 1

Claim 1	Exemplary Infringement Evidence
[1pre] A method for transmitting packet types of packets, the method comprising:	To the extent the preamble is limiting, each Accused Product comprises a method for transmitting packet types of packets. *See* [19pre]
[1a] receiving a packet having symbols;	Each Accused Product receives a packet having symbols. *See* [19a]
[1b] identifying a packet type of the packet;	Each Accused Product identifies a packet type of the packet. *See* [19a]
[1c] transmitting a synchronization symbol that corresponds to the	Each Accused Product transmits a synchronization symbol that corresponds to the identified packet type, wherein the transmitted synchronization symbol provides synchronization

[1] Claims 1-4, 6-9, 11-12, 14-22, 24-26, 28.
[2] Claims 1-4, 6-9, 11-12, 14-22, 24-26, 28.
[3] Claims 1-4, 6-9, 11-12, 14-22, 24-26, 28.
[4] Claims 11-12, 14-18.
[5] Claims 1-4, 6-9, 11-12, 14-22, 24-26, 28.

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Claim 1	Exemplary Infringement Evidence
identified packet type, wherein the transmitted synchronization symbol provides synchronization information and wherein each packet type has a different synchronization symbol,	information and wherein each packet type has a different synchronization symbol, and the synchronization symbol permitting an external receiving node to properly align with a synchronization primitive to be correctly aligned on a symbol boundary. *See* [19b]
[1d] and the synchronization symbol permitting an external receiving node to properly align with a synchronization primitive to be correctly aligned on a symbol boundary; and	Each Accused Product includes the synchronization symbol that permits an external receiving node to properly align with a synchronization primitive to be correctly aligned on a symbol boundary. *See* [19c]
[1e] transmitting the symbols of the received packet.	Each Accused Product transmits the symbols of the received packet. *See* [19c]

Claim 2

Claim 2	Exemplary Infringement Evidence
[2] The method of claim 1 wherein the symbols of the packet include in-band symbols and the synchronization symbols are out-of-band symbols.	Each Accused Product practices the method of claim 1 wherein the symbols of the packet include in-band symbols and the synchronization symbols are out-of-band symbols. For example, the symbols of the packet include in-band symbols (e.g. data symbols-D codes which are scrambled) and the synchronization symbols are out-of-band symbols (e.g. K codes which are out-of-band and not scrambled). *See e.g.*

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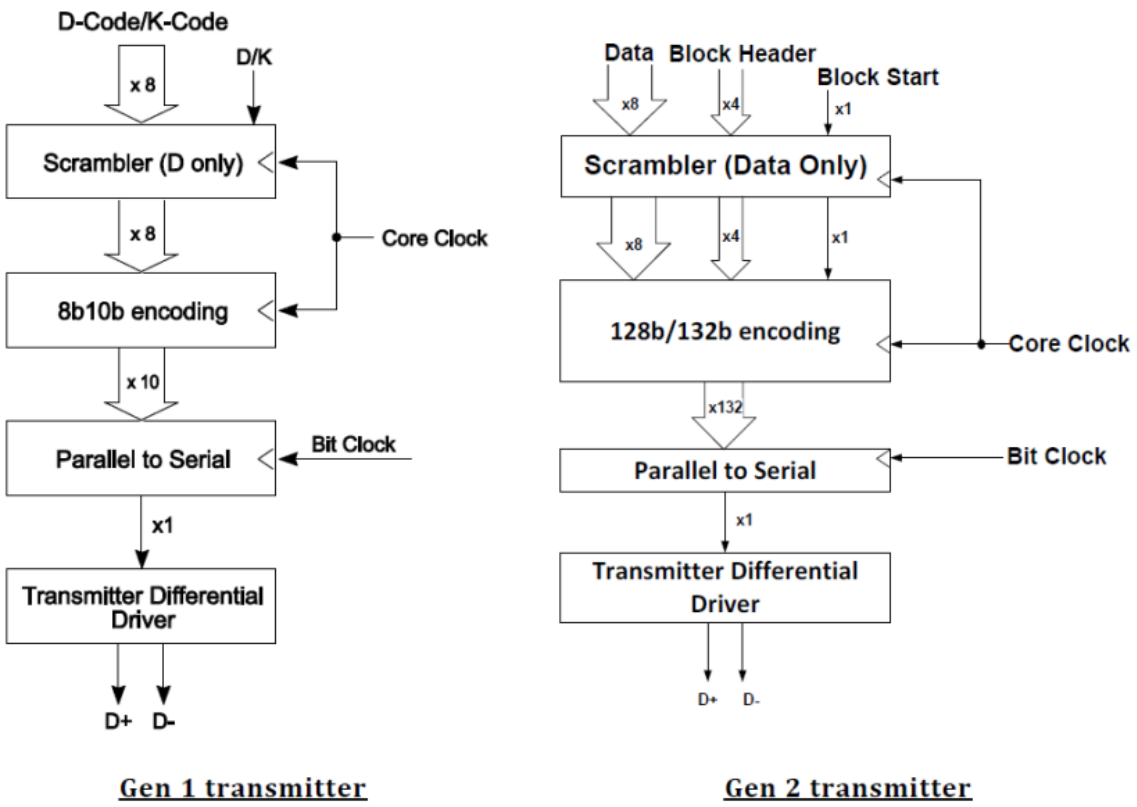
Claim 2	Exemplary Infringement Evidence
	Figure 6-2. Transmitter Block Diagram  **Gen 1 transmitter** **Gen 2 transmitter** USB 3.2 Specification, Revision 1.0, pg. 52

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Claim 2	Exemplary Infringement Evidence
	6.3.1.3 Gen 1 Data Scrambling The scrambling function is implemented using a free running Linear Feedback Shift Register (LFSR). On the Transmit side, scrambling is applied to characters prior to the 8b/10b encoding. On the receive side, descrambling is applied to characters after 8b/10b decoding. The LFSR is reset whenever a COM symbol is sent or received. The LFSR is graphically represented in Figure 6-9. Scrambling or unscrambling is performed by serially XORing the 8-bit (D0-D7) character with the 16-bit (D0-D15) output of the LFSR. An output of the LFSR, D15, is XORed with D0 of the data to be processed. The LFSR and data register are then serially advanced and the output processing is repeated for D1 through D7. The LFSR is advanced after the data is XORed. The mechanism to notify the physical layer to disable scrambling is implementation specific and beyond the scope of this specification. The data scrambling rules are as follows: 1. The LFSR implements the polynomial: $G(X)=X^{16}+X^5+X^4+X^3+1$ 2. The LFSR value shall be advanced eight serial shifts for each Symbol except for SKP. 3. All 8b/10b D-codes, except those within the Training Sequence Ordered Sets shall be scrambled. 4. K codes shall not be scrambled. 5. The initialized value of an LFSR seed (D0-D15) shall be FFFFh. After COM leaves the Transmitter LFSR, the LFSR on the transmit side shall be initialized. Every time COM enters the Receive LFSR, the LFSR on the receive side shall be initialized. This also applies to the BRST sequence during loopback mode (see section 6.8.4.1).

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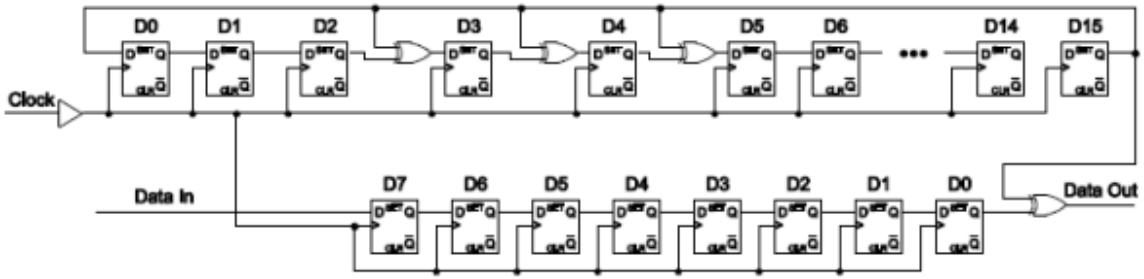
Claim 2	Exemplary Infringement Evidence
	Figure 6-9. LFSR with Scrambling Polynomial  USB 3.2 Specification, Revision 1.0, pg. 58

Claim 3

Claim 3	Exemplary Infringement Evidence
[3] The method of claim 2 wherein the in-band symbols are transition optimized and the out-of-band synchronization symbols are not transition optimized.	Each Accused Product practices the method of claim 2 wherein the in-band symbols are transition optimized and the out-of-band synchronization symbols are not transition optimized. For example, scrambling of the symbols of packets comprising D-codes which are in-band symbols applies a multiplicative sequence to the underlying data, thereby optimizing transitions between 0 and 1 for EMI reduction. The synchronization symbols are comprised of K special characters and are not scrambled to be transition optimized. *See, e.g.:*

Claim 3	Exemplary Infringement Evidence
	3.2.1.1 Gen 1 Physical Layer The nominal signaling data rate for Gen 1 physical layer is 5 Gbps. A Gen 1 transmitter encodes data and control characters into symbols using an 8b/10b code. The physical layer receives 8-bit data from the link layer and scrambles the data to reduce EMI emissions. It then encodes the scrambled 8-bit data into 10-bit symbols for transmission over the physical connection. The resultant data are sent at a rate that includes spread spectrum to further lower the EMI emissions. The bit stream is recovered from the differential sublink by the receiver, assembled into 10-bit symbols, decoded and descrambled, producing 8-bit data that are then sent to the link layer for further processing. *See* USB 3.2 Specification, Revision 1.0, pg. 21

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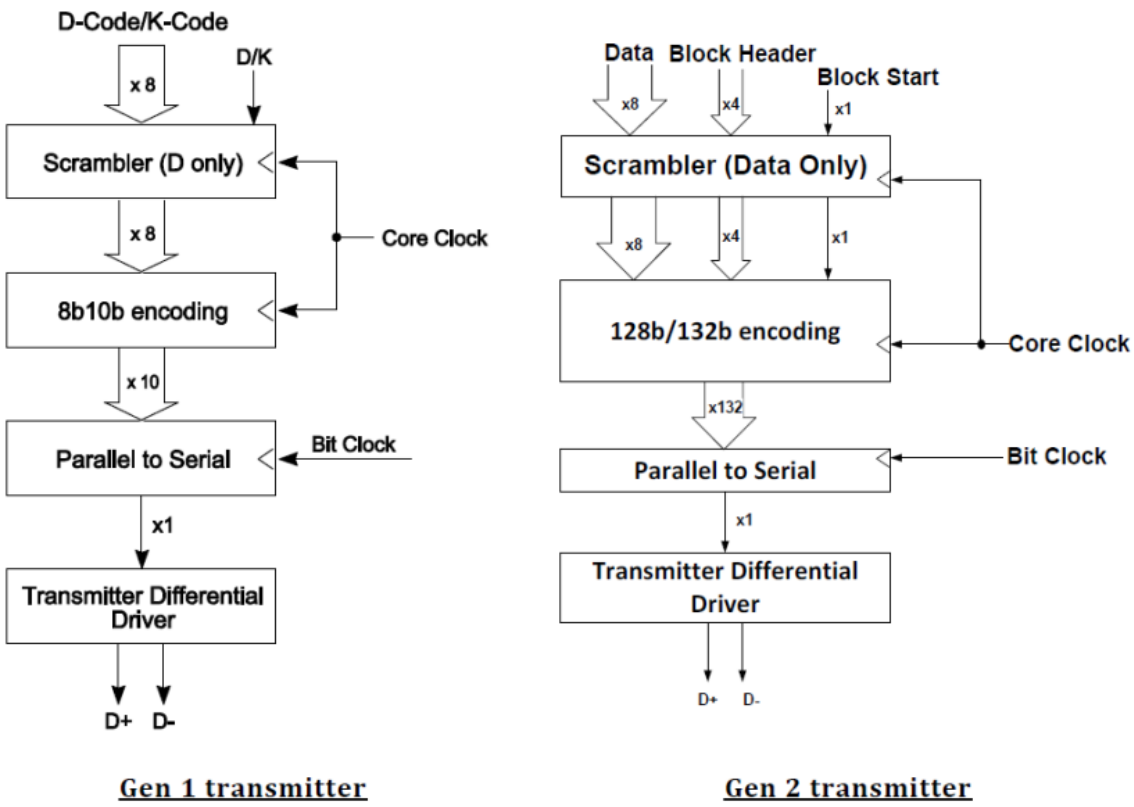
Claim 3	Exemplary Infringement Evidence
	Figure 6-2. Transmitter Block Diagram  Gen 1 transmitter Gen 2 transmitter USB 3.2 Specification, Revision 1.0, pg. 52

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Claim 3	Exemplary Infringement Evidence
	6.3.1.3 Gen 1 Data Scrambling The scrambling function is implemented using a free running Linear Feedback Shift Register (LFSR). On the Transmit side, scrambling is applied to characters prior to the 8b/10b encoding. On the receive side, descrambling is applied to characters after 8b/10b decoding. The LFSR is reset whenever a COM symbol is sent or received. The LFSR is graphically represented in Figure 6-9. Scrambling or unscrambling is performed by serially XORing the 8-bit (D0-D7) character with the 16-bit (D0-D15) output of the LFSR. An output of the LFSR, D15, is XORed with D0 of the data to be processed. The LFSR and data register are then serially advanced and the output processing is repeated for D1 through D7. The LFSR is advanced after the data is XORed. The mechanism to notify the physical layer to disable scrambling is implementation specific and beyond the scope of this specification. The data scrambling rules are as follows: 1. The LFSR implements the polynomial: $G(X)=X^{16}+X^5+X^4+X^3+1$ 2. The LFSR value shall be advanced eight serial shifts for each Symbol except for SKP. 3. All 8b/10b D-codes, except those within the Training Sequence Ordered Sets shall be scrambled. 4. K codes shall not be scrambled. 5. The initialized value of an LFSR seed (D0-D15) shall be FFFFh. After COM leaves the Transmitter LFSR, the LFSR on the transmit side shall be initialized. Every time COM enters the Receive LFSR, the LFSR on the receive side shall be initialized. This also applies to the BRST sequence during loopback mode (see section 6.8.4.1).

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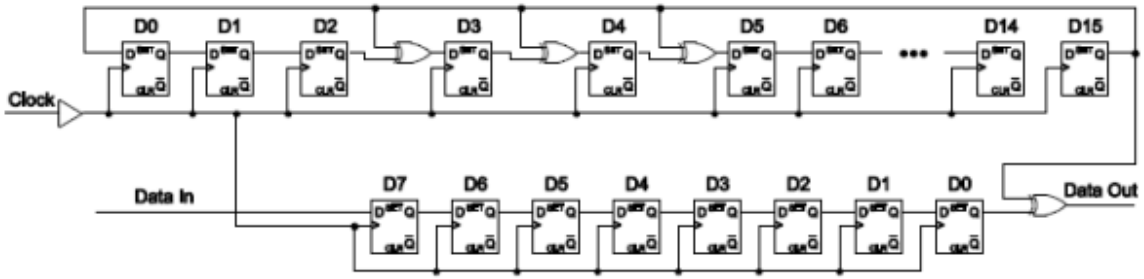
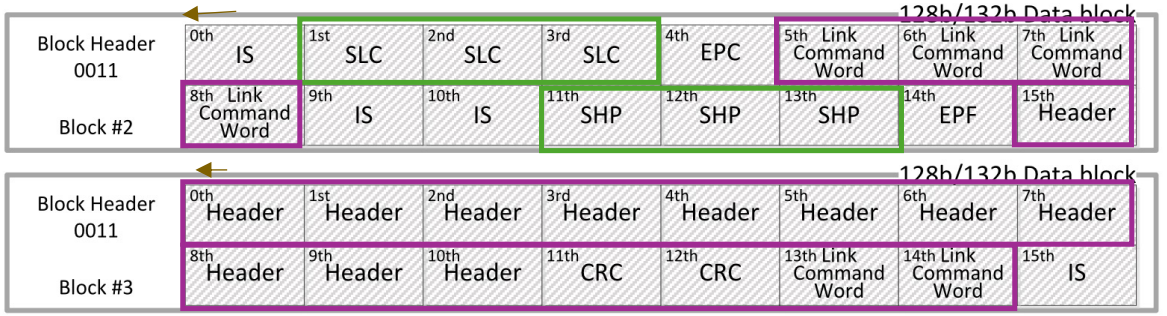
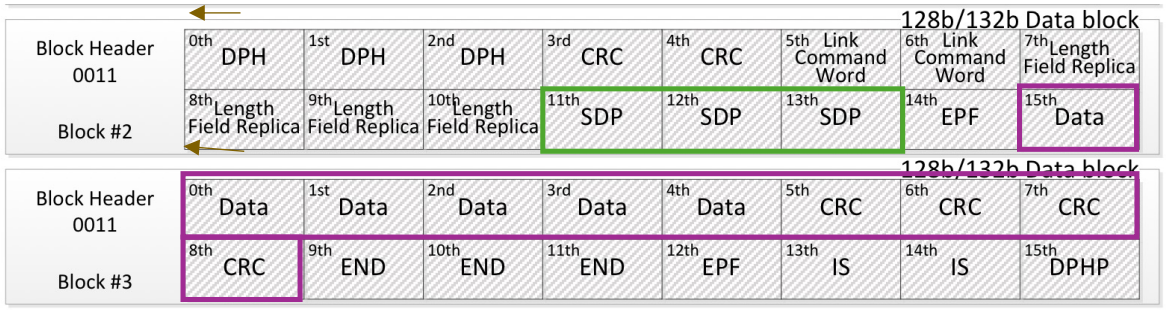
Claim 3	Exemplary Infringement Evidence
	Figure 6-9. LFSR with Scrambling Polynomial  USB 3.2 Specification, Revision 1.0, pg. 58

Claim 4

Claim 4	Exemplary Infringement Evidence
[4] The method of claim 1 wherein the synchronization symbol is transmitted before transmitting the symbols of the packet.	Each Accused Product practices the method of claim 1 wherein the synchronization symbol is transmitted before transmitting the symbols of the packet. *See* [19b] Specifically, for example, the Physical layer of the transmitting USB-C device transmits the HPSTART, DPPSTART, or LCSTART framing symbol set that corresponds to the identified packet type. Each framing symbol set comprises a defined sequence of synchronization codes that are different from the defined sequence of synchronization codes of any other framing symbol set. For example, the SLC, SHP, and SDP are each synchronization symbols that correspond to different packet types.

Claim 4	Exemplary Infringement Evidence
	See, e.g.:  *See* USB 3.2 Specification, Figure D-3, pg.482; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.  *See* USB 3.2 Specification, Figure D-4, pg.483; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.

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Claim 6

Claim 6	Exemplary Infringement Evidence
[6] The method of claim 1 wherein the packet types include a data packet.	Each Accused Product practices the method of claim 1 wherein the packet types include a data packet. For example, the exemplary Lenovo ThinkPad T14 Gen 3 Laptop with USB 3.2 transmits the DPP (Data Packet Payload) in a data stream transmitted by a transmitting USB-C device over a USB 3.x cable, such as a USB-C or USB-A cable. *See, e.g.:* "Data packets are a special type of packet consisting of a Data Packet Header (DPH) and a Data Packet Payload (DPP)… The DPP consists of a data packet payload framing and a variable length of data followed by 4 bytes of CRC-32…" *See* USB 3.2 Specification, Section 7.2.1.2, pg.118; *see also* USB 3.1 Specification, Section 7.2.1.2, pg. 7-8.

Claim 7

Claim 7	Exemplary Infringement Evidence
[7] The method of claim 1 wherein the packet types include a control packet.	Each Accused Product practices the method of claim 1 wherein the packet types include a control packet. For example, the exemplary Lenovo ThinkPad T14 Gen 3 Laptop with USB 3.2 transmits the link command packets in a data stream transmitted by a transmitting USB-C device over a USB 3.x cable, such as a USB-C or USB-A cable. *See, e.g.:*

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Claim 7	Exemplary Infringement Evidence
	"Link commands are used for link-level data integrity, flow control, and link power management. Link commands are a fixed length of eight symbols and contain repeated symbols to increase the error tolerance…" *See* USB 3.2 Specification, Section 7.2.2, pg.122; *see also* USB 3.1 Specification, Section 7.2.2, pg. 7-12. "Link commands shall be eight symbols long… The first four symbols, LCSTART, are the link command starting frame ordered set consisting of three consecutive SLCs followed by EPF. The second four symbols consist of a two-symbol link command word and its replica…" *See* USB 3.2 Specification, Section 7.2.2.1, pg.122; *see also* USB 3.1 Specification, Section 7.2.2.1, pg. 7-12. "The link-layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters • Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8.

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Claim 8

Claim 8	Exemplary Infringement Evidence
[8] The method of claim 1 wherein the symbols are transmitted to a switch network.	Each Accused Product practices the method of claim 1 wherein the symbols are transmitted to a switch network. For example, the USB 3.2 Link Layer uses packets such as HP (Header Packet), DPP (Data Packet Payload), and link command packets to communicate with one or more devices on a shared bus is a switch network. *See e.g.;* USB 3.2 is similar to earlier versions of USB in that it is a cable bus supporting data exchange between a host computer and a wide range of simultaneously accessible peripherals. The attached peripherals share bandwidth through a host -scheduled protocol. The bus allows peripherals to be attached, configured, used, and detached while the host and other peripherals are in operation. *See* USB 3.2 Specification, Section 3, pg. 15

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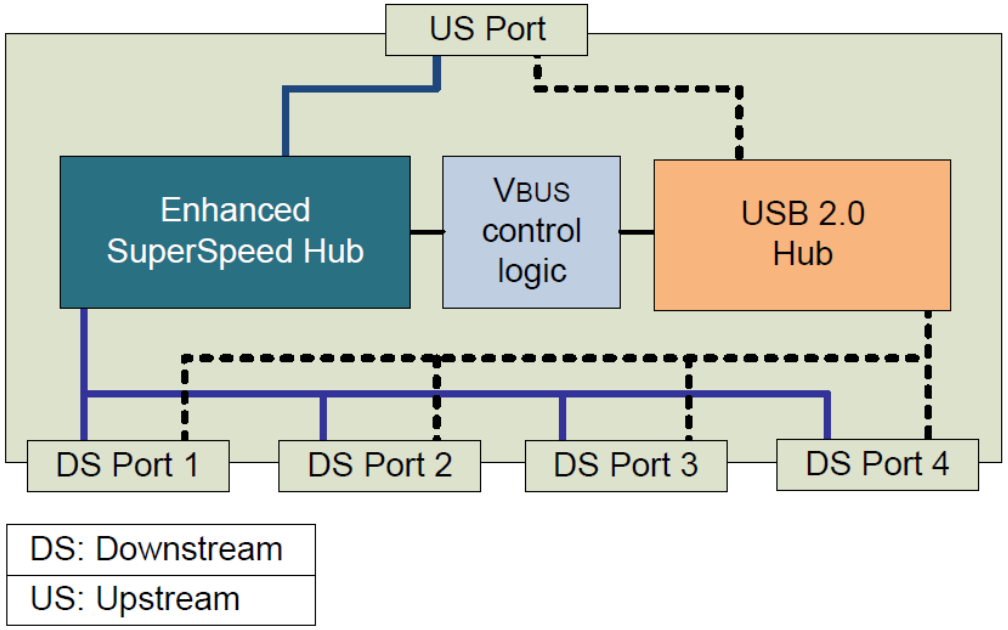
Claim 8	Exemplary Infringement Evidence
	Figure 10-1. USB Hub Architecture  *See* USB 3.2 Specification, Section 10.1, pg. 367

Claim 9

Claim 9	Exemplary Infringement Evidence
[9] The method of claim 1 wherein the synchronization primitive is made up of a sequence of bit-string synchronization symbols.	Each Accused Product practices the method of claim 1 wherein the synchronization primitive is made up of a sequence of bit-string synchronization symbols. For example, the transmitted synchronization symbol permits an external receiving node to align with a synchronization primitive (e.g., Training Sequence TS1/TS2), so that the received symbol (and packet) is correctly aligned on the symbol boundary. These training sequences include a sequence of four synchronization symbols each of which is a COM (Comma) or K28.5 encode value. *See, e.g.:*

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Claim 9	Exemplary Infringement Evidence

Table 6-4. Gen 1 TS1 Ordered Set

Symbol Number	Encoded Values	Description
0-3	K28.5	COM (Comma)
4	D0.0	Reserved for future use
5	See Table 6-6	Link Functionality
6-15	D10.2	TS1 Identifier

Table 6-5. Gen 1 TS2 Ordered Set

Symbol Number	Encoded Values	Description
0-3	K28.5	COM (Comma)
4	D0.0	Reserved
5	See Table 6-6	Link Functionality
6-15	D5.2	TS2 Identifier

See USB 3.2 Specification, Section 6.4.1.1, pg.64-65; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12.

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Claim 11

Claim 11	Exemplary Infringement Evidence
[11pre] A method for identifying packet types of packets of symbols, the method comprising:	To the extent the preamble is limiting, each Accused Product comprises a method for identifying packet types of packets of symbols. For example, the exemplary Lenovo ThinkPad T14 Gen 3 Laptop comprises USB link layer for identifying packet types of received packets of symbols. *See, e.g.*: ThinkPad T14 Gen 3 (14” AMD) Laptop 4.4 (186)

Claim 11	Exemplary Infringement Evidence
	Ports / Slots • 2 x USB-C 3.2 Gen 2 • 2 x USB-A 3.2 Gen 1 (1 Always on) • HDMI 2.0b • Headphone / mic combo • RJ45 • SIM https://www.lenovo.com/us/en/p/laptops/thinkpad/thinkpadt/thinkpad-t14-gen-3-(14-inch-amd)/len101t0013#tech_specs **USB 3.2 Specification** **Language Usage Guidelines from USB-IF**

Claim 11	Exemplary Infringement Evidence

	USB 3.2 Specification
	The USB 3.2 specification defines multi-lane operation for new USB 3.2 hosts and devices, allowing for up to two lanes of 10Gbps operation to realize a 20Gbps data transfer rate. While USB hosts and devices were originally designed as single-lane solutions, USB Type-C® cables were designed from the outset to support multi-lane operation to ensure a path for scalable performance.
	
	The USB 3.2 specification absorbed all prior 3.x specifications. USB 3.2 identifies three transfer rates, USB 3.2 Gen 1 at 5Gbps, USB 3.2 Gen 2 at 10Gbps and USB 3.2 Gen 2x2 at 20Gbps. It is important that vendors clearly communicate the performance signaling that a product delivers in the product's packaging, advertising content, and any other marketing materials.
	
	• Marketing name: **SuperSpeed USB 5Gbps**
	  ○ Product capability: product signals at 5Gbps
	• Marketing name: **SuperSpeed USB 10Gbps**
	  ○ Product capability: product signals at 10Gbps
	• Marketing name: **SuperSpeed USB 20Gbps**
	  ○ Product capability: product signals at 20Gbps
	
	https://www.usb.org/sites/default/files/USB_3_2_Language_Product_and_Packaging_Guidelines_FINAL.pdf

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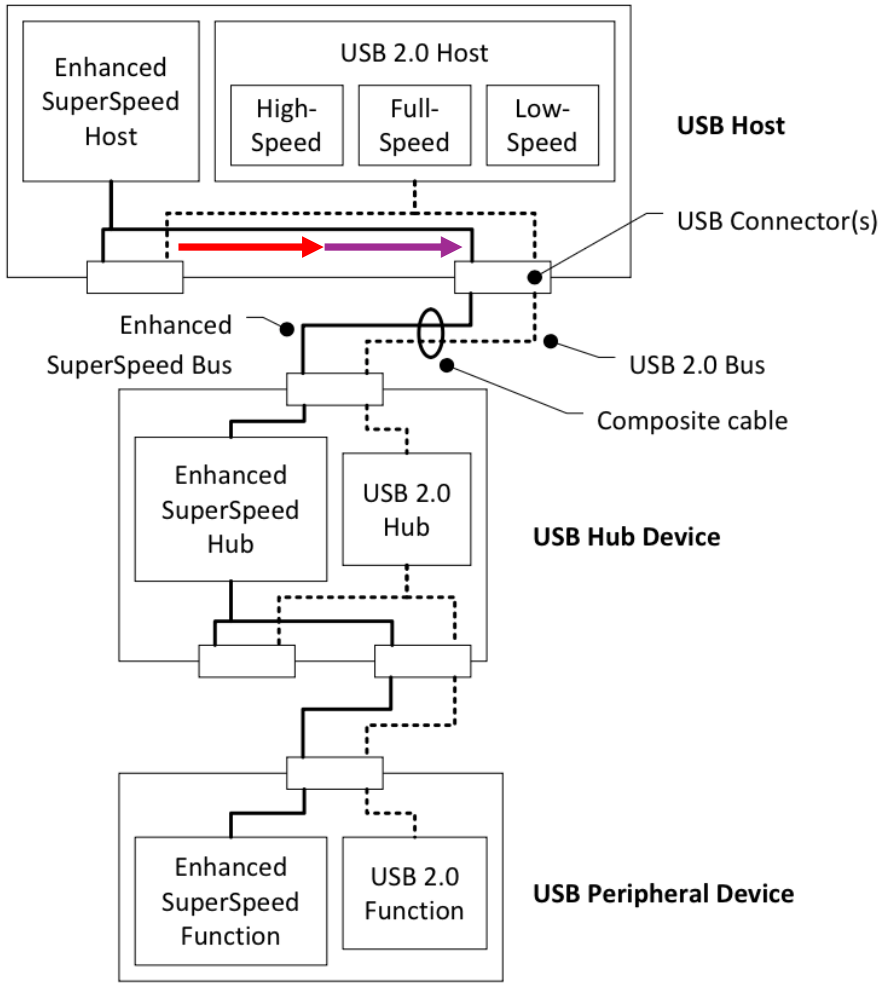
Claim 11	Exemplary Infringement Evidence
	Figure 3-1. USB 3.2 Dual Bus System Architecture 

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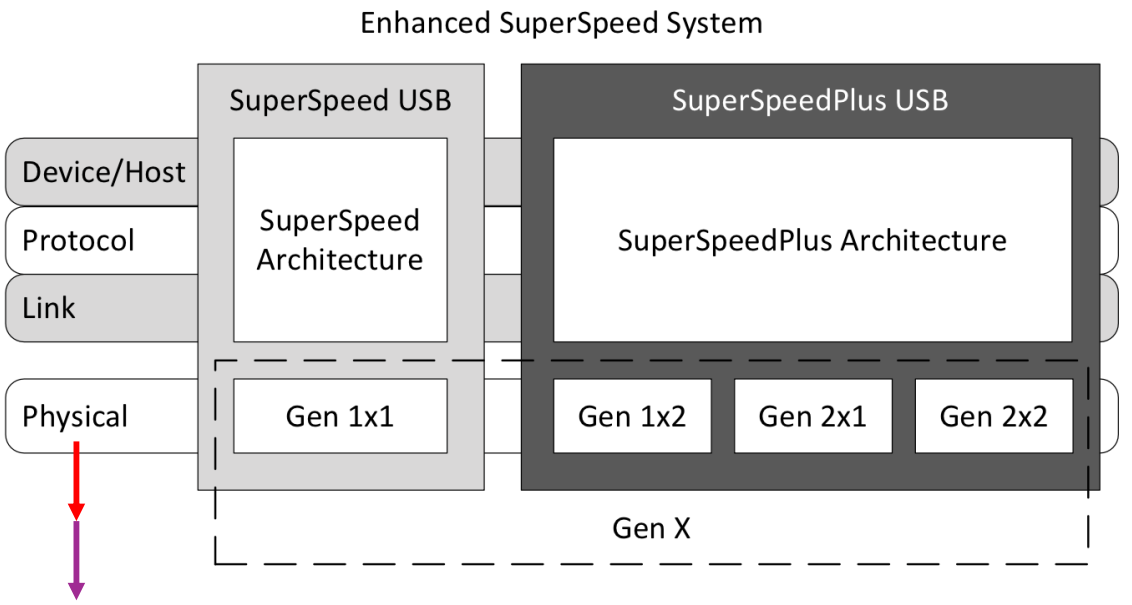
Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Figure 3-1, pg.16; *see also* USB 3.1 Specification, Figure 3-1, page 3-2. **Figure 3-2. USB 3.2 Terminology Reference Model**  *See* USB 3.2 Specification, Figure 3-2, pg.19; *see also* USB 3.1 Specification, Figure 3-3, pg. 3-5. "Enhanced SuperSpeed Bus Data Flow Models…Data and control exchanges between the host and devices are via sets of either unidirectional or bi-directional pipes."

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Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Section 3-3, pg. 31; *see also* USB 3.1 Specification, Section 3.3, pg. 3-16. "The nominal signaling data rate for Gen 1 Physical layer is 5 Gbps. …The bitstream is recovered from the differential sublink by the receiver, assembled into 10-bit symbols, decoded and descrambled, producing 8-bit data that is then sent to the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.1, pg.21; *see also* USB 3.1 Specification, Section 3.2.1.1, pg. 3-7. " The nominal signaling data rate for the Gen 2 physical layer is 10Gbps. …The bitstream is recovered from the electrical interconnect by the receiver and then assembled and aligned into 132-bit blocks. The data is descrambled, and the identifier information and the descrambled bits are passed onto the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.2, pg.21; *see also* USB 3.1 Specification, Section 3.2.1.2, pg. 3-7. "…For Gen 1 operation, the transmitter encodes data and control characters into symbols. Control symbols are used to achieve byte alignment and are used for framing data and managing the link. Special characteristics make control symbols uniquely identifiable from data symbols. For Gen 2 operation, the transmitter block encodes the data and control bytes…"

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Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Section 3.2.1., pg.21; *see also* USB 3.1 Specification, Section 3.2.1, pg. 3-7. "In Gen 1 operation, all header packets are 20 symbols long, as is formatted in Figure 7-3.This includes LMPs [Link Management Packets], TPs [Transaction Packets], ITPs [Isochronous Timestamp Packets], and DPHs [Dta Packet Header].A header packet consists of three parts, a header packet framing, a packet header, and a Link Control Word. In Gen2 operation, all header packets except for non-deferred DPH are the same as Gen1 operation…" *See* USB 3.2 Specification, Section 7.2.1.1, pg.114; *see also* USB 3.1 Specification, Section 7.2.1.1, pg. 7-3. "Header packet framing, HPSTART ordered set, is a four-symbol header packet starting frame ordered set. Gen1 operation is defined as three consecutive k symbols of SHP followed by a single K-symbol of EPF. In Gen2 operation, HPSTART ordered set is the framing ordered set for all header packets except for non-deferred DPH and is defined as three consecutive symbols of SHP followed by a single symbol of EPF…" *See* USB 3.2 Specification, Section 7.2.1.1, pg.114; *see also* USB 3.1 Specification, Section 7.2.1.1.1, pg. 7-3. "Data packets are a special type of packet consisting of a Data Packet Header (DPH) and a Data Packet Payload (DPP)… The DPP consists of a data packet payload framing and a variable length of data followed by 4 bytes of CRC-32…"

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Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Section 7.2.1.2, pg.118; *see also* USB 3.1 Specification, Section 7.2.1.2, pg. 7-8. "DPP framing ordered sets consist of a starting framing ordered set called DPPSTART OS, and …ending framing ordered sets called DPPEND OS… a DPPSTART ordered set, which is a DPP starting frame ordered set, consists of three consecutive symbols of SDP followed by a single symbol of EPF…" *See* USB 3.2 Specification, Section 7.2.1.2.1, pg.118; *see also* USB 3.1 Specification, Section 7.2.1.2.1, pg. 7-8. "Link commands are used for link-level data integrity, flow control, and link power management. Link commands are a fixed length of eight symbols and contain repeated symbols to increase the error tolerance…" *See* USB 3.2 Specification, Section 7.2.2, pg.122; *see also* USB 3.1 Specification, Section 7.2.2, pg. 7-12. "Link commands shall be eight symbols long… The first four symbols, LCSTART, are the link command starting frame ordered set consisting of three consecutive SLCs followed by EPF. The second four symbols consist of a two-symbol link command word and its replica…" *See* USB 3.2 Specification, Section 7.2.2.1, pg.122; *see also* USB 3.1 Specification, Section 7.2.2.1, pg. 7-12.

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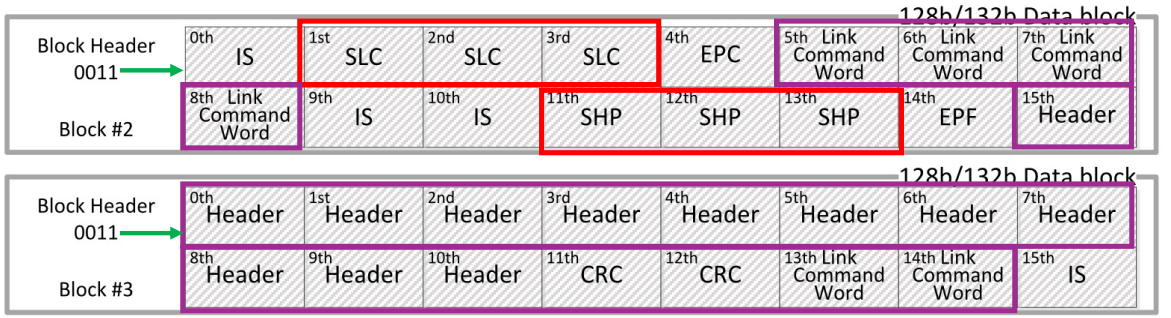
Claim 11	Exemplary Infringement Evidence
	"The link-layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters • Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8.  *See* USB 3.2 Specification, Figure D-3, pg.482; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.

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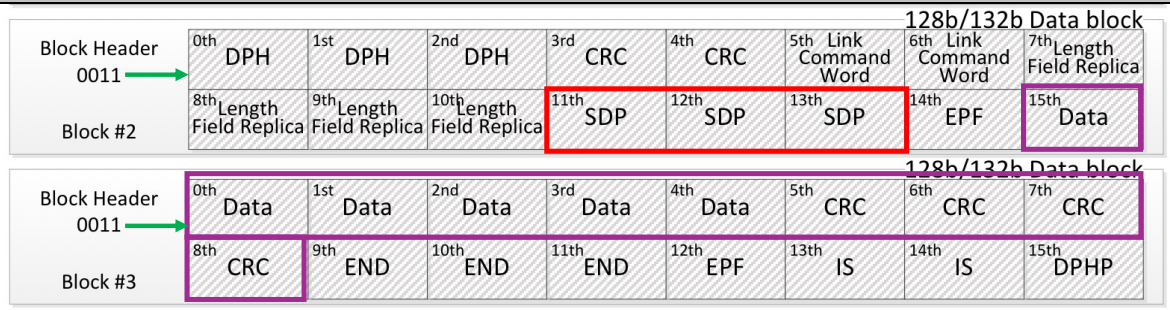
Claim 11	Exemplary Infringement Evidence
	 *See* USB 3.2 Specification, Figure D-4, pg.483; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.
[11a] receiving a synchronization symbol by a receiver indicating a packet type, each packet type having a different synchronization symbol; receiving a packet of symbols; indicating that the received packet of symbols has the packet type of the received synchronization symbol; and	Each Accused Product receives a synchronization symbol by a receiver indicating a packet type with each packet type having a different synchronization symbol, receiving a packet of symbols, and indicating that the received packet of symbols has the packet type of the received synchronization symbol. For example, the Physical layer of the receiving USB-C device receiving the HPSTART, DPPSTART, or LCSTART framing symbol set that corresponds to the identified packet type. Each framing symbol set comprises a defined sequence of synchronization codes that are different from the defined sequence of synchronization codes of any other framing symbol set. For example, the SLC, SHP, and SDP are each synchronization symbols that correspond to different packet types. *See, e.g.*: "A Gen1 transmitter encodes data and control characters into symbols using an 8b/10b code… It then encodes the scrambled 8-bit data into 10-bit symbols for transmission over the physical connection… The bitstream is recovered from the differential sublink by the

Claim 11	Exemplary Infringement Evidence
	receiver, assembled into 10-bit symbols, decoded and descrambled, producing 8-bit data that is then sent to the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.1, pg. 21; *see also* USB 3.1 Specification, Section 3.2.1.1, pg. 3-7. "A Gen 2 Transmitter frames data and control bytes (referred to as symbols) by prepending a 4-bit block identifier to 16 symbols (128 bits) to create a 128b/132b block…As in Gen1 operation, the resultant data are sent out across the electrical interconnect using spread spectrum clocking to lower EMI emissions. The Bitstream is recovered from the electrical interconnect by the receiver and then assembled and aligned into 132-bit blocks. The data is descrambled, and the identifier information and the descrambled bits are passed onto the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.2, pg. 21; *see also* USB 3.1 Specification, Section 3.2.1.2, pg. 3-7.

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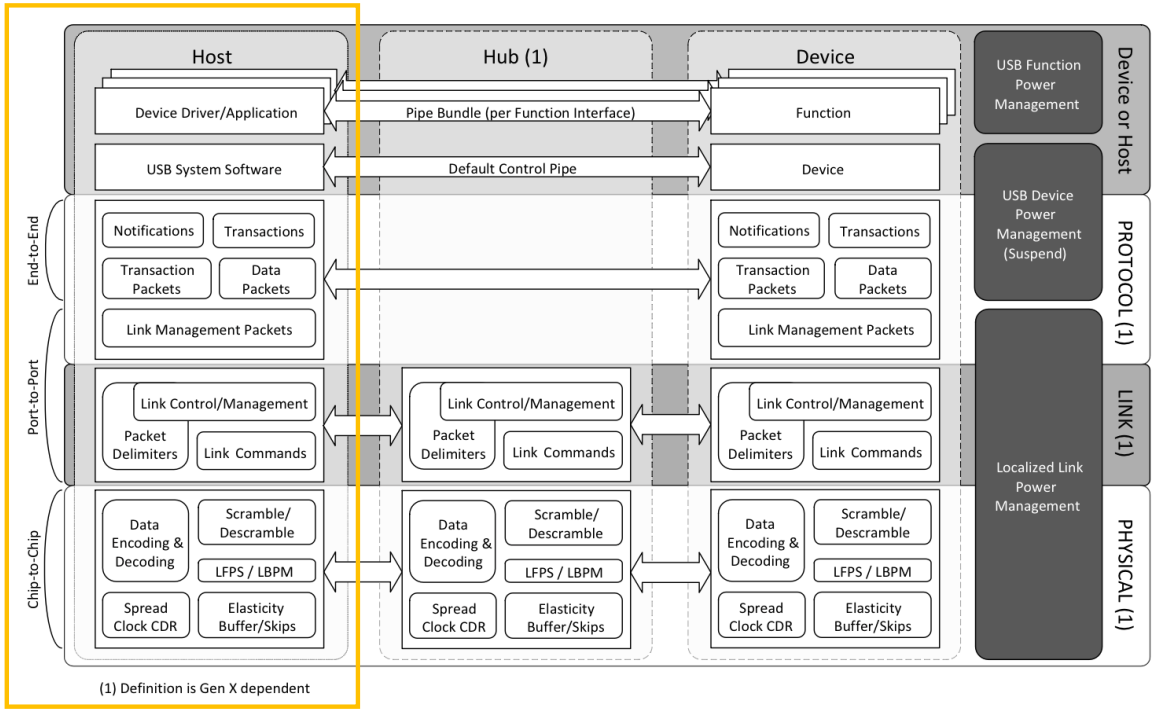
Claim 11	Exemplary Infringement Evidence
	Figure 3-3. Enhanced SuperSpeed Bus Communications Layers and Power Management Elements  *See* USB 3.2 Specification, Figure 3-3, pg.122; *see also* USB 3.1 Specification, Figure 3-4, pg. 3-6. "... For Gen1 operation, the transmitter encodes data and control characters into symbols. Control symbols are used to achieve byte alignment and are used for framing data and managing the link. Special characteristics make control symbols uniquely identifiable from

Claim 11	Exemplary Infringement Evidence
	data symbols. For Gen2 operation, the transmitter block encodes the data and control bytes…" *See* USB 3.2 Specification, Section 3.2.1, pg.21; *see also* USB 3.1 Specification, Section 3.2.1, pg. 3-7. "The [Gen 1] 8b/10b encoding scheme provides Special symbols that are distinct from the Data symbols used to represent characters. These special symbols are used for various Link Management mechanisms described later. Table 6-2 lists the special symbols used and provides a brief description for each… For Gen2 [128b/132b] operation, the block header identifies whether the following 16 symbols have special meaning or represent data. In Gen 2 operation, a receiver shall always perform single bit error correction on the special symbols part of a control block. For Gen1 and Gen2, the following special symbols are defined." *See* USB 3.2 Specification, Section 6.3.3, pg.63; *see also* USB 3.1 Specification, Section 6.3.3, pg. 6-12.

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Table 6-2. Special Symbols

Symbol	Name	Gen 1 Symbol	Gen 2 Symbol	Description
SKP	Skip	K28.1	CCh	Compensates for different bit rates between two communicating ports. SKPs may be dynamically inserted or removed from the data stream. For Gen 2 operation, unscrambled.
SKPEND	Skip End	Not applicable	33h	Marks the boundary between SKP symbols and the remainder of the SKP OS. Unscrambled.
SDP	Start Data Packet	K28.2	96h	Marks the start of a Data Packet Payload. For Gen 2 operation, scrambled and transmitted only in data block.
EDB	End Bad	K28.3	69h	Marks the end of a nullified Packet. For Gen 2 operation, scrambled and transmitted only in data block.
SUB	Decode Error Substitution	K28.4	Not applicable	Symbol substituted by the 8b/10b decoder when a Decode error is detected.
COM	Comma	K28.5	Not applicable	Used for symbol alignment.
-----	-----	K28.6	Not applicable	Reserved
SHP	Start Header Packet	K27.7	9Ah	Marks the start of a Data Packet (Gen 1 operation only), Transaction Packet or Link Management Packet. For Gen 2 operation, scrambled and transmitted only in data block.
DPHP	Start Data Packet Header	Not applicable	95h	Marks the start of a Data Packet (Gen 2 only). Scrambled and transmitted only in data block.
END	End	K29.7	65h	Marks the end of a packet. For Gen 2 operation, scrambled and transmitted only in data block.
SLC	Start Link Command	K30.7	4Bh	Marks the start of a Link Command. For Gen 2 operation, scrambled and transmitted only in data block.

Symbol	Name	Gen 1 Symbol	Gen 2 Symbol	Description
EPF	End Packet Framing	K23.7	36h	Marks the end of a packet framing. For Gen 2 operation, scrambled and transmitted only in data block.
SDS	Start of Data Stream	Not applicable	E1h	Marks the start of an SDS Ordered Set. Unscrambled.

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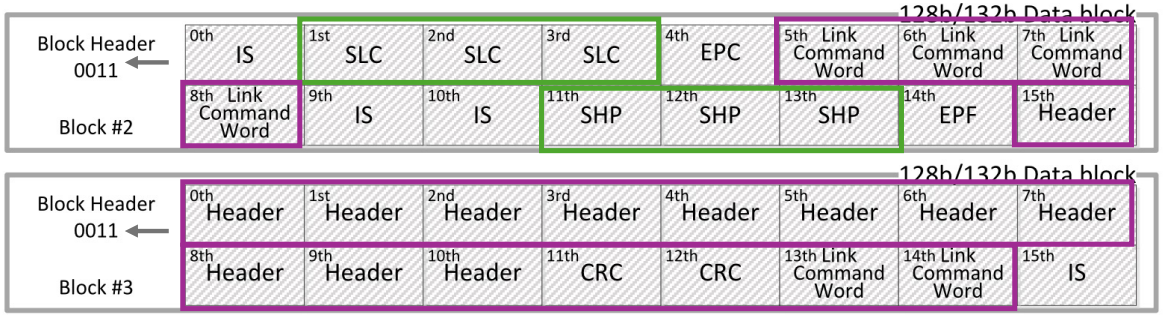
Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Table 6-2, pg.63; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12. "The link layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters • Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8.  *See* USB 3.2 Specification, Figure D-3, pg.482; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.

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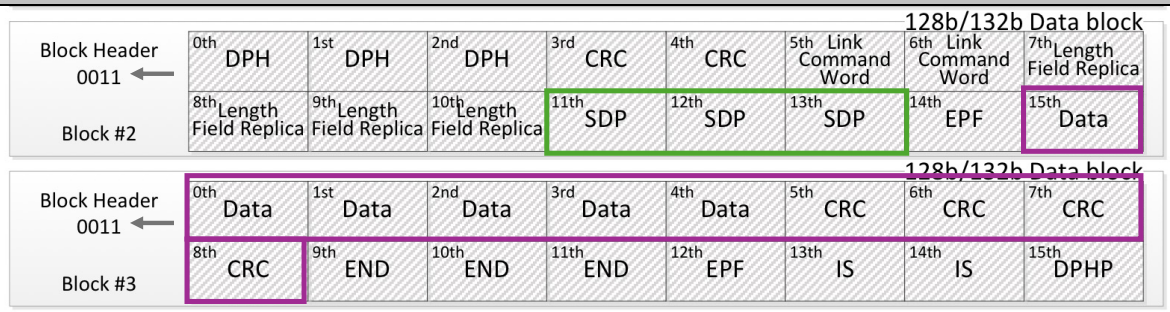
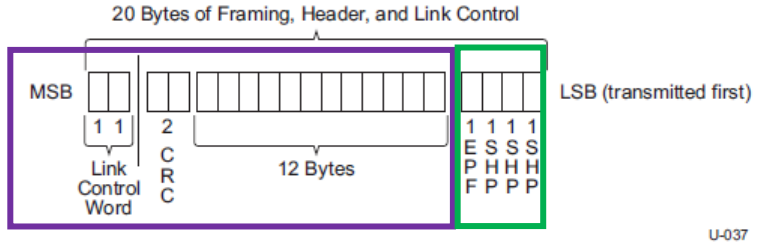
Claim 11	Exemplary Infringement Evidence



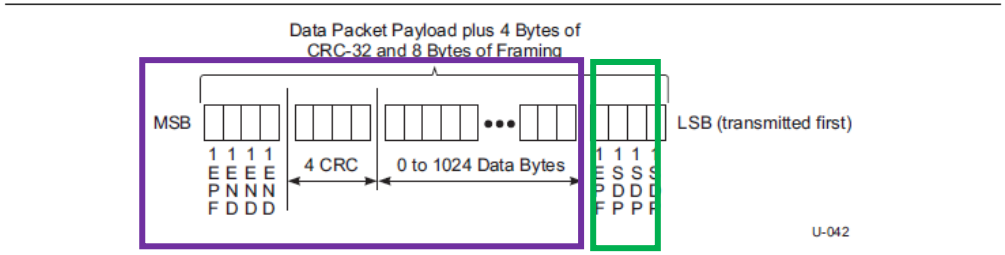
See USB 3.2 Specification, Figure D-3, pg.483; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.

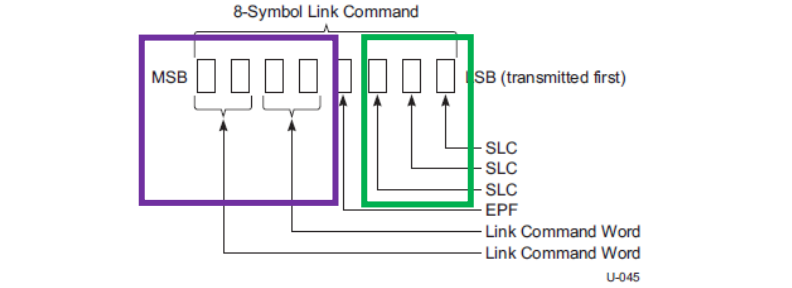
7.2.1.1.1 Header Packet Framing

Header packet framing, HPSTART ordered set, is a four-symbol header packet starting frame ordered set based on K-symbols. It is defined as three consecutive symbols of SHP followed by a K-symbol of EPF. A header packet shall always begin with HPSTART ordered set. The construction of the header packet framing is to achieve one symbol error tolerance.



See USB 3.2 Specification, Figure 7-3, pg.115; *see also* USB 3.1 Specification, Figure 7-3, pg. 7-4.

Claim 11	Exemplary Infringement Evidence
	7.2.1.2.1 Data Packet Payload Framing DPP framing consists of eight K-symbols, a four-symbol DPP starting frame ordered set and a four-symbol DPP ending frame ordered set. As indicated by Figure 7-8, a DPPSTART ordered set, which is a DPP starting frame ordered set, consists of three consecutive K-symbols of SDP followed by a single K-symbol of EPF. A DPP ending frame ordered set has two different types. The first type, DPPEND ordered set, is a DPP ending frame ordered set which consists of three consecutive K-symbol of END followed by a single K-symbol of EPF. The second type, DPPABORT ordered set, is a DPP aborting frame ordered set which consists of three consecutive K-symbol of EDB (end of nullified packet) followed by a single K-symbol of EPF. The DPPEND ordered set is used to indicate a normal ending of a complete DPP. The DPPABORT ordered set is used to indicate an abnormal ending of a DPP.  **Figure 7-8. Data Packet Payload with CRC-32 and Framing** *See* USB 3.2 Specification, Figure 7-8, pg.119; *see also* USB 3.1 Specification, Figure 7-8, pg. 7-8.

Claim 11	Exemplary Infringement Evidence
	 **Figure 7-11. Link Command Structure** *See* USB 3.2 Specification, Figure 7-11, pg.122; *see also* USB 3.1 Specification, Figure 7-12, pg 7-12.
[11d] the synchronization symbol permitting properly alignment upon receiving with a synchronization primitive to be correctly aligned on a symbol boundary.	Each Accused Product comprises a method for identifying packet types of packets of symbols including the synchronization symbol permitting properly alignment upon receiving with a synchronization primitive to be correctly aligned on a symbol boundary. For example, the received synchronization symbol permits the receiving node to align with a synchronization primitive (e.g., Training Sequence TS1/TS2), so that the received symbol (and packet) is correctly aligned on the symbol boundary. *See, e.g.*: "The receiver needs to reliably recover clock and data from the bit stream. For Gen1 operation, the transmitter encodes data and control characters into symbols. Control symbols are used to achieve byte alignment and are used for framing data and managing the link. Special characteristics make control symbols uniquely identifiable from data symbols. For Gen2 operation, the transmitter block encodes the data and control bytes…"

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Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Section 3.2.1, pg.21; *see also* USB 3.1 Specification, Section 3.2.1, pg. 3-7. "The link layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters • Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8. "6.3.3 Special Symbols for Framing and Link Management The 8b/10b encoding scheme provides Special Symbols that are distinct from the Data Symbols used to represent characters. These Special Symbols are used for various Link Management mechanisms described later. Table 6-2 lists the Special Symbols used and provides a brief description for each. Special Symbols shall follow the proper 8b/10b disparity rules. The compliance tests are defined in the USB SuperSpeed Compliance Methodology white paper. For Gen 2 operation the block header identifies whether the following 16 symbols have special meaning or if they represent data. In Gen 2 operation a receiver shall always perform single bit error correction on the special symbols when they are part of a control block. For Gen 1 and Gen 2 the following special symbols are defined.

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Table 6-2. Special Symbols

Symbol	Name	Gen 1 Symbol	Gen 2 Symbol	Description
SKP	Skip	K28.1	CCh	Compensates for different bit rates between two communicating ports. SKPs may be dynamically inserted or removed from the data stream. For Gen 2 operation, unscrambled.
SKPEND	Skip End	Not applicable	33h	Marks the boundary between SKP symbols and the remainder of the SKP OS. Unscrambled.
SDP	Start Data Packet	K28.2	96h	Marks the start of a Data Packet Payload. For Gen 2 operation, scrambled and transmitted only in data block.
EDB	End Bad	K28.3	69h	Marks the end of a nullified Packet. For Gen 2 operation, scrambled and transmitted only in data block.
SUB	Decode Error Substitution	K28.4	Not applicable	Symbol substituted by the 8b/10b decoder when a Decode error is detected.
COM	Comma	K28.5	Not applicable	Used for symbol alignment.
-----	-----	K28.6	Not applicable	Reserved
SHP	Start Header Packet	K27.7	9Ah	Marks the start of a Data Packet (Gen 1 operation only), Transaction Packet or Link Management Packet. For Gen 2 operation, scrambled and transmitted only in data block.
DPHP	Start Data Packet Header	Not applicable	95h	Marks the start of a Data Packet (Gen 2 only). Scrambled and transmitted only in data block.
END	End	K29.7	65h	Marks the end of a packet. For Gen 2 operation, scrambled and transmitted only in data block.
SLC	Start Link Command	K30.7	4Bh	Marks the start of a Link Command. For Gen 2 operation, scrambled and transmitted only in data block.
EPF	End Packet Framing	K23.7	36h	Marks the end of a packet framing. For Gen 2 operation, scrambled and transmitted only in data block.
SDS	Start of Data Stream	Not applicable	E1h	Marks the start of an SDS Ordered Set. Unscrambled.

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Claim 11	Exemplary Infringement Evidence
	See USB 3.2 Specification, Section 6.3.3, pg.62-63; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12. "6.4. Link Training 6.4.1.1 Gen 1 Operation This section defines the sequences that are used for configuration and initialization . The sequences are used by the Initialization State Machine (refer to Chapter 7) for the following functions: • Configuring and initializing the link • Bit-lock and symbol lock • Rx equalization training • Lane polarity inversion Training sequences are composed of Ordered Sets used for initializing bit alignment, Symbol alignment and optimizing the equalization. Training sequence Ordered Sets are never scrambled but are always 8b/10b encoded." "6.4.1.1.1 Normative Training Sequence Rules for Gen 1 Operation Training sequences are composed of Ordered Sets used for initializing bit alignment, symbol alignment, and receiver equalization."

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Claim 11	Exemplary Infringement Evidence

Table 6-4. Gen 1 TS1 Ordered Set

Symbol Number	Encoded Values	Description
0-3	K28.5	COM (Comma)
4	D0.0	Reserved for future use
5	See Table 6-6	Link Functionality
6-15	D10.2	TS1 Identifier

Table 6-5. Gen 1 TS2 Ordered Set

Symbol Number	Encoded Values	Description
0-3	K28.5	COM (Comma)
4	D0.0	Reserved
5	See Table 6-6	Link Functionality
6-15	D5.2	TS2 Identifier

See USB 3.2 Specification, Section 6.4.1.1, pg.64-65; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12.

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Claim 11	Exemplary Infringement Evidence
	"6.4.1.2 Gen 2 Operation This section defines the sequences that are used for configuration and initialization of a link operating at Gen 2 rates. The sequences are used by the Initialization State Machine (refer to Chapter 7) for the following functions: • Configuring and initializing the link • Bit-lock and symbol lock • Rx equalization training • Lane polarity inversion • Block alignment Training sequences are composed of Ordered Sets used for initializing bit alignment, Symbol alignment, block alignment and optimizing the equalization."

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Claim 11	Exemplary Infringement Evidence
	Table 6-7. Gen 2 TS1 Ordered Set **Symbol Number** / **Symbol** / **Description** 0-3 / 1Eh / TS1 Identifier 4 / 00h / Reserved for future use 5 / See Table 6-6 / Link Functionality 6-13 / 1Eh / TS1 Identifier 14-15 / TS1 Identifier (1Eh) or a DC Balance Symbol / TS1 Identifier or DC balance **Table 6-8. Gen 2 TS2 Ordered Set** **Symbol Number** / **Symbol** / **Description** 0-3 / 2Dh / TS2 Identifier 4 / 00h / Reserved for future use 5 / See Table 6-6 / Link Functionality 6-13 / 2Dh / TS2 Identifier 14-15 / TS2 Identifier (2Dh) or a DC Balance Symbol / TS2 Identifier or DC balance *See* USB 3.2 Specification, Section 6.4.1.2, pg.67-68.

Claim 12

Claim 12	Exemplary Infringement Evidence
[12] The method of claim 11 wherein the symbols of the packets include in-band symbols and the synchronization symbols are out-of-band symbols.	Each Accused Product practices the method of claim 11 wherein the symbols of the packets include in-band symbols and the synchronization symbols are out-of-band symbols. *See* [2]

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Claim 14

Claim 14	Exemplary Infringement Evidence
[14] The method of claim 11 wherein the synchronization symbol is received before the symbols of the packet are received.	Each Accused Product practices the method of claim 11 wherein the synchronization symbol is received before the symbols of the packet are received. *See* [4]

Claim 15

Claim 15	Exemplary Infringement Evidence
[15] The method of claim 11 wherein the packet types include a data packet.	Each Accused Product practices the method of claim 11 wherein the packet types include a data packet. *See* [6]

Claim 16

Claim 16	Exemplary Infringement Evidence
[16] The method of claim 11 wherein the packet types include a control packet.	Each Accused Product practices the method of claim 11 wherein the packet types include a control packet. *See* [7].

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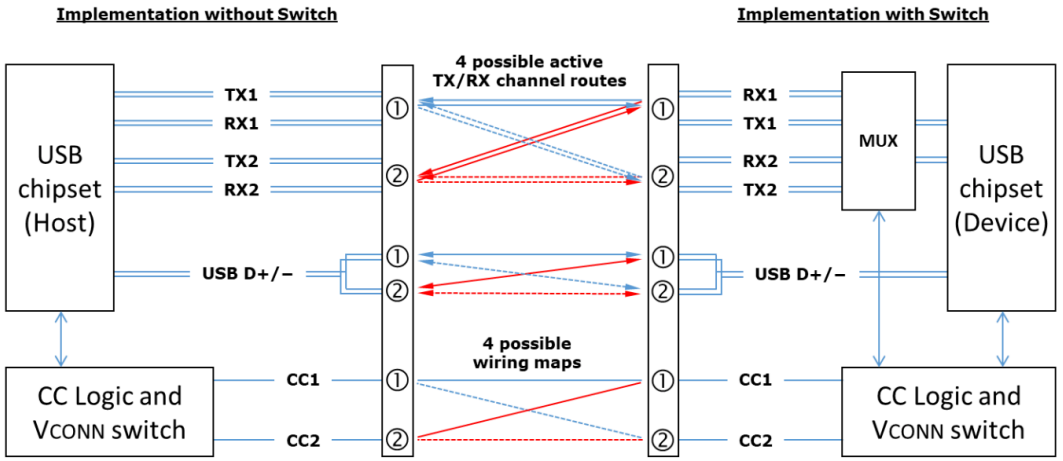
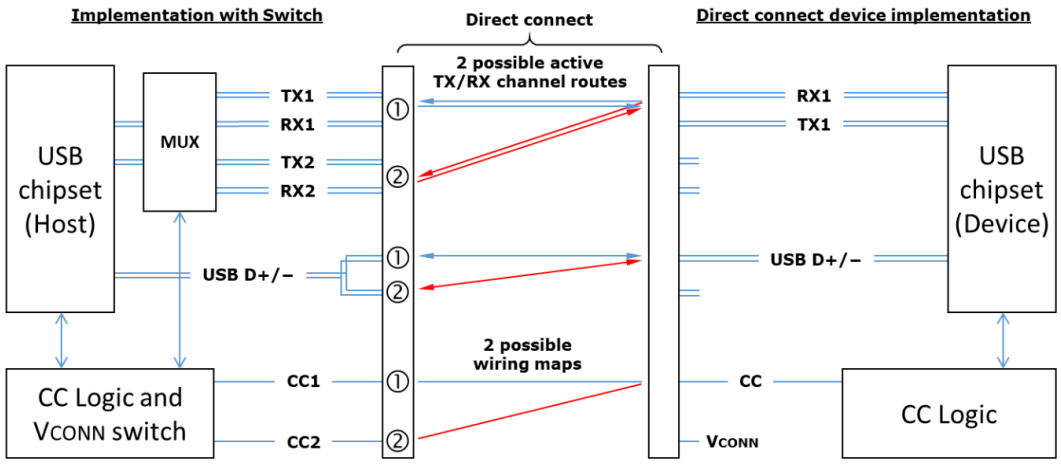
Claim 17

Claim 17	Exemplary Infringement Evidence
[17] The method of claim 11 wherein the symbols are received from a switch.	Each Accused Product practices the method of claim 11 wherein the symbols are received from a switch. *See* [8]

Figure 4-3 Logical Model for Single-Lane Data Bus Routing across USB Type-C-based Ports



While Figure 4-3 illustrates the functional model as a host connected to a device, this model equally applies to a USB hub's downstream ports as well.

Claim 17	Exemplary Infringement Evidence
	Figure 4-4 Logical Model for USB Type-C-based Ports for a Single-Lane Direct Connect Device  *See* USB Type-C Cable and Connector Specification Release 2.0, Figure 4-3, pg. 149

Claim 18

Claim 18	Exemplary Infringement Evidence
[18] The method of claim 11 wherein the synchronization primitive is made up of a sequence of bit-string synchronization symbols.	Each Accused Product practices the method of claim 11 wherein the synchronization primitive is made up of a sequence of bit-string synchronization symbols. *See* [9]

Claim 19

Claim 19	Exemplary Infringement Evidence
[19pre] A communications device for transmitting packet types of packets, comprising:	To the extent the preamble is limiting, each Accused Product comprises a communications device for transmitting packet types of packets. For example, the exemplary Lenovo ThinkPad T14 Gen 3 Laptop comprises a communications device for transmitting packet types of packets. For example, the exemplary Lenovo ThinkPad T14 Gen 3 Laptop with USB 3.2 transmits the HPSTART, DPPSTART, and LCSTART framing symbol sets for HP (Header Packet), DPP (Data Packet Payload), and link command packets in a data stream transmitted by a transmitting USB-C device over a USB 3.x cable, such as a USB-C or USB-A cable. *See, e.g.*: ThinkPad T14 Gen 3 (14” AMD) Laptop 4.4 (186)

Claim 19	Exemplary Infringement Evidence

Claim 19	Exemplary Infringement Evidence
	Ports / Slots • 2 x USB-C 3.2 Gen 2 • 2 x USB-A 3.2 Gen 1 (1 Always on) • HDMI 2.0b • Headphone / mic combo • RJ45 • SIM https://www.lenovo.com/us/en/p/laptops/thinkpad/thinkpadt/thinkpad-t14-gen-3-(14-inch-amd)/len101t0013#tech_specs **USB 3.2 Specification** **Language Usage Guidelines from USB-IF**

Claim 19	Exemplary Infringement Evidence

	USB 3.2 Specification
	The USB 3.2 specification defines multi-lane operation for new USB 3.2 hosts and devices, allowing for up to two lanes of 10Gbps operation to realize a 20Gbps data transfer rate. While USB hosts and devices were originally designed as single-lane solutions, USB Type-C® cables were designed from the outset to support multi-lane operation to ensure a path for scalable performance.
	
	The USB 3.2 specification absorbed all prior 3.x specifications. USB 3.2 identifies three transfer rates, USB 3.2 Gen 1 at 5Gbps, USB 3.2 Gen 2 at 10Gbps and USB 3.2 Gen 2x2 at 20Gbps. It is important that vendors clearly communicate the performance signaling that a product delivers in the product's packaging, advertising content, and any other marketing materials.
	
	• Marketing name: **SuperSpeed USB 5Gbps**
	  ○ Product capability: product signals at 5Gbps
	• Marketing name: **SuperSpeed USB 10Gbps**
	  ○ Product capability: product signals at 10Gbps
	• Marketing name: **SuperSpeed USB 20Gbps**
	  ○ Product capability: product signals at 20Gbps
	
	https://www.usb.org/sites/default/files/USB_3_2_Language_Product_and_Packaging_Guidelines_FINAL.pdf

[19a] an identification component that identifies a packet type of a packet of symbols; and	Each Accused Product includes an identification component that identifies a packet type of a packet of symbols. For example, USB 3.2 Link Layer identifies HP (Header Packet), DPP (Data Packet Payload), and link command packets using the HPSTART, DPPSTART, and LCSTART framing symbol sets in a data stream. *See, e.g.*:

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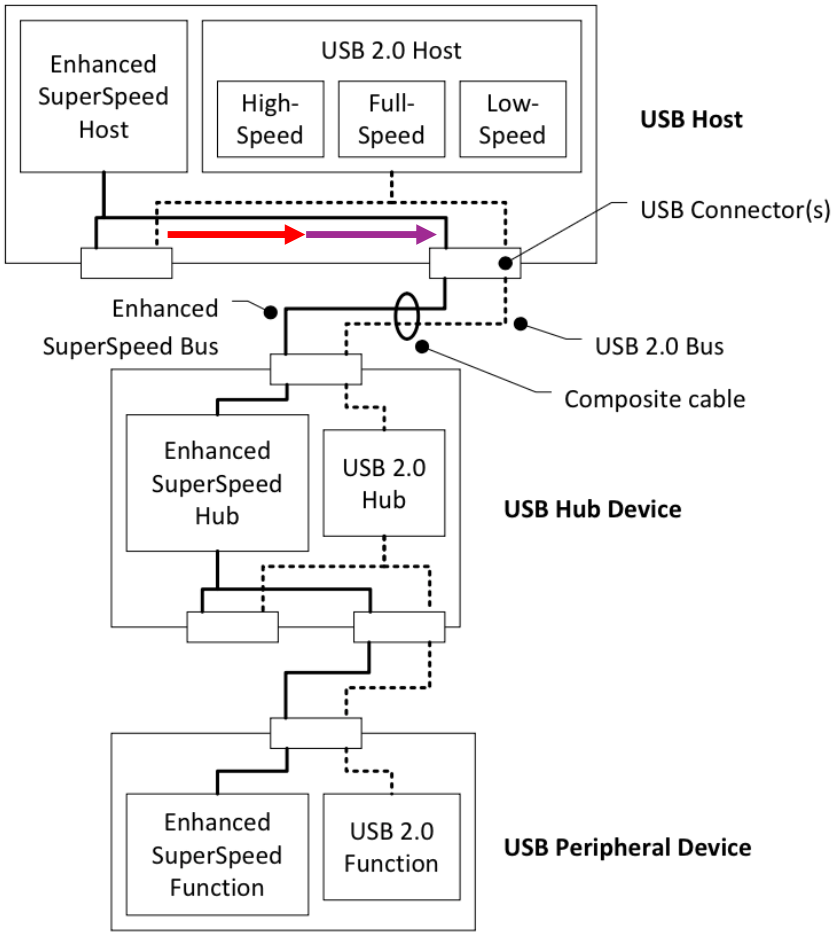
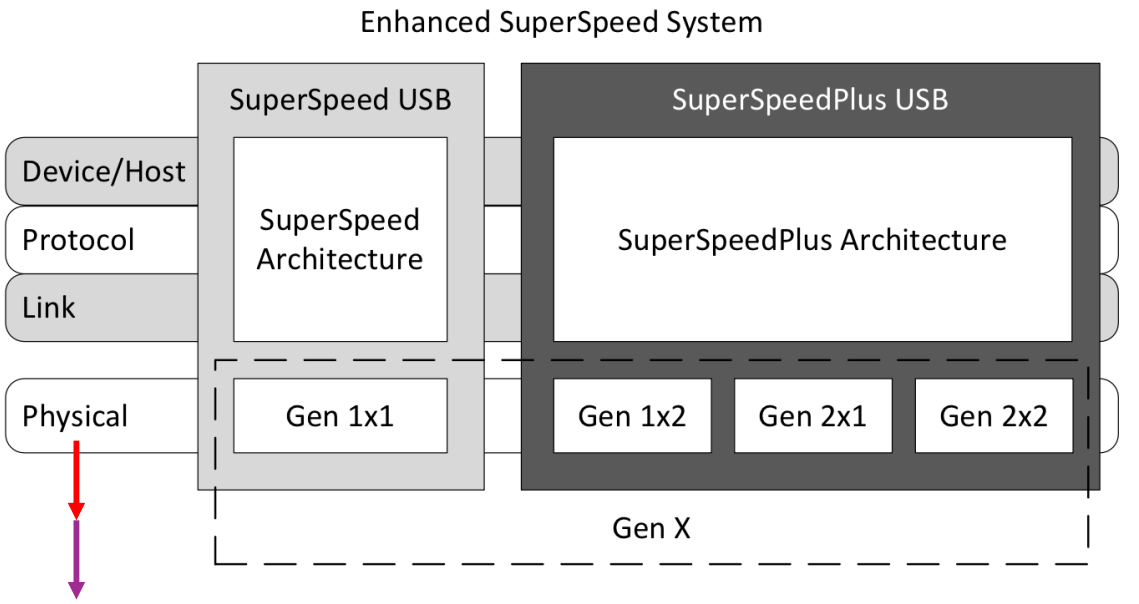
Claim 19	Exemplary Infringement Evidence
	Figure 3-1. USB 3.2 Dual Bus System Architecture  *See* USB 3.2 Specification, Figure 3-1, pg.16; *see also* USB 3.1 Specification, Figure 3-1, page 3-2.

Claim 19	Exemplary Infringement Evidence
	Figure 3-2. USB 3.2 Terminology Reference Model  *See* USB 3.2 Specification, Figure 3-2, pg.19; *see also* USB 3.1 Specification, Figure 3-3, pg. 3-5. "Enhanced SuperSpeed Bus Data Flow Models…Data and control exchanges between the host and devices are via sets of either unidirectional or bi-directional pipes." *See* USB 3.2 Specification, Section 3-3, pg. 31; *see also* USB 3.1 Specification, Section 3.3, pg. 3-16.

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Claim 19	Exemplary Infringement Evidence
	"The nominal signaling data rate for Gen 1 Physical layer is 5 Gbps. …The bitstream is recovered from the differential sublink by the receiver, assembled into 10-bit symbols, decoded and descrambled, producing 8-bit data that is then sent to the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.1, pg.21; *see also* USB 3.1 Specification, Section 3.2.1.1, pg. 3-7. " The nominal signaling data rate for the Gen 2 physical layer is 10Gbps. …The bitstream is recovered from the electrical interconnect by the receiver and then assembled and aligned into 132-bit blocks. The data is descrambled, and the identifier information and the descrambled bits are passed onto the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.2, pg.21; *see also* USB 3.1 Specification, Section 3.2.1.2, pg. 3-7. "…For Gen 1 operation, the transmitter encodes data and control characters into symbols. Control symbols are used to achieve byte alignment and are used for framing data and managing the link. Special characteristics make control symbols uniquely identifiable from data symbols. For Gen 2 operation, the transmitter block encodes the data and control bytes…" *See* USB 3.2 Specification, Section 3.2.1., pg.21; *see also* USB 3.1 Specification, Section 3.2.1, pg. 3-7.

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Claim 19	Exemplary Infringement Evidence
	"In Gen 1 operation, all header packets are 20 symbols long, as is formatted in Figure 7-3.This includes LMPs [Link Management Packets], TPs [Transaction Packets], ITPs [Isochronous Timestamp Packets], and DPHs [Dta Packet Header].A header packet consists of three parts, a header packet framing, a packet header, and a Link Control Word. In Gen2 operation, all header packets except for non-deferred DPH are the same as Gen1 operation…" *See* USB 3.2 Specification, Section 7.2.1.1, pg.114; *see also* USB 3.1 Specification, Section 7.2.1.1, pg. 7-3. "Header packet framing, HPSTART ordered set, is a four-symbol header packet starting frame ordered set. Gen1 operation is defined as three consecutive k symbols of SHP followed by a single K-symbol of EPF. In Gen2 operation, HPSTART ordered set is the framing ordered set for all header packets except for non-deferred DPH and is defined as three consecutive symbols of SHP followed by a single symbol of EPF…" *See* USB 3.2 Specification, Section 7.2.1.1, pg.114; *see also* USB 3.1 Specification, Section 7.2.1.1.1, pg. 7-3. "Data packets are a special type of packet consisting of a Data Packet Header (DPH) and a Data Packet Payload (DPP)… The DPP consists of a data packet payload framing and a variable length of data followed by 4 bytes of CRC-32…" *See* USB 3.2 Specification, Section 7.2.1.2, pg.118; *see also* USB 3.1 Specification, Section 7.2.1.2, pg. 7-8.

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Claim 19	Exemplary Infringement Evidence
	"DPP framing ordered sets consist of a starting framing ordered set called DPPSTART OS, and …ending framing ordered sets called DPPEND OS… a DPPSTART ordered set, which is a DPP starting frame ordered set, consists of three consecutive symbols of SDP followed by a single symbol of EPF…" *See* USB 3.2 Specification, Section 7.2.1.2.1, pg.118; *see also* USB 3.1 Specification, Section 7.2.1.2.1, pg. 7-8. "Link commands are used for link-level data integrity, flow control, and link power management. Link commands are a fixed length of eight symbols and contain repeated symbols to increase the error tolerance…" *See* USB 3.2 Specification, Section 7.2.2, pg.122; *see also* USB 3.1 Specification, Section 7.2.2, pg. 7-12. "Link commands shall be eight symbols long… The first four symbols, LCSTART, are the link command starting frame ordered set consisting of three consecutive SLCs followed by EPF. The second four symbols consist of a two-symbol link command word and its replica…" *See* USB 3.2 Specification, Section 7.2.2.1, pg.122; *see also* USB 3.1 Specification, Section 7.2.2.1, pg. 7-12. "The link-layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters

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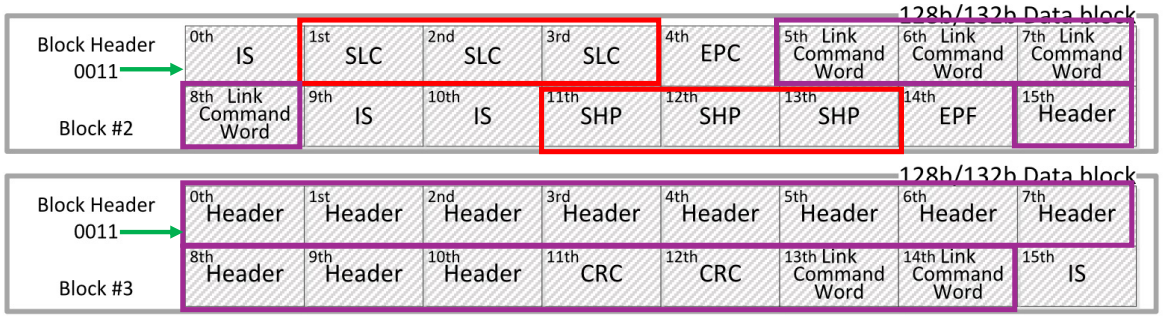
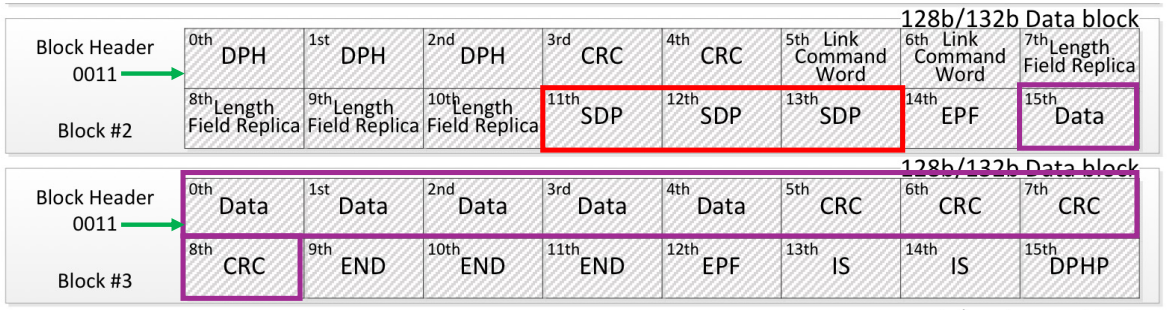
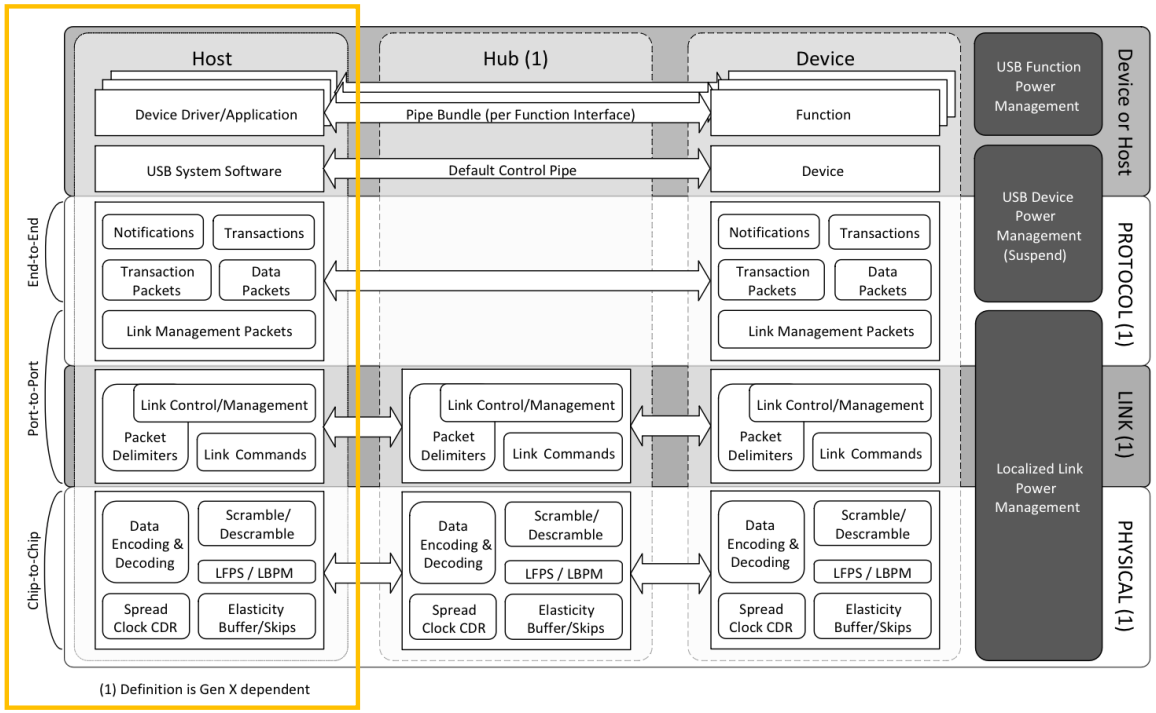
Claim 19	Exemplary Infringement Evidence
	• Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8.  *See* USB 3.2 Specification, Figure D-3, pg.482; *see also* USB 3.1 Specification, Figure D-3, pg. D-2. 

Claim 19	Exemplary Infringement Evidence
	See USB 3.2 Specification, Figure D-4, pg.483; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.
[19b] a transmission component that transmits a synchronization symbol that corresponds to the identified packet type, the transmitted synchronization symbol providing synchronization information and each packet type having a different synchronization symbol	Each Accused Product includes a transmission component that transmits a synchronization symbol that corresponds to the identified packet type, the transmitted synchronization symbol providing synchronization information and each packet type having a different synchronization symbol. For example, the Physical layer of the transmitting USB-C device transmits the HPSTART, DPPSTART, or LCSTART framing symbol set that corresponds to the identified packet type. Each framing symbol set comprises a defined sequence of synchronization codes that are different from the defined sequence of synchronization codes of any other framing symbol set. For example, the SLC, SHP, and SDP are each synchronization symbols that correspond to different packet types. *See, e.g.*: "A Gen1 transmitter encodes data and control characters into symbols using an 8b/10b code… It then encodes the scrambled 8-bit data into 10-bit symbols for transmission over the physical connection… The bitstream is recovered from the differential sublink by the receiver, assembled into 10-bit symbols, decoded and descrambled, producing 8-bit data that is then sent to the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.1, pg. 21; *see also* USB 3.1 Specification, Section 3.2.1.1, pg. 3-7. "A Gen 2 Transmitter frames data and control bytes (referred to as symbols) by prepending a 4-bit block identifier to 16 symbols (128 bits) to create a 128b/132b block…As in Gen1 operation, the resultant data are sent out across the electrical interconnect using spread

Claim 19	Exemplary Infringement Evidence
	spectrum clocking to lower EMI emissions. The Bitstream is recovered from the electrical interconnect by the receiver and then assembled and aligned into 132-bit blocks. The data is descrambled, and the identifier information and the descrambled bits are passed onto the link layer for further processing." *See* USB 3.2 Specification, Section 3.2.1.2, pg. 21; *see also* USB 3.1 Specification, Section 3.2.1.2, pg. 3-7. **Figure 3-3. Enhanced SuperSpeed Bus Communications Layers and Power Management Elements** 

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Claim 19	Exemplary Infringement Evidence
	See USB 3.2 Specification, Figure 3-3, pg.122; *see also* USB 3.1 Specification, Figure 3-4, pg. 3-6. "... For Gen1 operation, the transmitter encodes data and control characters into symbols. Control symbols are used to achieve byte alignment and are used for framing data and managing the link. Special characteristics make control symbols uniquely identifiable from data symbols. For Gen2 operation, the transmitter block encodes the data and control bytes…" *See* USB 3.2 Specification, Section 3.2.1, pg.21; *see also* USB 3.1 Specification, Section 3.2.1, pg. 3-7. "The [Gen 1] 8b/10b encoding scheme provides Special symbols that are distinct from the Data symbols used to represent characters. These special symbols are used for various Link Management mechanisms described later. Table 6-2 lists the special symbols used and provides a brief description for each… For Gen2 [128b/132b] operation, the block header identifies whether the following 16 symbols have special meaning or represent data. In Gen 2 operation, a receiver shall always perform single bit error correction on the special symbols part of a control block. For Gen1 and Gen2, the following special symbols are defined." *See* USB 3.2 Specification, Section 6.3.3, pg.63; *see also* USB 3.1 Specification, Section 6.3.3, pg. 6-12.

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Table 6-2. Special Symbols

Symbol	Name	Gen 1 Symbol	Gen 2 Symbol	Description
SKP	Skip	K28.1	CCh	Compensates for different bit rates between two communicating ports. SKPs may be dynamically inserted or removed from the data stream. For Gen 2 operation, unscrambled.
SKPEND	Skip End	Not applicable	33h	Marks the boundary between SKP symbols and the remainder of the SKP OS. Unscrambled.
SDP	Start Data Packet	K28.2	96h	Marks the start of a Data Packet Payload. For Gen 2 operation, scrambled and transmitted only in data block.
EDB	End Bad	K28.3	69h	Marks the end of a nullified Packet. For Gen 2 operation, scrambled and transmitted only in data block.
SUB	Decode Error Substitution	K28.4	Not applicable	Symbol substituted by the 8b/10b decoder when a Decode error is detected.
COM	Comma	K28.5	Not applicable	Used for symbol alignment.
-----	-----	K28.6	Not applicable	Reserved
SHP	Start Header Packet	K27.7	9Ah	Marks the start of a Data Packet (Gen 1 operation only), Transaction Packet or Link Management Packet. For Gen 2 operation, scrambled and transmitted only in data block.
DPHP	Start Data Packet Header	Not applicable	95h	Marks the start of a Data Packet (Gen 2 only). Scrambled and transmitted only in data block.
END	End	K29.7	65h	Marks the end of a packet. For Gen 2 operation, scrambled and transmitted only in data block.
SLC	Start Link Command	K30.7	4Bh	Marks the start of a Link Command. For Gen 2 operation, scrambled and transmitted only in data block.
EPF	End Packet Framing	K23.7	36h	Marks the end of a packet framing. For Gen 2 operation, scrambled and transmitted only in data block.
SDS	Start of Data Stream	Not applicable	E1h	Marks the start of an SDS Ordered Set. Unscrambled.

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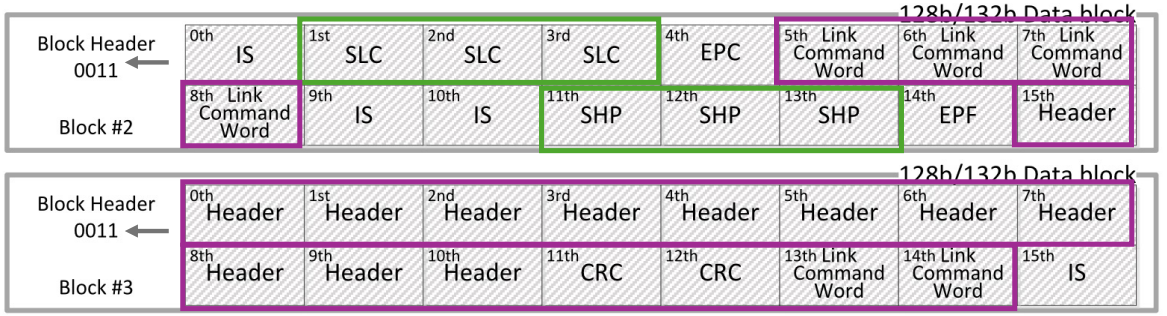
Claim 19	Exemplary Infringement Evidence
	See USB 3.2 Specification, Table 6-2, pg.63; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12. "The link layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters • Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8.  *See* USB 3.2 Specification, Figure D-3, pg.482; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.

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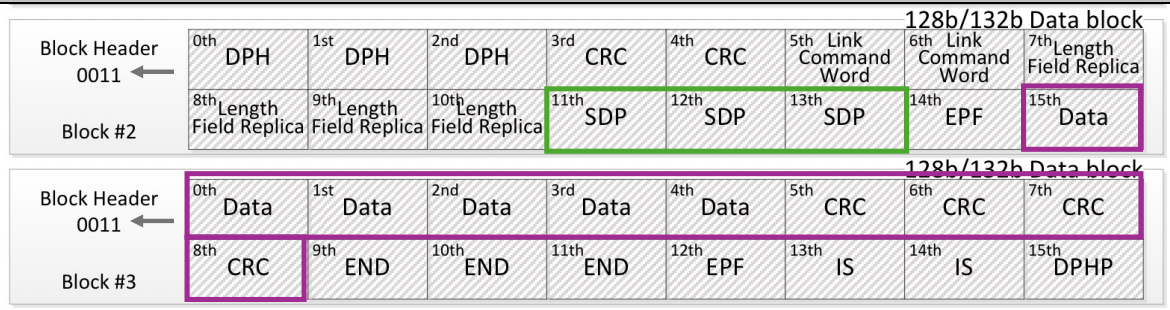
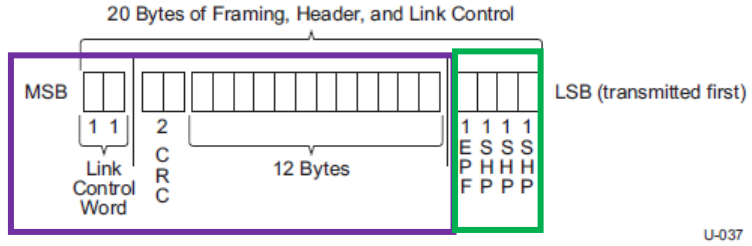
Claim 19	Exemplary Infringement Evidence



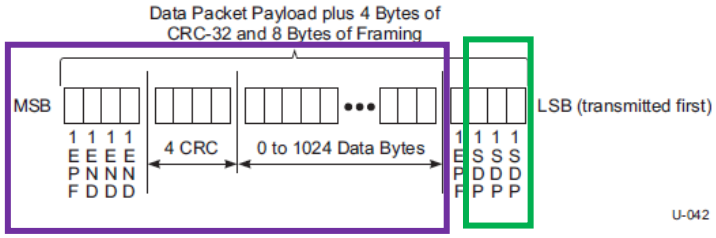
See USB 3.2 Specification, Figure D-4, pg.483; *see also* USB 3.1 Specification, Figure D-3, pg. D-2.

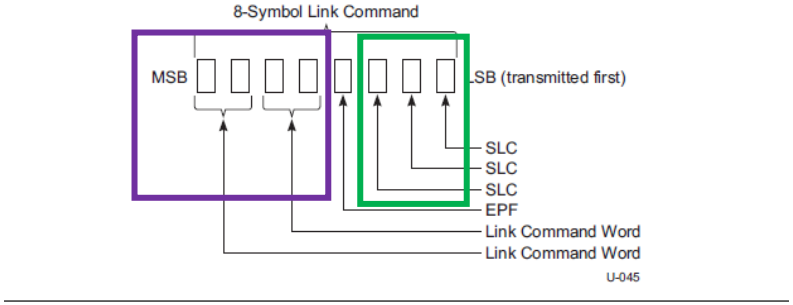
7.2.1.1.1 Header Packet Framing

Header packet framing, HPSTART ordered set, is a four-symbol header packet starting frame ordered set based on K-symbols. It is defined as three consecutive symbols of SHP followed by a K-symbol of EPF. A header packet shall always begin with HPSTART ordered set. The construction of the header packet framing is to achieve one symbol error tolerance.



See USB 3.2 Specification, Figure 7-3, pg.115; *see also* USB 3.1 Specification, Figure 7-3, pg. 7-4.

Claim 19	Exemplary Infringement Evidence
	7.2.1.2.1 Data Packet Payload Framing DPP framing consists of eight K-symbols, a four-symbol DPP starting frame ordered set and a four-symbol DPP ending frame ordered set. As indicated by Figure 7-8, a DPPSTART ordered set, which is a DPP starting frame ordered set, consists of three consecutive K-symbols of SDP followed by a single K-symbol of EPF. A DPP ending frame ordered set has two different types. The first type, DPPEND ordered set, is a DPP ending frame ordered set which consists of three consecutive K-symbol of END followed by a single K-symbol of EPF. The second type, DPPABORT ordered set, is a DPP aborting frame ordered set which consists of three consecutive K-symbol of EDB (end of nullified packet) followed by a single K-symbol of EPF. The DPPEND ordered set is used to indicate a normal ending of a complete DPP. The DPPABORT ordered set is used to indicate an abnormal ending of a DPP.  **Figure 7-8. Data Packet Payload with CRC-32 and Framing** *See* USB 3.2 Specification, Figure 7-8, pg.119; *see also* USB 3.1 Specification, Figure 7-8, pg. 7-8.

Claim 19	Exemplary Infringement Evidence
	 **Figure 7-11. Link Command Structure** *See* USB 3.2 Specification, Figure 7-11, pg.122; *see also* USB 3.1 Specification, Figure 7-12, pg 7-12.
[19c] and permitting an external receiving node to properly align with a synchronization primitive to be correctly aligned on a symbol boundary, and that transmits the symbols of the packet.	Each Accused Product includes a transmission component that transmits a synchronization symbol that corresponds to the identified packet type, the transmitted synchronization symbol providing synchronization information and each packet type having a different synchronization symbol and permitting an external receiving node to properly align with a synchronization primitive to be correctly aligned on a symbol boundary, and that transmits the symbols of the packet. For example, the transmitted synchronization symbol permits an external receiving node to align with a synchronization primitive (e.g., Training Sequence TS1/TS2), so that the received symbol (and packet) is correctly aligned on the symbol boundary. *See, e.g.*: "The receiver needs to reliably recover clock and data from the bit stream. For Gen1 operation, the transmitter encodes data and control characters into symbols. Control symbols are used to achieve byte alignment and are used for framing data and managing the link. Special

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Claim 19	Exemplary Infringement Evidence
	characteristics make control symbols uniquely identifiable from data symbols. For Gen2 operation, the transmitter block encodes the data and control bytes…" *See* USB 3.2 Specification, Section 3.2.1, pg.21; *see also* USB 3.1 Specification, Section 3.2.1, pg. 3-7. "The link layer also: • Provides correct framing of sequences of bytes into packets during transmission; e.g., insertion of packet delimiters • Detects received packets, including packet delimiters and error checks of received header packets (for reliable delivery) • Provides an appropriate interface to the protocol layer for pass-through of protocol layer packet information exchanges." *See* USB 3.2 Specification, Section 3.2.2, pgs. 22-23; *see also* USB 3.1 Specification, Section 3.2.2, pg. 3-8. "6.3.3 Special Symbols for Framing and Link Management The 8b/10b encoding scheme provides Special Symbols that are distinct from the Data Symbols used to represent characters. These Special Symbols are used for various Link Management mechanisms described later. Table 6-2 lists the Special Symbols used and provides a brief description for each. Special Symbols shall follow the proper 8b/10b disparity rules. The compliance tests are defined in the USB SuperSpeed Compliance Methodology white paper. For Gen 2 operation the block header identifies whether the following 16 symbols have special meaning or if they represent data. In Gen 2 operation a receiver shall always perform single bit error correction on the special symbols when they are part of a control block. For Gen 1 and Gen 2 the following special symbols are defined.

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Table 6-2. Special Symbols

Symbol	Name	Gen 1 Symbol	Gen 2 Symbol	Description
SKP	Skip	K28.1	CCh	Compensates for different bit rates between two communicating ports. SKPs may be dynamically inserted or removed from the data stream. For Gen 2 operation, unscrambled.
SKPEND	Skip End	Not applicable	33h	Marks the boundary between SKP symbols and the remainder of the SKP OS. Unscrambled.
SDP	Start Data Packet	K28.2	96h	Marks the start of a Data Packet Payload. For Gen 2 operation, scrambled and transmitted only in data block.
EDB	End Bad	K28.3	69h	Marks the end of a nullified Packet. For Gen 2 operation, scrambled and transmitted only in data block.
SUB	Decode Error Substitution	K28.4	Not applicable	Symbol substituted by the 8b/10b decoder when a Decode error is detected.
COM	Comma	K28.5	Not applicable	Used for symbol alignment.
-----	-----	K28.6	Not applicable	Reserved
SHP	Start Header Packet	K27.7	9Ah	Marks the start of a Data Packet (Gen 1 operation only), Transaction Packet or Link Management Packet. For Gen 2 operation, scrambled and transmitted only in data block.
DPHP	Start Data Packet Header	Not applicable	95h	Marks the start of a Data Packet (Gen 2 only). Scrambled and transmitted only in data block.
END	End	K29.7	65h	Marks the end of a packet. For Gen 2 operation, scrambled and transmitted only in data block.
SLC	Start Link Command	K30.7	4Bh	Marks the start of a Link Command. For Gen 2 operation, scrambled and transmitted only in data block.
EPF	End Packet Framing	K23.7	36h	Marks the end of a packet framing. For Gen 2 operation, scrambled and transmitted only in data block.
SDS	Start of Data Stream	Not applicable	E1h	Marks the start of an SDS Ordered Set. Unscrambled.

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Claim 19	Exemplary Infringement Evidence
	See USB 3.2 Specification, Section 6.3.3, pg.62-63; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12. "6.4. Link Training 6.4.1.1 Gen 1 Operation This section defines the sequences that are used for configuration and initialization . The sequences are used by the Initialization State Machine (refer to Chapter 7) for the following functions: • Configuring and initializing the link • Bit-lock and symbol lock • Rx equalization training • Lane polarity inversion Training sequences are composed of Ordered Sets used for initializing bit alignment, Symbol alignment and optimizing the equalization. Training sequence Ordered Sets are never scrambled but are always 8b/10b encoded." "6.4.1.1.1 Normative Training Sequence Rules for Gen 1 Operation Training sequences are composed of Ordered Sets used for initializing bit alignment, symbol alignment, and receiver equalization."

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Claim 19	Exemplary Infringement Evidence

Table 6-4. Gen 1 TS1 Ordered Set

Symbol Number	Encoded Values	Description
0-3	K28.5	COM (Comma)
4	D0.0	Reserved for future use
5	See Table 6-6	Link Functionality
6-15	D10.2	TS1 Identifier

Table 6-5. Gen 1 TS2 Ordered Set

Symbol Number	Encoded Values	Description
0-3	K28.5	COM (Comma)
4	D0.0	Reserved
5	See Table 6-6	Link Functionality
6-15	D5.2	TS2 Identifier

See USB 3.2 Specification, Section 6.4.1.1, pg.64-65; *see also* USB 3.1 Specification, Table 6-1, pg. 6-12.

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Claim 19	Exemplary Infringement Evidence
	"6.4.1.2 Gen 2 Operation This section defines the sequences that are used for configuration and initialization of a link operating at Gen 2 rates. The sequences are used by the Initialization State Machine (refer to Chapter 7) for the following functions: • Configuring and initializing the link • Bit-lock and symbol lock • Rx equalization training • Lane polarity inversion • Block alignment Training sequences are composed of Ordered Sets used for initializing bit alignment, Symbol alignment, block alignment and optimizing the equalization."

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Claim 19	Exemplary Infringement Evidence
	Table 6-7. Gen 2 TS1 Ordered Set **Symbol Number** / **Symbol** / **Description** 0-3 / 1Eh / TS1 Identifier 4 / 00h / Reserved for future use 5 / See Table 6-6 / Link Functionality 6-13 / 1Eh / TS1 Identifier 14-15 / TS1 Identifier (1Eh) or a DC Balance Symbol / TS1 Identifier or DC balance **Table 6-8. Gen 2 TS2 Ordered Set** **Symbol Number** / **Symbol** / **Description** 0-3 / 2Dh / TS2 Identifier 4 / 00h / Reserved for future use 5 / See Table 6-6 / Link Functionality 6-13 / 2Dh / TS2 Identifier 14-15 / TS2 Identifier (2Dh) or a DC Balance Symbol / TS2 Identifier or DC balance *See* USB 3.2 Specification, Section 6.4.1.2, pg.67-68.

Claim 20

Claim 20	Exemplary Infringement Evidence
[20] The communications device of claim 19 wherein the symbols of the packet include in-band symbols and the synchronization symbols are out-of-band symbols.	Each Accused Product includes the communications device of claim 19 wherein the symbols of the packet include in-band symbols and the synchronization symbols are out-of-band symbols. *See* [2]

Claim 21

Claim 21	Exemplary Infringement Evidence
[21] The communications device of claim 20 wherein the in-band symbols are transition optimized and the out-of-band synchronization symbols are not transition optimized.	Each Accused Product includes the communications device of claim 20 wherein the in-band symbols are transition optimized and the out-of-band synchronization symbols are not transition optimized. *See* [3]

Claim 22

Claim 22	Exemplary Infringement Evidence
[22] The communications device of claim 19 wherein the synchronization symbol is transmitted before transmitting the symbols of the packet.	Each Accused Product includes the communications device of claim 19 wherein the synchronization symbol is transmitted before transmitting the symbols of the packet. *See* [4]

Claim 24

Claim 24	Exemplary Infringement Evidence
[24] The communications device of claim 19 wherein the packet types include a data packet.	Each Accused Product includes the communications device of claim 19 wherein the packet types include a data packet. *See* [6]

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Claim 25

Claim 25	Exemplary Infringement Evidence
[25] The communications device of claim 19 wherein the packet types include a control packet.	Each Accused Product includes the communications device of claim 19 wherein the packet types include a control packet. *See* [7]

Claim 26

Claim 26	Exemplary Infringement Evidence
[26] The communications device of claim 19 wherein the symbols are transmitted to a switch network.	Each Accused Product includes the communications device of claim 19 wherein the symbols are transmitted to a switch network. *See* [8]

Claim 28

Claim 28	Exemplary Infringement Evidence
[28] The communications device of claim 19 wherein the synchronization primitive is made up of a sequence of bit-string synchronization symbols.	Each Accused Product includes the communications device of claim 19 wherein the synchronization primitive is made up of a sequence of bit-string synchronization symbols. *See* [9]

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