

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELL INC., DELL TECHNOLOGIES INC., HP INC., and LENOVO (UNITED STATES) INC.

Petitioners

v.

UNIVERSAL CONNECTIVITY TECHNOLOGIES INC.,

Patent Owner.

PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,852,103

Case No. IPR2024-01480

Mail Stop Patent Board
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

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EXHIBIT LIST

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1001	U.S. Patent No. 9,852,103 (“the ’103 Patent”)
1002	Prosecution history of the ’103 Patent
1003	Declaration of James Webb
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1005	U.S. Patent Publ. No. 2007/0201492 to Kobayashi
1006	U.S. Patent No. 8,799,537 (“Zhu”)
1007	Declaration of William Lempesis
1008	U.S. Patent No. 7,558,326 (“Lyle”)
1009	U.S. Patent No. 5,974,464 (“Shin”)
1010	U.S. Publ. No. 2013/0266154 (“McCormack”)
1011	Excerpts from Newton’s Telecom Dictionary, 12 th Ed. (1997)
1012	U.S. Patent No. 4,486,739 (“Frasaszek”)
1013	Exhibit K to UCT’s First Amended Infringement Contentions in <i>Universal Connectivity Technologies Inc. v. Dell Technologies Inc. and Dell Inc.</i> , No. 1:23-CV-01506-RP (W.D. Tex.)
1014	U.S. Patent Publ. No. 2014/0019653 (“Amchislavsky”)
1015	Declaration of Nathaniel E. Frank-White of the Internet Archive
1016	Maxim Application Note 3524, “Efficient Bit-Banged SPI Port for 8051-Compatible Microcontrollers” (June 8, 2015)
1017	Muller and Niesler, “Development of a USB Telephony Interface Device for Speech Recognition Applications,” <i>Southern African Telecommunication Networks and Applications Conference (SATNAC) 2005 Proceedings</i> , Vol. 1 at 487-492 (2005).

Exhibit	Description
1018	Halder et al., “Implementation of MCU Invariant I2C Slave Driver Using Bit Banging,” <i>ICONS 2011: The Sixth International Conference on Systems</i> (2011).
1019	Aly et al., “Scalable ZigBee-Based Smart Authentication and Access Control System Design Using XMOS Programmable Chips,” <i>International Journal of Scientific & Engineering Research</i> , Vol. 2, Issue 9 (September 2011).
1020	U.S. Patent App. Publ. No. 2012/0146989
1021	U.S. Patent App. Publ. No. 2013/0174208 (“Lee”)
1022	U.S. Patent App. Publ. No. 2005/0209808
1023	U.S. Patent No. 8,235,294
1024	U.S. Patent No. 7,652,752
1025	U.S. Patent No. 7,973,566
1026	U.S. Patent No. 8,680,777
1027	U.S. Patent App. Publ. No. 2012/0142032
1028	U.S. Patent No. 7,356,789
1029	U.S. Patent No. 6,496,546
1030	U.S. Patent No. 9,210,010 (“Whitby-Strevens”)
1031	U.S. Patent Prov. App. No. 61/979,483 (“the ’103 Provisional Application”)
1032	DisplayPort Standard, Version 1, Revision 2 (“DisplayPort 1.2”) and October 8, 2010 Errata Version 1

LISTING OF CHALLENGED CLAIMS

Claim 1	
1[p]	1. A method of transmitting data over a multimedia link, comprising:
1[a]	over a first physical channel of the multimedia link: sending forward units of data from a source device to a sink device during one or more first time periods, the forward units of data comprising video data and forward data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;
1[b]	receiving backward units of data at the source device from the sink device during one or more second time periods, the backward units of data comprising backward data compliant with the first standard; and
1[c]	over a second physical channel of the multimedia link distinct from the first physical channel: sending control data from the source device to the sink device.
Claim 2	
	2. The method of claim 1, further comprising sending a first synchronization signal of a first length after sending a first forward unit of data of the forward units of data, and before sending another forward unit of data from the source device.
Claim 3	
	3. The method of claim 2, further comprising sending a second synchronization signal of a second length longer than the first synchronization signal to initialize communication over the first physical channel before sending the first forward unit of data.
Claim 10	
	10. The method of claim 1, further comprising receiving control data from the sink device to the source device over the second physical channel of the multimedia link distinct from the first physical channel.

Claim 11	
11[p]	11. A method of transmitting data over a multimedia link, comprising:
11[a]	over a first physical channel of the multimedia link: receiving forward units of data from a source device by a sink device during one or more first time periods, the forward units of data comprising video data and forward communication data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;
11[b]	sending backward units of data from the sink device to the source device during one or more second time periods, the backward units of data comprising backward communication data compliant with the first standard; and
11[c]	over a second physical channel of the multimedia link distinct from the first physical channel: receiving control data from the source device to the sink device.
Claim 12	
	12. The method of claim 11, further comprising receiving a first synchronization signal of a first length after receiving a first forward unit of data of the forward units of data, and before receiving a second forward unit of data from the source device.
Claim 13	
	13. The method of claim 12, further comprising detecting a second synchronization signal of a second length longer than the first synchronization signal to initialize communication over the first physical channel before receiving the first forward unit of data.
Claim 17	
	17. The method of claim 11, further comprising aligning a boundary of a symbol in a first forward unit of data of the forward units of data using the first synchronization signal.

Claim 20	
	20. The method of claim 11, further comprising sending control data from the sink device to the source device over the second physical channel of the multimedia link distinct from the first physical channel.
Claim 21	
21[p]	21. A source device for communicating data with a sink device over a multimedia link, comprising:
21[a]	a transmitter coupled to a first physical channel of the multimedia link and configured to send forward units of data from the source device to the sink device over the first physical channel during one or more first time periods, the forward units of data comprising video data and forward data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;
21[b]	a receiver coupled to the first physical channel and configured to receive backward units of data at the source device from the sink device over the first physical channel during one or more second time periods, the backward units of data comprising backward data compliant with the first standard; and
21[c]	a control signal transceiver coupled to a second physical channel of the multimedia link distinct from the first physical channel and configured to at least send control data from the source device to the sink device over the second physical channel.
Claim 22	
22[a]	22. A non-transitory computer readable storage medium storing instructions thereon, the instructions representing a digital design of a circuit comprising:

22[b]	a transmitter coupled to a first physical channel of the multimedia link and configured to send forward units of data from a source device to a sink device over the first physical channel during one or more first time periods, the forward units of data comprising video data and forward data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;
22[c]	a receiver coupled to the first physical channel and configured to receive backward units of data at the source device from the sink device over the first physical channel during one or more second time periods, the backward units of data comprising backward data compliant with the first standard; and
22[d]	a control signal transceiver coupled to a second physical channel of the multimedia link distinct from the first physical channel and configured to at least send control data from the source device to the sink device over the second physical channel.

I. INTRODUCTION

Dell Inc., Dell Technologies Inc., HP Inc., and Lenovo (United States) Inc. (collectively, “Petitioners”) petition for *Inter Partes* Review (“IPR”) of claims 1-3, 10-13, 17, and 20-22 of U.S. Patent No. 9,852,103 (“the ’103 Patent”), assigned to Universal Connectivity Technologies Inc. (“UCT”).

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Parties-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioners hereby name Dell Inc., Dell Technologies Inc., HP Inc., and Lenovo (United States) Inc. as real parties-in-interest and, solely because it is named as a defendant in a co-pending district court case listed below, further identify Lenovo Group Ltd. as a real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

UCT asserted eight patents, including the ’103 Patent, against Dell in *Universal Connectivity Technologies Inc. v. Dell Technologies Inc. et al.*, CA 1:23-cv-01506 (W.D. Tex.), against HP in *Universal Connectivity Technologies Inc. v. HP Inc.*, CA 1:23-cv-01177 (W.D. Tex.) (terminated and transferred) and *Universal Connectivity Technologies Inc. v. HP Inc.*, CA 4:24-cv-04097 (N.D. Cal.), and against Lenovo Group Limited in *Universal Connectivity Technologies Inc. v. Lenovo Group Limited*, Civ. 2:23-00449 (E.D. Tex.).

Petitioners are concurrently filing this Petition and IPR petitions for other asserted patents: IPR2024-01428, IPR2024-01429, IPR2024-01478, IPR2024-01479, IPR2024-01481, and IPR2024-01482.

C. Lead and Back-Up Counsel under 37 C.F.R. § 42.8(b)(3)

Petitioners provide the following designation of counsel.

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D. Service Information

Please address all correspondence to the address above. Petitioners consent to electronic service by email at DL-DELL-UCT-MWE@mwe.com, HP-UCT-IPR@shb.com, Lenovo-UCT-IPR@cov.com.

III. PAYMENT OF FEES UNDER 37 C.F.R. § 42.103

Petitioners authorize the Office to charge Deposit Account No. 50-0417 for the petition fee set in 37 C.F.R. §42.15(a) and for any other required fees.

IV. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

A. Grounds for Standing Under 37 C.F.R. § 42.104(a)

Pursuant to 37 C.F.R. § 42.104(a), Petitioners certify that the '103 Patent is available for IPR and that Petitioners are not barred or estopped from requesting IPR.

B. Challenge under 37 C.F.R. § 42.104(b) and Relief Requested

Petitioners request IPR of claims 1-3, 10-13, 17, and 20-22 of the '103 Patent on the grounds listed below. In support, this petition includes a declaration of James Webb (EX1003).

Ground	Claims	Basis
1	1, 10, 11, 20-22	Anticipated under 35 U.S.C. §102 by Zhu

2	1, 2, 10-12, 20-22	Obvious under 35 U.S.C. §103 over Zhu and knowledge of a POSITA
3	1-3, 10-13, 17, 20-22	Obvious under 35 U.S.C. §103 over Zhu and DisplayPort 1.2
4	1, 2, 10-12, 17, 20-22	Obvious under 35 U.S.C. §103 over Lyle and knowledge of a POSITA
5	2, 3, 12, 13, 17	Obvious under 35 U.S.C. §103 over Lyle and Shin

U.S. Patent No. 8,799,537 (“Zhu”) was filed as U.S. Application No. 13/461,761 on May 1, 2012 and issued on August 5, 2014. Zhu is prior art under §102(a)(2) because it is an issued US patent that names another inventor and that was filed before the earliest effective filing date of the ’103 Patent (April 14, 2014, hereinafter the “Priority Date”). *See* EX1006 at 1.

Display Port Version 1, Revision 2 (“DisplayPort 1.2”) is a standard developed by the Video Electronics Standards Association (“VESA”). DisplayPort 1.2 was published on January 5, 2010, and is therefore prior art under 35 U.S.C.

102(a)(1). *See, e.g.*, EX1032 at 1; EX1007, ¶¶1-6.¹ DisplayPort 1.2 was publicly accessible and sufficiently accessible to the public interested in the art before the Priority Date. EX1007, ¶¶6-10; EX1003, ¶¶48-50. For example, VESA’s Executive Director explains that DisplayPort 1.2 was released to the public and made available online as of January 5, 2010 and that, as of that date, VESA members had free access to the standard and non-members were able to purchase it for a fee. EX1007, ¶¶1-10; EX1015, ¶¶1-7, pp. 27-39. As of March 29, 2014 (before the Priority Date), 206 companies (including dozens of major players in display technology at the time) were VESA members. EX1007, ¶7; *see also* EX1015, pp. 4-9. Twenty-four non-members purchased a copy of DisplayPort 1.2 between 2010 and January 2012. EX1007, ¶8. Throughout 2010-2013, the Wikipedia entry for “DisplayPort” referred to DisplayPort 1.2. EX1015, pp. 10-26. DisplayPort standards were well known to POSITAs—for example, both Zhu and the ’103 Patent refer to DisplayPort standards. EX1006 at 1:42-47; EX1001 at 3:53-59; EX1020 at [0008].

¹ EX1007 contains both the Declaration of William Lempesis and, as Exhibit A, a copy of DisplayPort 1.2. To simplify citations, DisplayPort 1.2 is also included as EX1032.

U.S. Patent No. 7,558,326 (“Lyle”) was filed September 12, 2001 and issued on July 7, 2009, more than one year before the Priority Date, and is therefore prior art under §102(a)(1).

U.S. Patent No. 5,974,464 (“Shin”) was filed September 30, 1996 and issued October 26, 1999, more than one year before the Priority Date, and is therefore prior art under §102(a)(1).

V. SUMMARY OF THE ’103 PATENT

A. Brief Description

The ’103 Patent relates to “half-duplex bidirectional transmission of data compliant with a first standard (e.g., Universal Serial Bus (USB) standard) over a physical channel of a multimedia link for transmitting audio/video (‘A/V’) data compliant with a second standard (e.g., Mobile High-Definition Link (MHL)) between a source device and a sink device using time division multiplexing (TDM).” EX1001 at Abstract; *see also id.* at 1:17-19 and EX1003, ¶¶29-36.

According to the ’103 Patent, prior art USB links did not provide the speed required to transmit high-definition video data according to standards such as MHL or High-Definition Multimedia Interface (HDMI), while such prior art video standards purportedly did not provide for bidirectional USB transmission. *Id.* at 1:21-47. The ’103 Patent purports to solve this problem by providing methods and apparatuses for transmitting, over an A/V physical channel of a multimedia link

between a source and a sink, both video data and USB data in the forward direction and USB data in the backward direction. *See id.* at 3:20-37. In particular, the data may be transmitted over the A/V physical channel in a half-duplex manner, in which forward and backward data are each respectively transmitted during non-overlapping time periods. *Id.* The claimed embodiments also include a second bi-directional physical channel for sending and/or receiving control data between the source and sink. *Id.* at claims 1, 10.

As shown in Figure 1 of the '103 Patent, an embodiment includes source device 110 and sink device 120. *Id.* at 3:50-53.

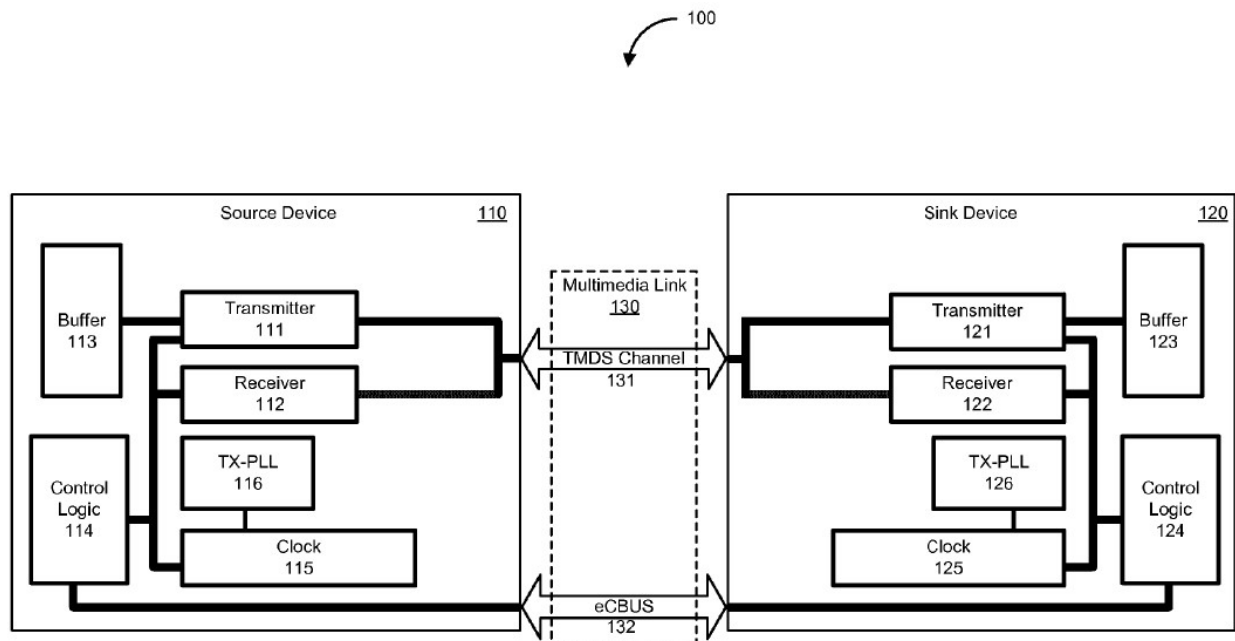


FIG. 1

The source and sink are connected by multimedia link 130 including an A/V channel (e.g., Transition Minimized Differential Signaling (TMDS) Channel 131)

and a bidirectional channel for control data (e.g., eCBUS 132). *Id.* at 3:60 – 4:14. Source device 110 includes transmitter 111 for encoding and sending packets of A/V and USB data from the source to the sink over TMDS channel 131 and receiver 112 for receiving and decoding USB data received from the sink over TMDS channel 131. *Id.* at 4:21-43. Similarly, sink device 120 includes transmitter 121 that sends USB data over TMDS channel 131 to the source device 110 and receiver 122 that receives both USB data and A/V data over the TMDS channel. *Id.* at 5:3-17. Transmitters 111 and 121 may also encode and transmit, and receivers 112 and 122 may also receive and decode, control data over eCBUS 132. *Id.* at 4:21-43.

Although the disclosed embodiments are described with reference to a modified version of the MHL standard, the '103 Patent explains that the same principles can be applied to other standards including HDMI standards, Digital Visual Interface (DVI) standards, and DisplayPort standards. *Id.* at 3:53-59.

Figure 2 (annotated below) illustrates half-duplex TDM transmission of USB and A/V in the forward direction and USB data in the reverse direction over the A/V physical channel.

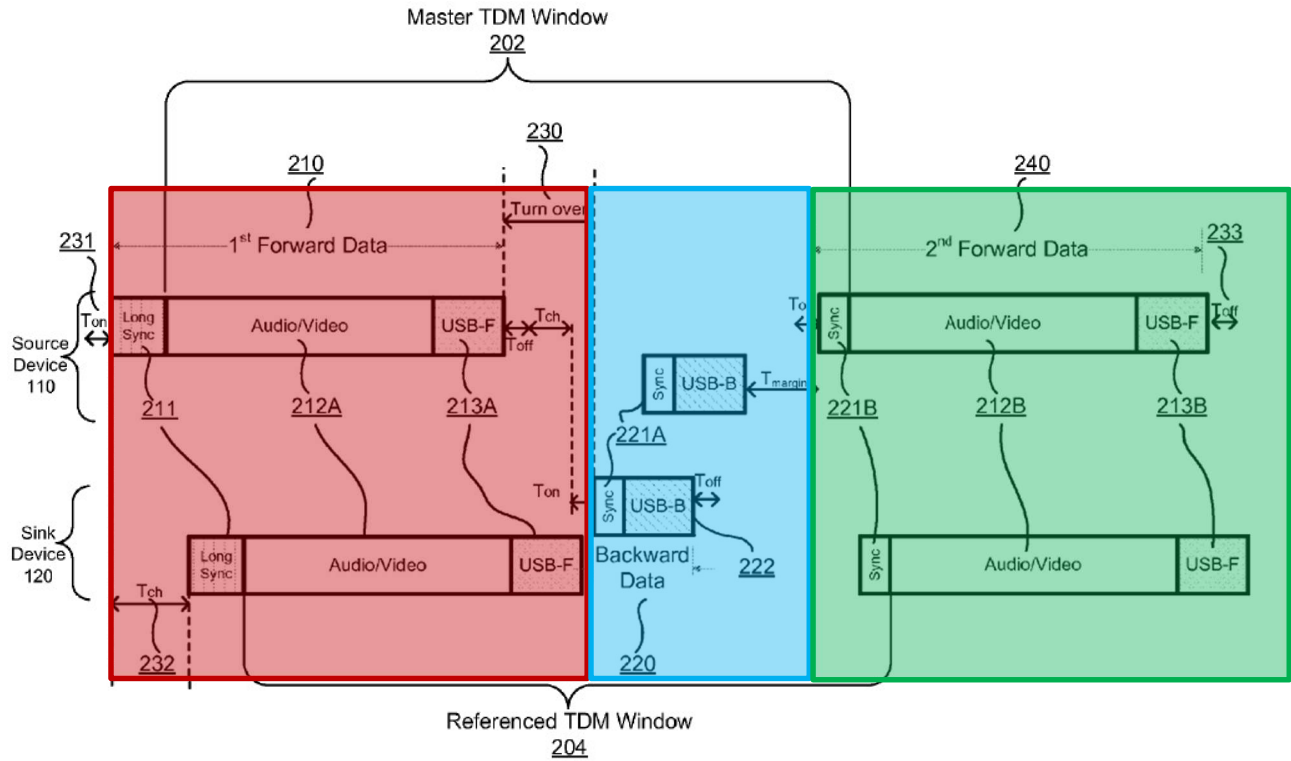


FIG. 2

In particular, during a time period for forward transmission (red box in annotated Fig. 2, above), first forward data packet 210 including long synchronization signal 211, A/V data 212A and USB-forward data 213A is transmitted by the source and received by the sink over the A/V physical channel. *Id.* at 5:19-6:4; Fig. 5; 7:64 – 8:8. Long synchronization signal 211 initializes communication between the source and sink. *Id.* at 5:52-54.

During a time period for backward transmission (blue box in annotated Fig. 2, above), backward data packet 220, including short synchronization signal 221A (which includes character symbol data used to align symbol boundaries), and USB-

backward data 222 is transmitted from the sink and received by the source over the A/V physical channel. *Id.* at 6:5-21, Fig. 5, 8:9-26.

Second forward data packet 240, which is sent during a subsequent time period for forward transmission (green box in annotated Fig. 2, above), is similar to first forward data packet 210, except that it includes short synchronization signal 221B. *Id.* at 6:22-27.

B. Summary of the Prosecution

On April 8, 2015, the '103 Patent was filed as Application No. 14/681,992 (“the '992 Application”) entitled “Bidirectional Transmission of USB Data Using Audio/Video Data Channel.” *See* EX1001. The '992 Application claims priority to Provisional Application No. 61/979,483, filed on April 14, 2014 (EX1031), and lists twenty-four claims. EX1002 at 25. The original applicant was Silicon Image, Inc. EX1002 at 1.

During prosecution of the '992 Application, the PTO issued one non-final office action on April 10, 2017. EX1002 at 81. In the office action, the Examiner rejected claims 1-24 as anticipated by U.S. Patent Publ. No. 2007/0201492 (“Kobayashi”). EX1002 at 84-88. In response, the Applicant amended the claims to specifically require that the recited “first standard” is a USB standard and argued only that Kobayashi teaches sending video data over a channel (“main link 222”) that is distinct from an auxiliary channel over which USB data is communicated,

whereas the claims required that USB data be sent and received over the same physical channel used to send video data. EX1002 at 99-106. Representative amended claim 1 is reproduced below.

1. **(Currently Amended)** A method of transmitting data over a multimedia link, comprising:
 - sending a first unit of data from a source device to a sink device over a first physical channel of the multimedia link during a first time, the first unit of data comprising video data and forward data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;
 - receiving a second unit of data by the source device over the first physical channel of the multimedia link during a second time, the second unit of data comprising backward data compliant with the first standard; and
 - sending control data from the source device to the sink device over a second physical channel of the multimedia link distinct from the first physical channel.

EX1002 at 99. Applicant did not dispute the Examiner's mapping of Kobayashi to any other elements, including the Examiner's argument that signals sent during link training and/or link setup and management in Kobayashi satisfy the first and second synchronization signals recited in various claims. EX1002 at 85; EX1005 at [0071], [0079], and [0086].

The Examiner entered an examiner's amendment and allowed claims 1-6, 8-14, and 16-24 on August 25, 2017. EX1002 at 117-125. Exemplary claim 1 as amended by the examiner is reproduced below. The amendments appear to clarify

that unidirectional video data and bidirectional USB are communicated over the same “first physical channel.”

1. **(Currently Amended)** A method of transmitting data over a multimedia link, comprising:

over a first physical channel of the multimedia link:

sending ~~a first~~ forward units of data from a source device to a sink device

~~over a first physical channel of the multimedia link~~ during [[a]]

one or more first time periods, the ~~first~~ forward units of data comprising video data and forward data compliant with a first

standard comprising a universal serial bus (USB) standard and different from a standard of the video data;

receiving ~~a second~~ backward units of data ~~by~~ at the source device from the

sink device ~~over the first physical channel of the multimedia link~~

during [[a]] one or more second time periods, the ~~second~~ backward units of data comprising backward data compliant with the first standard; and

over a second physical channel of the multimedia link distinct from the first physical channel:

sending control data from the source device to the sink device ~~over a~~

~~second physical channel of the multimedia link distinct from the first physical channel.~~

EX1002 at 118-119. As explained below, the prior art teaches the claimed invention, including the feature Applicant cited to distinguish its claims during prosecution.

VI. THE BOARD SHOULD NOT DISCRETIONARILY DENY INSTITUTION

A. Section 325(d)

Advanced Bionics and §325(d) do not support discretionary denial given that the Zhu, DisplayPort 1.2, Lyle, and Shin references used by Petitioner in the grounds were not considered by the Office, and no similar references were evaluated during prosecution. Denial under §325(d) is thus unwarranted. *See Thorne Rsch., Inc. v. Trs. of Dartmouth Coll.*, IPR2021-00491, Paper 18 at 8-9 (PTAB Aug. 12, 2021).

VII. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (POSITA) working with this technology, would have had a bachelor's degree in electrical engineering, computer engineering, computer science, or equivalent training, and three years of experience with data communications systems or interfaces, including at least some experience with serial or display data communications systems or interfaces. Additional education can substitute for less work experience, and vice versa.

VIII. CLAIM CONSTRUCTION UNDER 37 C.F.R. § 42.104(B)(3)

Petitioner submits that all claim terms should be construed according to the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. §42.100. Construction of any terms is unnecessary because it is not

dispositive of this case—the art teaches the limitations under any construction under the *Phillips* standard. *Cf. Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

IX. OVERVIEW OF THE PRIOR ART

A. Zhu (EX1006)

Zhu discloses the same idea as the '103 Patent except that, instead of modifying the MHL standard, it modifies DisplayPort 1.2 to allow bidirectional USB transmission over the A/V link. *See* EX1003, ¶¶42-47. According to the '103 Patent, however, the disclosed principles apply equally to DisplayPort. EX1001 at 3:53-59.

Zhu discloses a system and method in which a “first device may be configured to transmit, on a DisplayPort link to the second device, a data flow comprising both USB protocol data and uncompressed high definition media data signals [and t]he devices may be configured such that the USB protocol data is transferred from the second device to the first device during a video blanking period associated with the uncompressed high definition media data signals.” EX1006 at Abstract. Figure 35c in particular illustrates a “mixed mode” in which source device 3405 is “configured to transmit a data flow including both USB protocol data and uncompressed high definition media data to the sink device” 3415 and the sink device is configured to send USB data to the source. *Id.* at 33:63

– 34:38. Figure 35c illustrates the combined forward USB / video data flow as 3530 and the backward USB data flow as 3550. EX1006 at 34:48-51.

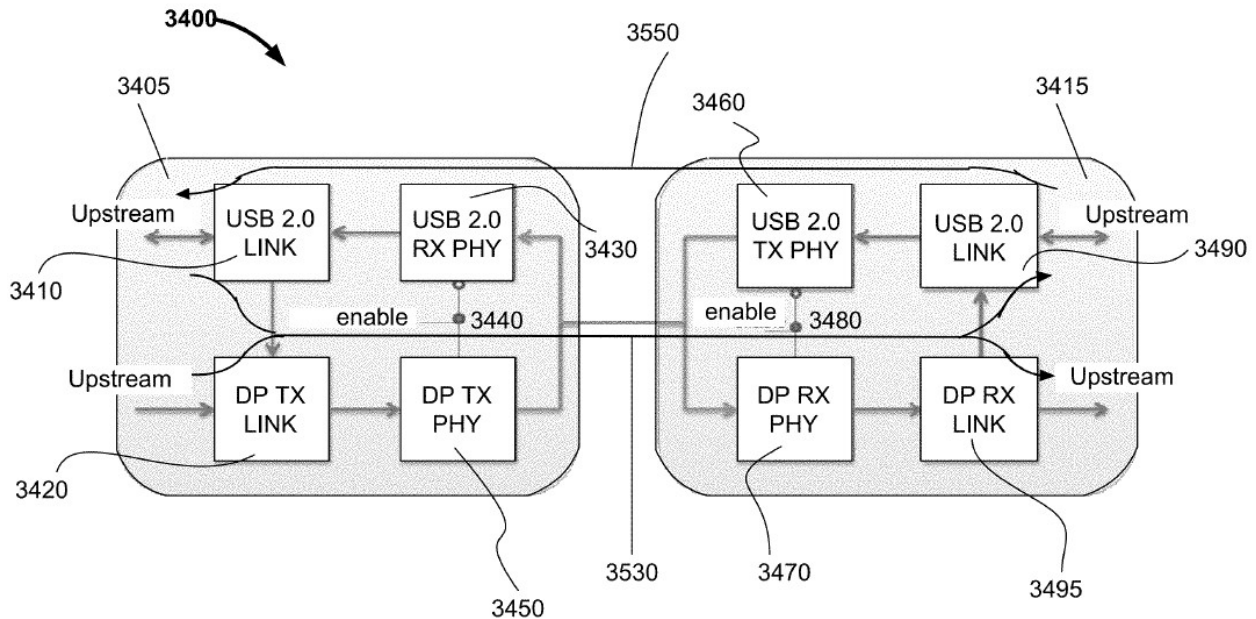


FIG. 35c

Like the '103 Patent, Zhu teaches that transmission on the link is half-duplex such that forward and backward data flows occur at different times. *Id.* at Fig. 41, 34:1-38, 35:58 – 36:17. USB and video data may be sent from source to sink when DP TX PHY 3450 of source device 3405 and DP RX PHY 3470 of sink device 3415 are enabled, *Id.* at 34:3-10; 34:47-51. As illustrated in Figure 37, a USB data packet is included in the forward data stream with the VC (virtual channel) video data payload in a packet (MTP) of the DisplayPort 1.2 multi-stream transport (MST) protocol. *Id.* at 34:52-61; 35:35-44.

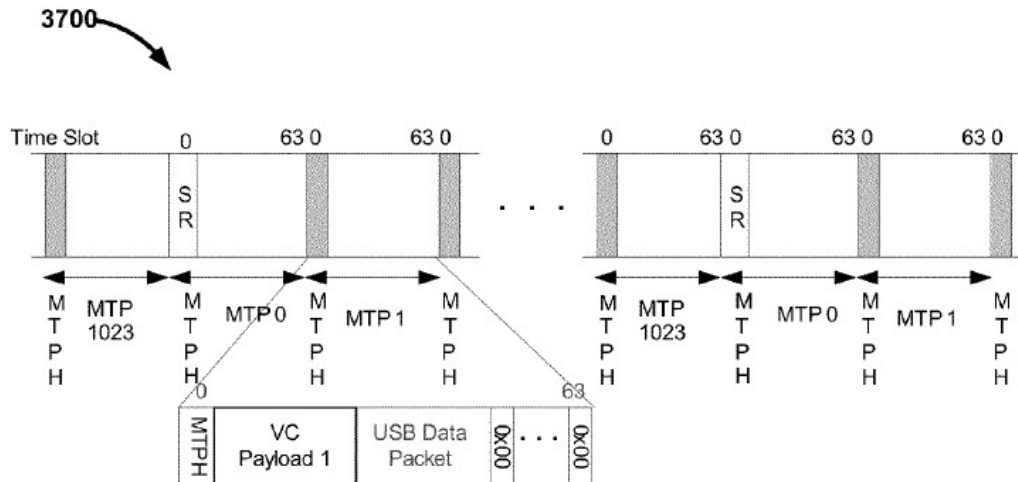


FIG. 37

At other times, such as a video blanking period, USB 2.0 TX PHY 3450 of sink device 3415 and USB 2.0 RX PHY 3430 of source device 3405 are enabled and USB data may be sent from the sink to the source. *Id.* at 34:25-31; 34:47-51.

Zhu also discloses a second physical channel for bidirectional communication of control data—in particular, a “two way serial communication side-band channel” such as the DisplayPort AUX channel or a C-wire that carries AUX channel signals. *See id.* at 1:52-57, 5:6-11, 7:28-35, 34:39-41.

B. DisplayPort 1.2 (EX1032)

DisplayPort 1.2 “define[s] a flexible system and apparatus capable of transporting video, audio and other data between a Source Device and a Sink Device over a digital communications interface.” EX1032 at 1; EX1003, ¶¶48-54. In particular, DisplayPort 1.2 defines several transport channels, including a

unidirectional main link for A/V data, a half-duplex bidirectional auxiliary channel (AUX) used for link management and device control, and a hot plug detect signal.

Id. at 34.

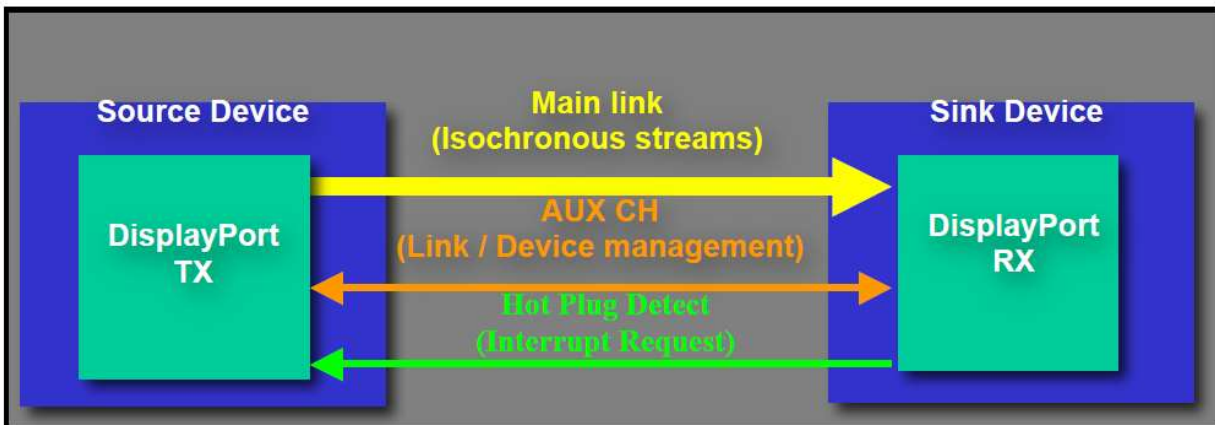


Figure 1-1: DisplayPort Data Transport Channels

A DisplayPort 1.2 source device includes a transmitter for transmitting A/V data over the main link, while a DisplayPort sink device includes a receiver for receiving A/V data. *Id.* at 28, 34. The source and sink devices each also include a “transceiver circuit for AUX CH.” *Id.* at 28.

DisplayPort 1.2 teaches synchronization signals that are communicated between the source and sink devices during link training and data transmission. These include control functions defined in 8b/10b format, many of which are “comma characters”—that is, symbols that have unique properties that make them useful for synchronization. *Id.* at 165, 353; EX1012 at 8:39-9:36 and Table III.

C. Lyle (EX1008)

Lyle discloses “a communication system including a transmitter, a receiver, and a TMDS-like link, such as defined in the DVI standard, in which video data and auxiliary data (often including timing data associated with other auxiliary data) are transmitted from the transmitter to the receiver, or in which video data are transmitted over the link from the transmitter to the receiver, and auxiliary data (often including timing data associated with other auxiliary data) are transmitted from the receiver to the transmitter (or from the transmitter to the receiver and also from receiver to the transmitter).” EX1008 at 6:25-34; *See* EX1003, ¶¶55-57. The auxiliary data may be USB data. *Id.* at 50:47-54. The TMDS link may be half-duplex and bidirectional. For example, one or more video data transmission channels of the TMDS link may be reversed “during blanking periods (to send auxiliary data from the receiver of the video data to the transmitter of the video data).” *Id.* at 45:43-48. Lyle also discloses a control channel “for bidirectional communication between the transmitter and a monitor associated with the receiver in accordance with the conventional Display Data Channel standard.” *Id.* at 28:28-34.

D. Shin (EX1009)

Shin discloses a system for transition-minimized signaling. In particular, in the context of TMDS, Shin describes the use of multiple consecutive out-of-band

synchronization characters for synchronization and boundary alignment during link initialization and data transmission. *See* EX1009 at 14:36-15:28; *See* EX1003, ¶58.

X. THERE IS A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Grounds 1 and 2: Claims 1, 10, 11, 20-22 anticipated by Zhu and claims 1, 2, 10-12, and 20-22 obvious over Zhu and the knowledge of a POSITA

1. Claims 1 and 11

a. “A method of transmitting data over a multimedia link, comprising:” [1.p] / [11.p]

To the extent the preamble is limiting, Zhu teaches the limitation. EX1003, ¶¶64-66. Specifically, Zhu discloses methods for “transmit[ting], on a DisplayPort link [from a first device] to [a] second device, a data flow comprising both USB protocol data and uncompressed high definition media data signals” and transmitting “USB protocol data . . . from the second device to the first device during a video blanking period.” EX1006 at Abstract; *see also id.* at Figs. 34, 35c, and 41; 33:20-34:51. For example, Figures 34 and 35c illustrate “system[s] that allow[] USB data transmission on a media port link.” *Id.* at 4:14-26.

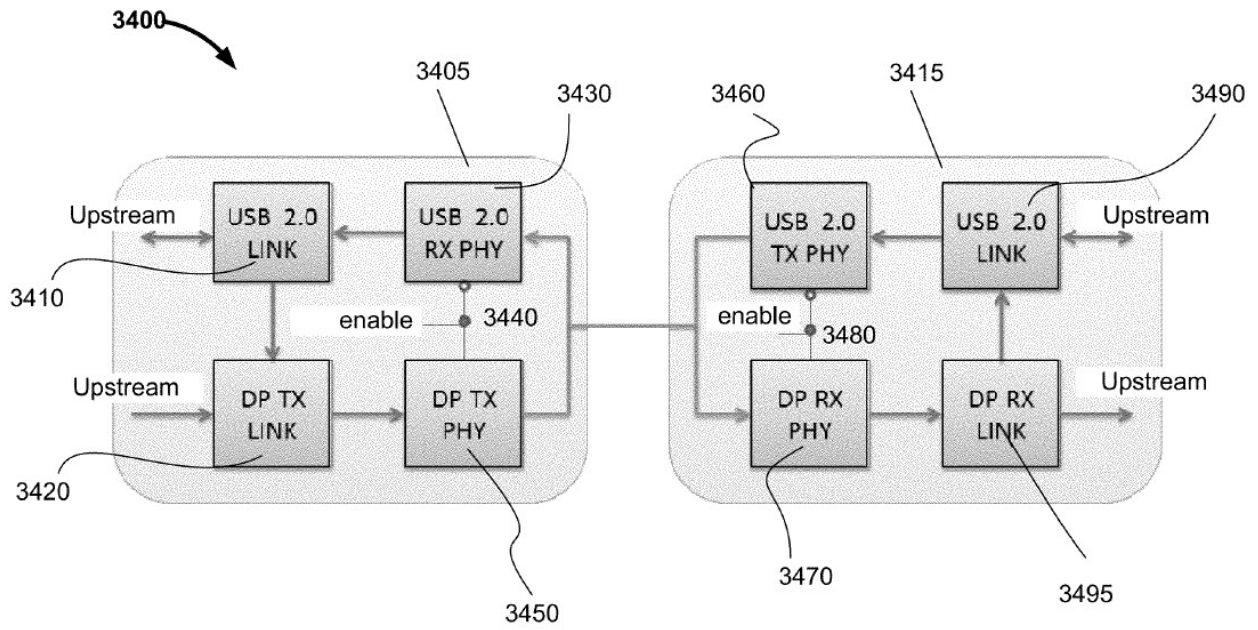


FIG. 34

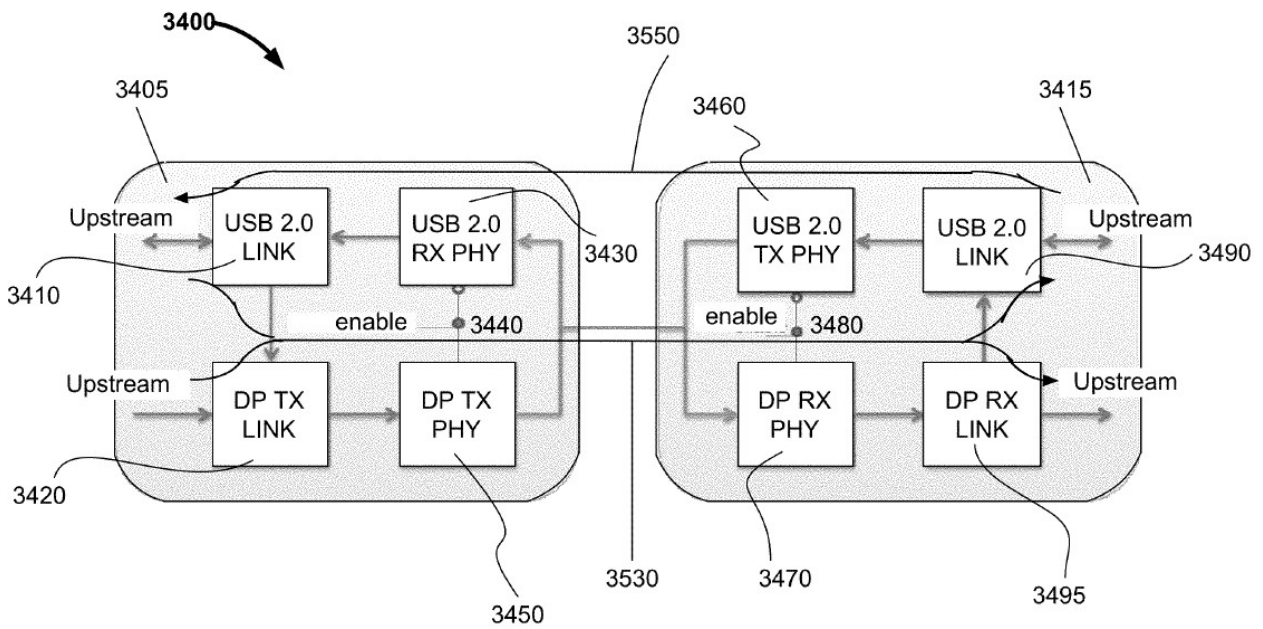


FIG. 35c

The DisplayPort link is a “multimedia link” as claimed. EX1006 at 5:4-6 (“The uncompressed high definition media data may comprise at least one lane of media or multimedia data in accordance with a DisplayPort standard.”), 31:38-39 (“DisplayPort defines a high-speed audio/video data transfer interface with 1 to 4 data lanes and one AUX channel”); EX1003, ¶66. Indeed, the ’103 Patent explicitly teaches that its “principle can be applied to . . . a DisplayPort standard.” *Id.* at 3:53-59.

b. “over a first physical channel of the multimedia link: [sending / receiving] forward units of data from a source device [to / by] a sink device during one or more first time periods, the forward units of data comprising video data and forward [communication] data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;” [1.a] / [11.a]

Zhu teaches this limitation. EX1003, ¶¶67-72. Zhu discloses embodiments in which a source device sends, and a sink device receives, “a data flow comprising both USB protocol data and uncompressed high definition media data signals” over a DisplayPort Main Link data lane (*first physical channel*). EX1006 at Abstract, 31:25-27 (“A protocol to merge the USB data stream into the DisplayPort data lane(s) to more efficiently utilize the available bandwidth on the DisplayPort link is described herein.”), 7:21-28 (DisplayPort lane is a differential wire pair), 12:53-58 (same). Figures 34 and 35a-c illustrate “exemplary embodiment[s] of [] systems that allows USB data transmission on a media port link.” *Id.* at 4:14-26. Figure 35c

illustrates a “mixed mode” operation in which “the DisplayPort source side may be configured to transmit a data flow that includes both USB protocol data and uncompressed high definition media data to the sink device.” *Id.* at 33:63-66. “The exemplary [mixed-mode] data flow 3530 may include the DisplayPort data flow together with USB forward data flow.” *Id.* at 34:47-51.

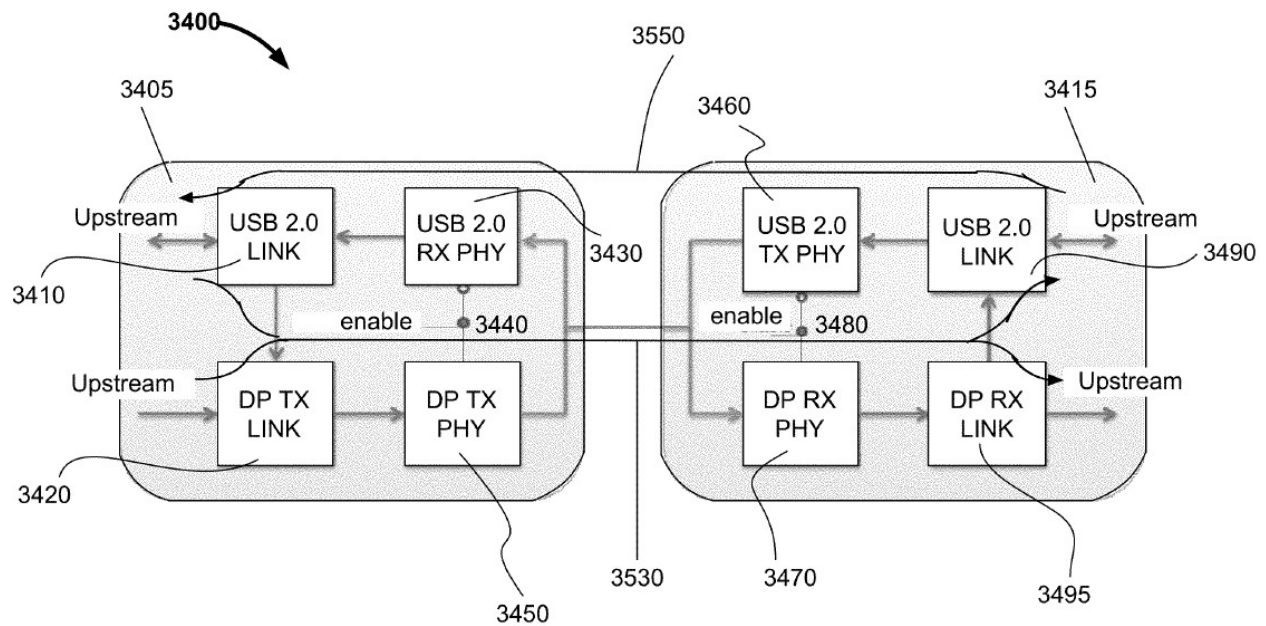


FIG. 35c

In mixed mode, “the USB 2.0 transmitter data is sent to the DPTX LINK 3420 and multiplexed (muxed) together with the video data from upstream.” *Id.* at 34:11-15. This is achieved by modifying the MST protocol of DisplayPort 1.2 to insert USB data packets alongside the virtual channel (VC) payloads, which “represent[] active video pixels,” in MTPs (*forward units of data...*). *Id.* at 34:13-15, Fig. 37, and 34:52-35:5. A POSITA would recognize that an MTP in this

context is a DisplayPort 1.2 “Multi-stream Transport Packet.” EX1032 at 120, 136; EX1003, ¶70. An MTP with USB packet and video data payload “in parallel” is shown in Figure 37. EX1006 at 35:38-40.

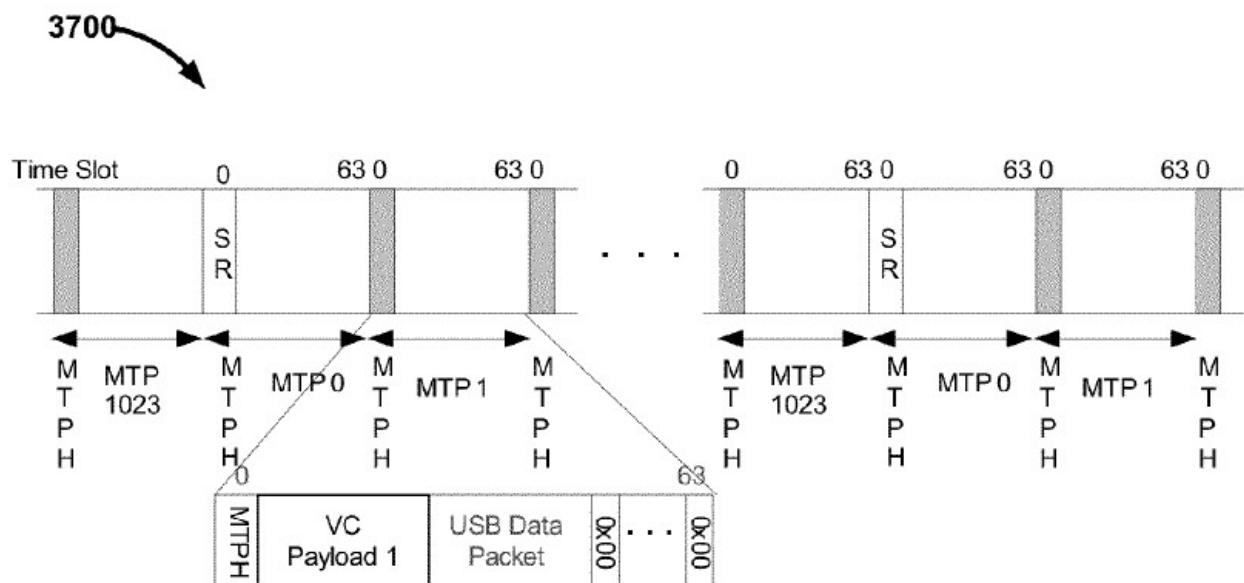


FIG. 37

Zhu teaches that the USB data (*forward [communication] data compliant with a first standard*) is compliant with a “*first standard comprising a universal serial bus (USB) standard,*” such as USB 2.0, and the DisplayPort video data (*video data*) is compliant with “*standard of the video data,*” such as DisplayPort 1.2. See, e.g., EX1006 at 31:25-44; 33:20-29; 34:52-56; 34:62-65. USB 2.0 is different from DisplayPort 1.2. EX1003, ¶71.

In Zhu, MTPs containing DisplayPort and USB data (*forward units of data...*) are sent over the first physical channel “*during one or more first time periods.*” Zhu describes a process of “link turn-around,” which selectively activates (and deactivates) the transmitters and receivers in the source and sink to ensure that data flows in only one direction at a time. EX1006 at 33:63-34:10. USB and DisplayPort data are sent forward from the source device and received by the sink device when DP TX PHY 3450 and DP RX PHY 3470 are enabled but USB 2.0 TX PHY 3460 and USB 2.0 RX PHY 3430 are disabled. *Id.* at 34:3-6. Conversely, USB data is sent backward when DP TX PHY 3450 and DP RX PHY 3470 are disabled but USB 2.0 TX PHY 3460 and USB 2.0 RX PHY 3430 are enabled. *Id.* at 34:28-31. “The link turn-around from the forward direction to the backward direction may take place after the last active pixel of the current display line is sent and the necessary MSA/VBID/SDP is transferred, which is done in the forward direction.” *Id.* at 34:31-38. After the backward transmission of USB data is complete, “another link turn-around may occur. That is, the link may go from the backward direction back to the forward direction, and the link may prepare for the next video line active pixels transfer.” *Id.* at 34:41-46. Thus, Zhu teaches that forward USB and video data are sent from the source and received by the sink when DP TX PHY 3450 and DP RX PHY 3470 are enabled

but USB 2.0 TX PHY 3460 and USB 2.0 RX PHY 3430 are disabled (*first time periods*). EX1003, ¶72.

c. “over a first physical channel of the multimedia link: . . . [receiving / sending] backward units of data [at the source device from the sink device / from the sink device to the source device] during one or more second time periods, the backward units of data comprising backward [communication] data compliant with the first standard; and” [1.b] / [11.b]

Zhu teaches this limitation. EX1003, ¶¶73-74. As recited in [1.a] and [11.a], the “first standard” is a USB standard. In the “mixed mode” embodiment of Figure 35c, “USB 2.0 transaction is bi-directional, so the data transfer on the link may be performed in either the forward direction or backward direction.” EX1006 at 34:1-3; *see also id.* at 34:25-26 (“In the backward direction, the USB data may be sent from DisplayPort sink side back to the DisplayPort source side.”). An example allocation of USB data packets transmitted as part of DisplayPort transfer units (“TU”) in the backward direction is illustrated in Figure 40 of Zhu:

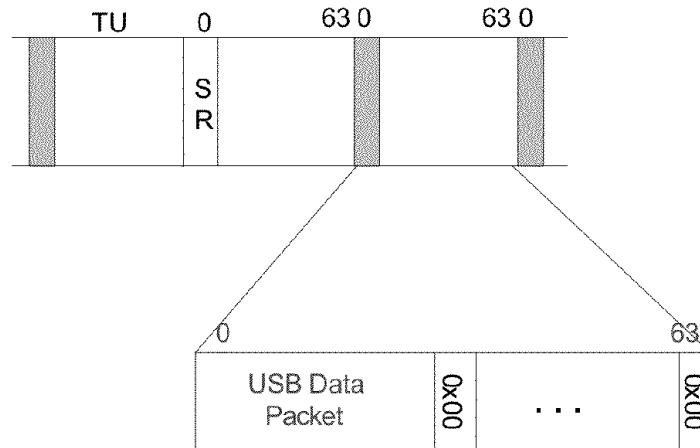


FIG. 40

See EX1006 at 35:35-44.

Zhu teaches that this backward transmission of USB data packets in TUs (*backward units of data comprising backward [communication] data compliant with the first standard*) occurs over the same channel (*first physical channel*) over which USB data and video data are sent in the forward direction, but during time periods when the DP TX PHY 3450 and DP RX PHY 3470 are disabled and the USB 2.0 TX PHY 3460 and USB 2.0 RX PHY 3430 are enabled (*second time periods*). *Id.* at 34:28-31; Section X.A.1.b. For example, USB data may be communicated in the backward direction “during the video blanking period.” *Id.* at 34:27-29.

d. “over a second physical channel of the multimedia link distinct from the first physical channel: [sending / receiving] control data from the source device to the sink device.” [1.c] / [11.c]

Zhu teaches this limitation. EX1003, ¶¶75-81. Specifically, Zhu discloses a distinct “*second physical channel*” in the form of a “two-way serial communication side-band channel [] for setting up the lanes requirement and other communications on both sides.”² EX1006 at 5:6-11; *see also id.* at 1:67-2:3; 7:21-35; 12:61-65; 20:7-57; 31:38-39. In the “mixed mode” embodiment, for example, the source and sink send messages to each other over the AUX channel to implement mixed-mode link turn-around. EX1006 at 34:39-41; 35:58-66.

One wire of a USB connector may be assigned as a single wire for side-band information, known as the C-wire. *See, e.g.*, EX1006 at 5:6-17, 20:7-57, 23:10-29, 26:28-36. Figure 19 illustrates a USB connector 1910 that includes a C-wire (annotated in red, below).

² Notably, in the co-pending district court litigations, UCT alleges that this limitation is satisfied by a “sideband channel” in USB4. EX1013 at 40-41.

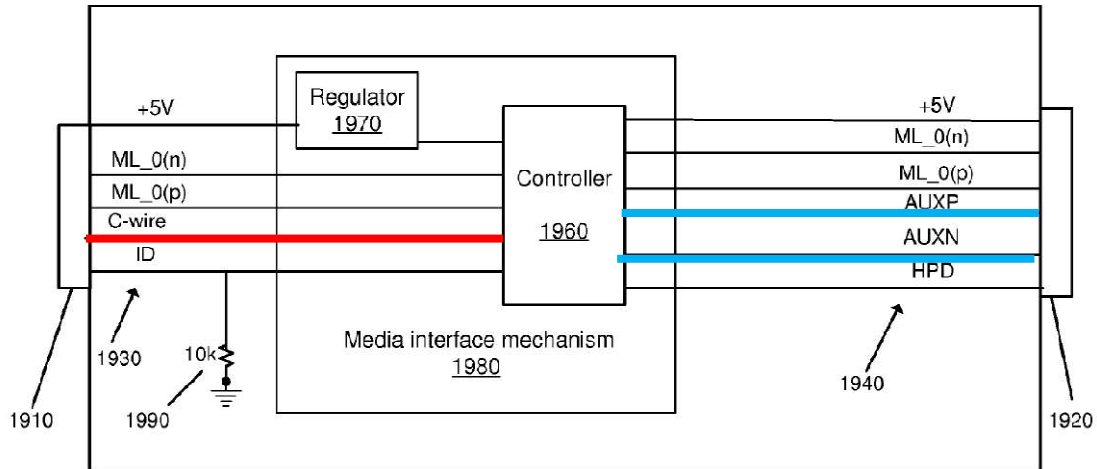


FIG. 19

Alternatively, the side-band information may be “communicated through the AUX channel of the DisplayPort link.” EX1006 at 34:39-41; *see also id.* at 31:36-39 and 35:60-63. Figure 19 also illustrates a media connector 1920 having a dedicated differential wire pair for the DisplayPort AUX channel (annotated in blue, above). EX1006 at 23:55-64.

Zhu explains that either or both connector types may be used at the sink and source devices of the described embodiments. EX1006 at 36:28-35 (“In various embodiments, various USB connectors and/or DisplayPort connectors, examples of which are described herein, may be used at sink and/or source device to couple to an external interface for data transfer between the devices.”). Thus, Zhu discloses that the mixed mode embodiment of Figure 35c includes a distinct physical side-

band channel (*second physical channel*) in the form of either a C-wire (in the USB-type connector) or a differential AUX wire pair (in the DisplayPort-type connector). EX1003, ¶77.

Alternatively, given Zhu's explicit teaching that either connector type could be used with the disclosed embodiments, it would have been obvious to implement Zhu's teaching of a distinct C-wire or differential AUX wire pair in connection with the mixed mode embodiment of Figure 35c. *See* EX1006 at 34:39-41, 35:60-66; 36:28-32; EX1003, ¶78. Such use would involve merely a simple substitution of one known element (either the USB-type or DisplayPort-type connector) for another (other possible connectors) to obtain predictable results and the predictable use or combination of prior art elements (one of the disclosed connectors with the source and sink devices of Figure 35c) according to their established function (providing a connection to these devices). EX1003, ¶78.

Zhu discloses that "*control data*" is sent over the second physical channel. EX1003, ¶79. Specifically, the side-band channel is used "for device configurations on either side" and "to identify and set the correct transmission of the multimedia content." *Id.* at 1:52-57. The C-wire, for example, may communicate data signals for various control functions, such as "plugged device type identification," "link training," and "downstream HDCP authentication . . . to transfer the hand shake information as defined in a DisplayPort standard

specification.” *Id.* at 27:17-27; 27:34-37; 29:14-17; 29:26-29. Figures 32 and 33 illustrate request and reply transactions over the C-wire, which can include up to 16 bytes of “Data.”



FIG. 32

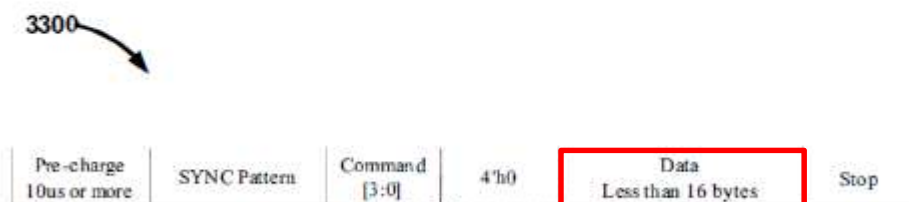


FIG. 33

EX1006 at Figs. 32-33 (annotated); *see also id.* at 26:38-27:13.

Moreover, the source and sink exchange *control data* over the DisplayPort AUX channel to implement mixed-mode link turn-around. EX1006 at 34:39-41 (“[t]he number of bytes [of USB data] to be sent in the backward direction may be precalculated and communicated through the AUX channel of the DisplayPort link”), 35:58-66; EX1003, ¶80. In particular, the source may send the sink an inquiry over the AUX channel. *Id.* If the sink device sends a message to the source acknowledging its receipt of the inquiry, both devices prepare for link turn-around.

Id. A POSITA would understand that the “AUX channel” described in that portion of Zhu may be implemented either as a distinct, dedicated DisplayPort AUX channel or as a C-wire that carries AUX channel signals. EX1003, ¶80; EX1006 at 20:7-20 (describing C-wire), 31:36-39 and 34:39-41 (describing DisplayPort AUX channel).

A POSITA would understand that the previously-discussed AUX and C-wire signals are “*control data*.” EX1003, ¶81.

2. Claims 2 and 12: “The method of claim [1 / 11], further comprising [sending / receiving] a first synchronization signal of a first length after [sending / receiving] a first forward unit of data of the forward units of data, and before [sending / receiving] [another / a second] forward unit of data from the source device.”

These claims are obvious in view of Zhu and the knowledge of a POSITA. EX1003, ¶¶82-85.

Zhu teaches sending MTPs forward according to the DisplayPort 1.2 MST protocol link timing scheme. EX1006 at Fig. 37, 34:52-61. As shown in Figure 37, a symbol “SR” (*first synchronization signal*) is sent/received in the forward data stream, after a “*first forward unit of data*” (e.g., MTP 1023) and before a “*second forward unit of data*” (e.g., MTP0, MTP1).

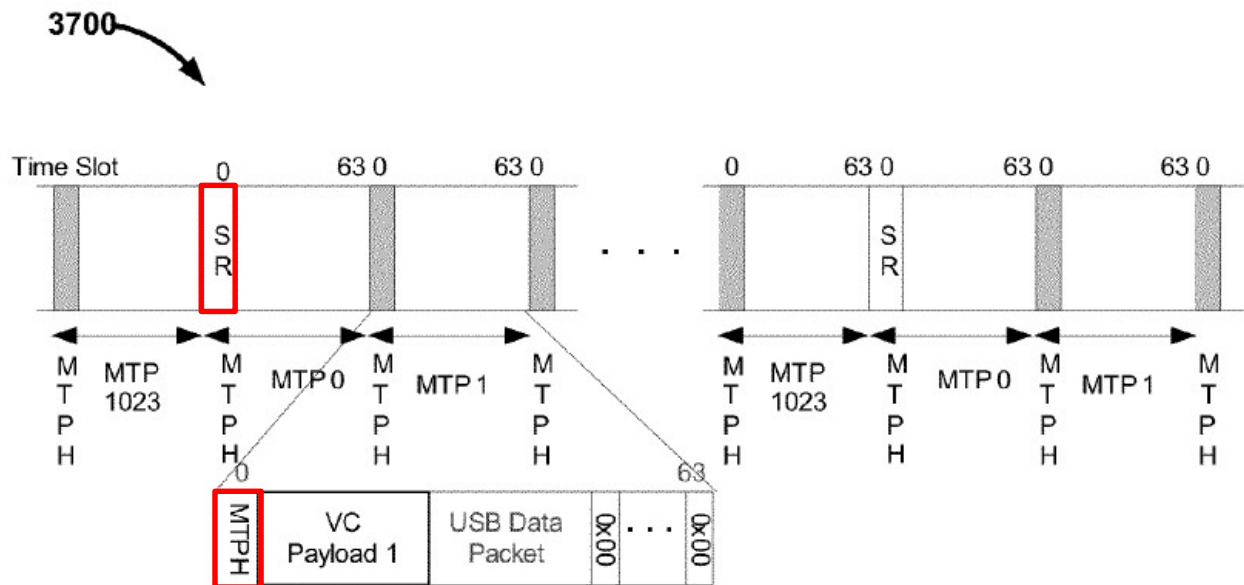


FIG. 37

EX1006 at Fig. 37 (annotated). SR has a “*first length*” (i.e. the length of the SR symbol).

A POSITA would understand that “SR” as used in Zhu is the DisplayPort 1.2 control function Scrambler Reset which is assigned to the comma symbol K28.5 in the DisplayPort 1.2 MST protocol. EX1032 at Table 2-65; EX1003, ¶84. A POSITA would have been familiar with 8b/10b K-codes and would have known that comma symbols (including K28.5) have special properties used for synchronization and control. EX1003, ¶84; EX1012 at 8:39-9:36 and Table III. A POSITA would therefore have found it obvious that SR in Zhu functions as a synchronization signal. EX1003, ¶84.

Moreover, SR is a “*first synchronization signal*” at least as interpreted by UCT. In the related litigation, UCT alleges that this limitation is satisfied by the “Blanking Start (BS) header” in the accused DisplayPort tunneling over USB4. EX1013 at 2 (“[E]ach accused product comprises sending a first synchronization signal of a first length as the Blanking Start (BS) header.”). Like SR, BS is a DisplayPort control symbol. EX1032 at 140. According to the evidence cited in UCT’s infringement contentions, the BS packet is used “to indicate the beginning of a horizontal or vertical blanking period, *reset scrambler* and transfer control information at the beginning of a blanking period” and the following figure cited in UCT’s contentions shows that the BS header includes an SR symbol (like the one discussed in Zhu):

Figure 10-31. Blank Start Header Format



EX1013 at 3 (emphasis added).

3. Claims 10 and 20: “The method of claim [1 / 11], further comprising [receiving / sending] control data from the sink device to the source device over the second physical channel of the multimedia link distinct from the first physical channel.”

Zhu discloses the additional limitations of these claims. EX1003, ¶¶86-88.

As explained in Section X.A.1.d above, Zhu discloses a distinct side-band channel (*second physical channel...*) that the source and sink use to bidirectionally

communicate control data. Thus, Zhu describes receiving / sending control data from sink to source over the second physical channel. EX1003, ¶86.

As a particular example, Zhu explains that the source and sink exchange control data over the AUX channel to implement link turn-around. EX1006 at 35:58-66; Fig. 41. After receiving an inquiry from the source regarding whether “there is a need for a USB backward transfer,” the sink device may send, and the source device receive, an acknowledgment over the AUX channel that results in both sides preparing for link turn-around. *Id.* As explained in Section X.A.1.d, a POSITA would understand that the “AUX channel” described in that portion of Zhu may be implemented either as a dedicated DisplayPort AUX channel or as a C-wire that carries AUX channel signals (and potentially other control signals). A POSITA would also understand that the acknowledgment sent by the sink device is link “*control data*.” EX1003, ¶87.

As another example, Zhu explains that the C-wire “may communicate handshake information for link training.” EX1006 at 20:48-52. A POSITA would recognize that a handshake necessarily involves bidirectional communication (and, thus, sending control data from sink to source). EX1003, ¶88.

4. Claim 21

a. “A source device for communicating data with a sink device over a multimedia link, comprising:” [21.p]

To the extent the preamble is limiting, Zhu teaches the limitation. EX1003, ¶¶89-90. Zhu discloses a source device 3405 (*source device*) that communicates data with a sink device 3415 (*sink device*) over the DisplayPort link (*multimedia link*).

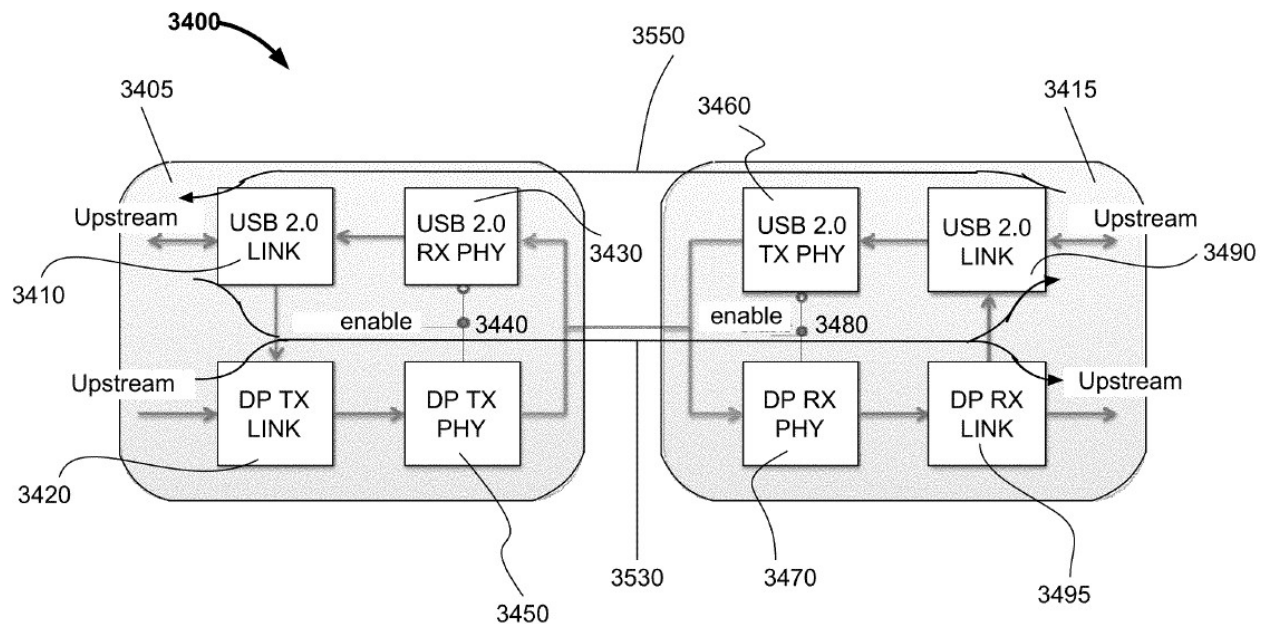


FIG. 35c

See also EX1006 at 33:63-34:24. See also Section X.A.1, *supra*.

b. “a transmitter coupled to a first physical channel of the multimedia link and configured to send forward units of data from the source device to the sink device over the first physical channel during one or more first time periods, the forward units of data comprising video data and forward data compliant with a first standard comprising a universal

serial bus (USB) standard and different from a standard of the video data;” [21.a]

Zhu teaches limitation 1.a. *See* Section X.A.1.b. Zhu also teaches this limitation, which recites a “*transmitter*” coupled to the first physical channel and configured to perform the function recited in limitation 1.a. EX1003, ¶91. The source device of Zhu includes DP TX PHY 3450 and/or DP TX LINK 3420 (*transmitter*) coupled to a DisplayPort Main Link data lane (*first physical channel*), that transmits DisplayPort and USB data to the sink device 3415. EX1006 at 33:63-34:10; 34:47-50. *See also* Section X.A.1.

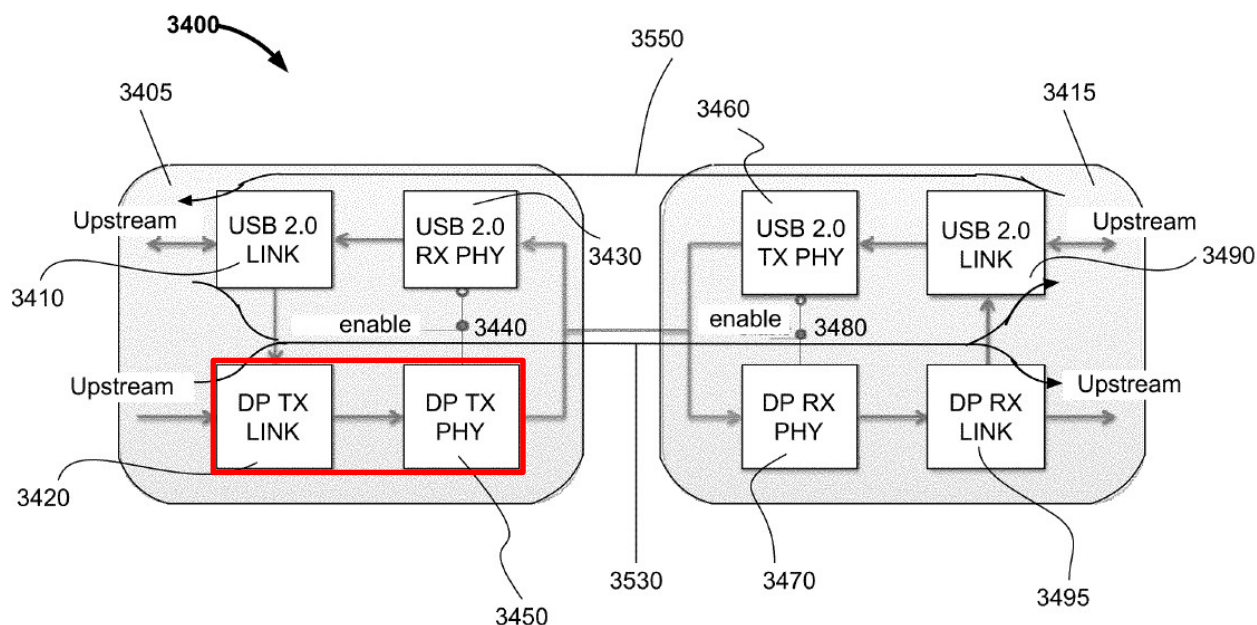


FIG. 35c

c. “a receiver coupled to the first physical channel and configured to receive backward units of data at the source device from the sink device over the first physical channel during one or more second time periods, the backward

units of data comprising backward data compliant with the first standard; and” [21.b]

Zhu teaches limitation 1.b. *See* Section X.A.1.c. Zhu also teaches this limitation, which recites a “receiver” coupled to the first physical channel and configured to perform the function recited in limitation 1.b. EX1003, ¶92. The source device of Zhu includes USB 2.0 RX PHY 3430 and/or USB 2.0 LINK 3410 (*receiver*) coupled to the first physical channel, that receives USB data from the sink device. EX1006 at 34:25-38. *See also* Section X.A.1.

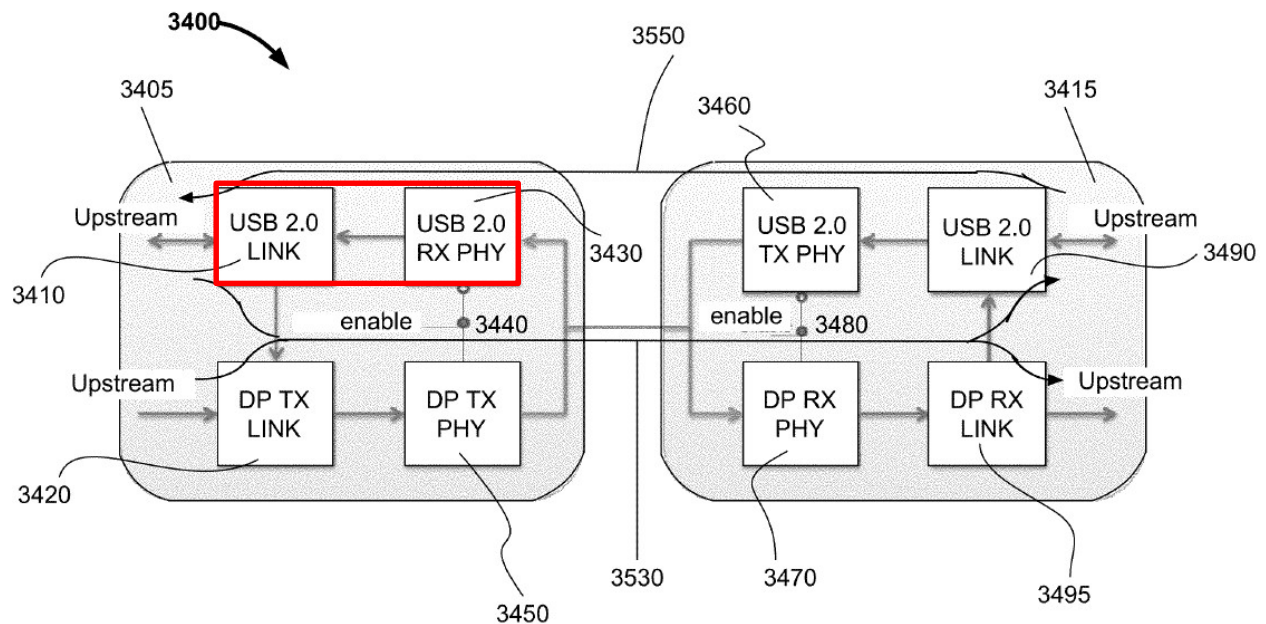


FIG. 35c

d. “a control signal transceiver coupled to a second physical channel of the multimedia link distinct from the first physical channel and configured to at least send control

data from the source device to the sink device over the second physical channel.” [21.c]

Limitation 1.c is disclosed by or obvious in view of Zhu. *See* Section X.A.1.d. Zhu also teaches or renders obvious this limitation, which recites a “*control signal transceiver*” coupled to the second physical channel and configured to perform the function recited in limitation 1.c. EX1003, ¶¶93-99. As discussed in Section X.A.1.d, Zhu discloses a side-band channel for transmitting control data bidirectionally between the source and sink.

Zhu also discloses a “*control signal transceiver*” to perform bidirectional side-band channel communication. For example, Zhu discloses a circuit 1810 within a source device that includes “a transmitter TX 1820 [and] a receiver RX 1840” (*control signal transceiver*) for sending and receiving, respectively, “side-band communication data” on a second physical channel (i.e. the C-wire). EX1006 at 22:43-60.

1800

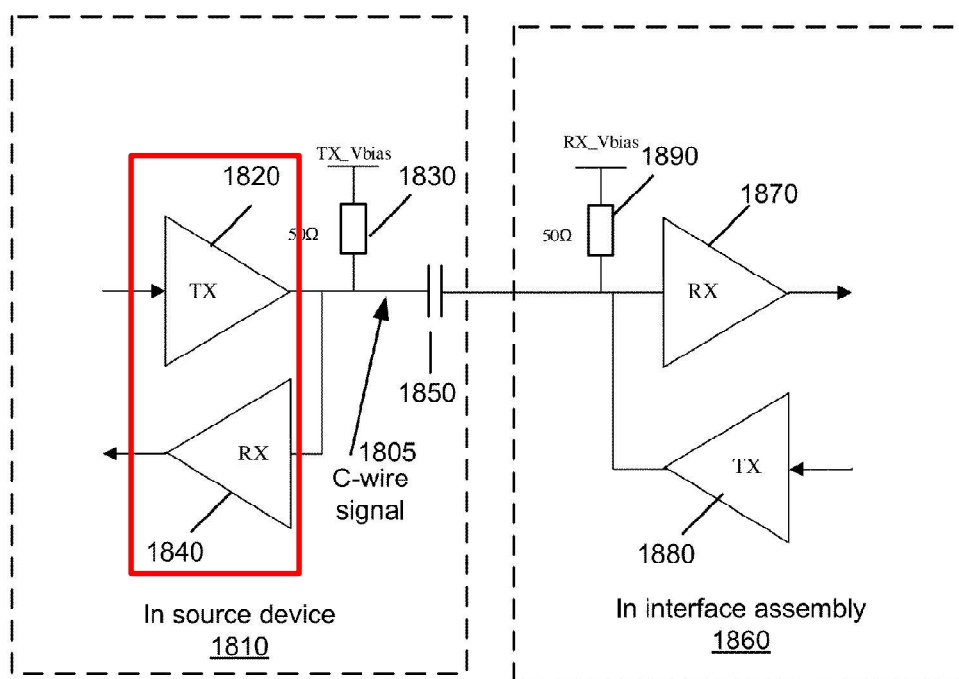


FIG. 18

EX1006 at Fig. 18. Although 1860 is identified as an “interface assembly,” a POSITA would recognize that it acts as a sink device. EX1003, ¶94; EX1001 at 4:15-16 (“The source device 110 herein refers to a device that sends A/V data to other devices (e.g., sink device 120).”).

A POSITA would have understood Zhu’s teachings of bidirectional communication of control data over the side-band channel (either AUX channel or C-wire) between the source and sink to disclose a control signal transceiver

coupled to the side-band channel (*second physical channel*). EX1003, ¶95. To make this bidirectional communication possible, a POSITA would have understood that the source device includes something that transmits and receives control data. *Id.* A device (or combination of devices) that transmits and receives signals is, by definition, a “transceiver.” *Id.*; EX1011 at 665 (defining “transceiver” as “[a]ny device that transmits and receives”).

Moreover, a POSITA would have at least found it obvious and been motivated to include a control signal transceiver in the source device of Zhu to perform the disclosed bidirectional communication of control data over the side-band channel. EX1003, ¶96. Transceivers are a well-known technology for transmitting and receiving data and a POSITA would have found it obvious that a transceiver could be used to transmit and receive the control data discussed in Zhu. EX1003, ¶96. A POSITA would have been motivated to include, within the source device, a control signal transceiver coupled to the second physical channel to send control signals because doing so would merely involve (a) the predictable use of a prior art element (transceiver) according to its established functions (transmitting and receiving signals), (b) the use of known techniques (transmitting and receiving signals via a transceiver) to improve similar devices (the source device) in the same way, (c) applying a known technique (transmitting and receiving signals via a transceiver) to a known device (DisplayPort source device) ready for improvement

to yield predictable results, and (d) choosing from a finite number of identified, predictable solutions (transceiver versus other options), with a reasonable expectation of success. EX1003, ¶97. A POSITA would have had a reasonable expectation of success in doing so at least because transceivers were well known and widely used before the Priority Date. EX1003, ¶97.

Even if “transceiver” is narrowly defined to require a combined transmitter and receiver within a single package, a POSITA would have found it obvious to use such a transceiver to transmit and receive the control signals described in Zhu, as it is one of a finite number of identified, predictable solutions for transmitting and receiving signals (the other being the use of separately packaged transmitter and receiver), with a reasonable expectation of success based on the widespread use of such transceivers for this purpose. EX1003, ¶98.

As just one example, a POSITA would have found it obvious to employ the side-band channel transceiver of Figure 18 of Zhu in the source device of the Figure 35c “mixed mode” embodiment. EX1003, ¶99.

5. Claim 22

Claim 22 recites substantially identical elements compared to claim 21; the only difference between the two claims is in the preamble. UCT’s infringement contentions cite no evidence in connection with the claim 22 preamble and, for every other element, merely cross-reference to the corresponding element of claim

21. EX1013 at 44-45. Thus, at least according to UCT’s interpretation for purposes of infringement, Zhu anticipates or renders obvious claim 22 for the same reasons stated in connection with claim 21. *See* Section X.A.4; EX1003, ¶¶100-101.

Claim 22 is obvious in view of Zhu for the additional reasons below.

a. “A non-transitory computer readable storage medium storing instructions thereon, the instructions representing a digital design of a circuit comprising:” [22.p]

This limitation is obvious in view of Zhu and the knowledge of a POSITA. EX1003, ¶¶102-119.

The phrase “digital design of a circuit” is not used anywhere else in the ’103 Patent and it is not discussed in the prosecution history.

To the extent the preamble refers to a memory storing a digital schematic (or other design) of a circuit having the recited elements, it would have been obvious to a POSITA that the circuit recited in claim 22 could be designed using a digital circuit design tool and such design stored in computer memory. EX1003, ¶103. Software-based digital circuit design is a known method that yields predictable results (a digital circuit design), would merely require applying a known technique (designing a circuit on a computer) to a known device (the circuit design described in claim 22) to yield predictable results, and would at the very least be obvious to try because digital circuit design is one of a finite number of identified, predictable solutions (others include designing a circuit by hand or building a physical circuit

by trial-and-error) with a reasonable expectation of success. EX1003, ¶¶103-104 (discussing prior art on digital circuit design software); EX1022 at [0027]-[0028]; EX1023 at 20:61-67; EX1024 at 18:49-52, 20:51-59; EX1025 at 12:24-25, 13:62-66, 14:43-46; EX1026 at 9:57-10:7; EX1027 at [0035], [0085], [0089]-[0091], [0100]; EX1028 at 1:15-21, 2:11-23. Moreover, digital circuit design is supported by market incentives such as the ability to design, simulate, debug, and manufacture products with complicated circuits inexpensively. EX1003, ¶103.

To the extent the preamble refers to a memory storing instructions capable of performing the functions of the recited *transmitter*, *receiver*, and *control signal transceiver*, this would also be obvious in view of Zhu and the knowledge of a POSITA. EX1003, ¶¶105-118. The '103 Patent includes very thin description of such an embodiment. In describing the source device 110 of Figure 1, the '103 Patent states merely that each of transmitter 111, receiver 112, buffer 113, and control logic 114 “is hardware, firmware, software, or a combination thereof.” EX1001 at 4:21-63. Figure 6 of the '103 Patent discloses a system that includes transmitter 652, receiver 654, and control logic 656 (which transmits and receives control data) and one or more non-volatile memories “for storing information and instructions to be executed by the processor(s) 604.” EX1001 at 8:64-9:41.

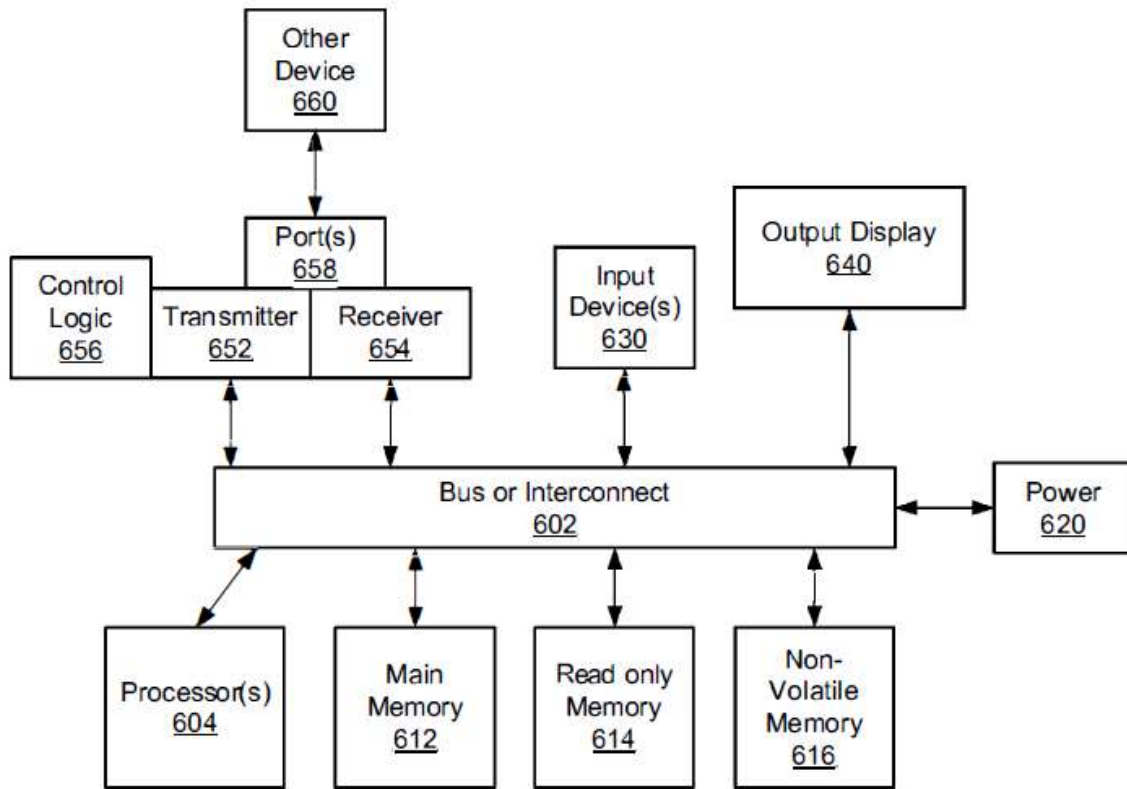


FIG. 6

600

EX1001 at Fig. 6. However, the '103 Patent does not state that the instructions stored on memory perform the functions of the transmitter, receiver, or control signal transceiver.

Zhu includes similar disclosure. *See* EX1006 at 21:12-21 and 6:21-29; EX1003, ¶¶105-106. Figure 1B of Zhu illustrates a source device that “includes a processor 132, memory 134, input 135, display 138, and data communication mechanism 140.” EX1006 at 6:14-20. Data communication mechanism 140 includes the circuitry used for transmission and reception of signals according to

protocols such as DisplayPort and USB. *Id.* at 6:39-56. Like the '103 Patent, Zhu teaches that “[p]rocessor 132 may be used to execute instructions that are stored in memory 134.” *Id.* at 6:21-29.

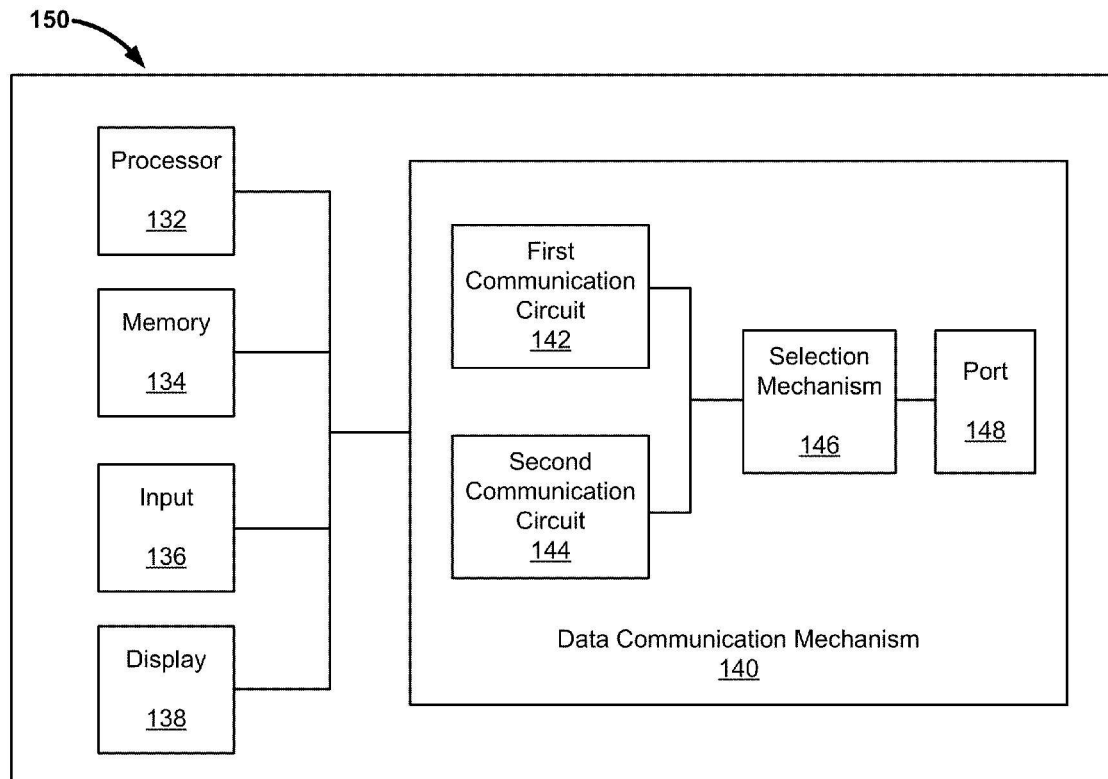


FIG. 1B

More generally, software implementations of transceivers (and thus, of transmitters and receivers) were well-known in the art and a POSITA would have been familiar with them before the Priority Date. EX1003, ¶¶107-117 (discussing prior art that describes software-based transceivers); EX1014 at Fig. 1, [0132]; EX1021 at [0003]-[0012], [0038], [0044]; EX1029 at 2:5-34; EX1030 at Fig. 4A, 7:63-8:3. For example, U.S. Publ. No. 2013/0266154 (“McCormack”) was

published October 10, 2013, and is therefore prior art under at least §102(a)(1).

McCormack discloses a well-known technique for implementing a software-based transceiver known as “bit banging,” specifically in the context of communicating data according to a standardized protocol (such as USB, DisplayPort, HDMI, etc.). EX1010 at [0069] (transceiver chip “may be “implemented, at least partially, by software running on a microcontroller. For example, ‘bit banging’ is a technique for serial communications using software instead of dedicated hardware.”), [0075]-[0076], [0084], [0148]; EX1003, ¶¶116-117; *see also* EX1016-EX1019 (all describing bit-banging).

A POSITA would have been motivated to implement the *transceiver*, *receiver*, and *control signal transceiver* of Zhu in software (such as the “bit-banging” technique) at least because doing so would have involved (a) the simple substitution of one known element (a software-based transmitter, receiver, or transceiver) for another (hardware implementation of same) to obtain predictable results, (b) the predictable use of prior art elements (software-based transmitter, receiver, and transceiver) according to their established functions, (c) the use of known techniques (software implementation) to improve similar devices (transmitter, receiver, transceiver) in the same way, (d) applying a known technique (software implementation) to a known device transmitter, receiver, transceiver) ready for improvement to yield predictable results (transmitter,

receiver, and transceiver operation), choosing from a finite number of identified, predictable solutions (software or hardware), with a reasonable expectation of success, and (e) design incentives and market forces (e.g. the lower cost, greater design flexibility and simplicity of implementing a software-based circuit). EX1003, ¶118; EX1016; EX1019 at 3. Moreover, as explained above, Zhu suggests the use of software for implementing portions of the disclosed circuit, which would have further inspired a POSITA to implement a transmitter, receiver, and control signal transceiver of Zhu in software. EX1003, ¶118. A POSITA would have had a reasonable expectation of success in doing so, because software-based transmitters, receivers, and transceivers were well-known and widely used before the Priority Date. *Id.*

b. Limitations 22.a, 22.b, and 22.c

Limitations 22.a-c are substantially identical to limitations 21.a-c which, as explained in Section X.A.4.b-d, are disclosed by or obvious in view of Zhu. For the reasons stated in the previous section, it would have been obvious that a digital design of the *transmitter, receiver, and control signal transceiver* circuit of Zhu could be represented by instructions on a computer-readable storage medium. EX1003, ¶120.

B. Ground 3: Claims 1-3, 10-13, 17, and 20-22 obvious over Zhu and DisplayPort 1.2

1. Motivation to Combine Zhu and DisplayPort 1.2

A POSITA would have been motivated to combine Zhu with DisplayPort 1.2 and would have had a reasonable expectation of success in doing so, because (a) DisplayPort 1.2 was a well-known protocol for AV communication and (b) Zhu specifically builds upon DisplayPort 1.2. EX1003, ¶122.

The motivation to combine Zhu and DisplayPort 1.2 can be found in the teachings of Zhu itself. EX1003, ¶123; *Comaper Corp. v. Antec, Inc.*, 596 F.3d 1343, 1351 (Fed. Cir. 2010) (The obviousness analysis “typically invokes the familiar teaching-suggestion-motivation (‘TSM’) test, asking whether a person having ordinary skill in the art would have found some teaching, suggestion, or motivation to combine or modify the prior art references.”); MPEP § 2143 (“teaching, suggestion, or motivation” is a proper basis for motivation to combine). Zhu explicitly cites several versions of the DisplayPort specification, including version 1.2. EX1006 at 1:42-47. To enable “mixed-mode” operation, Zhu instructs adding extra hardware blocks to “legacy DisplayPort 1.2 specification” source and sink devices. EX1006 at 33:20-29 (“Compared with legacy DisplayPort 1.2 specification, the USB 2.0TX/RX PHY 3430 and 3460 and LINK blocks 3410 and 3490 are extra hardware to support USB 2.0 data transfer on the DisplayPort link.”); *see also id.* at 33:63-34:38. Zhu further employs the “same link timing

generation scheme” of the DisplayPort 1.2 MST protocol, with minor modifications to include USB data in the MTPs sent over the DisplayPort 1.2 Main Link. EX1006 at 34:47-36:24. Zhu further instructs that USB data may be transmitted from sink to source using “the SST (single-stream transport) protocol defined in DP 1.2 standard.” EX1006 at 35:45-49.

A POSITA would have been motivated to implement the control symbols, link training, AUX channel, and AUX channel transceiver of DisplayPort 1.2 in conjunction with the methods and apparatuses disclosed in Zhu. EX1003, ¶124. Such a combination would reflect the use of a known technique to improve similar devices (methods or products) in the same way and applying a known technique to a known device (method or product) ready for improvement to yield predictable results. *Id.*

A POSITA would have had a reasonable expectation of success in combining Zhu and DisplayPort 1.2, at least because Zhu teaches use of DisplayPort 1.2 with minor modifications. EX1003, ¶125. Zhu provides detailed guidance that would enable a POSITA to make the disclosed modifications to DisplayPort 1.2. *Id.*; EX1006 at 33:20-36:35. A POSITA would therefore have been motivated to consult DisplayPort 1.2 and apply the modifications and hardware disclosed in Zhu to a system that is otherwise compliant with (and

includes the features of) DisplayPort 1.2, and would have a reasonable expectation of success in doing so. EX1003, ¶125.

2. Claims 1 and 11

As explained in Section X.A.1, Zhu anticipates or renders obvious these claims. Claims 1 and 11 are further obvious over Zhu combined with DisplayPort 1.2. EX1003, ¶¶121, 126-131.

To the extent it is argued that Zhu’s reference to MTPs in the forward data flow according to the DisplayPort 1.2 MST protocol does not explicitly disclose “*forward units of data*” as recited in limitation 1.a, that is disclosed in DisplayPort 1.2, which explains that an MTP is a “Multi-stream Transport Packet.” EX1032 at 136; EX1003, ¶127.

To the extent it is argued that Zhu does not disclose a “*first physical channel*” and a “*second physical channel . . . distinct from the first physical channel*,” this would also have been obvious in view of DisplayPort 1.2. Zhu explicitly describes the communication of bidirectional control data over the DisplayPort “AUX channel” in connection with the “mixed mode” embodiment. See EX1006 at 35:60-66. DisplayPort 1.2 discloses bidirectional communication of control data between source and sink over a physical AUX channel (*second physical channel*...) that is distinct from the Main Link lanes (each a *first physical channel*). EX1003, ¶¶128-131; EX1032 at 34 (“The auxiliary channel is a half-

duplex bidirectional channel used for link management and device control”); 35 (“The correct number of lanes is enabled at the correct link rate with the correct drive current and equalization level through the handshake between DisplayPort transmitter and receiver via AUX CH.”); 170 (“This section describes the DisplayPort AUX transaction syntax suitable for a half-duplex, bidirectional AUX CH PHY”).

The DisplayPort 1.2 AUX channel is a “*second physical channel . . . distinct from the first physical channel*” (i.e. Main Link data lane). EX1003, ¶¶129-130; EX1032 at 29 (each Main Link lane is a “differential pair[]”), 35 (“AUX CH consists of an AC-coupled, doubly-terminated differential pair.”).

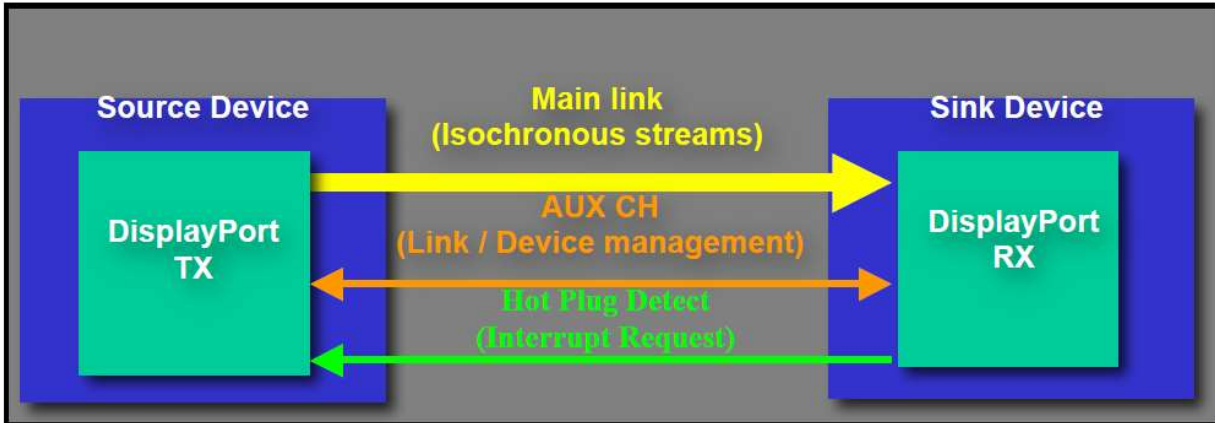


Figure 1-1: DisplayPort Data Transport Channels

EX1032 at 34. Pins 15 and 17 (“AUX_CH(p)” and “AUX_CH(n)”) of a DisplayPort connector are assigned to the AUX channel, further demonstrating that the AUX channel is a physical channel (in the form of a differential wire pair) that

is distinct from the Main Link lanes, such as pins ML_Lane_1(n) and ML_Lane_1(p).

Table 4-4 Downstream Port Connector Pin Assignment

Pin Number	Signal Type	Pin Name	Mating Row Contact Location	Vertically Opposed Connector's Front View
1	Out	ML Lane 0(p)	Top	
2	GND	GND	Bottom	
3	Out	ML Lane 0 (n)	Top	
4	Out	ML Lane 1 (p)	Bottom	
5	GND	GND	Top	
6	Out	ML Lane 1 (n)	Bottom	
7	Out	ML Lane 2 (p)	Top	
8	GND	GND	Bottom	
9	Out	ML Lane 2 (n)	Top	
10	Out	ML Lane 3 (p)	Bottom	
11	GND	GND	Top	
12	Out	ML Lane 3 (n)	Bottom	
13	CONFIG (see note 1)	CONFIG1	Top	
14	CONFIG (see note 1)	CONFIG2	Bottom	
15	I/O	AUX CH (p)	Top	
16	GND	GND	Bottom	
17	I/O	AUX CH (n)	Top	
18	In	Hot Plug Detect	Bottom	
19	RTN	Return	Top	
20	PWR Out (see note 2)	DP PWR	Bottom	

EX1032 at 401 (annotated).

Zhu explicitly describes “merg[ing] the USB data stream into the DisplayPort data lane(s)” and communicating bidirectional control data over the DisplayPort AUX channel in connection with the “mixed mode” embodiment. *See* EX1006 at 31:25-30, 35:60-66. A POSITA would thus understand, or at least find it obvious, that the side-band channel and Main Link data lanes of Zhu are distinct physical channels, as described in DisplayPort 1.2. EX1003, ¶131.

3. Claims 2 and 12: “The method of claim [1 / 11], further comprising [sending / receiving] a first synchronization signal of a first length after [sending / receiving] a first forward unit of data of the forward units of data, and before [sending / receiving] [another / a second] forward unit of data from the source device.”

These claims are obvious in view of Zhu and DisplayPort 1.2. EX1003, ¶¶132-136.

As explained in Section X.A.2, Zhu teaches that the forward data stream includes control function SR, which satisfies the additional limitations of these claims. Zhu modifies the DisplayPort 1.2 MST protocol to insert a USB Data Packet within the MST packet (MTP). EX1006 at 34:52-61; Fig. 37. DisplayPort 1.2 offers more detail about the MTP, the MTP header (MTPH), and the “control function codes” that may be used for synchronization, including SR. *See* EX1032 at 165 (annotated tables below).

Table 2-65: MTP Header Control Functions

Control Function	Code/Control Symbol Sequence ²	Comment
SR (Scrambler Reset)	K28.5	Comma character; Link Frame Indicator
RESERVED	K28.1	Not used.
RESERVED	K28.7	Not used to avoid coding complication
RESERVED	K28.4	Not used for EMI reduction purpose
ACT (Allocation Change Trigger)	C0-C1-C1-C0	Trigger to downstream device indicating change in allocation on local link. ACT Control Function sequence is unique from others; its 4-code control symbol sequence spans four consecutive MTP Header time slots).

Table 2-66: MTP Payload Control Functions

Control Function	Control Symbol Sequence (C_x, C_y, C_z, C_aa)
RG (Rate Governing)	C0-C1-C2-C3
BS (Blank Start)	C0-C0-C0-C0
BE (Blank End)	C1-C1-C1-C1
RESERVED	C2-C2-C2-C2
SS (Secondary Start)	C3-C3-C3-C3
SF (Stream Fill)	C4-C4-C4-C4
RESERVED	C5-C5-C5-C5
SE (Secondary End)	C6-C6-C6-C6
RESERVED	C7-C7-C7-C7

For example, DisplayPort 1.2 explains that SR is a “comma character,” which is an 8b/10b symbol with special properties that make it useful for synchronization. EX1012 at 8:39-9:36 and Table III. As shown in Figure 37 of Zhu, SR is sent/received “*after a first forward unit of data*” (an MTP sent before SR) and

“before [another / a second] forward unit of data” (an MTP sent after SR).

EX1003, ¶134-135.

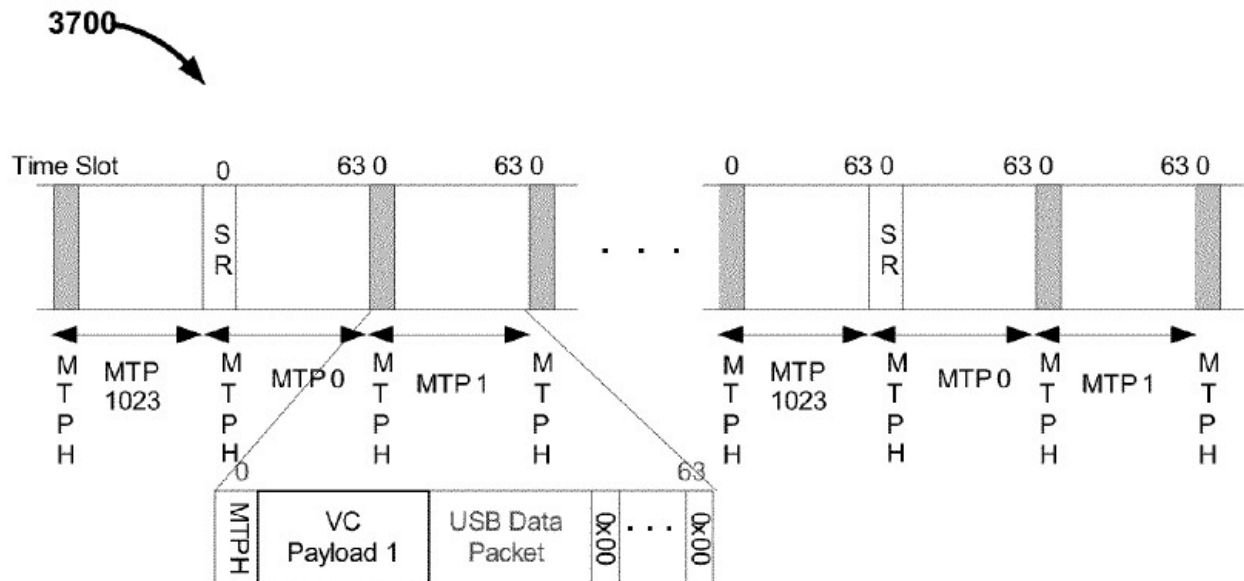


FIG. 37

Moreover, SR has a “*first length*” (40 bits, the length of four K28.5 codes).

EX1032 at 46 (“In Enhanced Framing Mode, the Scrambler Reset consists of four symbol sequence on each lane.”); EX1003, ¶135.

The MTP payload includes additional synchronization signals. EX1003, ¶136. For example, it may include “Blank Start” (BS), represented by a sequence of four 8b/10b symbols. EX1032 at 165-166. In the related litigation, UCT alleges that the BS header in DisplayPort tunneling over USB4 satisfies this element EX1013 at 2 (“[E]ach accused product comprises sending a first synchronization

signal of a first length as the Blanking Start (BS) header.”). Thus, at least under UCT’s own interpretation of this claim, BS is also a “*first synchronization symbol*.”

4. Claims 3 and 13: “The method of claim [2 / 12], further comprising [sending / detecting] a second synchronization signal of a second length longer than the first synchronization signal to initialize communication over the first physical channel before [sending / receiving] the first forward unit of data.”

These claims are obvious in view of Zhu and DisplayPort 1.2. EX1003, ¶¶137-143.

DisplayPort 1.2 describes link training, which initializes the DisplayPort Main Link and synchronizes the DisplayPort receiver to Main Link data and “must be performed unless the Source Main Link transmitter and the Sink Main Link receiver are already in synchronization.”³ EX1032 at 250; EX1003, ¶138. Link training involves two tasks: (1) Clock Recovery and (2) Channel Equalization / Symbol-Lock / Inter-lane Alignment. EX1032 at 250, 354. As part of the Channel Equalization Sequence, the source device (“Upstream device”) transmits (*sending*) training pattern TPS2 or TPS3. EX1032 at 358 (“In the Channel Equalization (EQ)

³ Zhu also references DisplayPort “link training” throughout its disclosure. EX1006 at 20:48-51; 27:30-36; and 29:14-25.

sequence, the Upstream device transmits the appropriate pattern (TPS2 or TPS3) with scrambling disabled.”).

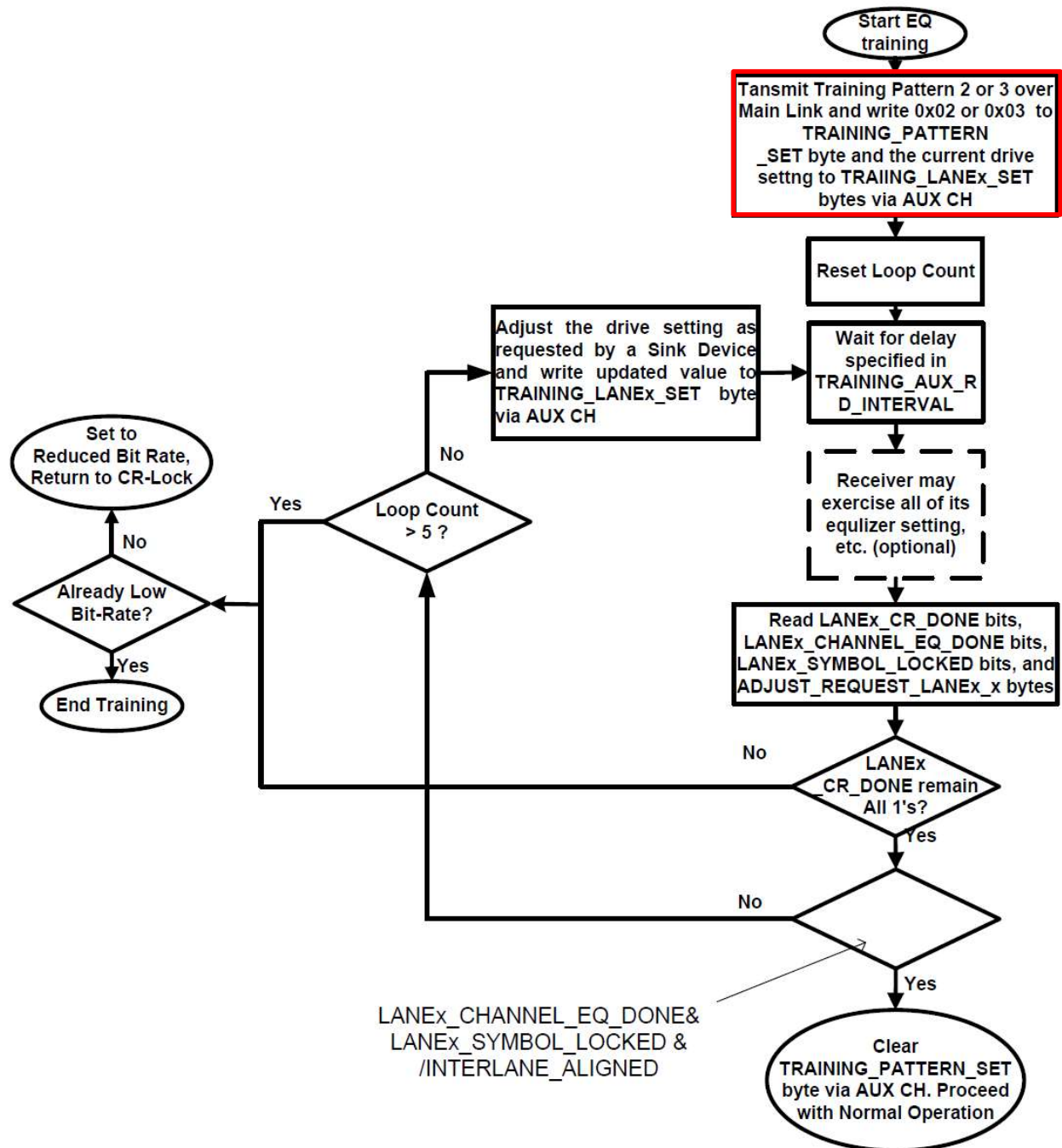


Figure 3-33: Channel Equalization Sequence of Link Training

EX1032 at 360 (annotated). TPS2 and TPS3 are each a sequence of 8b/10b symbols.

Table 3-16: Symbol Patterns of Link Training

Pattern Number	Purpose	Name
TPS1	For locking clock recovery circuit of the DisplayPort receiver	Repetition of D10.2 characters without scrambling
TPS2	For optimizing equalization, determining symbol boundary, and achieving inter-lane alignment	K28.5-, D11.6, K28.5+, D11.6, D10.2, D10.2, D10.2, D10.2, D10.2, D10.2 without scrambling
TPS3	For optimizing equalization, determining symbol boundary, and achieving inter-lane alignment	K28.5-, K28.5+, K28.5-, K28.5+, D10.2-, D10.2-, D10.2-, D10.2-, D10.2-, D10.2-, D10.2-, K28.5-, K28.5+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+, D30.3-, D30.3+ without scrambling

EX1032 at 355-56. TPS2 and TPS3 are each a “*second synchronization signal . . .* to initialize communication over the first physical channel” because they are sent as part of link training, through which the “DisplayPort receiver is synchronized to incoming Main Link data.” EX1003, ¶139; EX1032 at 250. Moreover, TPS2 and TPS3 each include instances of K28.5- and K28.5+, 8b/10b comma characters with special properties useful for synchronization. EX1003, ¶139; EX1012 at 8:39-9:36 and Table III. Furthermore, one “purpose” of TPS2 and TPS3 is “determining symbol boundary,” which is a form of synchronization. EX1032 at 356; EX1003, ¶139.

DisplayPort 1.2 teaches that TPS2 and TPS3 are “*received*” and “*detected*” by the sink device, explaining that “[t]he receiver must use the recognition of this training pattern [i.e. either TPS2 or TPS3] to decide whether the channel equalization is successful or not” and “[t]he receiver sets the

LANEx_SYMBOL_LOCKED bits in DPCD Link Status field only when it has properly detected and aligned the ANSI8B/10B symbol boundaries” in the training patterns. EX1032 at 358-59; EX1003, ¶140.

TPS2 is a sequence of ten 8b/10b symbols, and TPS3 is a sequence of 34 8b/10b symbols. Both are therefore “*longer than the first synchronization signal*” (SR or BS, each a series of four 8b/10b symbols). EX1003, ¶141.

TPS2 and/or TPS3 are sent “*before sending the first forward unit of data*” because DisplayPort link training must typically be performed before transporting a stream. *Id.*; EX1032 at 250; EX1003, ¶141.

Notably, during prosecution of the ’103 Patent, the examiner mapped claim 3 to paragraphs in U.S. Patent Publ. No. 2007/0201492 (“Kobayashi”) that describe similar 8b/10b training patterns. EX1002 at 85; EX1005 at ¶¶ 0071, 0075-76; EX1003, ¶¶ 61-62, 143. The applicant did not dispute that mapping.

5. Claims 10 and 20: “The method of claim [1 / 11], further comprising [receiving / sending] control data from the sink device to the source device over the second physical channel of the multimedia link distinct from the first physical channel.”

As explained in Section X.A.3, Zhu teaches the additional limitation of dependent claims 10 and 20 expressly. These claims are further obvious over Zhu in further view of DisplayPort 1.2, for the reasons explained in Section X.B.2. EX1003, ¶¶ 144-145.

6. Claim 17: “The method of claim 11, further comprising aligning a boundary of a symbol in a first forward unit of data of the forward units of data using the first synchronization signal.”

This claim is obvious in view of Zhu and DisplayPort 1.2. EX1003, ¶¶146-152.

As explained in Section X.A.2 above, the forward data stream of Zhu and DisplayPort 1.2 includes SR (*first synchronization signal*). SR is used to align a boundary of a symbol in a first forward unit of data. EX1003, ¶147. SR is a “Link Frame Indicator” that is inserted in the “MTP Header time slot every 1024th MTP as a Link Frame boundary marker.” EX1032 at 136, 165.

Table 2-65: MTP Header Control Functions

Control Function	Code/Control Symbol Sequence ³	Comment
SR (Scrambler Reset)	K28.5	Comma character; Link Frame Indicator
RESERVED	K28.1	Not used.
RESERVED	K28.7	Not used to avoid coding complication
RESERVED	K28.4	Not used for EMI reduction purpose
ACT (Allocation Change Trigger)	C0-C1-C1-C0	Trigger to downstream device indicating change in allocation on local link. ACT Control Function sequence is unique from others; its 4-code control symbol sequence spans four consecutive MTP Header time slots).

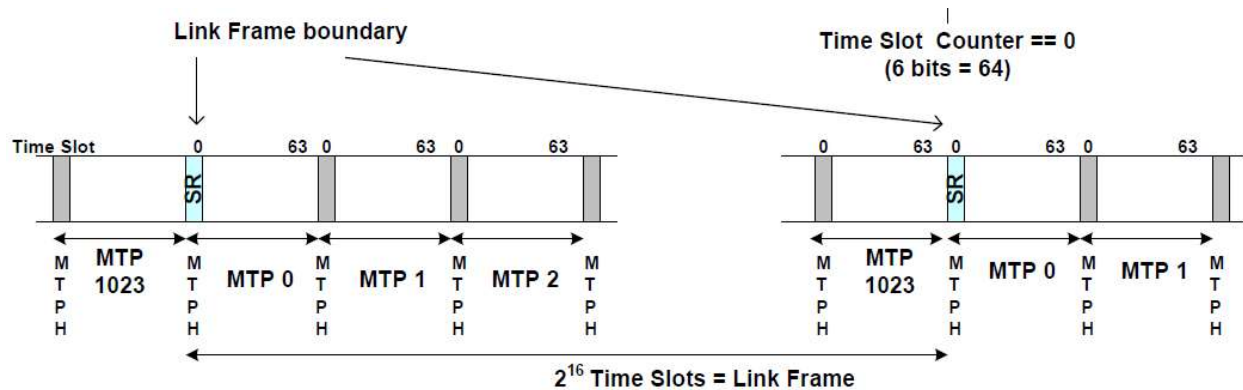


Figure 2-66: Link Timing Generation in MST Mode

SR is assigned a unique out-of-band symbol (K28.5) that is a comma character (i.e. a uniquely identifiable boundary marker) and thus serves to “align a boundary of a symbol” in data sent and received over the link (i.e. a first forward unit of data).

EX1003, ¶148. A POSITA would have known that a comma character (including K28.5) “indicates the proper byte boundaries and can be used for instantaneous acquisition or verification of byte synchronization.” EX1012 at 9:2-12; EX1003, ¶148.

Indeed, DisplayPort 1.2 explicitly teaches that K28.5 is used in Fast AUX (“FAUX”) mode “in the Preamble sequence for both bit sync and comma alignment.” EX1032 at 332; *see also id.* at 339 (describing use of K28.5 for “symbol alignment”). Certain symbols are reserved in FAUX mode for USB.

Table 3-5: ANSI 8B/10B Special Characters for DisplayPort Control Symbols

Special Character	Symbol for FAUX Transactions	Comments
K28.0	XUSB_IDLE_START	RESERVED for USB, see Note 2
K28.1	RESERVED	
K28.2	XUSB_FRAME_START	See Note 2 RESERVED for USB, see Note 2
K28.3	XUSB_IDLE_END	RESERVED for USB, see Note 2
K28.4	RESERVED	See Note 1
K28.5	Preamble	K28.5 rd- is used in the Preamble sequence for both bit sync and comma alignment See Note 1
K28.6	XUSB_CRC_MARKER	RESERVED for USB, see Note 2
K28.7	Preamble/XUSB_FRAME_END	K28.7 rd- is used in the Preamble sequence for squelch detection, and it otherwise RESERVED for USB, see Note 2
K23.7	FAUX_END	
K27.7	Preamble	
K29.7	RESERVED	See Note 1
K30.7	FAUX_START	

A POSITA would have found it obvious from this teaching that the same technique could be applied to use SR (which is assigned K28.5 in MST protocol) for symbol alignment on the main link, especially in combination with Zhu’s teaching of bidirectional USB communication on the main link. EX1003, ¶¶149-150. Such a modification would involve merely the use of a known technique to improve similar devices. *Id.*

Moreover, the MTP may also include control function BS. *See* Section X.B.3. BS is “[i]nserted after the last active pixel during the vertical display period.” EX1032 at 45. In MST mode, “[t]he BS symbol sequence is used as Stream Framing Control Symbol only.” EX1032 at 139-140.

Table 2-60: Summary of VC Payload Control Symbol Sequence

VC Payload Control Symbol Sequence ¹	Symbol Name	Control Code Sequence
VC Payload Fill Control	VCPF	C0-C1-C2-C3 ²
Stream Control		
Stream Framing Control	BS	C0-C0-C0-C0
	BE	C1-C1-C1-C1
	SS	C3-C3-C3-C3
	SE	C6-C6-C6-C6
Stream Fill Control	SF	C4-C4-C4-C4

In the related litigation, UCT alleges that the BS header in the accused DisplayPort tunneling over USB4 satisfies this claim. EX1013 at 2 and 15. Thus, BS also satisfies the additional limitation of dependent claim 17 at least under UCT’s interpretation of the claim in the litigation. EX1003, ¶152.

7. Claims 21 and 22

a. Limitations 21.p, 21.a, 21.b, 22.p, 22.a, and 22.b

As explained in Sections X.A.4 and X.A.5 and, Zhu discloses or renders obvious these limitations. EX1003, ¶¶153-154

b. “a control signal transceiver coupled to a second physical channel of the multimedia link distinct from the first physical channel and configured to at least send control data from the source device to the sink device over the second physical channel.” [21.c] / [22.c]

As explained in Sections X.A.4.d and X.A.5.b, this limitation is disclosed by or obvious in view of Zhu. It is further obvious in view of DisplayPort 1.2, which

teaches that the transmitter in the source device includes “[c]ircuitry that transmits the DisplayPort Main Link data [and a]lso contains the transceiver circuit for AUX CH” (*control signal transceiver...*). EX1003, ¶155; EX1032 at Figure 1-1 and p. 28. “AUX CH” refers to the auxiliary side-band channel (*second physical channel...*) of DisplayPort 1.2 referenced by Zhu. *See* EX1003, ¶155; EX1032 at 34. Thus, claim 21 is further obvious in view of Zhu combined with DisplayPort 1.2. EX1003, ¶¶154-155.

C. Ground 4: Claims 1, 2, 10-12, 17, and 20-22 obvious over Lyle and the knowledge of a POSITA

1. Claims 1 and 11

a. “A method of transmitting data over a multimedia link, comprising:” [1.p] / [11.p]

To the extent the preamble is limiting, Lyle teaches the limitation. EX1003, ¶¶156-158. Specifically, Lyle discloses “[a] communication system including a transmitter, a receiver, and a TMDS-like link [*(multimedia link)*], in which video data and auxiliary data . . . are transmitted from the transmitter to the receiver, or in which video data are transmitted over the link from the transmitter to the receiver, and auxiliary data . . . are transmitted from the receiver to the transmitter.” EX1008 at Abstract.

b. “over a first physical channel of the multimedia link: [sending / receiving] forward units of data from a source device [to / by] a sink device during one or more first time periods, the forward units of data comprising video data

and forward [communication] data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;" [1.a] / [11.a]

This limitation is obvious in view of Lyle and the knowledge of a POSITA.

EX1003, ¶¶159-168.

Lyle describes a TMDS link according to a Digital Video Interface (DVI) standard. EX1008 at 1:63-2:2, 27:10-20, 28:26-44. As shown in Figure 21, the TMDS link includes several channels.

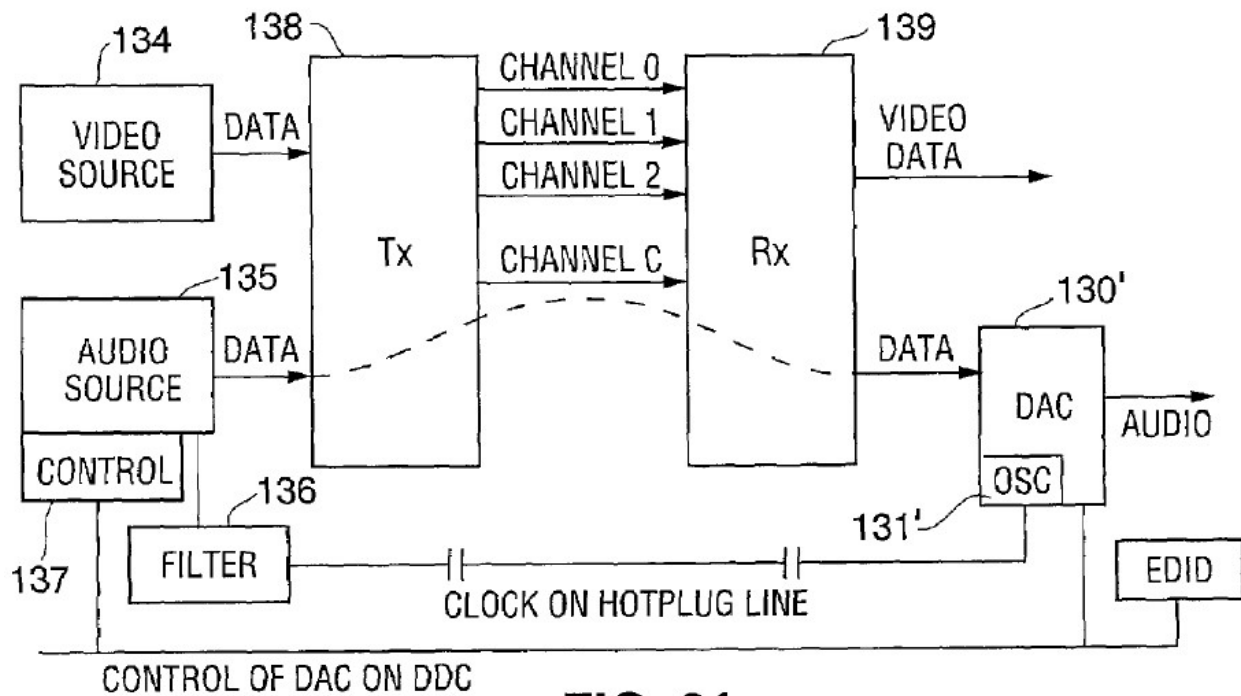


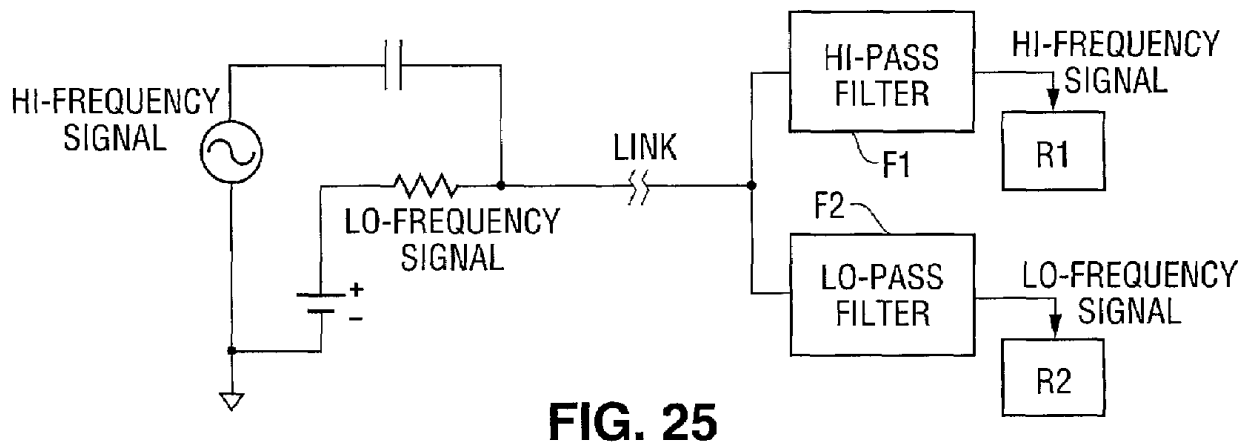
FIG. 21

EX1008 at Fig. 21; *see also id.* at Figs. 6, 19, and 29. Typically, “video data are transmitted from transmitter 138 to receiver 139 over Channels 0, 1, [and] 2” (any one a *first physical channel*). EX1008 at 27:12-20. Lyle describes embodiments in which “[e]ach available conductor or channel can be employed to transmit

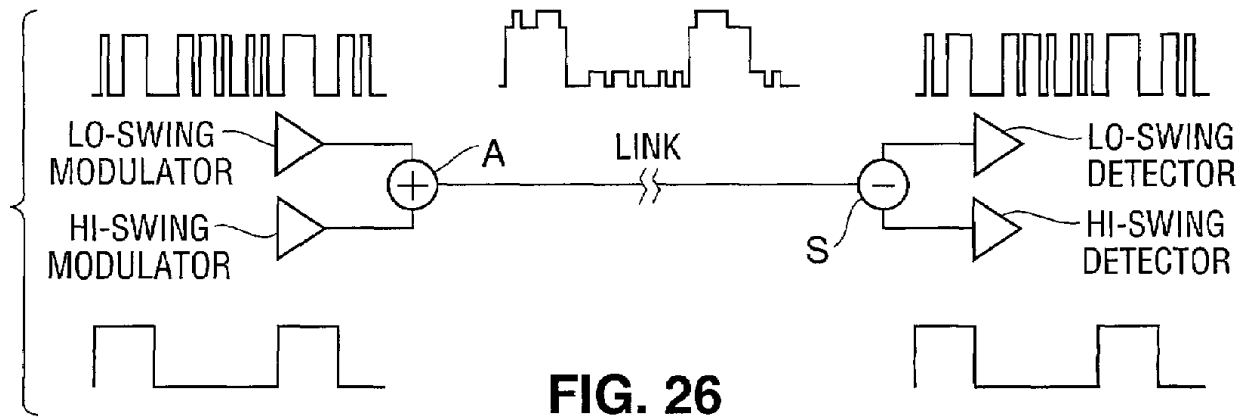
auxiliary data (or a clock therefor) either in addition to or instead of each conventional function for which it is employed in a conventional TMDS-like link.” EX1008 at 27:49-63. Because “auxiliary data” is a broad term that encompasses “any other type of data other than video data and timing information for video data” (*id.* at 5:57-60), a POSITA would understand that the auxiliary data could be USB data (*forward [communication] data compliant with a first standard...*). EX1003, ¶160. Indeed, Lyle lists high-bandwidth USB data as an example of such auxiliary data. EX1008 at 50:47-54. USB is different from the standard of the video data, which, in Lyle, may be a DVI standard. EX1008 at 11:26-30; EX1003, ¶160. Thus, it would have been obvious that the Lyle source device could send (and the sink device receive) forward units of data comprising video data and USB data over a first physical channel (e.g., one of Channels 0-2). EX1003, ¶160. Lyle explains that both video data and auxiliary data are transmitted in packets (*forward units of data*) and a POSITA would understand that these two types of data could be contained in a single packet. EX1008 at 16:65-17:9 (describing transmitting TMDS data in packets), 19:22-60 (describing transmitting auxiliary data in packets); EX1003, ¶164.

Lyle describes several different strategies for sending video and auxiliary data on the same channel, and a POSITA would find it obvious that any one of these strategies could be used to send both video and USB data over the same

channel. EX1003, ¶¶162-168. **First**, Lyle describes a “frequency multiplication” technique, in which “one or more conventional signals” (e.g., video data for a Channel 0-2) are sent “as a ‘Hi-Frequency Signal’ in a first wavelength band . . . and one or more auxiliary signals” (e.g., USB data) are sent “as a ‘Lo-Frequency Signal’ in the second wavelength band.” EX1008 at 36:54-37:3; Fig. 25.



Second, Lyle describes a “threshold level multiplexing” technique, in which one type of data (e.g., video data) generated by a “low swing modulator” is superimposed via an adder with the other type of data (e.g., auxiliary USB data) generated by a “high swing modulator” and then the combined signal is transmitted over the TMDS channel. EX1008 at 38:13-43; Fig. 26.



Third, Lyle explains that “[i]n the specific case of a channel conventionally used for video data transmission, auxiliary data as well as video data can be sent over the channel in one or both directions using the same physical layer protocol of in-band and out-of-band characters, while at the same time using a macro layer to pack data in various protocols onto the same lines. For example, TMDS-encoded video data can be sent using in-band characters to indicate the pixel data. Using the same physical interconnect and either the same or a different in-band/out-of-band character scheme, auxiliary data can also be sent.” EX1008 at 44:54-64. A POSITA would understand that the in-band characters (for video pixel data) and out-of-band characters (for auxiliary data, such as USB) could be contained within a single packet for transmission on a TMDS channel. EX1003, ¶164.

Lyle also teaches a switching approach, illustrated in Figure 24, that allows “transmit[ting] auxiliary data or a clock therefor in one direction over the channel,

and some other signal in another direction over the same channel.” EX1008 at 35:25-59.

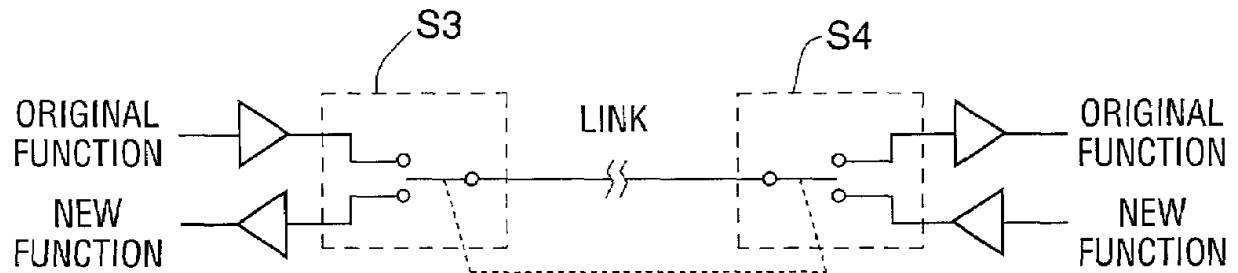


FIG. 24

Switches S3 and S4 can be implemented so that signals pass in opposite directions over the link during different time periods. *See* EX1008 at 36:9-14 and 36:49-53.

Lyle further teaches that “many combinations of the described auxiliary data (and clock) transmission strategies (and variations thereon) are possible” and “[f]or example, switching can be combined with frequency or level multiplexing schemes to change either the direction of auxiliary data transmission, or to eliminate conflicts or interference with conventional functions.” EX1008 at 40:5-15. Thus, Lyle teaches that the frequency multiplication, threshold level multiplexing, and/or in-band/out-of-band techniques can be combined with a switching approach such that video data and auxiliary data are transmitted from the source device to the sink device over one of Channels 0-2 (*first physical channel*) during times when the switches are set to allow forward data transmission (*first time periods*). EX1003, ¶167.

A POSITA would have found it obvious to make such a combination at least based on the explicit teaching or suggestion found in Lyle. EX1003, ¶168; *Comaper*, 596 F.3d at 1351. Moreover, such a combination would merely involve (a) combining prior art elements (the different strategies of Lyle) according to known methods to yield predictable results (ability to send video and send and receive USB data over the same channel) and (b) the predictable use or combination of prior art elements (the different strategies of Lyle) according to their established functions (allowing transmission of more than one data type over the same channel). EX1003, ¶168.

c. “over a first physical channel of the multimedia link: . . . [receiving / sending] backward units of data [at the source device from the sink device / from the sink device to the source device] during one or more second time periods, the backward units of data comprising backward [communication] data compliant with the first standard; and” [1.b] / [11.b]

This limitation is obvious in view of Lyle and the knowledge of a POSITA. EX1003, ¶¶169-171.

Lyle teaches that auxiliary data may be transmitted bidirectionally over the same channel of a TMDS link, such as a channel conventionally used to transmit video data. EX1008 at 44:54-59 (“[A]uxiliary data as well as video data can be sent over the channel in one or both directions[.]”). As explained in Section X.C.1.b, Lyle teaches a combination of frequency multiplication, threshold level

multiplexing, and/or in-band/out-of-band techniques with a switching approach.

EX1008 at 40:7-12. In such a combination, auxiliary data (*backward units of data...*) is sent by the sink device and received by the source device during “*second time periods*” (times when the channel is not being used to transmit forward data).

EX1008 at 35:65-36:53. Auxiliary data may be sent in the backward direction (from sink to source) by “reversing one video data transmission channel . . . during blanking periods (to send auxiliary data from the receiver of the video data to the transmitter of the video data).” EX1008 at 45:43-48; *see also id.* at 29:3-9, 46:61-67.

Lyle discloses (and it would at least be obvious to a POSITA) that the auxiliary data of Lyle could be USB data (and that such USB data would be compliant with a USB standard). EX1003, ¶171; *see* Section X.C.1.b.

d. “over a second physical channel of the multimedia link distinct from the first physical channel: [sending / receiving] control data from the source device to the sink device.” [1.c] / [11.c]

Lyle teaches this limitation. EX1003, ¶¶172-173. Specifically, Lyle discloses a DDC interface (*second physical channel*), which “provides a serial bus for bidirectional communication between the transmitter and a monitor associated with the receiver” and “employed to initialize and authenticate an HDCP link.” EX1008 at 28:26-44; *see also id.* at 28:29-38, 39:50-62, and Figs. 23-26. These DDC signals are used for control functions, such as initialization and

authentication. *See id.* For example, Lyle explains that, over the DDC bus (*second physical channel*), a monitor (*sink device*) transmits “an Extended Display Identification (‘EDID’) message that specifies various characteristics of the monitor” and a TMDS transmitter (*source device*) transmits “control signals for the monitor” (*sink device*). EX1008 at 2:17-23. A POSITA would understand that the EDID message and control signals are “*control data*.” EX1003, ¶172.

The DDC bus is distinct from a DVI data channel used to carry video (*first physical channel*). EX1008 at 2:2-23 (describing the DDC lines as “conductors” separate from the conductors that carry Channels 0-2), 47:17-23 (“the invention typically cannot eliminate the need for all special conductors that are conventionally used for bidirectional communication between the transmitter and receiver” which would include the DDC lines.).

2. Claims 2 and 12: “The method of claim [1 / 11], further comprising [sending / receiving] a first synchronization signal of a first length after [sending / receiving] a first forward unit of data of the forward units of data, and before [sending / receiving] [another / a second] forward unit of data from the source device.”

Lyle discloses the additional limitations of these claims. EX1003, ¶¶174-176.

Lyle teaches that “[t]he pre-reserved time slots allocated (by the specifications of the conventional DVI link) for transmission of out-of-band words indicative of control bits CTL0, CTL1, CTL2 and CTL3 allow data transmitted in

these slots to be used to accomplish synchronization within a video frame.”

EX1008 at 29:16-21; 1:29-37 (“the encoder can generate . . . ‘out-of-band’ words in response to control or sync signals”). In particular, Lyle describes a TMDS link in which “a byte boundary is realigned only in response to the occurrence of three consecutive ones of the above-mentioned special characters” (that is, the out-of-band words indicative of control bits CTL0, CTL1, CTL2 and CTL3). *Id.* at 30:65-31:1. Thus, three consecutive instances of the special characters is a “*first synchronization signal*” of a “*first length*” (i.e. the collective length of three out-of-band words). EX1003, ¶175.

Because this synchronization signal comprises out-of-band words transmitted as part of the data stream, it is sent/received after a “*first forward unit of data*” (i.e. video and/or USB data preceding the out-of-band words) and before a “*second forward unit of data*” (i.e. video and/or USB data following the out-of-band words). EX1003, ¶176.

3. Claim 10 / 20: “The method of claim [1 / 11], further comprising [receiving / sending] control data from the sink device to the source device over the second physical channel of the multimedia link distinct from the first physical channel.”

Lyle discloses the additional limitations of these claims EX1003, ¶¶177-178. Lyle teaches that control data is communicated bidirectionally over the DDC bus (*second physical channel*) between a TMDS transmitter (*source device*) and a monitor (*sink device*). EX1008 at 28:26-44, 39:50-62; Section X.C.1.d. The

monitor transmits “an Extended Display Identification (‘EDID’) message that specifies various characteristics of the monitor” to the transmitter over the DDC lines. EX1008 at 2:17-23. Thus, Lyle teaches that an EDID message (*control data*) is sent from a monitor (*sink device*) to, and received by, a transmitter (*source device*) over the DDC bus (*second physical channel*).

4. Claim 17: “The method of claim 11, further comprising aligning a boundary of a symbol in a first forward unit of data of the forward units of data using the first synchronization signal.”

Lyle discloses the additional limitation of this claim. EX1003, ¶¶179-180.

As explained in Section X.C.2, Lyle teaches a “*first synchronization signal*” (three consecutive instances of the special characters) and using this first synchronization signal to realign a byte boundary in data (*aligning a boundary of a symbol...*). Lyle further explains that “video data are encoded and then transmitted as encoded words (each 8-bit word of digital video data is converted to an encoded 10-bit word before transmission).” EX1008 at 1:26-28. A POSITA would thus understand that one byte (that is, 8 bits of data) corresponds to a “*symbol*” (that is, as a 10-bit encoded word). EX1003, ¶180.

5. Claim 21

a. “A source device for communicating data with a sink device over a multimedia link, comprising:” [21.p]

To the extent the preamble is limiting, Lyle teaches the limitation. EX1003, ¶¶181-182. Lyle discloses that video source 134 and transmitter 138 (*source*

device) communicates with a monitor associated with receiver 139 (*sink device*) over a DVI link (*multimedia link*). EX1008 at Fig. 21, 27:10-20, 28:26-44.

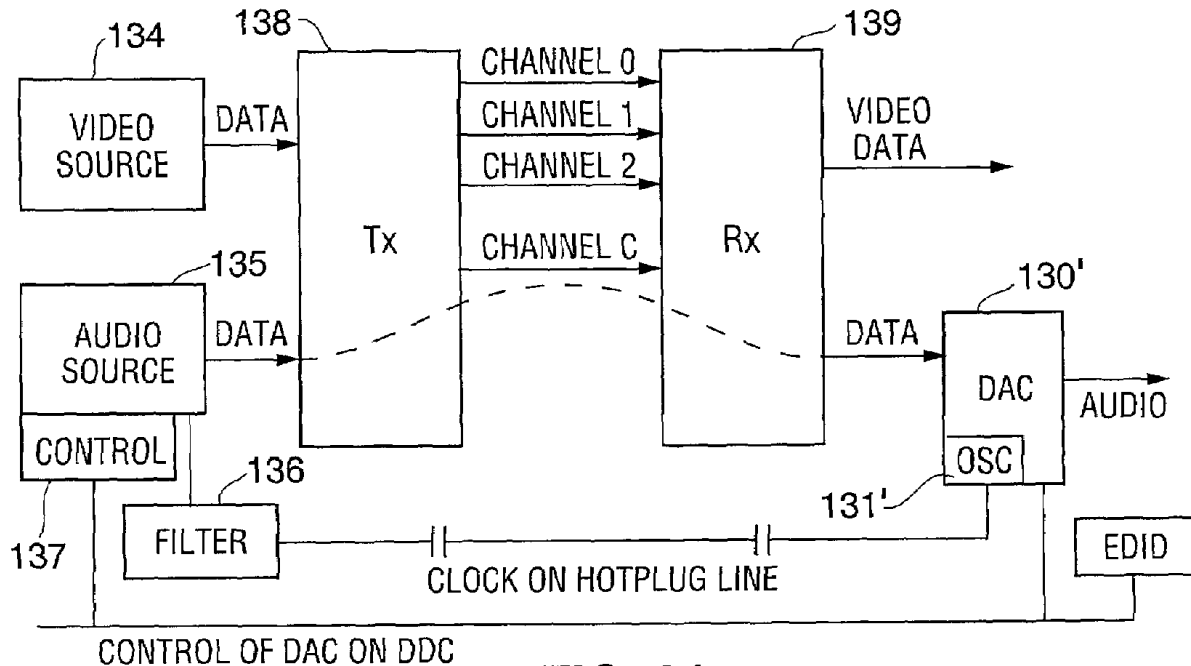


FIG. 21

b. “a transmitter coupled to a first physical channel of the multimedia link and configured to send forward units of data from the source device to the sink device over the first physical channel during one or more first time periods, the forward units of data comprising video data and forward data compliant with a first standard comprising a universal serial bus (USB) standard and different from a standard of the video data;” [21.a]

Limitation 1.a is obvious over Lyle. *See* Section X.C.1.b. Limitation 21.a recites a “transmitter” coupled to the first physical channel and configured to perform the function recited in limitation 1.a. It would have been obvious to a

POSITA that the transmitter disclosed in Lyle could be used to perform that function. EX1003, ¶¶183-184; *see* Section X.C.1.b.

Lyle discloses transmitter 138 (*transmitter*) that is coupled to and sends video data and auxiliary data, such as USB data, over a TMDS channel (*first physical channel*). EX1008 at Fig. 21, 27:12-20, Fig. 24, 32:6-15; EX1003, ¶184. As discussed in Section X.C.1.b, Lyle teaches the combination of, for example, either the frequency multiplier or threshold level multiplexing approach for sending video and auxiliary data in one direction over a TMDS channel with the switching approach that allows use of the same TMDS channel to send auxiliary data in the opposite direction over the same channel. Lyle discloses transmitters in connection with each of these approaches.

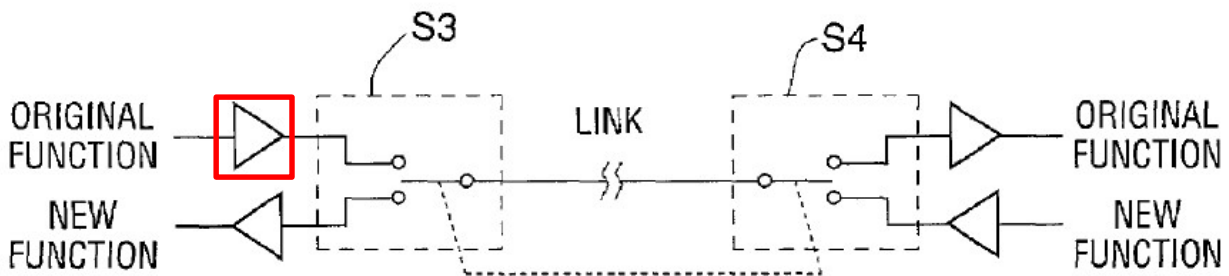


FIG. 24

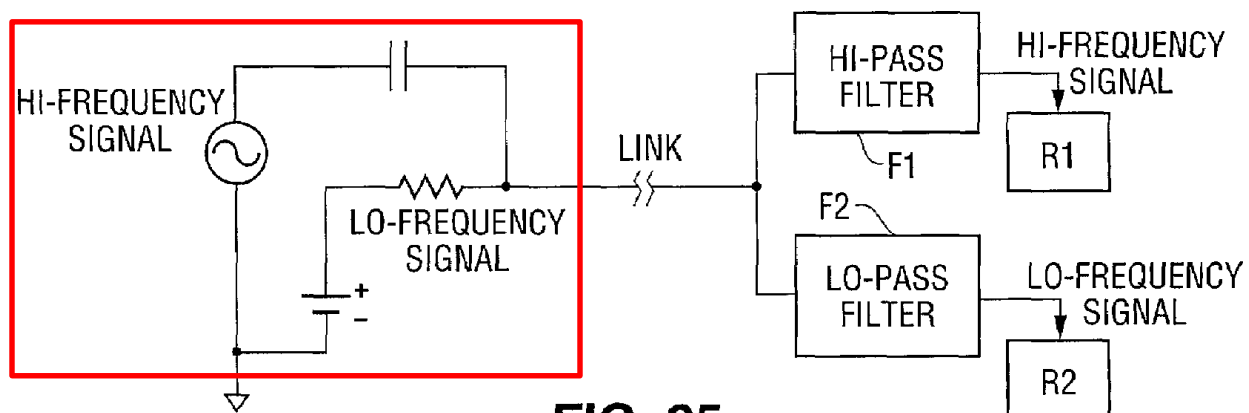


FIG. 25

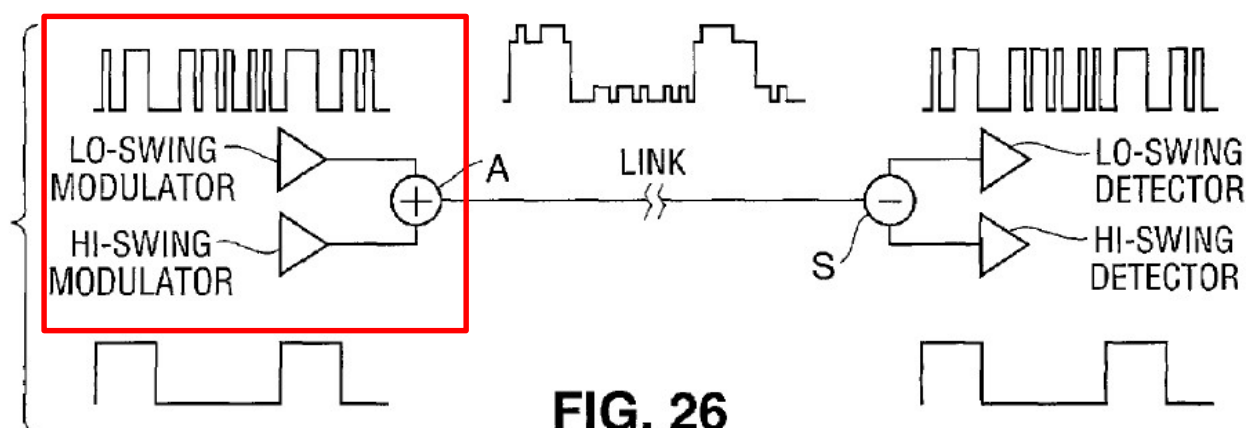


FIG. 26

EX1008 at Figs. 24-26 (annotated).

c. “a receiver coupled to the first physical channel and configured to receive backward units of data at the source device from the sink device over the first physical channel during one or more second time periods, the backward units of data comprising backward data compliant with the first standard; and” [21.b]

Limitation 1.b is obvious over Lyle. *See* Section X.C.1.c. Limitation 21.b recites a “receiver” coupled to the first physical channel and configured to perform the function recited in limitation 1.b. It would have been obvious to a POSITA that

the receiver of Lyle could be used to perform that function. EX1003, ¶¶185-186; *see* Section X.C.1.c.

In connection with the switching approach, Figure 24 illustrates a receiver “configured to recover each auxiliary signal” in the source device. EX1008 at 35:25-64.

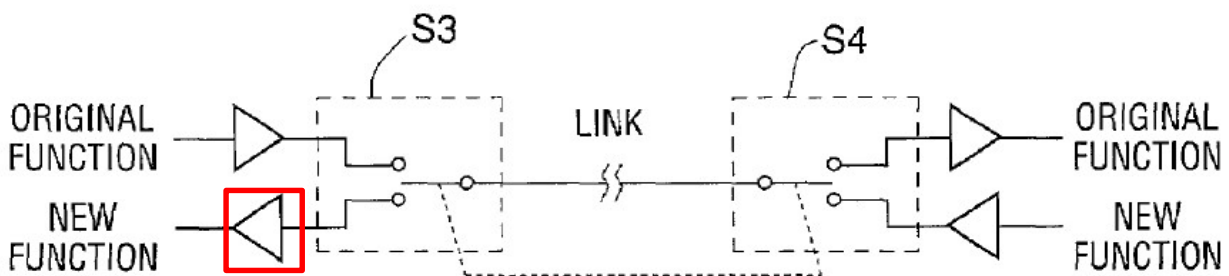


FIG. 24

EX1008 at Fig. 24 (annotated). As explained in Sections X.C.1.b-c above, it would have been obvious to a POSITA that this auxiliary signal could include USB data; EX1003, ¶186.

d. “a control signal transceiver coupled to a second physical channel of the multimedia link distinct from the first physical channel and configured to at least send control data from the source device to the sink device over the second physical channel.” [21.c]

Lyle teaches limitation 1.c. *See* Section X.C.1.d. Lyle also teaches this limitation, which recites a “control signal transceiver” coupled to, and configured to send control data from source to sink over, the second physical channel.

EX1003, ¶¶187-191. As discussed in connection with limitation 1.c above, Lyle

discloses bidirectional communication of control data over the DDC bus (*second physical channel*).

As also discussed above, Lyle describes a switching approach that can be used for bidirectional communication over a TMDS channel, such as the DDC lines. A source device employing this switching approach includes a transceiver (see red box).

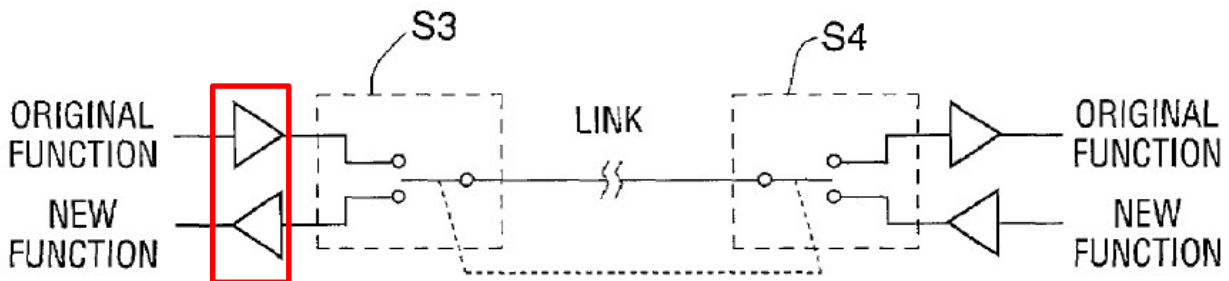
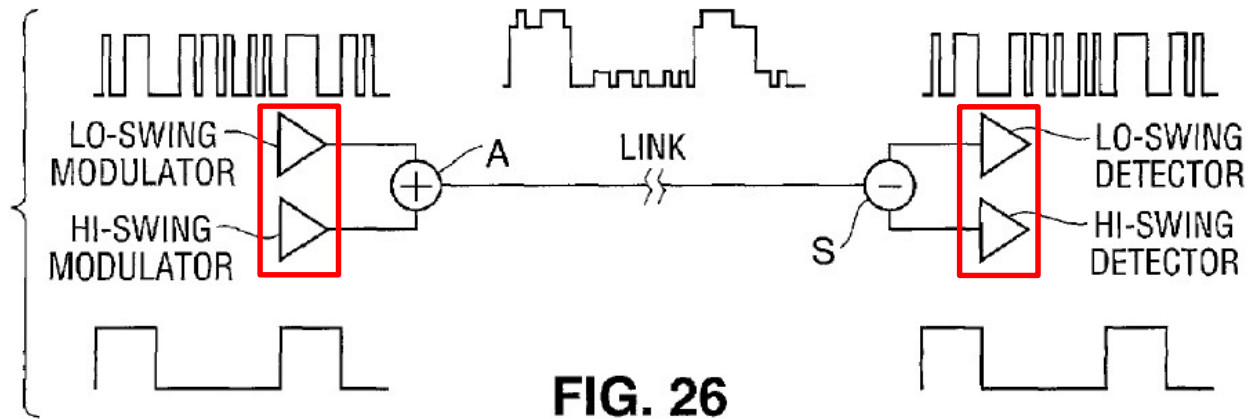


FIG. 24

EX1008 at Fig. 24 (annotated). Lyle specifically describes an example in which the switching approach is employed on the DDC channel (*second physical channel*).

EX1008 at 36:24-53.

Moreover, Figure 26 of Lyle illustrates transmitters and receivers for threshold level multiplexing.



EX1008 at Fig. 26 (annotated); EX1003, ¶190. Lyle further teaches that “since a conventional DDC bus is bidirectional, two of the FIG. 26 circuits can be included in an embodiment of the invention (one with the circuitry on the left side of FIG. 26 in the transmitter and the other with the circuitry on the right side of FIG. 26 in the transmitter) to allow bidirectional transmission of the auxiliary data as well as the DDC signals” (*control data*). EX1008 at 39:50-62.

Moreover, a POSITA would have understood Lyle’s teaching of bidirectional transmission between the source and sink of DDC signals (*control data*) over the DDC bus (*second physical channel*) (EX1008 at 39:50-62) to disclose (or render obvious) a control signal transceiver coupled to the second physical channel. EX1003, ¶¶188-191; *see* Section X.A.4.d.

6. Claim 22

UCT does not distinguish between claims 21 and 22 in its infringement contentions. EX1013 at 44-45. Thus, at least according to UCT’s interpretation of this claim for purposes of infringement, claim 22 is obvious over Lyle and the

knowledge of a POSITA for at least the reasons explained in connection with claim 21 above. EX1003, ¶¶192-193.

Moreover, claim 22 is obvious in view of Lyle and the knowledge of a POSITA for the additional reasons explained below.

a. “A non-transitory computer readable storage medium storing instructions thereon, the instructions representing a digital design of a circuit comprising:” [22.p]

To the extent the preamble is limiting, the limitation is obvious in view of Lyle and the knowledge of a POSITA. EX1003, ¶¶194-198.

To the extent claim 22 recites a non-transitory memory storing a digital circuit design such as an electronic schematic file, it would have been obvious to a POSITA that instructions representing a digital design of a circuit comprising the transmitter, receiver, and control signal transceiver of Lyle could be stored on a non-transitory computer readable medium for the same reasons explained in Section X.A.5.a. EX1003, ¶195.

To the extent claim 22 instead recites a memory storing instructions to perform the functions of the recited transmitter, receiver, and control signal transceiver, this would also be obvious in view of Lyle and the knowledge of a POSITA. EX1003, ¶¶196-197. Lyle explains that at least some aspects of a receiver may be implemented in software. EX1008 at 18:52-58, 19:29-34, and 19:45-50 (each describing receiver functions implemented in either hardware or

software). Lyle further describes a software-based control signal transceiver.

EX1008 at 41:7-24 (“Some implementations employ single-sided control, in which a smart agent (e.g., a software driver or firmware) on one side of the link has direct control over auxiliary data transmission and reception operating modes for both sides of the link.”). Software implementation of transceivers (and thus, of transmitters and receivers) was well-known in the art. *See* Section X.A.5. Thus, in view of this knowledge and Lyle’s teaching to use software for at least some or all of the receiver and control signal transceiver functionality, and in further view of the reasons explained in Section X.A.5, it would have been obvious to implement the transmitter, receiver, and control signal transceiver in Lyle in software and a POSITA would have had a reasonable expectation of success in doing so. EX1003, ¶¶196-198.

b. Limitations 22.a, 22.b, and 22.c

Limitations 22.a-c are substantially identical to limitations 21.a-c which, as explained in Section X.C.5, are obvious in view of Lyle and the knowledge of a POSITA. For the reasons stated in the previous section, it would have been obvious to a POSITA that the transmitter, receiver, and transceiver recited in these limitations could be represented by instructions stored on a computer readable storage medium. EX1003, ¶199.

D. Ground 5: Claims 2, 3, 12, 13, and 17 obvious over Lyle and Shin

1. Motivation to Combine Lyle and Shin

The motivation to combine Lyle and Shin can be found in the teachings of the references themselves. EX1003, ¶¶200-202. Lyle and Shin were both assigned to Silicon Image. Lyle discusses a TMDS-based link. EX1008 at 6:25-34. Shin was cited by the examiner during prosecution of Lyle. EX1008 at 2. The inventors of the Shin patent were at Silicon Image, where TMDS was developed. EX1009. Shin relates to TMDS. EX1003, ¶201; EX1009 at Abstract, 20:10-23:60. A POSITA would recognize Shin as a reference relating to TMDS and would have been motivated to implement, to the extent possible, the TMDS signaling of Shin in the system disclosed in Lyle at least because it would have involved merely combining prior art elements (TMDS signaling of Shin with the TMDS-based communication system of Lyle) according to known methods to yield predictable results. EX1003, ¶201. Because Lyle applies the TMDS signaling described and defined in Shin, a POSITA would have a reasonable expectation of success in making such a combination. EX1003, ¶202.

2. Claims 2 and 12: “The method of claim [1 / 11], further comprising [sending / receiving] a first synchronization signal of a first length after [sending / receiving] a first forward unit of data of the forward units of data, and before [sending / receiving] [another / a second] forward unit of data from the source device.”

These claims are obvious in view of Lyle and Shin. EX1003, ¶¶203-204.

Lyle discloses sending and receiving a first synchronization signal in the form of three consecutive out-of-band TMDS characters. *See* Section X.C.2. Shin teaches a “decoder synchronization module 114 [that] provides an indication to the decoder 44 of the frame boundary of each transmitted 10-bit character T[9:0].” EX1009 at 14:37-39. Shin explains that a “preamble sequence is produced by the encoder 18 at various times (e.g., at system power-up) in order to facilitate frame boundary detection by the synchronization module” and that “[d]uring each preamble period, three repetitions of the same synchronization character are produced by the encoder.” *Id.* at 14:43-46; 15:20-28. Thus, Shin teaches sending and receiving a “*first synchronization signal*” (three repetitions of an out-of-band character) of a “*first length*” (30 bits, the length of three out-of-band characters). EX1003, ¶204. Because the out-of-band characters may be sent “within any preamble period” and “at various other times,” they are sent/received after a “*first forward unit of data*” (i.e. video and/or USB data preceding the out-of-band characters) and before a “*second forward unit of data*” (i.e. video and/or USB data following the out-of-band characters). *Id.*; EX1009 at 10:41-51; EX1003, ¶204.

3. Claims 3 and 13: “The method of claim [2 / 12], further comprising [sending / detecting] a second synchronization signal of a second length longer than the first synchronization signal to initialize communication over the first physical channel before [sending / receiving] the first forward unit of data.”

These claims are obvious in view of Lyle and Shin. EX1003, ¶¶205-208.

Shin teaches that an “out-of-band synchronization character[]” (*second synchronization signal*) may be “transmitted three **or more** consecutive times within any preamble period” including “as part of system initialization” EX1009 at 10:41-51 (emphasis added). A POSITA would understand that system initialization initializes communication over the system, which, in the combination of Lyle and Shin, would include the first physical channel (e.g., one of TMDS Channels 0-2 of Lyle). EX1003, ¶206. Moreover, a POSITA would understand that initializing an idle channel may require precharging the channel to eliminate any DC imbalance. *Id.* This may be achieved by sending a long string of DC-balanced symbols of the out-of-bound type. *Id.* For example, in DisplayPort, idle channel initialization sequences can last up to 10ms. *See id.*; EX1032 at 359 (explaining that the “duration of the link training period” is “10ms or less”).

Thus, Shin teaches sending and detecting a “*second synchronization signal*” (more than three consecutive out-of-band synchronization characters) of a “*second length [(> 30 bits)] longer than the first synchronization signal to initialize communication over the first physical channel.*” EX1003, ¶207. Because initialization occurs before data transmission, the second synchronization signal is sent “*before [sending/receiving] the first forward unit of data.*” EX1003, ¶208.

4. Claim 17: “The method of claim 11, further comprising aligning a boundary of a symbol in a first forward unit of data of the forward units of data using the first synchronization signal.”

This claim is further obvious over Lyle in view of Shin, which teaches using the preamble containing three or more consecutive out-of-band characters “to facilitate frame boundary detection by the synchronization module.” EX1003, ¶¶209-210; EX1009 at 14:43-46. Shin further explains that “several repetitions of specially selected out-of-band characters are produced by the encoder 18 during the preamble period as a means of ensuring rapid frame boundary identification within the decoder synchronization module 114. At the conclusion of the preamble period, the module 114 will ‘know’ which of the bit lines RX[9:0] corresponds to the first bit T[0] of the 10-bit transmitted character.” *Id.* at 14:53-62. Thus, Shin discloses aligning a boundary of a 10-bit transmitted character (*symbol in a first forward unit of data*) using three consecutive out-of-band characters (*first synchronization signal*). EX1003, ¶210.

XI. CONCLUSION

Accordingly, Petitioner requests *inter partes* review of claims 1-3, 10-13, 17, and 20-22 pursuant to Grounds 1-5 set forth above.

Date: October 1, 2024

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE WITH WORD COUNT

Under the provisions of 37 C.F.R. § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,877 words, which is less than the 14,000 allowed under 37 C.F.R. § 42.24(a)(1)(i).

/s/ Brian W. Oaks

Brian W. Oaks

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(a), the undersigned certifies that on October 1, 2024, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided by Federal Express, cost prepaid, to the Patent Owner by serving the correspondence address of record:

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Petitioner knows this to be an additional address likely to affect service.

/s/ Brian W. Oaks

Brian W. Oaks

Lead Counsel for Petitioners