

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

In re *Inter Partes* Review of:

U.S. Patent No. 7,856,520

DECLARATION OF BRIAN A. BERG

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XII. JURAT 105

I. INTRODUCTION

1. My name is Brian A. Berg. I am currently an independent technology consultant. I have been retained by counsel for Lenovo (United States) Inc., Dell Inc., Dell Technologies Inc., and HP Inc. (collectively, “Petitioners”) to investigate and opine on certain issues relating to United States Patent No. U.S. Patent No. 7,856,520 (EX. 1001) (the “’520 patent”) in Petitioners’ Petition (the “Petition”) for *Inter Partes* Review (“IPR”) of the ’520 patent.

2. The Petition requests that the Patent Trial and Appeal Board (“PTAB” or “Board”) review and cancel claims 1, 2, 4, 8-10, 12-13, 15, 18-20, and 25 of the underlying ’520 patent (the “Challenged Claims”), and I understand that the ’520 patent has been assigned to Universal Connectivity Technologies Inc. (“UCT” or “Patent Owner”). I hereby submit this Declaration in support of the Petition.

3. I have been asked to opine on whether the ’520 patent is anticipated and/or rendered obvious by the prior art from the viewpoint of a person having ordinary skill in the relevant art (a “POSITA”) as of 2008. The opinions set forth herein are based on my personal knowledge, professional experience, education, and judgment in consideration of the ’520 patent and its prosecution history and cited references, the documents identified in the Petition, and the documents, materials and information referenced herein. I may rely upon these materials, my personal knowledge and professional experience, and/or additional materials to rebut arguments raised by

Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

4. My analysis of the materials produced in this investigation is ongoing, and I will continue to review any new material as it is provided. This Declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information, and on my continuing analysis of the materials already provided.

5. I am being compensated for my services at an hourly rate of \$650. I am also being reimbursed for any reasonable and customary expenses associated with my work and testimony. My compensation is in no way contingent upon the outcome of this IPR, I have no financial or personal interest in either its outcome or of any related litigation, and I have no financial interest in, or affiliation with, Petitioners or Patent Owner. I expect to be available to provide oral testimony should the need arise.

II. BACKGROUND AND QUALIFICATIONS

6. My qualifications for forming the opinions set forth in this report are summarized here, and are addressed more fully in my Curriculum Vitae (“CV”) (EX.1004). Based on my education, research, and work experience, I am knowledgeable about the subject matter of the ’520 patent and the related prior art,

including the state of the art in the field of interfaces and buses as used for communication with computer peripherals and consumer electronics devices.

7. I am an independent computer consultant with extensive experience in consumer electronics devices and their interfaces. I have worked in the industry as a computer engineer since 1974, and in the consumer electronics industry since 1985. This has included extensive experience with hardware, software, buses, peripherals, and device interfaces, including performing teardowns and analysis of the inner hardware components as well as of the software, networking, and communications functionalities of a number of consumer electronics products. I have designed, implemented, and debugged device drivers, embedded firmware, middleware, and applications, and I have integrated hardware and software in the process of creating consumer products. I have also been a project leader, industry analyst, marketing team member, and seminar leader, and I have extensive public speaking experience at computer conferences as well as industry and IEEE events.

8. I have worked extensively with consumer electronic device interfaces including USB, IDE/ATA/ATAPI/SATA, Fibre Channel, SCSI, iSCSI, FireWire 1394, and PCMCIA. I have also worked extensively with data storage and memory technologies including flash memory (*e.g.*, USB devices, solid state disks (SSDs), memory cards, and memory chips), magnetic disk drives, disk arrays (RAID),

magnetic tape, optical storage (Compact Disc, CD-ROM, DVD, and Blu-ray Disc), and library autochangers for removable storage media.

9. I have been a session speaker, conference session chair, program chair, conference chair, conference advisory board member, and event organizer for over 100 industry events which have encompassed technologies including flash memory, networking, server design, magnetic storage, optical storage, storage interfaces, and Storage Area Networks. For example, I am Technical Chair of the FMS: the Future of Memory and Storage conference (formerly Flash Memory Summit), held annually since 2006. My publications include books that I co-edited and/or co-wrote, and articles for journals, periodicals, and newsletters. I have also been a book reviewer, and I have been actively involved in professional computer societies and organizations for over 30 years.

10. I am an IEEE Senior Member, and was Chair, Vice Chair, and Secretary of the IEEE Santa Clara Valley (SCV) Section (the largest IEEE Section in the U.S. at about 8,000 members) during the years 2010-2012, and I remain active in the SCV Section. I am a Director and past Chair of the IEEE Consultants' Network of Silicon Valley (IEEE-CNSV), and Vice Chair and past Chair of the IEEE Silicon Valley Tech History Committee. I was the recipient of the 2012 Outstanding Leadership and Professional Service Award for the SCV Section, the Central Area of IEEE Region 6, and Region 6 itself (which includes 10 western states). I was also the recipient of the

2017 Outstanding Service and Leadership to the IEEE Award for the SCV Section and Region 6, the 2017 IEEE-USA Regional Professional Leadership Award, and the 2019 SCV Section Chair's Special Award for Outstanding Leadership and Valued Contributions.

11. I have been the IEEE Milestone Coordinator for Region 6 since 2015, the History Chair for Region 6 since 2019, and a member of the IEEE History Committee since 2021. I am currently Vice Chair of the IEEE History Committee, and Chair of its Milestones Subcommittee. I have worked in various capacities on well over 40 IEEE Milestones such as those detailed in my CV, including The Floating Gate EEPROM, the Intel 4004 Microprocessor, and the Universal Serial Bus (USB).

12. I received a Bachelor of Science degree in Mathematics in 1974 from Pacific Lutheran University in Tacoma, WA. Before starting a consulting company with some associates, I completed about 90% of the Electrical Engineering and Computer Science coursework toward a Master of Science in Computer Engineering degree at Stanford University from 1975 to 1978 – this was while I was employed full-time as an engineer at NASA-Ames Research Center in Mountain View, CA (1974-1976) and at Ford Aerospace and Communications Corporation (FACC) in Palo Alto, CA (1976-1979).

13. In 1978, I co-founded Digital Software Corporation (DSC). While employed full-time at DSC from 1979 to 1985, my work focused on device drivers for

various kinds of hardware including satellite systems. In 1985, I founded Berg Software Design (BSD), and I have worked as a consultant there since that time. I have performed consulting services for well over 100 companies.

14. I have previously offered testimony at deposition and trial as a technical Expert Witness, as detailed in my CV.

III. MATERIALS REVIEWED

15. I am not an attorney and offer no legal opinions. However, in my work I have had experience studying and analyzing patents and patent claims from the perspective of a person skilled in the art.

16. In preparing this declaration, I reviewed the '520 patent, including the claims of the patent in view of the specification. I have also reviewed the prosecution history of the '520 patent and numerous prior art and technical references from the time of the alleged invention. More specifically, I have reviewed each of the following:

Exhibit	Description
1001	U.S. Patent No. 7,856,520 (“’520 patent”)
1002	File History of the ’520 patent
1004	<i>Curriculum Vitae</i> of Brian A. Berg
1005	US Patent Application No. 2006/0095596 A1 to Lin Che Yung, <i>et al.</i> (“Yung”)
1006	HDMI Specification Version 1.3 and a CEC 1.3 Supplement (“HDMI 1.3”)

Exhibit	Description
1007	<i>Design of a Multicode Bi-phase Encoder for Data Transmission</i> , Raida Al-Alawi et al., Journal of Circuits Systems and Computers, February 2006 (“Al-Alawi”)
1008	Declaration of Steve Venuti
1009	Declaration of June Ann Munford
1010	<i>Universal Connectivity Techs. Inc. v. Lenovo Grp. Ltd.</i> , No. 2:23-cv-00449-JRG, Dkt 1-15
1011	Universal Serial Bus Specification, Revision 2.0, April 27, 2000 (“USB 2.0”)
1012	HDMI Specification Version 1.0 (“HDMI 1.0”)
1013	HDMI Specification Version 1.1 (“HDMI 1.1”)

17. I have also relied on my academic and professional experience in reaching the opinions expressed in this Declaration.

IV. RELEVANT LEGAL STANDARDS

18. I am not an attorney. For the purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to forming my opinions. I have applied the following understanding of the law.

A. Claim Construction

19. I understand that terms appearing in the patent claims are to be interpreted according to their “ordinary and customary meaning” in an IPR proceeding. In determining the ordinary and customary meaning, the words of a claim are first given their plain meaning as they would have been understood by a POSITA at the time of

the alleged invention, in light of the specification and file history. I understand that treatises and dictionaries may be consulted, albeit under limited circumstances, to determine the meaning attributed by a POSITA at the time of the alleged invention. I have followed this approach in my analysis, and have applied the ordinary and customary meaning of those terms throughout my analysis in this Declaration.

20. I understand that the words of the claims should be interpreted as they would have been understood by a POSITA at the time the alleged invention was made (not today).

B. Anticipation

21. I understand that if each and every element of a claim is disclosed in a single prior art reference, then the claimed invention is anticipated and not patentable under pre-AIA 35 U.S.C. § 102. In order for the invention to be anticipated, each element of the claimed invention must be described or embodied, either expressly or inherently, in a single prior art reference. I also understand that a reference inherently discloses a claim element when that claim element is necessarily present in the reference.

C. Obviousness

22. I have been informed that a patent claim is invalid as “obvious” under pre-AIA 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (1) the scope and content of the prior

art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so-called “secondary considerations” of non-obviousness, which include: (i) “long felt need” for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) “copying” of the claimed invention by others.

23. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

D. Means-Plus-Function Limitation

24. I have been informed that an element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, but that such claims must be

narrowly construed so as to restrict the scope of coverage to only the structure, materials, or acts described in the specification as corresponding to the claimed function and equivalents thereof.

V. TECHNOLOGY BACKGROUND

25. This section provides an overview of some of the basic technology underlying the '520 patent.

A. HDMI (High-Definition Multimedia Interface)

26. HDMI is highly popular worldwide standard for transmitting digital video and digital audio to devices such as a digital television or a computer monitor with built-in speakers. HDMI is also popular for transmitting digital audio to a device such as an amplifier or receiver for a home audio system. Video is transmitted in uncompressed form, and audio is transmitted in compressed or uncompressed form.

The official logo for HDMI is shown here:



HDMI cabling with Type A cable connectors are the most popular. They are shown here, with a male plug (left) and a female receptacle (right):



27. Sources for digital video and audio that typically use HDMI cabling include a DVD or Blu-ray disc player while playing a disc, and devices that support internet streaming including an Apple TV box, a Roku TV box or stick, or an Amazon Fire TV stick. Sources for audio playback that typically use HDMI cabling include a DVD or Blu-ray disc player while playing a CD.

1. HDMI Specifications

28. The first HDMI specification is dated December 9, 2002. It was developed by the seven companies that made up the original HDMI Technical Working Group (TWG), which consisted of four Japanese companies (Hitachi, Ltd., Matsushita Electric Industrial Co., Ltd. (Panasonic), Sony Corp., and Toshiba Corp.) along with Thomson, Inc., Philips Consumer Electronics, International B.V., and Silicon Image, Inc.

29. The High-Definition Multimedia Interface Specification Version 1.3 (“HDMI 1.3”) is dated June 22, 2006. It introduced a number of new capabilities and features, including increasing the single link bandwidth to 340 MHz and providing a data rate of 10.2 Gbps. It also introduced the Type B Extended Pin HDMI connector,

and the Type C miniature connector for use in particular with mobile and portable devices.

30. Although not relevant to this discussion, the newest HDMI specification is Version 2.1b which was released on August 10, 2023. It supports a range of higher video resolutions and refresh rates using the Ultra High Speed HDMI Cable. HDMI specifications are currently developed by the HDMI Forum's TWG. To date, approximately 12 billion devices which include support for HDMI have been shipped worldwide.

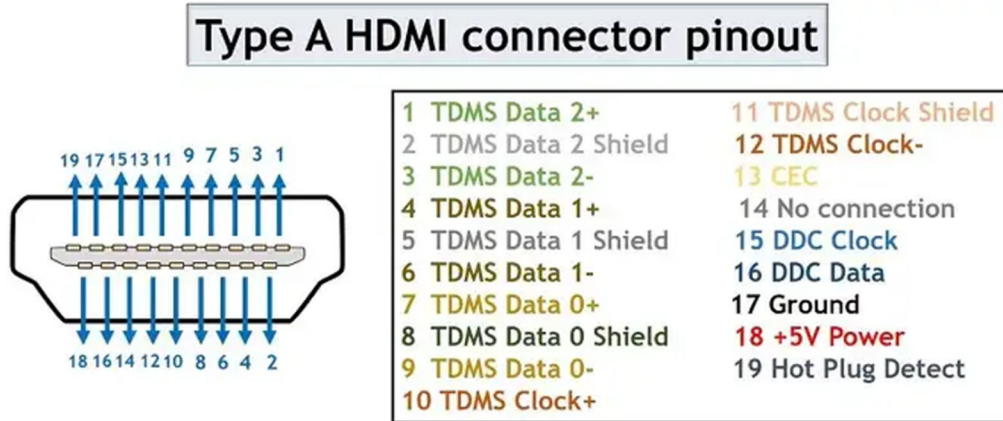
2. HDMI Connectors

31. HDMI 1.3 describes connectors which are able to accommodate different device types and applications.

a) Type A HDMI Connector

32. The most popular and most recognized HDMI connector is the Type A connector, also known as the "Standard" connector. This is used on most TVs, audio receivers, and DVD and Blu-ray Disc players. A Type A plug on the end of an HDMI cable mates with a Type A receptacle on an HDMI device.

33. Shown here is a diagram of the two rows of the pinout for the 19 conductors on a cable with a Type A connector, as well as the pinout assignments:



b) Type C HDMI Connector

34. Based on both the desire and need to easily enable HDMI for portable and mobile devices such as tablets, camcorders, and DSLR cameras, HDMI 1.3 added the Type C connector¹, also called the “Mini-Connector,” the “mini-HDMI” connector, and the “HDMI-mini” connector. Like the Type A connector, the Type C connector has 19 conductors. Also like for a Type A cable, a Type C plug mates with a Type C receptacle on an HDMI device.’

35. The layout and the assignment of the 19 pins s of a Type C plug and receptacle are different from those for Type A, with all 19 pins in a Type C connector in a single row as shown here:

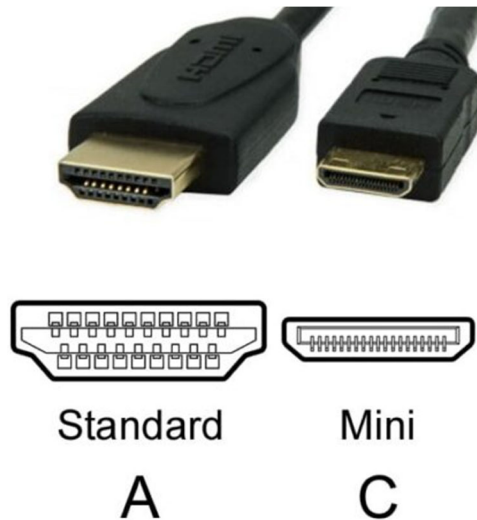
Type C HDMI connector

¹ See the Document Revision History for HDMI 1.3 at iii.



c) Comparison of Type A and Type C Connectors

36. The Type A and Type C plug connectors and their pin arrangements are shown side-by-side here:

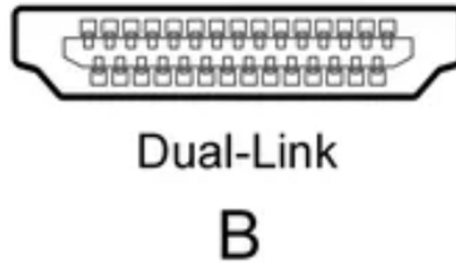


37. As Type A and Type C connectors each carry the same 19 electrical signals, cables using either connector are functionally equivalent. Cables with Type A on one end and Type C on the other end are often used to connect a portable or mobile device to an existing HDMI environment.

d) Type B HDMI Connector

38. HDMI 1.3 also added Type B HDMI connector, which is also called “Extended Pin HDMI” and “Dual-Link B.” Unlike the 19 pins used by Type A and

Type C, Type B uses 29 pins for video and audio signals. Type B provides a connection to three more line pairs (data channels) for enabling very high bandwidth video. Like for Type A and Type C cables, a Type B plug is able to mate with a Type B receptacle on an HDMI device. The Type B pin arrangement is shown here:



e) Other HDMI Connectors

39. The Type D (aka “Micro D”) and Type E (aka “Automotive Connection System”) connectors are disclosed in later HDMI specifications as produced by the HDMI Forum’s Technical Working Group (TWG), and they are not relevant here.

3. CEC (Consumer Electronics Control)

40. HDMI 1.3 includes a 68-page Supplement 1 titled “Consumer Electronics Control (CEC)” (“CEC 1.3”) which states the following at CEC 1.3, CEC-1: “CEC is a protocol that provides high-level control functions between all of the various audiovisual products in a user’s environment.”

41. CEC control functions are specified by way of an “Opcode” parameter contained within a message transmitted on the CEC signal line. The “CEC 15: Message Descriptions” section of CEC 1.3, CEC-37 to -49 defines the format of the various messages that can be sent, which include command transmission (*e.g.*, “Play”

as in play a DVD disc), and status request (e.g., “Record Status” for a device’s recording status, and “Give Tuner Device Status”).

42. A generic depiction of the CEC bus interconnecting devices in an HDMI cluster is Figure 8-1 on HDMI 1.3, 123:

The CEC and DDC connections are shown in Figure 8-1.

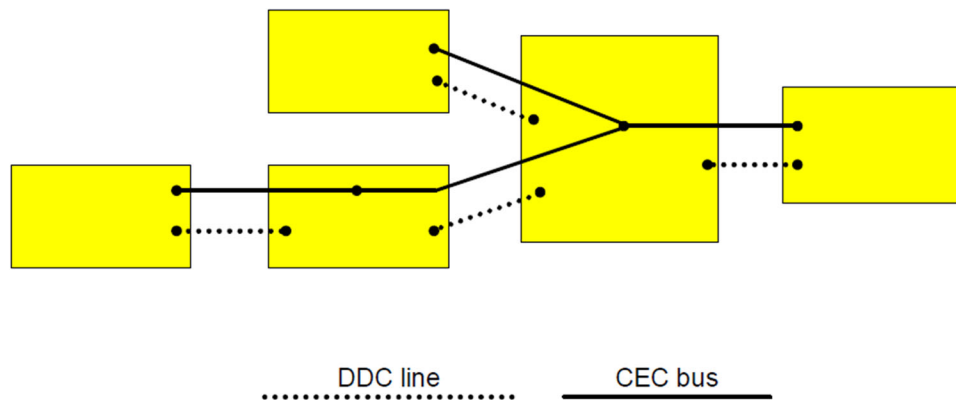


Figure 8-1 CEC and DDC line connections

43. Figure 3-1 at HDMI 1.3, 8 shows the CEC bus (here called “CEC Line”) interconnecting an HDMI Source with an HDMI Sink:

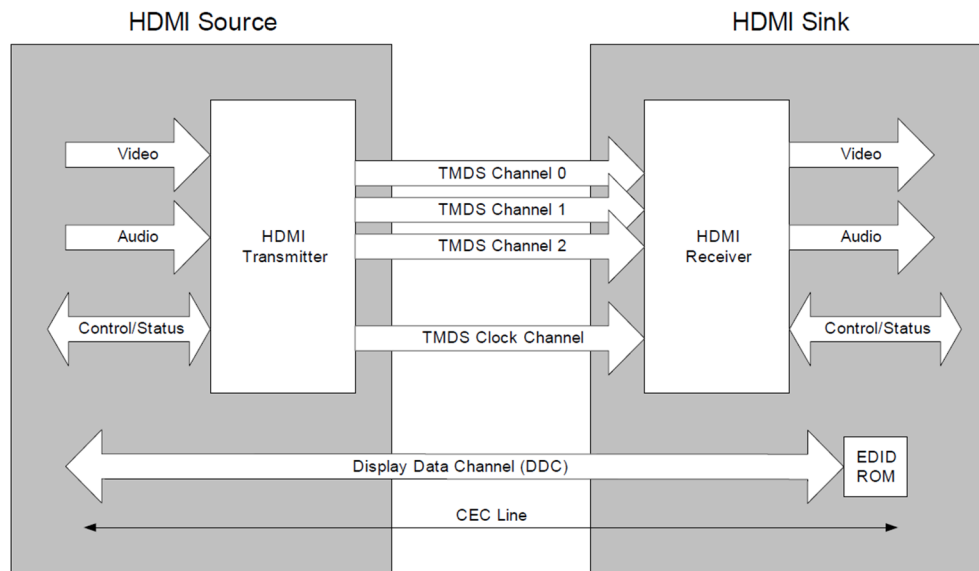


Figure 3-1 HDMI Block Diagram

a) CEC is Optional and Includes Special Features

44. CEC is optional² since HDMI devices are able to operate on their own when controlled, for example, from their own front panel buttons. However, CEC facilitates more sophisticated control of HDMI-connected devices by allowing them to communicate with each other, and to thereby enable a single remote control device to command and control the devices connected in a cluster. Examples of devices able to be controlled using a remote control include a Blu-ray disc player and a digital video recorder device.

45. CEC uses a single-wire bidirectional serial bus based on the CENELEC AV.link protocol, and it supports a number of special features including (1) Remote Control Passthrough, (2) System Audio Control, (3) One Touch Play, and (4) Deck Control.

46. Both the '520 patent ('520 patent at 3:15-16) and Yung (Yung at [0004] and [0027]) note that CEC is an optional protocol.

b) CEC Allows Vendor-Specific High-Level Commands

47. In addition, CEC allows vendor-specific commands (aka “messages” or “high level commands”) to be defined and used between devices manufactured by that vendor as shown in the Vendor Specific Commands Section 13.8 and CEC Table 13 of CEC 1.3. These are in addition to the standard messages defined in CEC 1.3.

² See HDMI 1.3, 8, 112, and 123; CEC 1.3, CEC-2.

c) CEC's Cabling

48. CEC's proper functionality requires only Standard HDMI cabling. This is compared with High Speed HDMI which requires Category 2 cabling as discussed in HDMI 1.3.

49. This leniency for CEC cabling is not surprising in consideration of the fact that CEC has a very slow average transfer rate of 417 bits/second (bps), as each CEC data bit is on the CEC bus for approximately 2.4 milliseconds.

50. Premium High Speed HDMI and Ultra High Speed HDMI cabling are discussed in later HDMI specs and so are not relevant here.

B. DVI (Digital Visual Interactive)

51. DVI is a digital video display interface that was originated in 1999 by the Digital Display Working Group (DDWG) for connecting a video source (such as a computer) to a display device (such as a monitor). The official logo for DVI is shown here:



52. DVI was developed with the intention of creating an industry standard for the transfer of uncompressed digital video content, although DVI devices

manufactured as DVI-I do support analog data. CEA-861³ signals carried by HDMI are electrically compatible with the CEA-861 signals used by DVI. There is no loss of video quality when a DVI-to-HDMI adapter is used. DVI connectors have generally not been included on electronics equipment for a number of years.

C. 8b/10b Encoding

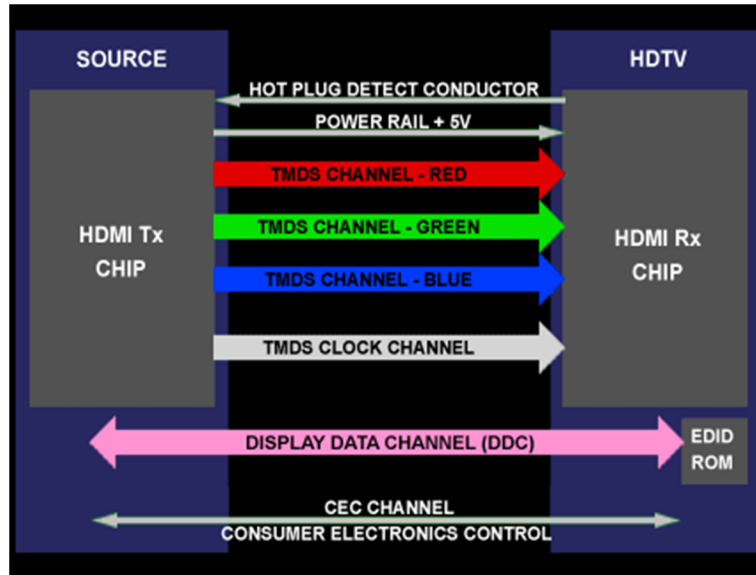
53. 8b/10b encoding is an algorithm for encoding data for transmission in which each 8-bit data byte is converted to a 10-bit transmission character (aka, a symbol). Widely used in telecommunications, this scheme supports continuous transmission with a nearly-balanced number of ones and zeros in the code stream, and it enables single-bit transmission error detection.

D. TMDS (Transmission-Minimized Differential Signaling)

54. TMDS is a high-speed serial link used by both HDMI and DVI. It incorporates a coding scheme to reduce electromagnetic interference over longer cables, and is an improvement over 8b/10b encoding and earlier differential signaling schemes. Its transition-minimized content is transmitted as two complementary signals in a differential mode over a shielded twisted pair (STP) of wires. The information (signal) being transmitted is found in the electronic difference between the

³ The Consumer Electronics Association (CEA) standardized the CEA-861 signal to establish protocols, requirements, and recommendations for using uncompressed digital interfaces in consumer electronics devices such as digital televisions (DTVs), digital cable boxes, satellite or terrestrial set-top boxes (STBs), and DVD players and recorders.

two wires. TMDS enables a “balanced” system by minimizing induced outside noise and improving resistance to electromagnetic interference.



55. TMDS interleaves video, audio, and auxiliary data. During the video data period, the pixels of an active video line are transmitted, as shown in the graphic above. Audio and auxiliary data are transmitted within a series of packets during the horizontal and vertical blanking intervals. The control period occurs between video and data island periods.

1. TMDS Character

56. A TMDS Character is a 10-bit symbol, which is the TMDS-encoding of an 8-bit word. One bit of each of three characters is carried on each of the three HDMI data channels simultaneously. The three characters are transmitted over the course of 10 TMDS clock cycles.

2. Transmitter

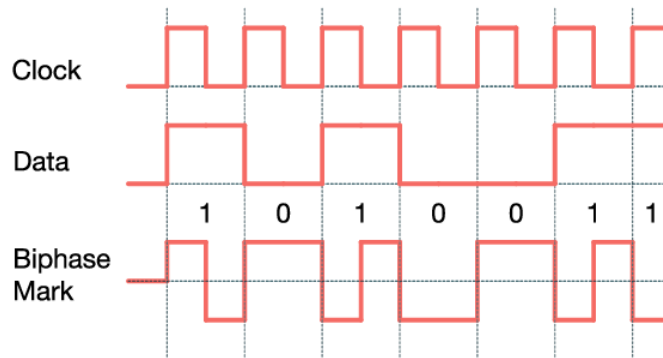
57. A Transmitter is an HDMI Source component responsible for driving the four differential TMDS output pairs into an HDMI output, and for clocking the data driven into those four output pairs. Examples of an HDMI Source incorporating a Transmitter is a television set-top box and a DVD player.

3. Receiver

58. A Receiver is an HDMI Sink component responsible for receiving the four differential TMDS input pairs at the input to the Sink, which converts those signals into a digital output, and which indicates it to be a 24-bit, 12-bit, or 6-bit TMDS-decoded word while also indicating the TMDS coding mode used to decode those bits. This digital output may be contained within a semiconductor device, or it may be output from a semiconductor device.

E. Bi-Phase Mark Signaling

59. Bi-Phase Mark signaling is a data encoding/decoding scheme that is widely used in telecommunications, data storage, and other fields. Sometimes called “Manchester Bi-Phase Mark signaling” and “Differential Manchester signaling,” it enables a “balanced” system like what was described above for TMDS.



60. As shown above, a Bi-Phase Mark encoded 1 is represented by a mid-bit level change, and a 0 is represented by no mid-bit level change. This scheme is self-clocking since clocking is embedded in the bit stream itself. As such, synchronization is ensured since within each bit period there is always at least one transition between high and low, but never more than two such transitions.

F. I²C (Inter-Integrated Circuit) Bus

61. I²C is a simple but flexible 1-bit wide single-ended serial communication bus first introduced in 1982 by Philips Semiconductors. Included amongst its applications is its basis for the Display Data Channel (DDC) interface.

62. The I²C bus includes a bi-directional Serial Data line (SDA), which is its one bit-wide data line. The I²C bus also includes a Serial Clock line (SCL). Communication on the I²C bus is only practical over a few meters.

G. DDC (Display Data Channel)

63. DDC is a simple communication channel based on the I²C spec that enables a display to communicate its supported display modes to a graphics adapter,

and to enable a host to adjust parameters such as brightness and contrast. The Video Electronics Standards Association (VESA) created the DDC standard as a collection of protocols to provide Plug and Play (PnP) and Display Power Management Signaling (DPMS) capabilities for computer displays.

64. HDMI includes the I²C SDA data line for transmitting a DDC data bit, the I²C SCL clock line to clock the data, and a ground line. A generic depiction of the DDC line interconnecting devices in an HDMI cluster is Figure 8-1 on p. 123 of HDMI 1.3:

The CEC and DDC connections are shown in Figure 8-1.

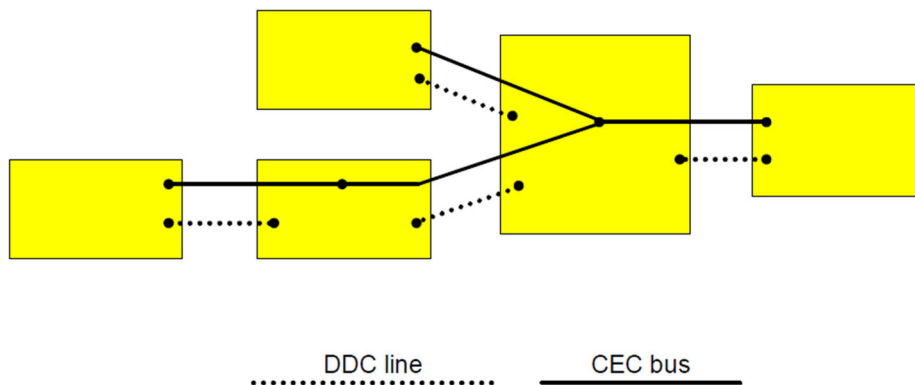


Figure 8-1 CEC and DDC line connections

H. USB (Universal Serial Bus)

65. USB is an extremely popular industry standard computer interface bus. It has achieved much of its success by simplifying the use of external computer peripherals.

1. USB Hot-Swapping & Plug and Play (PnP)

66. A key architectural feature of USB is its ability to allow the addition and removal of peripherals while a computer is operating – a process often called “hot-swapping” which was not possible in a reliable fashion prior to USB’s introduction in 1996. Hot-swapping requires a computer to support a functionality called “plug and play” (PnP) in which there is no need to add any hardware other than the USB peripheral itself, and the computer’s operating system (OS) becomes configured with a software driver for the new hardware with little or no user intervention.

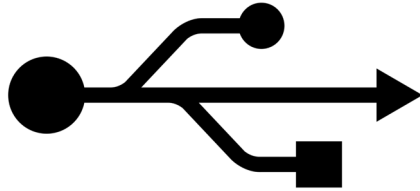
2. USB Implementers Forum (USB-IF)

67. The USB-IF is a non-profit entity formed in 1995 with the intent of creating and promoting USB as an industry standard.⁴ With the goal of accelerating market and consumer adoption of USB-compliant peripherals, the USB-IF was founded by a group of seven industry-leading computer hardware and software companies: Compaq Computer Corp., Digital Equipment Corp. (DEC), IBM PC Company, Intel, Microsoft, NEC, and Northern Telecom.

68. The USB-IF quickly grew “to 160 companies in the first month or so, and hundreds more were added over the next few months ... [and t]he USB-IF ma[de] its specifications and adopters agreements available for free download by anyone

⁴ See <https://www.usb.org/about>

worldwide.”⁵ Besides the USB standards specifications, the USB-IF also publishes white papers and reports, and provides support for USB compliance testing.



69. Shown above is the “USB trident” logo that is found on USB-compliant devices, as promoted by the USB-IF for products qualified to bear the logo if they have passed USB-IF Compliance Testing.

3. USB Standards

70. The January 1996 release of the USB 1.0 Specification enabled the electronics industry to begin to design and ship USB products. The USB 1.1 Specification, released in September 1998, advanced the USB standard with a number of enhancements to expand the scope of possible USB hardware, and thereby expanded its market presence.

71. When the USB 2.0 Specification (“USB 2.0”; Ex.1011) was released in April 2000, it added the 480 Mbit/sec High Speed mode to USB’s PnP architecture. Together these quickly led to widespread support from computer and peripheral

⁵ See “How USB Became the Most Successful Interface in Computing History” at 6, from <https://www.intel.com/content/www/us/en/standards/usb-two-decades-of-plug-and-play-article.html>

vendors, and USB's huge success made it the most popular computer interface the world had ever seen.

4. USB Connectors, Cables, Wires, and Ports

72. USB 2.0⁶ describes an architecture in which a USB host is connected to one or more USB devices through USB connectors and USB cables. USB 2.0⁷ discloses that the USB cable has four wires that carry each of the four signals: voltage on the V_{BUS} supply voltage line, a GND ground line, and the D+ and D- data lines which carry complementary signals in a differential pair. Transmitted data is interpreted at the receiving end by determining the voltage difference between the two signals – the basic differential signaling data interpretation scheme.

73. A USB connector has four pins that each connect to the corresponding line in a USB cable.

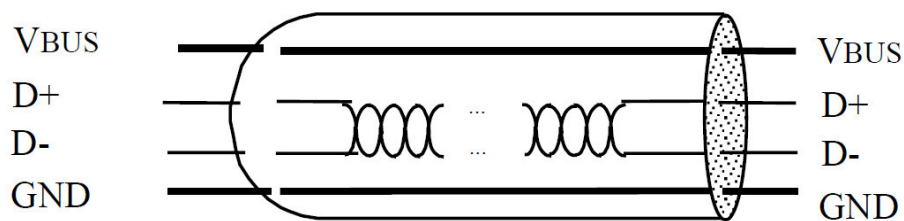


Figure 4-2. USB Cable

A USB cable's four wires are shown above in Fig. 4-2 from USB 2.0⁸.

⁶ See USB 2.0 at 15-18.

⁷ See USB 2.0 at 17-18 and 85-92.

⁸ See USB 2.0 at 17.

74. A USB port is a physical point of access, *i.e.*, “the point where a USB device is attached” as shown at USB 2.0⁹. A USB cable plugs into a USB port.

5. USB’s Device Type Flexibility

75. By its very design, USB has been able to accommodate many different types of devices, and this has been an important aspect of its broad success. USB device types that have been popular include keyboard, mouse, and Mass Storage Class (MSC) devices. Examples of MSC devices are the USB flash drive (UFD, aka “thumb drive”), floppy disk drive, and hard disk drive, which are used to store software, photographs, and many other kinds of data files. As such, it is possible to use USB to support new types of devices as long as software exists to perform the necessary operations with the device.

6. USB Physical and Logical Devices

76. Fig. 5-2 in USB 2.0 at 26 is a high-level view of the possible interactions between a host computer and a USB physical device, and how a USB physical device consists of multiple software entities including at least one USB logical device¹⁰:

⁹ See USB 2.0 at 8.

¹⁰ The USB Logical Device shown here is representative of one or more logical devices, each serving some functionality distinct from the others in some fashion.

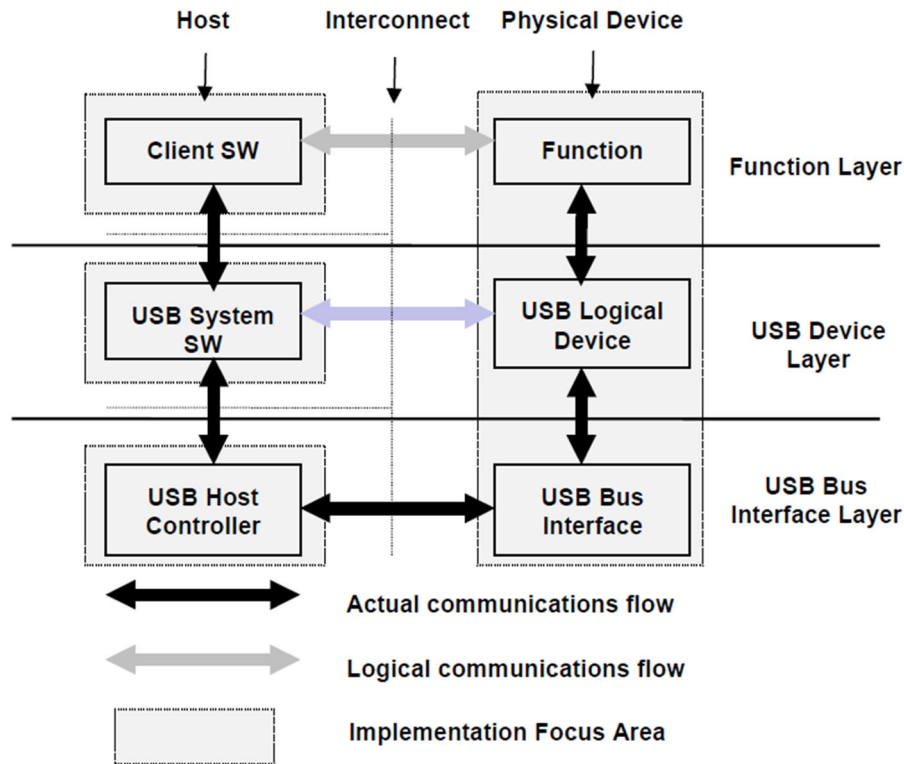
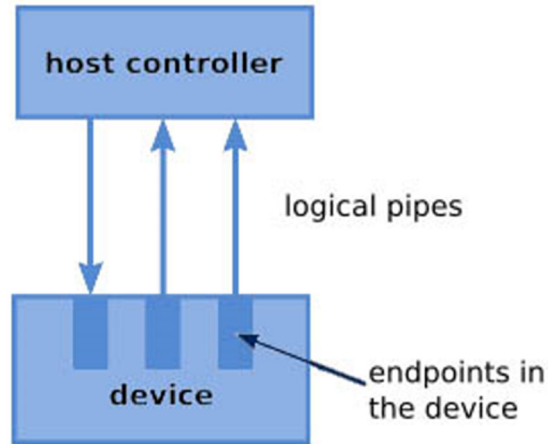


Figure 5-2. USB Implementation Areas

77. “The USB Device and Function layers each have a view of logical communication within their layer that actually uses the USB Bus Interface layer to accomplish data transfer.” USB 2.0 at 26.

7. USB Communication Flow Through “Pipes”

78. USB uses “pipes” for communication of both commands and data between a host computer and a USB device. The following diagram shows these pipes, which are simply logical constructs to distinguish the various pipes that are part of this process:



79. The endpoints in the above are also logical constructs that support this flow of commands and data. The following figure from USB 2.0 at 33 provides a more detailed depiction of how pipes are used:

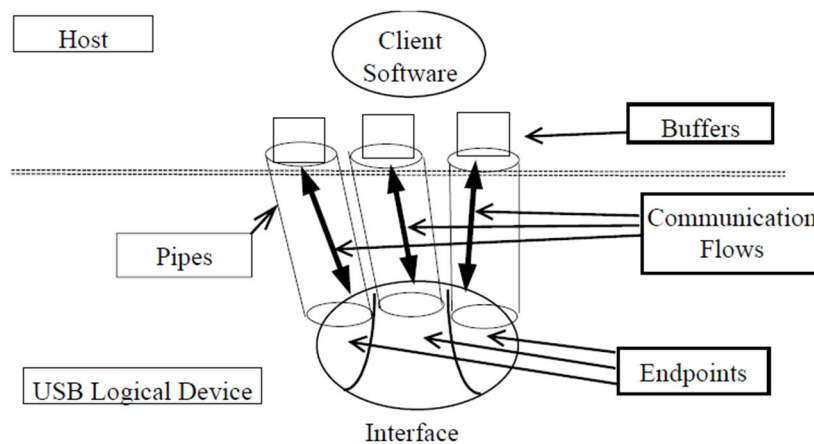
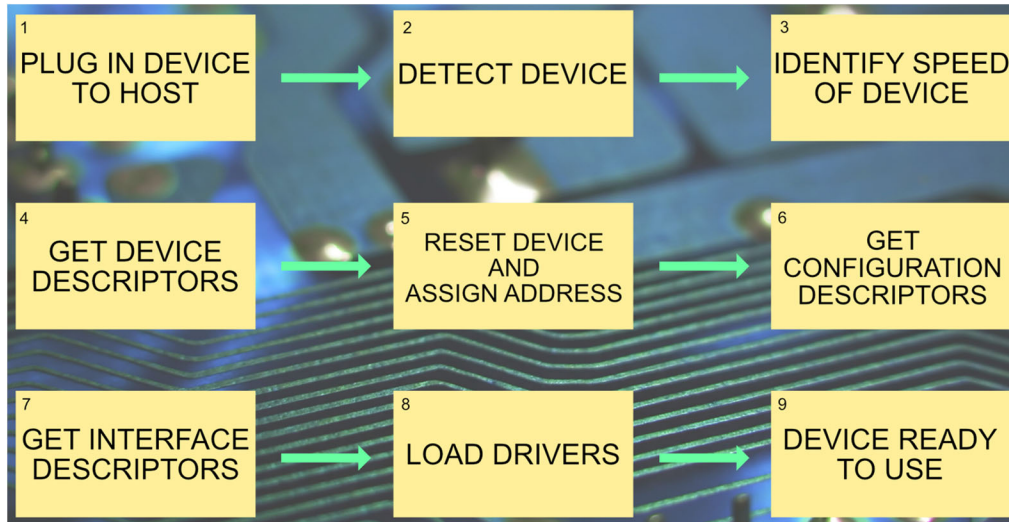


Figure 5-10. USB Communication Flow

8. USB Enumeration

80. “The Default Control Pipe is used by the USB System Software to determine device identification and configuration requirements and to configure the device. The Default Control Pipe can also be used by device-specific software after the device is configured.” USB 2.0 at 34.

81. The configuration process of a USB logical device is called enumeration, and the steps in this process which use the Default Control Pipe are shown here:



82. An example of a Device Descriptor¹¹ as retrieved in Step 4 above is the following:

Device Descriptor		Radix: auto
bLength	18 (0x12)	
bDescriptorType	DEVICE (0x01)	
bcdUSB	2.0 (0x0200)	
bDeviceClass	Defined in Interface (0x00)	
bDeviceSubClass	0x00	
bDeviceProtocol	0x00	
bMaxPacketSize0	8 (0x08)	
idVendor	1121 (0x0461)	
idProduct	19733 (0x4d15)	
bcdDevice	2.0 (0x0200)	
iManufacturer	(0x00)	
iProduct	USB Optical Mouse (0x02)	
iSerialNumber	(0x00)	
bNumConfigurations	1 (0x01)	

¹¹ The structure of a Device Descriptor is detailed in § 9.6.1 in USB 2.0 at 261-263.

9. USB's PID and VID Identifiers

83. Based on the lengthy “List of USB ID's”¹² maintained by the Linux community for USB products worldwide, this Device Descriptor was captured from what is shown as a Dell Optical Mouse (idProduct: 0x4d15) as produced by Primax Electronics, Ltd (idVendor: 0x0461). These two parameters are also known as the USB Product ID (PID) and USB Vendor ID (VID), respectively. The USB-IF assigns VIDs to companies so that this parameter is guaranteed to uniquely identify the vendor of a USB device. Companies can then assign PIDs on their own, choosing from amongst the 65,536 possible values for a PID.

84. As such, USB is very flexible regarding adding supports for new types of devices, including defining special commands to support any new capabilities that a new type of device is able to support. The means by which this support can be provided includes having the USB-IF assign a VID to the company or entity that would create and market the device if it does not already have a VID. In addition, the new device could have a new PID assigned to indicate its inclusion of the new functionality.

10. The USB Driver Interface (USB DI)

85. “The USB DI mechanism is used by a client to send one or more vendor-specific commands to a device.”¹³ Defining vendor-specific commands allows any

¹² See <http://www.linux-usb.org/usb.ids>

¹³ See USB 2.0 at 291 in § 10.5.2.9 Sending Vendor Commands

USB device to have new capabilities as determined by its market and the needs of its end-users.

11. Universal Serial Bus On-The-Go (USB-OTG)

86. The USB-IF expanded the scope of USB 2.0 in 2001 with its introduction of USB On-The-Go, aka USB-OTG. Prior to USB-OTG, USB 2.0 operation incorporated a host computer operating as a “host” to one or more devices, with each device operating in response to commands coming from the host. USB-OTG expanded this by enabling a USB product to operate as either a host or a device. Products able to operate in either manner are called an “OTG device.”

a) USB-OTG Operation

87. Examples of an OTG device include some smartphones, which by default usually operate as a device so that their data can be accessed by a computer. However, by using a special cable, an OTG-capable smartphone can operate, for example, as a host to a storage device such as a USB thumb drive.

88. In this scenario, the smartphone would be connected to the “A” end of this special cable (the “A-device”) so that it can operate as a host. The thumb drive connected to the “B” end of this cable (the “B-device”) acts as normal device. This setup thereby enables the smartphone to perform I/O operations with the thumb drive.

b) USB-OTG Spec

89. The USB-IF released *USB On-The-Go Supplement to the USB 2.0 Specification* (“USB-OTG Spec”) to describe USB-OTG functionalities and requirements. Revision 1.3 of the USB-OTG Spec¹⁴ is dated December 5, 2006.



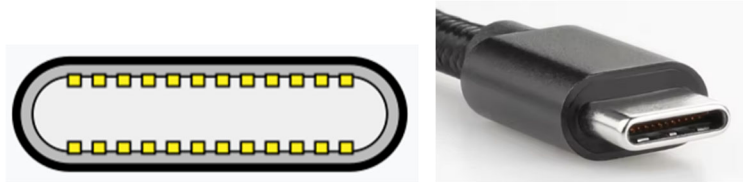
90. USB peripherals certified by the USB-IF as being compliant with the USB-OTG Spec are sold in packaging bearing the above label (“USB-OTG Label”) which includes the USB Trademark. In addition, USB-OTG Spec at 4 states, “Any device with OTG features is first and foremost a USB peripheral that is compliant with the USB 2.0 specification.”

12. USB 3.0 and Beyond

91. USB’s success continued with the release of USB 3.0 in November 2008 featuring SuperSpeed (“SS”) at 5 Gbits/sec, USB 3.1 Gen 2 in July 2013 featuring SuperSpeed+ at 10 Gbits/sec, and USB 3.2 in September 2017 with two-lane operation at 20 Gbits/sec.

¹⁴ This document is archived at https://web.archive.org/web/20070722212953/http://www.usb.org/developers/docs/USB_OTG_1-3.pdf

92. The USB Type-C connector was introduced in August 2014. More popularly known as USB-C, its connector has 12 conductors on each of the two sides of its connector, for a total of 24:



93. As the USB-C connector is reversible, its orientation when inserted does not matter. USB-C cabling has become popular for protocols besides USB such as HDMI and DisplayPort. Its cabling is able to carry audio and video in addition to computer data, as well as performing PD (power delivery) for use by devices such as a cell phone or a computer.

94. The USB-IF first introduced USB4 in August 2019 with a transfer rate of 20 GBits/sec, backward compatibility to USB 2.0 and USB 3.2 protocols, a requirement for use of USB-C cabling, the ability to carry DisplayPort (DP) audio and video signals, and support of alternate mode (Alt Mode). DP Alt Mode is the most widely implemented alternate mode, and it is used to provide video and audio in environments that lack HDMI or DP connectors.

VI. OVERVIEW OF THE '520 PATENT

A. Summary

95. The '520 patent relates to “a method and apparatus for a control bus for connection of electronic devices.” Ex. 1001, Abstract. In the '520 patent, a

transmitting device converts control signals to data packets and transmits them to a receiving device through a bi-directional, single-line control bus. *Id.*, Abstract, 1:57-67. Furthermore, the bi-directional bus can use “bi-phase mark encoding” – in which “each bit of data is presented by two logical states” – to transmit data bits. *Id.*, 3:23-26. The ’520 patent also discloses a modified protocol that “allows dual-mode operation in which a device may be connected to a personal computer or to another portable device.” *Id.*, 2:65-67.

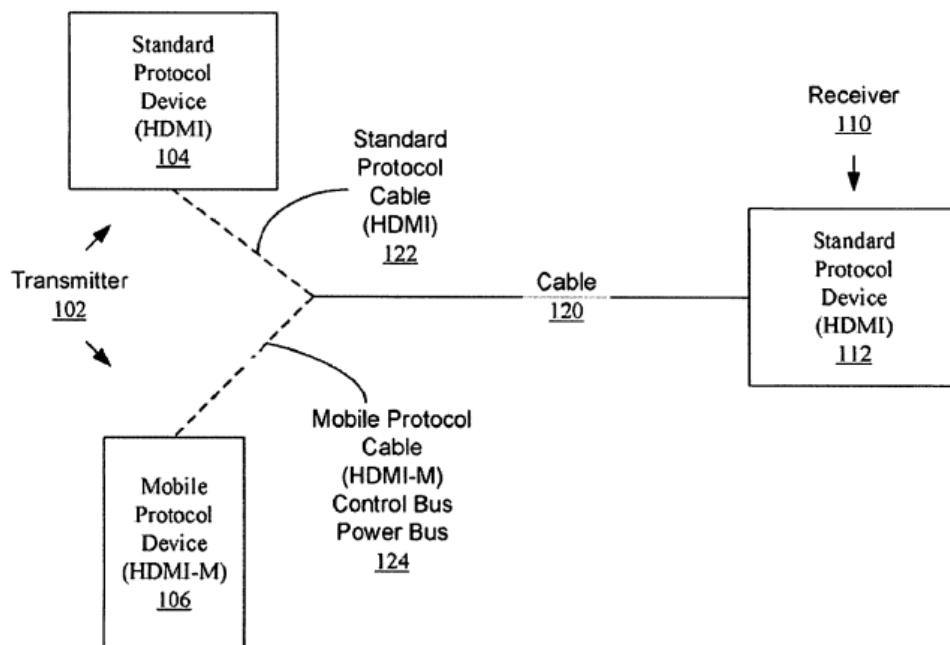


Fig. 1

’520 patent, Fig. 1.

96. The '520 patent also describes an arbitration process in which either the transmitter or the receiver is given control over the control bus as “an initiator,” while the other becomes “a follower,” to enable collision-free transmission over the control bus. *Id.*, Abstract. In this process, “there is [a] determination of the status of the control bus 304. If it is determined that the CBUS is idle (having been unused for a certain number of cycles) or has been unused by the other device for a certain number of cycles (indicating that it is the device's turn to utilize the control bus) 306, then the use of the bus may be arbitrated 310. Otherwise, the device may determine that the control bus is in use by the other device 308.” *Id.*, 7:48-67.

97. Regarding the cycles, the '520 patent explains that “because the duty cycle on a control bus (which may be engaged in bi-phase mark encoding) may tend to be skewed away from 50%, the follower [the device that receives data packets from an initiator] may maintain separate calibrations for the high time and low time of the sync pulse.” *Id.*, 6:16-20.

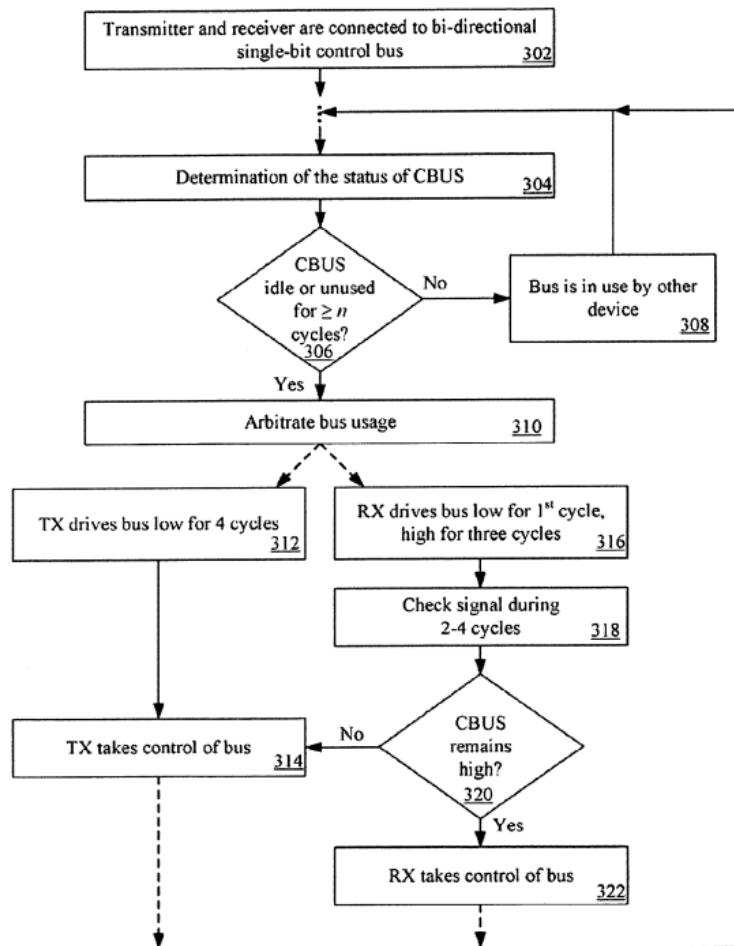


Fig. 3

Id., Fig. 3.

B. Prosecution History

98. I have reviewed the prosecution history of Application No. 11/969,852 that led to the '520 patent.

99. The application leading to the '520 patent was filed on January 4, 2008. Ex.1002, 1. The initial claims of U.S. Application No. 11/969,852 were rejected on September 25, 2009 under 35 U.S.C. 102(b) as anticipated by the prior art of Maxim

Application Note 244 “Advanced 1-Wire Network Driver.” *Id.*, 132. To overcome the rejection, the applicant narrowed the independent claims on December 29, 2009 by incorporating a standard protocol and a detailed arbitration process. *Id.*, 164-170. The Examiner allowed these amended claims on April 8, 2010. *Id.*, 311. The ’520 patent issued on December 21, 2010. Ex.1001, cover.

C. Level of Ordinary Skill in the Art

100. In rendering the opinions set forth in this Declaration, I was asked to consider the patent claims and the prior art through the eyes of a POSITA. The “art” is the field of technology to which a patent is related. I understand that the purpose of using the viewpoint of a POSITA is for objectivity.

101. I considered factors such as the educational level and years of experience of those working in the pertinent art, the types of problems encountered in the art, the teachings of the prior art, patents and publications of other persons or companies, and the sophistication of the technology. I understand that a POSITA is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors discussed above.

102. Taking these factors into consideration, it is my opinion that a POSITA as of the time of the alleged invention of the ’520 patent would have had a bachelor’s degree or equivalent academic or professional training in computer engineering, electrical engineering, computer science, or a closely related field, and approximately

three years of experience with consumer electronics device control interfaces and/or buses. I consider myself to be a person of at least ordinary skill in this art.

D. Claim Construction

103. I understand that the words of a claim are generally given their ordinary and customary meaning, which are the meanings that the terms would have to a POSITA in the relevant art at the time of the earliest priority claim. I further understand that the POSITA is deemed to have read the claim terms in the context of the entire patent and the prosecution history.

104. My opinions as set forth herein are based on the claims being given their plain and ordinary meaning. As such, no terms require specific construction.

VII. OVERVIEW OF THE PRIOR ART

A. Yung (Ex-1005)

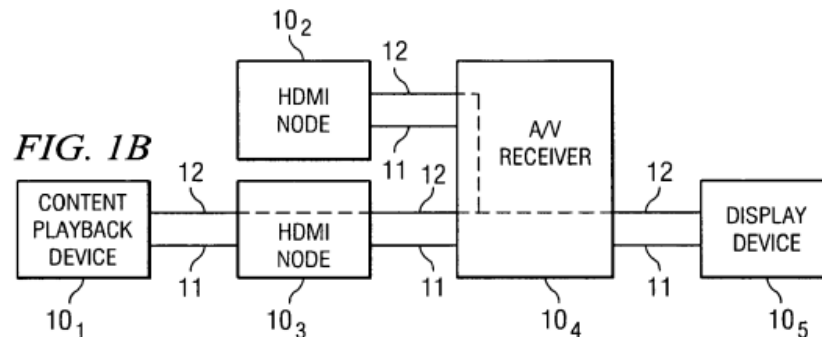
105. US Patent Application No. 2006/0095596 A1 to Lin Che Yung, *et al.* (“Yung”) was filed on November 3, 2004, and was published on May 4, 2006, and as such is prior art under 35 U.S.C. § 102(b).

106. Similar to the '520 patent, Yung relates to a “solution for consumer electronics control.” Yung, Abstract. Yung discloses a system including multiple devices, such as a content playback device, an Audio/Video Receiver, HDMI nodes, and a display device, which are interconnected using HDMI cables that have a consumer electronic control (“CEC”) bus. Yung, ¶¶4, 26-28. Each device includes a command control unit that switches between an initiator mode and follower mode to

avoid collisions during transmission. *Id.*, ¶¶9, 29. Specifically, to avoid collisions during transmission, the command control unit waits a signal free time prior to transmission of signals onto the command bus to confirm whether the command bus is active or inactive. *Id.*, ¶¶36-38. If no interrupt is detected during the signal free time, the command control unit switches to an “initiator” mode. *Id.*

107. Yung also teaches an arbitration process that determines which device takes control of the bus, if more than one device tries to take control of the bus at the same time. *Id.* Furthermore, Yung discloses that commands are transmitted as frames that include header blocks and data blocks for identifying source, destination, and content. *Id.* ¶¶34, 38.

108. Ultimately, Yung’s system uses the command control units to efficiently convert high-level commands to low-level signals and transmit them over HDMI and CEC lines without collisions. *Id.* ¶¶8-10.



Yung, Fig. 1B.

B. HDMI 1.3 (Ex-1006)

109. HDMI Specification Version 1.3 (“HDMI 1.3”), which includes its CEC 1.3 Supplement as part of the same document, was released on June 22, 2006 and is thus prior art under 35 U.S.C. § 102(b). I understand that HDMI 1.3 was widely available to interested members of the public by way of the website at <http://hdmi.org>, when publicly released on June 22, 2006, and that this document included a CEC 1.3 supplement at the end as part of the same document. Ex. 1008, ¶19.

110. HDMI 1.3 covers transmission of audiovisual signals from a variety of devices, such as set-top boxes and DVD players, to displays. HDMI 1.3, 1. HDMI 1.3 explains that HDMI can carry “high quality multi-channel audio data and can carry all standard and high definition consumer electronics video formats.” *Id.* Furthermore, HDMI 1.3 “completely describes the interface such that one could implement a complete transmission and interconnect solution or any portion of the interface. The underlying Transition Minimized Differential Signaling (TMDS)-based protocol and associated electrical signaling is described in detail.” *Id.*

111. CEC 1.3, which is part of HDMI 1.3, describes the CEC protocol, which “provides high-level control functions between all of the various audiovisual products in a user’s environment.” CEC 1.3, CEC-1.

C. Al-Alawi (Ex-1007)

112. Journal Publication *Design of a Multicode Bi-phase Encoder for Data Transmission* by Raida Al-Alawi (“Al-Alawi”) was published in the printed Journal of Circuits Systems and Computers by World Scientific Publishing Co Pte Ltd (based in Singapore) in February 2006, and its public availability has been verified. As such, Al-Alawi is prior art under 35 U.S.C. § 102(b). Ex. 1009.

113. Al-Alawi discloses a communication system that includes a Bi-Phase encoder for data transmission. Al-Alawi, Sec. 1. Al-Alawi’s objective is to “develop a controller in the physical layer that can cope with multiple protocols.” Al-Alawi, Sec. 1. Furthermore, Al-Alawi recognizes that “[s]ource encoding reduces the average number of data bits for a given message to the minimum possible value while channel coding is used for error control,” and uses a “Bi-Phase Mark” method in its encoder to support the intensive demands of using multiple protocols. *Id.*

114. Ultimately, Al-Alawi facilitates the process of altering the data transmission protocol without changing encoder hardware by using multiple lines that are capable of processing different protocols. *Id.*, Abstract.

VIII. SUMMARY OF OPINIONS

115. My opinions as detailed herein are summarized as follows:

- Ground 1: Claims 1, 4, 8-10, 12, 15, 18-19, and 25 of the ’520 patent are rendered obvious under 35 U.S.C. § 103 over Yung in view of HDMI 1.3 (the “Yung/HDMI” Combination)

- Ground 2: Claims 2, 13, and 20 of the '520 patent are rendered obvious under 35 U.S.C. § 103 over Yung in view of HDMI 1.3, and Al-Alawi (the “Yung/HDMI/ Al-Alawi Combination”)

A. Yung and HDMI 1.3 are Analogous to the '520 patent

116. Yung and HDMI 1.3 are analogous to the '520 patent. All the disclosed systems use HDMI for transmission and delivery of audio/video data and the optional CEC protocol for transport of command and control signals.

117. The '520 patent discloses a method and apparatus for a control bus for connection of electronic devices based on both HDMI and CEC (*e.g.*, '520 patent at 3:34-50). “CEC is an optional protocol that provides high-level control functions between all of the various audiovisual products in a user's environment.” *Id.* at 3:15-17.

118. The '520 patent discloses a method and apparatus for a control bus for connection of electronic devices based on both HDMI and other protocols such as USB in a mobile version of HDMI called HDMI-M, and in an “expanded” version of HDMI called “HDMI-E [which] is utilized here to designate a dual-mode device that can be interfaced with a modified protocol mobile device or a standard protocol device.” *Id.* at 2:67-3:2. “[C]ontrol data [is] transported [over] USB.” *Id.* at 9:12-13.

119. Yung discloses an invention “embodied in an HDMI compliant network of audio/visual devices in which the network is also compliant with and employs the

optional CEC protocol of the HDMI standard” (Yung, [0027]) which comprises “firmware/software [and/or] additional hardware” (*id.*, [0029]).

B. Reasons to Combine Prior Art

1. Reasons to Combine Yung and HDMI 1.3

120. For the reasons set forth below, a POSITA would have been motivated to combine the teachings of HDMI 1.3 with those of Yung.

121. In my opinion, Yung discloses that “[u]nder the HDMI standard, there is an optional protocol, the consumer electronic control (CEC) protocol,” and that the “CEC protocol is described in the supplement 1 attached to the HDMI standard.” Yung, ¶¶ 4, 5. Yung teaches that its “invention is embodied in an HDMI compliant network of audio/visual devices in which the network is also compliant with and employs the CEC protocol of the HDMI standard.” Yung, ¶ 26.

122. It is my opinion that while HDMI 1.3 was released after Yung’s filing date, Yung provides an express motivation to a POSITA to combine Yung’s teachings with such future versions of this protocol, including specifically its CEC protocol. Yung, ¶ 26 (“One of ordinary skill in the art will recognize that the teachings of the preferred embodiments can be applied in a variety of different contexts, including future versions of the CEC protocol as well as other protocols currently existing or that may be developed in the future.”).

123. Thus, it is my opinion that a POSITA, starting with Yung's HDMI-based audiovisual system, would have looked to HDMI 1.3 because Yung directly uses the HDMI standard and its CEC supplement, and because it expressly teaches that future versions can be used, to enable transmission of audiovisual signals between interconnected devices. Yung, ¶¶ 4, 5, 26.

124. Accordingly, it is my opinion that the combination of Yung and HDMI 1.3 would require applying only known techniques (as described in the HDMI 1.3 standard) to a known system ready for improvement (Yung's HDMI-based audiovisual systems) to yield predictable results (enabling digital communications between interconnected audiovisual devices).

2. Reasons to Combine Yung, HDMI 1.3, and Al-Alawi

125. A POSITA would have been motivated to combine the teachings of Yung with those of HDMI 1.3 and Al-Alawi for at least the reasons set forth in this section.

126. Al-Alawi is directed to multiple protocols employing line codes for digital communications network architectures for multimedia applications where data, voice, images, and video signals are to be transmitted. Al-Alawi, Sec. 1. As such, it is my opinion that Al-Alawi is in the same field of endeavor as, and reasonably pertinent to, the problems addressed by the '520 patent as well as Yung and HDMI 1.3, which are similarly directed to multi-protocol digital communications for audio-

video applications between interconnected devices. Yung, ¶¶4, 11, 26-28; HDMI 1.3, 1; Ex.1001, 1:7-39, 2:54-3:2; Al-Alawi, Sec. 1.

127. Therefore, it is my opinion that Al-Alawi is analogous art. Further, Al-Alawi discloses that an encoder circuit that uses Bi-Phase Mark modulation for signal transmission. Al-Alawi, Sec. 1. For example, Al-Alawi discloses that its transmission system includes a “Bi-Phase encoder circuit that can handle the change in the baseband encoding scheme,” where the encoder circuit can use a “Bi-Phase Mark” encoding standard. Al-Alawi, Sec. 1, 2.

128. In my opinion, a POSITA starting with Yung and HDMI 1.3’s multi-protocol systems for digital communications would have looked to and would have been motivated to combine Al-Alawi’s Bi- Phase Mark encoding because Al-Alawi discloses a specific encoding method in the form of Bi-Phase Mark encoding that can efficiently “cope with [the demands of] multiple protocols.” *Id.*

129. Further, it is my opinion that Yung’s teaching that “[t]he implementation of logical 0s and logical 1s can be defined by the designers, providing the implementation is recognizable by both initiators and followers” (Yung, ¶38) would have motivated a POSITA to look to known methods of defining logical 0s and 1s, of which bi-phase mark encoding, such as that taught by Al-Alawi, was one such known method.

130. Further, a POSITA would have appreciated that bi-phase mark encoding would have provided the benefits of robust clock recovery from a guaranteed transition occurring at least once every bit, and less errors being likely in noisy environments due to transition detection being less error-prone than comparing signal levels against a threshold.¹⁵

131. Accordingly, it is my opinion that the combination of Yung and HDMI 1.3 with Al-Alawi would have required applying only known techniques (Bi-phase Mark encoding) to a known system ready for improvement (Yung's and HDMI 1.3's encoder circuits in multi-protocol systems) to yield predictable results (coping with the intensive demands of multi-protocol systems, enhanced clock recovery, and less errors).

IX. CLAIMS ANALYSIS

A. Ground I: Claims 1, 4, 8-10, 12, 15, 18-19, and 25 Are Obvious Under 35 U.S.C. § 103 over Yung in View of HDMI 1.3

1. Claim 1

a) [1(pre)] A method comprising:

132. I have been informed that the preamble to a claim may or may not be viewed to be a limitation (or element) to the claim. It is my opinion that, to the extent the preamble is limiting, Yung discloses and/or renders obvious this element.

¹⁵ For Differential Manchester encoding (aka biphasic mark code), see https://en.wikipedia.org/wiki/Differential_Manchester_encoding (last visited September 25, 2024).

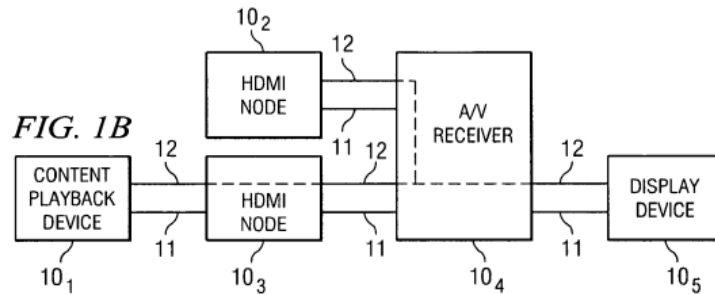
133. Yung discloses “a method and a device for a host control unit [of a device] to communicate over a protocol compliant bus via the introduction of an auxiliary control unit that handles communications to and from the protocol compliant bus.” Yung, ¶7. Thus, it is my opinion that Yung discloses a method by which interconnected devices transmit and receive audiovisual signals over a command bus.

- b) **[1(a)] coupling a first device to a second device, the first device being one of a transmitting device or a receiving device and the second device being the other of a transmitting device or a receiving device, coupling of the first and second devices including connecting a first control bus between the first device and the second device, the first control bus being a bi-directional, single-line bus;**

134. It is my opinion that Yung discloses and/or renders obvious this element.

135. In my opinion, Yung discloses “*a first device*” in the form of a “content playback device 10₁” and “*a second device*” in the form of a “display device 10₅” in Fig. 1B. Yung, ¶27. It is my opinion that as shown in Fig. 1B, these two devices are coupled via lines 11 and 12 (“*coupling a first device to a second device*”).¹⁶ *Id.*, ¶28.

¹⁶ Petitioners note that the '520 patent states it uses the term “couple” to encompass elements that are either “directly coupled” or “indirectly coupled” through other elements. Ex.1001 at 10:40-42 (“If it is said that an element “A” is coupled to or with element “B,” element A may be directly coupled to element B or be indirectly coupled through, for example, element C.”).



Yung, Fig. 1B.

136. Yung explains that “with reference to FIG. 1B, pressing a ‘play’ button of a DVD player **10₁** **generates a high-level command**. It is preferred that the high-level command be **transmitted to a display device, in this case a TV 10₅** connected to the DVD player.” Yung, ¶28. It is my opinion that a POSITA would have thus understood that the transmitting content playback device 10₁ transmits signals (“*the first device being one of a transmitting device*”) to the receiving display device 10₅ (“*the second device being the other of a transmitting device or a receiving device.*”) in Fig. 1B.

137. Yung further discloses an “HDMI cable that includes an additional **CEC bus [that] interconnects the display device, the content play back device** and other CEC compliant devices.” Yung, ¶11. Referring to Fig. 1B, Yung explains that “the devices 10 are compliant with both the HDMI standard and the CEC protocol, such as the system illustrated in FIG. 1B.” *Id.*, ¶27. Yung adds that “the optional CEC protocol provides high-level control functions between all of the CEC compliant nodes in the CEC network....**The CEC bus preferably consists of a single, bi-directional line.**”

Id. Thus, it is my opinion that the “content playback device 10₁” is “*coupl[ed]*” to the “display device 10₅” through a “**CEC bus** that preferably consists of a single, bi-directional line” (*coupling of the first and second devices including connecting a first control bus between the first device and the second device, the first control bus being a bi-directional, single-line bus*). Yung, ¶¶11, 27.

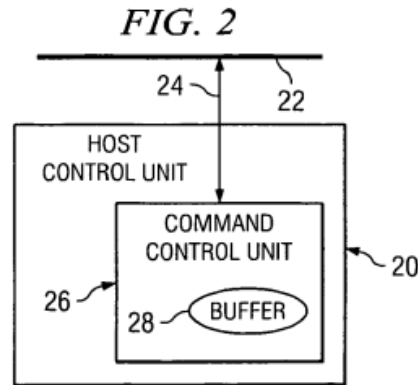
138. Furthermore, it is my opinion that Yung clarifies that the CEC bus is a control bus because it teaches that “the **consumer electronic control (CEC) protocol ... provides high-level control functions** between audio visual appliances interconnected in the HDMI environment.” Yung, ¶4; *see also id.*, ¶¶7, 8, 10, 11. Therefore, it is my opinion that Yung discloses a content playback device 10₁ in Fig. 1B that is connected to a display device 10₅ (“*coupling a first device to a second device, coupling of the first and second devices*”) through a CEC bus that consists of a single bi-directional line (“*coupling of the first and second devices including connecting a first control bus between the first device and the second device, the first control bus being a bi-directional, single-line bus*”).

c) [1(b)] determining whether the first control bus is in use by the second device;

139. It is my opinion that Yung discloses and/or renders obvious this element.

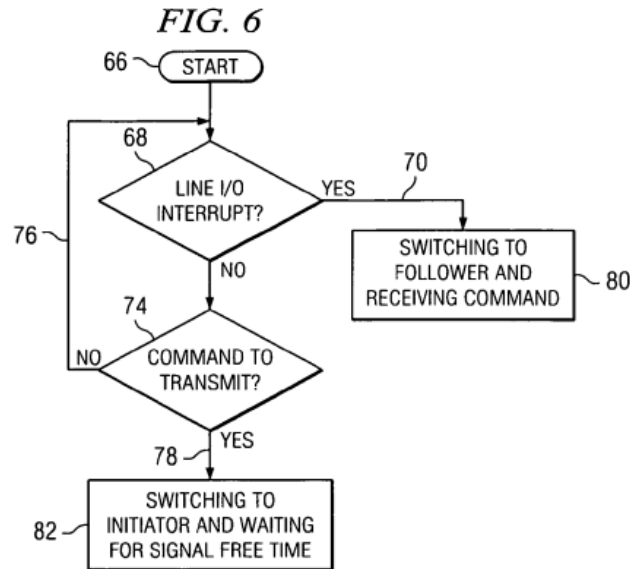
140. Yung discloses that “[a] host control unit [such as host control unit 20] is contained in each device 10 (HDMI node) [that] execut[es] high-level commands”

(Yung, ¶28), and that “a command control unit 26 is embedded in [each] host control unit 20 of [each] HDMI node, as illustrated in FIG. 2” (*id.*, ¶29).



Id., Fig. 2.

141. Yung further discloses that “commands sent by one command control unit are received by all other command control units incorporated into the respective devices 10 of the network,” and “when one command control unit starts to transmit a command frame, it ...caus[es] a command line interrupt.” *Id.*, ¶35. Referring to Fig. 6, Yung explains that “[w]hen a command control unit is not transmitting, it **checks interrupts on the command bus.**” *Id.*, ¶36, Fig. 6 (block 68).



Id., Fig. 6.

142. Therefore, it is my opinion that Yung discloses that the content playback device 10₁ in Fig. 1B checks the CEC bus for interrupts to determine if the CEC bus is in use, such as by being in use by the display device 10₅ (“*determining whether the first control bus is in use by the second device*”), and switches its operating mode accordingly.

- d) **[1(c)] if the first control bus is not in use by the second device, conducting arbitration for control of the first control bus; and**

143. It is my opinion that Yung discloses and/or renders obvious this element.

144. The ’520 patent discloses at least two scenarios for this element relating to conducting arbitration for control of the first control bus, depending on whether just the first device is attempting to take control if the bus is not in use, or whether the first

device and a second device are both attempting to take control.

145. *In a first scenario*, the '520 patent describes that “[i]f the bus is inactive, either side needs to arbitrate to gain control of it” (Ex.1001 at 5:61-63) and a first device (called “a potential initiator”) “must first check if the line is busy” and if it has been idle “for a certain time period” then the device “may start arbitration” and become an “initiator” after “arbitration is won” and “start sending packets of data” over the bus. Ex.1001 at 5:1-9. In other words, “[i]f it is determined that the CBUS [control bus] is idle ... or has been unused by the other device for a certain number of cycles ... then the use of the bus may be arbitrated” and the device may take control – “[o]therwise, the device may determine that the control bus is in use by the other device.” Ex.1001 at 7:51-60.

146. This first scenario is claimed in, for example, claim 4 of the '520 patent, which recites that the “arbitrating for control of the first control bus” of claim 1 includes “determining the first control bus is idle or unused for a first time period,” “sending a low signal for a first number of cycles,” and then “taking control of the first control bus.” Ex.1001 at 11:51-62 (claim 4).

147. This first scenario is illustrated by the highlighted path on the left side of Figure 3 below (304 > 306 > 310 > 312 > 314):

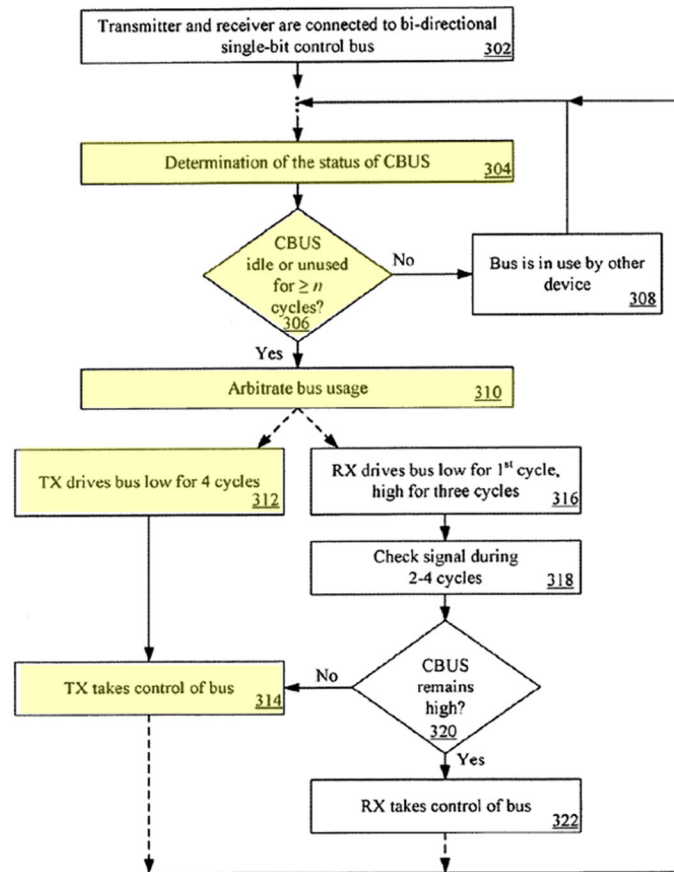


Fig. 3

Ex.1001, Fig. 3 (annotated).

148. *In a second scenario*, both the transmitter (*first device*) and receiver (*second device*) attempt to take control of the control bus, such that “the transmitter and receiver arbitrate at about the same time, [and] the transmitter always wins the arbitration.” Ex.1001 at 5:40-42, 7:60-67. Specifically, when “the transmitter seeks to control the bus,” the transmitter transmits a low signal for a time period of a certain number of cycles to “provide notice to the receiver that the transmitter is seeking control of the bus” and then “take[s] control of the bus.” Ex.1001 at 7:60-67.

149. This second scenario is claimed in, for example, claims 18 and 25, which recite “the logic to arbitrate use of the first control bus [claimed in claims 12 and 19] is further operable to allow the transmitting device to take control of the first control bus if the transmitting device and the receiving device arbitrate use of the first control bus at the same time.” Ex.1001 at 13:1-5 (claim 18), 14:21-25 (claim 25).

150. This second scenario is depicted by the two highlighted paths in Figure 3 below (304 > 306 > 310 > 316 > 318 > 320 > 314 and 304 > 306 > 310 > 312 > 314):

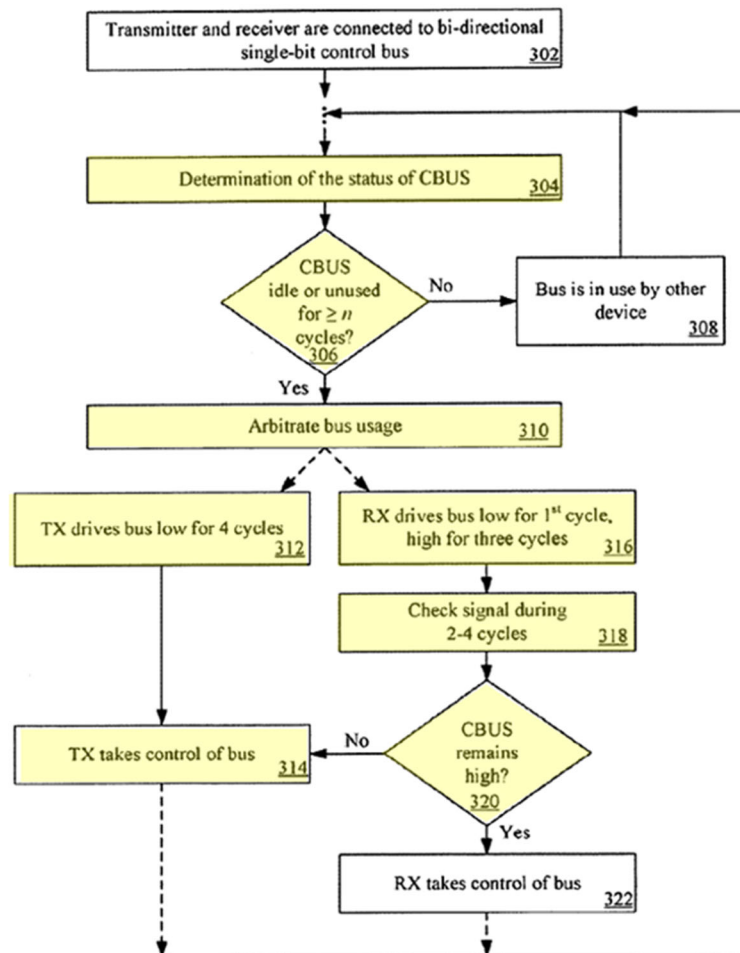


Fig. 3

Ex.1001, Fig. 3 (annotated).

151. Thus, both scenarios described by the '520 patent fall within the scope of *“arbitration for control of the first control bus.”*

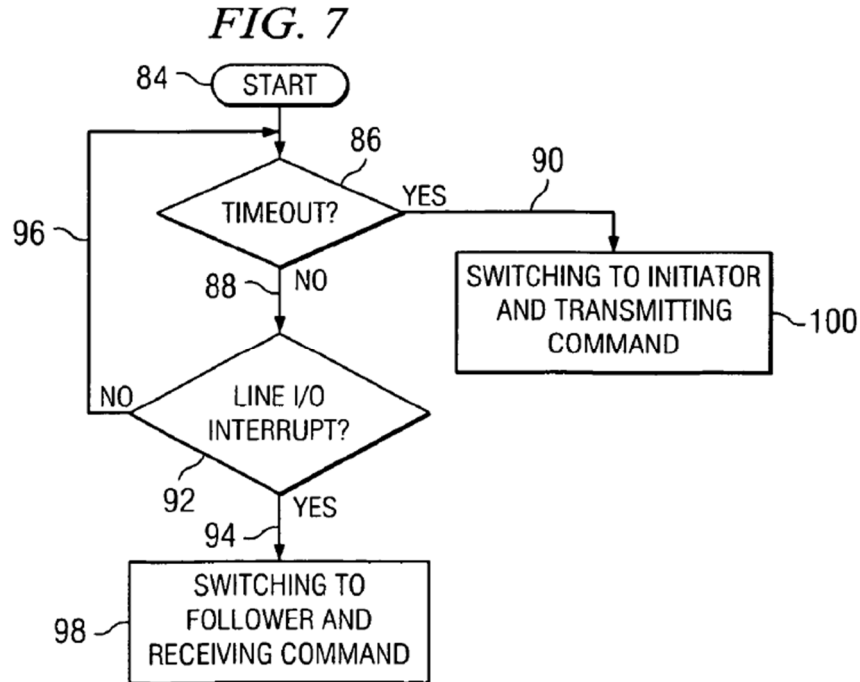
152. It is my opinion that Yung teaches both scenarios of *“arbitration for control of the first control bus.”* Yung discloses an overall arbitration process for determining which device has control of the bus that is described in connection with Figures 5-8 and paragraphs 35-38 of Yung. Yung, ¶¶35-38, Fig. 5-8.

153. As discussed in more detail below, it is also my opinion that Yung teaches performing an *“arbitration for control of the first control bus”* in at least two ways, both of which are consistent with the two above-described scenarios of the '520 patent: i) first, Yung teaches that the first device checks to see if the bus is in use, waits a defined “signal free” time period to see if the bus is in use, and then takes control if it is not in use (or cedes control to the second device if it is using the bus), and ii) second, Yung teaches that when the first device, after detecting the bus is not in use and waiting a defined “signal free” period, attempts to start transmitting on the bus, but if the second device is attempting to transmit simultaneously, an arbitration process is conducted to determine which device has higher priority. Yung, ¶¶35-38, Fig. 5-8.

154. **First**, as described for [1(b)] above, Yung teaches that the command control unit of a first device first checks the bus to determine whether it is in use by the second device. Yung, ¶¶35-36, Fig. 6. If the bus is not in use by the second device,

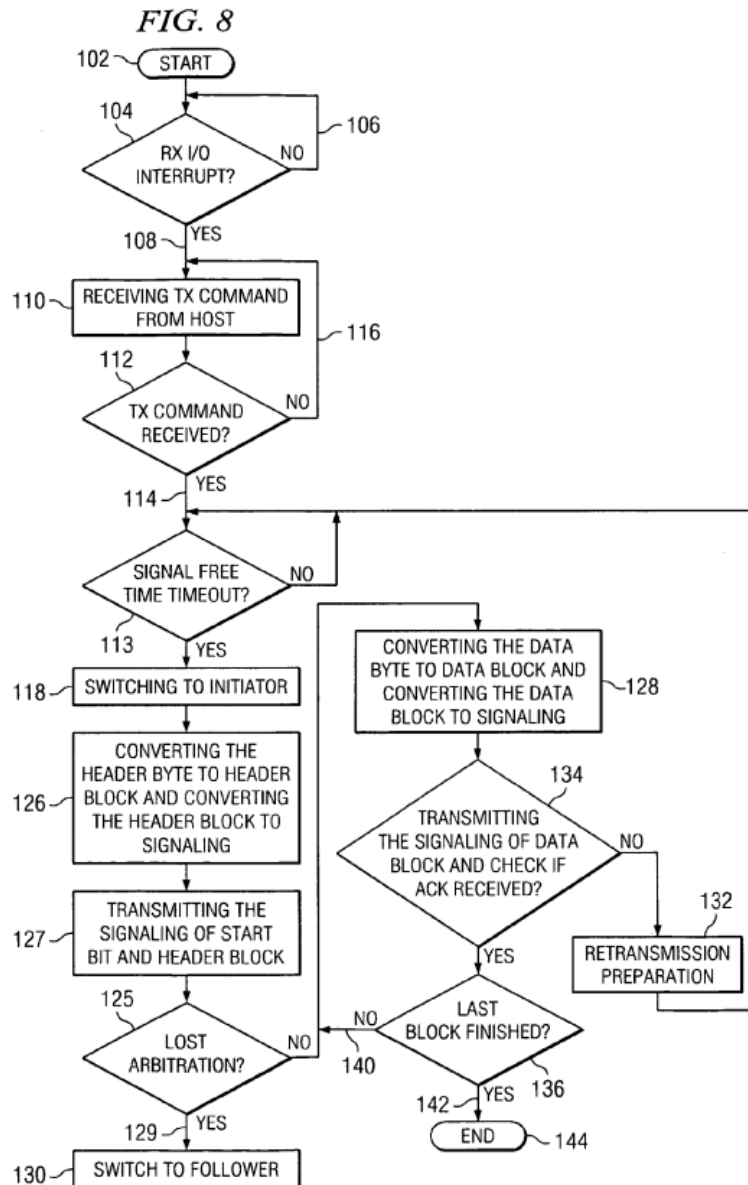
the “command control unit [of a device 10 in Fig. 1B] **does not transmit a message immediately** even if it detects that the command bus is not used. It goes through a **‘wait for signal free time’** process....ensuring that no collision occurs.” *Id.*, ¶37. It is my opinion that this “‘wait for free time’ process” is illustrated in Figure 7 and Yung describes that the “command control unit must wait before it switches to initiator mode.” *Id.*, ¶37, Fig. 7.

155. In my opinion, waiting for the signal free time to timeout is depicted in block 86 of Figure 7 below. *Id.*, ¶37, Fig. 7. If an interrupt is detected on the bus (indicating it is in use), the command control unit of the first device becomes a follower. *Id.*, ¶¶37, 9. However, if “the signal-free time has elapsed without a higher priority interrupt being generated on the bus,” then the command control unit of the first device “takes control of the command bus and starts transmitting a message” as block 100, which Figure 7 describes as “switching to initiator and transmitting command.” *Id.*, ¶37, Fig. 7.



Yung, Fig. 7.

156. In my opinion, a similar “[w]aiting for free time’ process” in which the “command control unit [] wait[s] and see[s] if the command bus is active or inactive prior to transmission of signals onto the command bus” is also described with reference to Fig. 8. Yung, ¶38, Fig. 8. As shown below, “the command control unit waits a time period, namely the signal free time (block 113)” and “[o]nce the command bus is inactive for a pre-determined bit period since this process starts, it shall be time for the command control unit to use the command bus.” Yung, ¶38, Fig. 8. “The command control unit then switches to initiator mode (block 118).” Yung, ¶38, Fig. 8.



Yung, Fig. 8.

157. It is my opinion that Yung’s process of the first device determining “*the first control bus is not in use by the second device*” and then taking control of the bus after waiting for a “signal-free” time period aligns with *the first scenario* of the ‘520 patent described above for “conducting arbitration for control of the first control bus.”

158. **Second**, Yung teaches that after the first device waits for “the signal-free time” and “[o]nce the command bus is inactive for a pre-determined bit period” after this “[w]aiting for free time’ process” starts, the first device starts “to use the command bus” and starts transmitting. Yung, ¶38, Fig. 8. If the second device starts “sending [] simultaneously,” then an “arbitration process is conducted” so as to “determine[] which device has higher priority to have control of the command bus.” Yung, ¶38. “The arbitration process may be conducted according to pre-set rules,” such as “[f]or example, the device having logical address 0001 (with three leading zeros) has higher priority than another device having logical address 0010 (with only two leading zeros).” Yung, ¶38. In my opinion, this arbitration process determines which device is the winner, and the loser “switches back to follower mode” while the winner is confirmed in initiator mode and “starts transmitting.” Yung, ¶38; *see also id.* at ¶¶9, 35-37.

159. In my opinion, Yung’s process of the first device determining “*the first control bus is not in use by the second device*” and then conducting an arbitration process to determine which device has priority in the event both devices attempt to start transmitting on the bus aligns with ***the second scenario*** of the ’520 patent described above for “*conducting arbitration for control of the first control bus.*”

160. Therefore, it is my opinion that Yung discloses and/or renders obvious this limitation [1(c)] in two ways by teaching two ways for performing this limitation

that align with two scenarios disclosed in the '520 patent for this limitation.

- e) **[1(d)] if the first device obtains control of the first control bus through the arbitration for control of the first control bus, the first device becoming an initiator and the second device becoming a follower,**

161. It is my opinion that Yung discloses and/or renders obvious this element.

162. In my opinion, as explained in [1(c)] above, after waiting a signal-free time, Yung's devices engage in arbitration to obtain control of the command bus through two ways that align with two scenarios disclosed in the '520 patent. Yung, ¶38. In both instances, Yung discloses that *if the first device obtains control of the first control bus through the arbitration for control of the first control bus, then the first device becom[es] an initiator and the second device becom[es] a follower.* The '520 patent describes that an "initiator" is "the device gaining control of the bus," while a "follower" is described as "the other device in the transaction," i.e., the loser, which does not gain control. Ex.1001 at 3:55-58.

163. ***In the first instance*** of arbitration in Yung, where a device takes control after a "signal free period" and begins transmitting, Yung teaches, with reference to Figs. 7 and 8, that after the device waits, it "switches to initiator mode." Yung, ¶9 ("When the command control unit has a command to send, it waits a signal free time to avoid conflicts and then switches to **initiator mode**."); ¶37 ("In preferred embodiments, each device on the network is associated with a predefined signal free time. A command control unit must wait before it switches to **initiator mode**."), ¶38

(“Once the command bus is inactive for a pre-determined bit period since this process starts, it shall be time for the command control unit to use the command bus. The command control unit then switches to **initiator mode** (block 118).”). After switching to initiator mode, the device “takes control of the bus and starts transmitting.” Yung, ¶37. Thus, it is my opinion that when the first device takes control of the bus after the waiting period, the first device would be understood to become an “*initiator*,” as claimed, both because Yung teaches that it switches to “initiator mode” and because the first device, at that point, aligns with the ’520 patent’s description of an “initiator” as being “the device gaining control of the bus.” Ex.1001 at 3:55-58.

164. Similarly, Yung teaches that the second device *becom[es] a follower* in this first instance of arbitration. “If a command control unit [of a device] detects that a command is to be sent by another command control unit in the network, it switches to a **follower mode**.” Yung, ¶9. Thus, it is my opinion that where the first device switches to initiator mode and starts transmitting, the second device then switches to follower mode. Yung, ¶9. It is also my opinion that the second device switching to follower mode would be understood to be “*becoming a follower*,” as claimed, because the ’520 patent describes a “follower” as being “the other device in the transaction,” which does not gain control. Ex.1001 at 3:55-58. Thus, in my opinion, in this first instance of *arbitration* in Yung, which is consistent with the first scenario described above in the ’520 patent, the first device, which takes control, *becom[es] an initiator*,

and the second device, which does not take control, *becom[es] a follower*.

165. *In the second instance* of arbitration in Yung, where a first device, after waiting, takes control after an arbitration is conducted to determine which of two simultaneously transmitting devices has priority, the first device, which is determined to have higher priority, is deemed the winner, while the second device is deemed the loser and “switches back to **follower mode**.” Yung, ¶38. When the first device wins, it takes control of the bus and “starts transmitting.” Yung, ¶38. In my opinion, this first device, which wins and takes control, would be understood to become an “*initiator*,” as claimed, because the ’520 patent describes an “initiator” as “the device gaining control of the bus.”¹⁷ Ex.1001 at 3:55-58. In my opinion, the second device, which loses, switches back to “follower mode,” and does not take control, would be understood to become a “*follower*,” as claimed, because the ’520 patent describes a “follower” as being “the other device in the transaction,” which does not gain control. Ex.1001 at 3:55-58.

166. Therefore, it is my opinion that Yung discloses and/or renders obvious

¹⁷ Although Yung’s second instance of *arbitration* uses a slightly different nomenclature in certain embodiments to refer to a device switching to an “initiator mode” (e.g., at block 118 in Figure 8) before arbitration is completed with a simultaneously transmitting second device, Petitioners do not rely on this “initiator mode” for satisfying the requirement of *becoming an initiator* in this claim limitation. Petitioners instead rely only on the first device *becoming an initiator* by winning this arbitration against the second device and gaining control of the bus as a result, which is consistent with the ’520 patent’s description of an “initiator” being “the device gaining control of the bus.” Ex.1001 at 3:55-58.

this limitation [1(d)] independently through each of the two instances of *arbitration* disclosed in Yung, which align with the two scenarios disclosed in the '520 patent discussed above.

- f) **[1(e)] then further comprising: converting one or more control signals for a standard protocol to one or more data packets, each of the one or more control signals representing one of a plurality of different types of control signals, each data packet including a plurality of bits to be transmitted; and**

167. It is my opinion that Yung discloses and/or renders obvious this element.

168. **First**, it is my opinion that Yung discloses “*converting one or more control signals for a standard protocol to one or more data packets.*” The '520 patent describes that “standard control commands and data are converted into data packets for transmission on the single bit control bus, with the data packets identifying the types of commands and data being transmitted” (Ex.1001, 3:34-37), and the receiver receives “one or more data packets containing command data” on the bus “and will handle each command as required **under the standard protocol 224, such as, for example, HDMI.**” *Id.*, 7:42-47. Thus, it is my opinion that the '520 patent describes HDMI as being a “standard protocol.” *Id.*, 7:44-47; *see also id.*, 6:33-37 (“a standard protocol device 104, such as a HDMI transmitting device”), and claim 6 (“wherein the standard protocol is HDMI”). Because the CEC protocol is part of the HDMI protocol (as discussed above with reference to paragraphs 4-5 of Yung), the '520 patent considers CEC controls signals to be HDMI control signals (*id.* at 6:53-57 and 7:31-

34) and, thus, also considers CEC to be a “standard protocol.” *Id.*, 3:3-11, 3:34-42.

169. Further, the ’520 patent describes that the control commands can be comprised of “bytes” that are converted to data packets for transmission over the bus. Ex.1001 at 7:28-31 (“In some embodiments, **the control signals are converted from bytes of data to data packets** that identify the type of data within each packet.”), 9:19-20 (“In an embodiment, **control data bytes are formed into data packets** for transfer on the control bus.”).

170. In my opinion, Yung’s teachings align with these disclosures of the ’520 patent and, therefore, disclose *converting one or more control signals for a standard protocol to one or more data packets*, because Yung teaches, after arbitration is complete such that one device has become an initiator and the other device has become a follower, “high-level” HDMI commands in the form of “CEC commands” comprised of “bytes” (*control signals for a standard protocol*) are converted to “frames,” such as “CEC frames” (*to one or more data packets*) for transmission over the bus. Yung, ¶¶4-5, 28-29, 31-34, 42, claims 1, 2, & 7. Specifically, Yung teaches that “CEC allows users to control all HDMI devices with a single remote and enables high-level functions such as ‘one-touch play’” and distributes commands it calls “CEC commands” between A/V components using a common communication protocol. Yung, ¶4.

171. These “high-level commands” can be generated, for example, by a user

“pressing a ‘play’ button of a DVD player 10₁” and transmitted to a receiving device, such as a TV 10₅. Yung, ¶28. In my opinion, to do so, the host control unit 20 of the transmitter “constructs a command” that can be comprised of fields comprised of “bytes,” just like the control signals described in the ’520 patent, and that are recognizable by the command control unit 26 of the transmitter. Yung, ¶¶31-32. “Once the recognizable command is determined to be valid, the fields of header and data bytes [of the command] are converted into command blocks for transmission.” Yung, ¶33. Specifically, the **“commands are transmitted as frames”** that are comprised of “a start bit and a header block” and “may further comprise one or more data blocks” where the header blocks and data blocks may be “command block[s]” that can be in “the command block format [] provided in the CEC protocol of the HDMI standard.” Yung, ¶34. Yung teaches that these command frames can be “CEC frames defined by the CEC protocol.” Yung, ¶42, claim 1, claim 7.

172. It is my opinion that a POSITA would have understood CEC frames would have constituted “*data packets*,” because such frames are comprised of a start bit and a header block and can also be comprised of one or more additional data blocks. Yung, ¶34 and HDMI 1.0 at CEC-9 & CEC-10 (describing CEC frame format). It is also my opinion that the ’520 patent expressly teaches that an example of a “data packet” transmitted over its bus can be a “CEC packet,” which a POSITA would have understood to refer to a CEC frame. Ex.1001, 9:48-59 (citing Yung, ¶34; HDMI 1.0

at CEC-9 & CEC-10 (describing CEC frame format); HDMI 1.1 at CEC-9 & CEC-10). Thus, it is my opinion that the '520 patent includes a CEC frame as an example of a "data packet."

173. Finally, in my opinion, when Yung references "the command block format [] provided in the CEC protocol of the HDMI standard," (Yung, ¶34), Yung, which was filed on November 3, 2004, would have been referring to the CEC frame format of either HDMI 1.0 (released December 9, 2002) or HDMI 1.1 (released May 20, 2004). *See* HDMI 1.0; HDMI 1.1. Thus, it is my opinion that the *one or more control signals for a standard protocol* that are *convert[ed]...to one or more data packets* in Yung are the CEC commands that are converted to CEC frames as defined by either HDMI 1.0 or HDMI 1.1 (i.e., the *standard protocol*). HDMI 1.0 at CEC-9 & CEC-10; HDMI 1.1 CEC-9 & CEC-10.

174. **Second**, it is my opinion that Yung discloses "*each data packet including a plurality of bits to be transmitted*" because Yung teaches that the transmitted CEC frames' command blocks are "**10-bit** command block[s]" in which "bits 1 through 8 are information bits" (Yung, ¶34) and in which the other two bits are an "'end of message' (EOM) bit, and an acknowledgement (ACK) bit." Yung, ¶38; *see also id.* at claim 2 ("wherein the CEC frames contain bits").

175. **Third**, it is my opinion that Yung discloses "*each of the one or more control signals representing one of a plurality of different types of control signals.*"

With regard to “*different types of control signals*,” the ’520 patent explains that “[t]he receiver will read **the header** of each received data packet and determine **the control type** 222.” Ex.1001, 7:44-45. Each data packet includes “a 2-bit header 804 to indicate the **type** of data packet.” *Id.* at 9:23-27; Figs. 8-9. The two header bits “indicate whether the data packet includes **a DDC packet** (header field '00), **a CEC packet** (header field “01), **or private channel data** for the control bus (header field 10).” *Id.* at Fig. 9, 9:31-32, 9:48-54. Thus, it is my opinion that the ’520 patent treats CEC and DDC commands as “*different types*” of control signals.

176. Similarly, Yung discloses that, in addition to transmitting CEC commands over CEC bus 12, it also uses HDMI cable 11 and “HDMI carries a display data channel (DDC),” which is used for transmitting control signals “for configuration and status exchange between HDMI nodes.” Yung, ¶27. Thus, it is my opinion that Yung teaches “*a plurality of different types of control signals*” because it discloses both DDC and CEC controls signals, which the ’520 patent describes as express examples of “different types” of control signals.

g) [1(f)] transmitting the generated data packets from the first device to the second device via the first control bus, and

177. It is my opinion that Yung discloses and/or renders obvious this element.

178. In my opinion, as explained in [1(a)] and [1(e)] above, Yung discloses a “content playback device 10₁” in Fig. 1B or other transmitting device that transmits

commands in the form of CEC frames over the CEC control bus to a receiving device, such as “display device 10₅” (“*transmitting the generated data packets from the first device to the second device via the first control bus*”). Yung, ¶¶7, 38, Fig. 8 (block 134).

- h) [1(g)] wherein the receiving device is a device utilizing the standard protocol and the transmitting device is a mobile device utilizing a modified protocol, the modified protocol being a modification of the standard protocol that is not included in the standard protocol.**

179. It is my opinion that Yung in view of HDMI 1.3’s HDMI-C protocol¹⁸ renders obvious this element.

180. Yung discloses that a transmitting device, such as content playback device 10₁, which can be “a DVD player, a CD player, or other devices,” transmits commands and data to receiving devices, such as display device 10₅, e.g., “a TV, a speaker, etc.” using HDMI’s CEC protocol. Yung, ¶¶3-5, 26-27. Yung was filed on November 3, 2004. Yung, at code (22).

181. Thus, it is my opinion that the version of HDMI that Yung would have been expressly implementing in its disclosure would have been a version that predated November 3, 2004, such as HDMI 1.0, which was released on December 9, 2002, or HDMI 1.1, which was released on May 20, 2004 – both of which included the CEC

¹⁸ I hereby introduce the term “HDMI-C protocol” to refer to the portions of HDMI 1.3 that specify the aspects of the Type C connector, including its pin assignments and receptacle.

protocol.¹⁹ See HDMI 1.0; HDMI 1.1. Versions 1.0 or 1.1, as implemented by Yung, would have been understood by a POSITA to encompass a “standard protocol” because those versions only included connectors that supported standard devices, such as DVD players and TVs, and not mobile devices. HDMI 1.0; HDMI 1.1. The ‘520 patent describes a “standard protocol” as one designed for use with a “standard device” that uses a “standard cable.” Ex.1001, 1:43-44 (describing problem of an interface for a “standard device” being difficult to use for “smaller devices”), 2:17-18, 2:42-25, 4:26-29, 8:14-15; *see also id.* 2:56-59 (describing “a standard HDMI device (such as, for example, a television monitor).”).

182. In addition, because Yung discloses a receiving device 105, such as a TV, that can receive HDMI signals (i.e., CEC frames), and which the ’520 patent deems a “standard HDMI device,” and because the available versions of HDMI prior to Yung’s filing included only HDMI 1.0 and 1.1 (which only supported standard devices, not mobile devices), it is my opinion that Yung discloses using a “standard HDMI” protocol and therefore, discloses “*wherein the receiving device is a device utilizing the standard protocol.*”

183. Further, it is my opinion that Yung in view of HDMI 1.3’s HDMI-C protocol renders obvious “*the transmitting device is a mobile device utilizing a modified protocol, the modified protocol being a modification of the standard protocol*”

¹⁹ HDMI 1.3 was not released until June 22, 2006. HDMI 1.3, at 1.

that is not included in the standard protocol.” As discussed above in Section VIII.B.1, Yung expressly teaches that its disclosure may be applied in the context of future versions of CEC and other protocols that may be developed in the future, and thus expressly teaches using its disclosure with future versions of HDMI (Yung, ¶26); this would have, therefore, expressly motivated a POSITA to combine Yung with HDMI 1.3’s HDMI-C protocol – and this was a future HDMI adopted in HDMI 1.3 about 18 months after the filing of Yung.

184. It is also my opinion that the HDMI-C protocol was added in HDMI 1.3 to add support for mobile devices through addition of the HDMI Type C connector. HDMI 1.3 at iii (revision history noting addition of Type C connector), 10 (“The Type C connector carries the same signals as the Type A but is **more compact and intended for mobile applications.**”). While the HDMI Type C connector uses the same 19 pin types as the HDMI Type A connector, the HDMI Type C connector uses a different pin layout and a smaller form factor designed for mobile devices, as shown below. HDMI 1.3, at 11 (Type A pin assignment), 13 (Type C pin assignment), 21-31 (Type A and Type C receptacle dimensions).

4.1.4 Connector Pin Assignments

Table 4-1 Type A Connector Pin Assignment

PIN	Signal Assignment	PIN	Signal Assignment
1	TMDS Data2+	2	TMDS Data2 Shield
3	TMDS Data2-	4	TMDS Data1+
5	TMDS Data1 Shield	6	TMDS Data1-
7	TMDS Data0+	8	TMDS Data0 Shield
9	TMDS Data0-	10	TMDS Clock+
11	TMDS Clock Shield	12	TMDS Clock-
13	CEC	14	Reserved (N.C. on device)
15	SCL	16	SDA
17	DDC/CEC Ground	18	+5V Power
19	Hot Plug Detect		

HDMI 1.3 at 11 (Type A pin assignments).

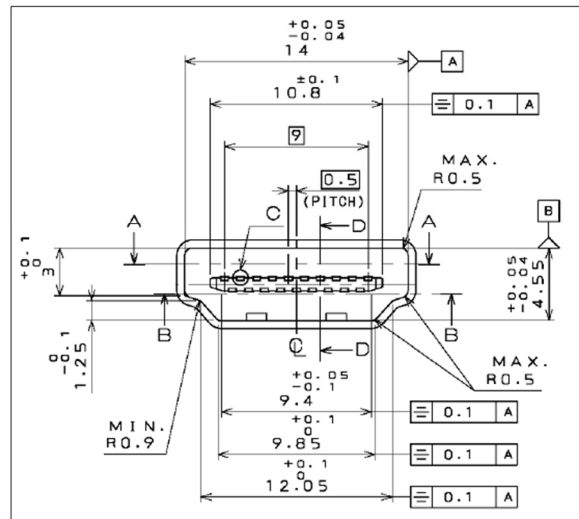
Table 4-3 Type C Connector Pin Assignment

PIN	Signal Assignment
1	TMDS Data2 Shield
2	TMDS Data2+
3	TMDS Data2-
4	TMDS Data1 Shield
5	TMDS Data1+
6	TMDS Data1-
7	TMDS Data0 Shield
8	TMDS Data0+
9	TMDS Data0-
10	TMDS Clock Shield
11	TMDS Clock+
12	TMDS Clock-
13	DDC/CEC Ground
14	CEC
15	SCL
16	SDA
17	Reserved
18	+5V Power
19	Hot Plug Detect

HDMI 1.3 at 13 (Type C pin assignments). As shown above, as compared with HDMI Type A, HDMI Type C has pins 1 and 2 switched, pins 4 and 5 switched, pins 7 and 8 switched, pins 10 and 11 switched, pins 17 and 13 switched for DDC/CEC Ground, and pins 13 and 14 switched for CEC. HDMI 1.3, at 11, 13. Further, as shown below,

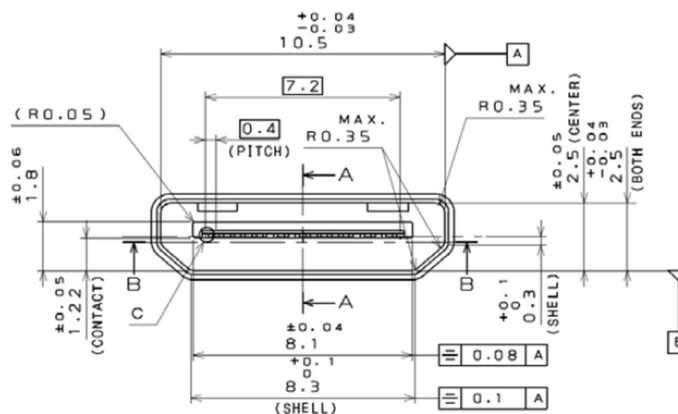
HDMI-C uses a smaller form factor receptacle than HDMI-A in order to be able to support mobile devices.

4.1.9.1 Type A Receptacle



HDMI 1.3 at 21 (Type A receptacle dimensions, with 14mm width and 4.55mm height).

4.1.9.5 Type C Receptacle



HDMI 1.3 at 29 (Type C receptacle dimensions, with 10.5mm width and 2.5mm height).

185. Continuing, HDMI 1.3 teaches that either a transmitter or receiver can use an HDMI Type C connector, which is for mobile devices, and that an HDMI Type A-to-HDMI Type C adaptor can be used to interface between the two. HDMI 1.3, at 10, 29-31 (describing both a “Type C Receptacle” (female) and a “Type C Plug” (male)), 37 (describing a Type C to Type A connector). Thus, it is my opinion that HDMI 1.3’s HDMI-C protocol discloses that the transmitting device can be a *mobile device*.

186. It is my opinion that Yung in view of HDMI 1.3’s HDMI-C protocol also discloses that the transmitting device is a mobile device *utilizing a modified protocol*. The ‘520 patent describes a “modified protocol” as a relative term in comparison to a “standard protocol” – and the term “modified protocol” here being “a modification of the standard protocol that is not included in the standard protocol,” and which is “utiliz[ed]” by a “mobile device,” and that uses “a different cable,” such as a “mobile protocol cable,” which may be the ‘520 patent’s coined “HDMI-M compatible cable,” as distinguished from “a standard protocol cable.” Ex.1001 at claim 1, 4:24-31, 6:39-43, 7:4-8. The ‘520 patent describes that this need for a modified/mobile protocol arises from the difficulty of using an interface designed for a standard device with smaller devices, such as mobile devices. *Id.*, 1:40-43. The ‘520 patent describes that its so-called HDMI-M cable may “in some embodiments” utilize “fewer lines because of smaller device size,” which indicates that not all embodiments of its HDMI-M cable

require fewer lines and can instead encompass the same number of lines. *Id.*, 8:61-64.

187. It is thus my opinion that HDMI 1.3's HDMI-C protocol discloses a *mobile device utilizing a modified protocol* in a manner consistent with the '520 patent because, as discussed above, the HDMI-C protocol uses a different connector having a different pin arrangement and smaller form factor designed for connection to mobile devices. HDMI 1.3, at 10, 11, 13, 21, 29-31.

188. It is also my opinion that like the '520 patent, HDMI 1.3 discloses an HDMI Type C-to-Type A adapter for connecting a mobile device to a standard device. HDMI 1.3, at 37.

189. As such, it is my opinion that Yung in view of HDMI 1.3's HDMI-C protocol renders obvious *the modified protocol being a modification of the standard protocol that is not included in the standard protocol*. As discussed above, Yung's implementation of either HDMI 1.0 or 1.1 constitutes "*the standard protocol*" that does not support mobile devices while HDMI 1.3's HDMI-C protocol constitutes "*the modified protocol*," because HDMI-C constitutes *a modification of the standard protocol* (HDMI 1.0 or 1.1) *that is not included in the standard protocol* given that neither HDMI 1.0 nor 1.1 used by Yung include the HDMI-C protocol for mobile devices. HDMI 1.0; HDMI 1.1; HDMI 1.3 at iii (revision history noting the addition in HDMI 1.3 of Type C as a "[s]ignificant new feature").

190. Finally, I understand that Petitioners note that during prosecution, the

Examiner rejected claims 6-8, among others, as unpatentable over a reference named Kobayashi in view of knowledge commonly known in the art, as evidenced by a Lindy article. Ex.1002, 141 (9-25-2009 Office Action, at p. 11). Specifically, I understand that while the examiner noted Kobayashi was “silent as to the protocol used,” he took official notice based on Lindy “that connecting a device having a standard protocol (HDMI) to a modified protocol (mini-HDMI) [was] well known in the art” and that “devices capable of communicating with both . . . [were] well known in the art.” *Id.* I understand that in response, the Applicant argued that Lindy was directed to HDMI 1.3 and that the HDMI 1.3 specification’s type C connector (mini-HDMI) used “the same 19-pin connection” as HDMI 1.3’s “standard HDMI.” (i.e., HDMI-A). *Id.*, at 186 (12-29-2009 Response, at p. 27). I understand that the Applicant further argued that “[t]hus, the Mini-HDMI connector shown in *Lindy* does not illustrate a modified protocol” and “illustrates an adaptor (sic) for a smaller scale connector that is provided in the HDMI [1.3] specification.” *Id.*

191. In my opinion, these arguments do not affect Petitioner’s mapping above for at least three reasons.

192. First, unlike the combination of Yung and HDMI 1.3, the combination of Kobayashi and Lindy did not include two different protocols. The only protocol at issue in Kobayashi and Lindy is HDMI 1.3, which the Examiner mapped to both the “standard protocol” (e.g., the standard HDMI Type A connector) and the “modified

protocol” (e.g., the HDMI Type C connector). Thus, Applicant was merely distinguishing the Examiner’s mapping of Lindy’s use of HDMI 1.3’s HDMI-C connector from HDMI 1.3’s “standard HDMI” connector contained in the same HDMI 1.3 specification as “not illustrat[ing] a modified protocol,” because, as argued by Applicant, HDMI Type C is “provided in the HDMI [1.3] specification.” Thus, Applicant was merely arguing that the HDMI-C protocol is not a modification of HDMI 1.3 and thereby not a “modified protocol” because the HDMI-C protocol is contained in HDMI 1.3. Petitioners, on the other hand, have mapped Yung’s disclosed HDMI protocol, which uses HDMI 1.0 or 1.1, as the “standard protocol” that does *not* include the “modified protocol” of HDMI Type C, which was first contained in HDMI 1.3. Thus, it is my opinion that unlike the mapping addressed by the Examiner, Petitioners’ mapping does identify a modified protocol that is *a modification of the standard protocol that is not included in the standard protocol*.

193. Second, it is my opinion that notwithstanding the fact that claims 16 and 25 recite “wherein the standard protocol is HDMI” and the ‘520 patent specification states that its receiver can use “standard protocol 224, such as, for example, HDMI” (Ex.1001, 7:46-47), the ’520 patent does not consider all HDMI protocols to be “standard protocols,” because its preferred embodiment of a “modified protocol” is coined “HDMI-M,” which is an HDMI protocol for connecting to mobile devices. Ex.1001, 2:61-62 (“As used herein, HDMI-M is utilized here to indicate a mobile

device utilizing a modified protocol.”), 6:37-41, 7:6-8, 8:13-17, 8:61-64. Thus, it is my opinion that Applicant could not have been arguing that all HDMI protocols are considered “standard protocols” by the ’520 patent.

194. Third, it is my opinion that Applicant was incorrect to assert that HDMI Type C uses “the same 19-pin connection as standard HDMI [i.e., HDMI Type A],” because, as discussed above, Type C uses a different configuration of pins than Type A and a smaller form factor. Moreover, it is my opinion that the ’520 patent itself makes clear that only “in some embodiments” does its modified protocol for mobile devices (HDMI-M) use “fewer lines,” indicating that some embodiments of a “modified protocol” can use the same number of lines/pins. Ex.1001, 8:61-64.

195. Fourth, as discussed above, the ’520 patent merely describes a “modified protocol” in the context of a different, mobile interface that can be designed for smaller mobile devices, as compared to a “standard protocol” that uses a standard interface for standard-size devices. Ex.1001 at 1:41-45, 2:56-59, 4:24-31, 6:39-43, 7:4-8. In my opinion, HDMI 1.3’s addition of HDMI-C thus aligns precisely with these teachings of the ’520 patent because it uses a different cable having a smaller form factor connector that is arranged differently and designed for mobile devices.

196. Finally, it is my opinion that Applicant’s statements are not appropriate here because Applicant ignored the ’520 patent’s statement that only “some embodiments” use fewer lines/pins, and Applicant’s argument regarding “a smaller

scale connector” that a cable having a smaller scale connector designed for mobile devices would not be a modified protocol overlooked that the ’520 patent’s only distinction between a standard protocol and a modified protocol is the use of a modified/different cable designed for smaller, mobile devices that is not the same as that used for standard-size devices.

2. Claim 4

- a) [4(pre)] The method of claim 1, wherein, if the first device is a transmitting device for transmission of data to the second device, then arbitrating for control of the first control bus includes:**

197. It is my opinion that to the extent this preamble is limiting, Yung discloses and/or renders obvious this element for the same reasons set forth above for elements [1(a)] and [1(c)].

- b) [4(a)] determining the first control bus is idle or unused for a first time period;**

198. It is my opinion that Yung discloses and/or renders obvious this element for the same reasons set forth above for element [1(b)].

- c) [4(b)] if the first control bus is idle or unused for the first time period, then sending a low signal for a first number of cycles; and**

199. It is my opinion that Yung discloses and/or renders obvious this limitation, and, in addition, Yung in view of HDMI 1.3 renders obvious this element.

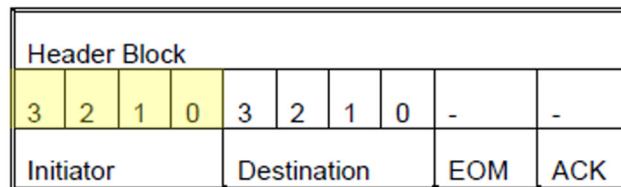
200. Yung discloses that its transmitting device, such as the content playback device 105 in Fig. 1B, waits for a time period, such as a “signal free time period,” to

determine whether the CEC command bus is inactive and, if so, then begins transmitting a signal on the bus (*“if the first control bus is idle or unused for the first time period”*). See [1(b)].

201. Yung further discloses that this initial signal transmission may “pull[] the high voltage on the command bus ... to a low voltage, causing a command line interrupt” (*then sending a low signal*). Yung, ¶35; see also *id.* at ¶¶36-38. Yung teaches that this low voltage may be transmitted for a “low voltage ... period[]” having “a time duration” that is measured by the command control units of other devices in the network. Yung, ¶35. It is my opinion that a POSITA would have understood that this “low voltage period” that has “a time duration” constitutes a *first number of cycles* because it is a defined time period having a duration, which would be consistent with at least one cycle defined by a “period” where the voltage is “low.”

202. In my opinion, to the extent it is argued that Yung does not disclose *sending a low signal for a first number of cycles*, then this would have been obvious over Yung in view of HDMI 1.3. HDMI 1.3 discloses that after “[a]n initiator ... tests[s] that the control signal line is free for use,” it then “generates a high to low transition on the CEC line, followed by a series of pulses comprising data bits whose starting point is defined by a high to low transition.” HDMI 1.3, at CEC-7. HDMI 1.3 teaches that “CEC line arbitration commences with the leading edge of the start bit and continues until the end of the initiator address bits within the header block.” HDMI

1.3, at CEC-14. The initiator address bits are contained in bits one to four of the header block, as shown below. HDMI 1.3 at CEC-11.



CEC Figure 7 Header Block

HDMI 1.3 at CEC-11 (CEC Figure 7) (annotated).

203. Further, these data bits, after the start bit, “have consistent timing,” which can be a “nominal data bit period” of “2.4ms.” HDMI 1.3 at CEC-7 to CEC-8. Thus, it is my opinion that HDMI 1.3 discloses an initiator transmitting a series of four data bits where each bit’s starting point is defined by a high to low transition (*sending a low signal*) that occurs during a consistent, defined bit period for each of the four bits (*for a first number of cycles*).

204. In my opinion, this teaching is consistent with the ’520 patent’s description that “[i]n one implementation, to arbitrate, a transmitting device drives the bus low for 4 bit times” and “the receiver drives high for a short time at the start of each bit time and then releases the bus” such that “the bus becomes low” during each bit time “if the transmitter drives the bus low to obtain the bus.” Ex.1001, 5:10-11, 5:22-24.

- d) [4(c)] after the conclusion of the first number of cycles, then taking control of the first control bus.**

205. It is my opinion that Yung in view of HDMI 1.3 renders obvious this element.

206. HDMI 1.3 discloses that “[o]nly one initiator is allowed at any one time” and “[a] control signal line arbitration mechanism avoids conflict when more than one initiator begins transmitting at the same time.” HDMI 1.3, at CEC-7. Specifically, “CEC line arbitration “continues until the end of the initiator address bits within the header block” (i.e., *after the four-bit periods constituting conclusion of the first number of cycles*), and after arbitration is completed, it is determined whether the initiator loses to a second initiator, or whether the initiator wins, *taking control of the first control bus*. HDMI 1.3 at CEC-14. Further, Yung, which uses CEC, discloses that the device that wins arbitration “takes control of the command bus.” Yung, ¶37.

3. Claim 8

- a) [8] The method of claim 1, wherein standard protocol requires that the plurality of different types of control signals be transmitted over a plurality of different control buses.**

207. It is my opinion that Yung discloses and/or renders obvious this limitation.

208. First, Yung discloses this limitation. As discussed above for [1(e)], Yung discloses using a “*standard protocol*” in the form of the HDMI protocol as it existed at the time of Yung (i.e., HDMI 1.0 or HDMI 1.1) and its included CEC protocol.

Yung further discloses that the HDMI protocol (i.e., HDMI 1.0 or 1.1) also includes a display data channel (“DDC”) that is used for configuration and status exchange between HDMI nodes. Yung, ¶27.

209. It is my opinion that a POSITA would have understood that in Yung’s HDMI protocol (i.e., HDMI 1.0 or 1.1), “[t] The DDC is used by the Source to read the Sink’s Enhanced Extended Display Identification Data (E-EDID) in order to discover the Sink’s configuration and/or capabilities.” HDMI 1.0, at 9; HDMI 1.1 at 9.

210. Further, it is my opinion that the DDC would have been understood to be a “separate communication channel” from CEC. HDMI 1.0, at 77; HDMI 1.1 at 83. As such, it is my opinion that a POSITA would have understood DDC to be a second control bus in addition to the CEC control bus (*plurality of different control buses*).

211. It is also my opinion that DDC connections send control signals to perform the function of enabling physical address discovery for CEC devices, which “cannot alone ascertain the physical connectivity of the network,” and, thus, the DDC signals sent over a separate DDC bus are *required* to allow CEC to ascertain physical connectivity of the network. HDMI 1.0 at CEC-14; HDMI 1.1 at CEC-14. This is *a first way* that the HDMI protocol *requires the plurality of different types of control signals be transmitted over a plurality of different control buses*.

212. As discussed above for element [1(e)], it is my opinion that Yung

discloses *a plurality of different types of control signals* through its disclosure of transmitting DDC signals and CEC signals. Further, Yung's HDMI standard (i.e., HDMI 1.0 or 1.1) requires these DDC signals and CEC signals be transmitted over "separate communication channels," i.e., the DDC bus and CEC bus, respectively. HDMI 1.0, at 77; HDMI 1.1 at 83. This is ***a second way*** that the HDMI protocol *requires the plurality of different types of control signals be transmitted over a plurality of different control buses*.

213. Therefore, it is my opinion that a POSITA would have understood that Yung discloses and/or renders obvious that *the standard protocol requires the plurality of different types of control signals be transmitted over a plurality of different control buses*.

4. Claim 9

- a) **[9] The method of claim 1, wherein the transmission of a data packet by the initiating device²⁰ is followed by an acknowledge (ACK) message from the following device to the initiating device on the first control line.**

214. It is my opinion that Yung discloses and/or renders obvious this claim.

215. Yung discloses that "[o]n the follower side, a receiving function is performed, which is illustrated by an exemplary flowchart in FIG. 9." Yung, ¶39. Yung further explains that after the "follower receives each bit" of the transmitted

²⁰ I understand that claim 1, on which claim 9 depends, does not recite an "initiating device," a "following device," or a "first control line."

frames, the follower “combines bits into bytes and sends an **acknowledgement** for each byte.” *Id.*, ¶39; *see also id.* at ¶¶33-34, 42. Specifically, “[a]fter eight bits are received, the eight bits are combined to form a byte (block 164), and an **acknowledgement** is sent to the initiator (block 170).” *Id.*, ¶39; *see also id.*, ¶38 (“**Acknowledgement** is expected from the receiver; otherwise re-transmission occurs.”), claim 21 (“checking acknowledgement from the remote command unit”).

216. Further, it is my opinion that for facilitating this “acknowledgment” sent by the follower device back to the initiator device, Yung teaches that the initiator device adds an “ACK” bit or “acknowledgment (ACK) bit” to the end of command blocks that are transmitted via frames over the command bus to the follower device. Yung, ¶38. Specifically, the ACK bit can be the “tenth bit ‘acknowledgment’ indicating the received status of a command block” that “contains 10 bits.” *Id.*, ¶34. A POSITA would have understood that such ACK bits in Yung, which uses CEC, are used by follower devices to acknowledge receipt by the follower changing an ACK bit set to “1” by the initiator to a “0” and transmitting the ACK bit back over the CEC bus to the initiator, which reads a “1” as indicating a successful transmission of the block. HDMI 1.0 at CEC-9 to CEC-10.

217. Therefore, it is my opinion that a POSITA would have understood that the acknowledgment is transmitted over the same CEC bus over which the initiator transmits to the follower, and as such, Yung discloses and/or renders obvious this

limitation.

5. Claim 10

- a) [10] The method of claim 9, wherein the initiating device transmits a second data packet after receipt of the ACK message from the following device.**

218. It is my opinion that Yung discloses and/or renders obvious this limitation, and, in addition, Yung in view of HDMI 1.3 also renders obvious this claim.

219. First, Yung discloses and/or renders obvious this limitation. Referring to step 134 of Fig. 8, Yung discloses that following transmission, a transmitter's "command control unit then checks whether the transmitted byte has been acknowledged or not" by the receiving device, and if the transmission was successful, at step 136, additional "bytes are transmitted one by one until all the bytes have been transmitted." Yung, ¶38, ¶39 ("The follower continues receiving until it determines that the last command block is received (block 174) . . . [as] indicated by an EOM bit in the command block.")

220. As discussed for [1(e)] above, Yung's frames (*data packets*) are comprised of "command blocks" comprised of "bytes," such as "header and data bytes," and may be in the format of CEC frames. Yung, ¶33 ("Once the recognizable command is determined to be valid, the fields of header and data bytes are converted into command blocks for transmission."), ¶34 (stating that "commands are transmitted in frames" and the command block format may be that provided in the CEC protocol).

221. As discussed for claim 9 above, it is my opinion that “the transmitted byte [that is] acknowledged or not” in Yung would be understood to be the ACK bit at the end of a command block of a frame (a first data packet). Therefore, it is my opinion that a POSITA would have understood that the bytes transmitted by the transmitter after receipt of an acknowledgement “until all bytes have been transmitted” and “until the last command block is received” would have constituted transmitting an additional CEC frame, which would be a *second data packet* transmitted after acknowledgment of the ACK bit in the first data packet (i.e., *the initiating device transmits a second data packet after receipt of the ACK message from the following device*).

222. In my opinion, to the extent it is argued that Yung does not disclose or render obvious this limitation, Yung in view of HDMI 1.3 renders obvious this limitation. HDMI 1.3 teaches that, for certain messages, an ACK bit can be “negatively acknowledged” by the follower device adjusting a “1” ACK bit to a “0” ACK bit (an *ACK message*), indicating to the initiator that the message/frame has been “rejected” by the follower. HDMI 1.3, at CEC-11 to CEC-12.

223. In my opinion, in such a case, a frame can be re-transmitted, which a POSITA would have understood to constitute the transmitting of a new frame (*second packet*) given that the first frame was rejected and is, therefore, lost. *Id.* at CEC-12. Therefore, it is my opinion that a POSITA would have understood this to constitute *wherein the initiating device transmits a second data packet after receipt of the ACK*

message from the following device.

6. Claim 12

a) [12(pre)] A transmitting device comprising:

224. See claim element [1(pre)] in Sec. IX.A.1.a). Additionally, it is my opinion that Yung discloses a “*transmitting device*” as a “content playback device 10₁” in Fig. 1B. Yung, ¶27.

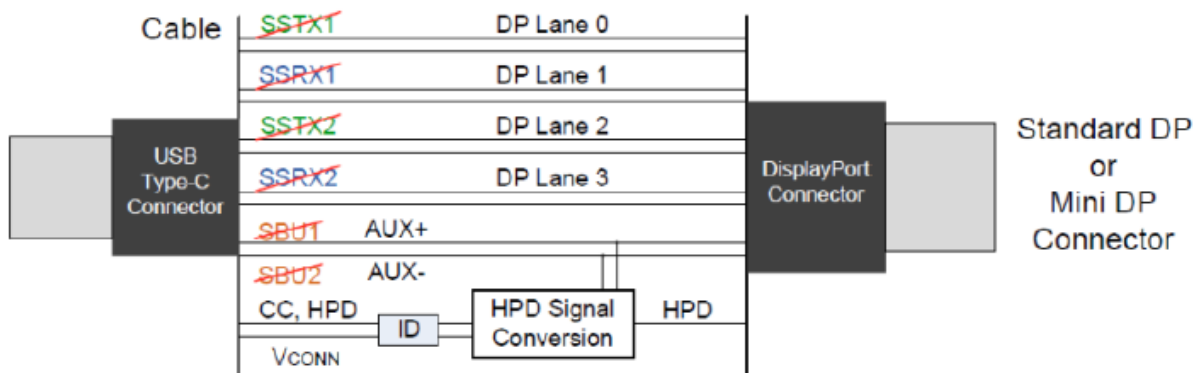
b) [12(a)] a connection to a single first control bus, the first control bus being a bi-directional, single-line bus, wherein the transmitting device is operable for coupling with a receiving device via the first control bus;

225. It is my opinion that Yung discloses and/or renders obvious this element for the same reasons set forth above for [1(a)]. Further, Yung discloses that its CEC bus, such as CEC bus 12, can be “referred to as a command line, or command bus” (*control bus*) and that “[t]he CEC bus preferably consists of a **single**, bi-directional line.” Yung, ¶12.

226. In my opinion, to the extent *the transmitting device comprising a connection to a single first control bus* is not limited to a connection to one and only one control bus and is instead broad enough to encompass a transmitting device being connected to more than one control bus, as Patent Owner contends in parallel litigation, then Yung discloses this limitation. Specifically, under this interpretation of Patent Owner, Yung’s CEC bus is a “**single first control bus**” notwithstanding that Yung’s

transmitting device (e.g., device 10₁) is also connected to Yung's receiving device (e.g., device 10₅) by HDMI cable 11, and in addition by way of CEC bus 12.

227. In particular, I understand that in its district court preliminary infringement contentions attached to the complaint, Patent Owner accuses, *inter alia*, products employing DisplayPort Alt Mode on USB-C. Ex. 1010, 1-3. Patent Owner maps the “single first control bus” to the “CC bus” of USB4. *Id.* at 5-8. However, as is clear from Patent Owner's contentions, the CC bus is not the only control bus present to which the transmitter is connected. As shown in the following figure from a DisplayPort Alt Mode overview (quoted in the preliminary infringement contentions), the USB Type-C connector includes multiple control buses, including AUX, HPD, and VCONN in addition to the CC bus, and the DisplayPort side includes multiple control buses, including AUX and HPD:



Id. at 12.

228. Thus, Patent Owner interprets “single first control bus” as not requiring a connection to one and only one control bus, but as encompassing a connection to

multiple control buses. In my opinion, under this interpretation, Yung's CEC bus 12 is a "single first control bus."

- c) **[12(b)] logic to convert each of one or more control signals into a data packet, each of the one or more control signals being one of a plurality of different types of control signals for a standard protocol, each data packet including a plurality of bits to be transmitted;**

229. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner's position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation and, in addition, Yung in view of HDMI 1.3 also renders obvious this limitation for the reasons set forth above for [1(e)].

230. For example, Yung explains that its flowcharts and description (including Figures 8-9, for example) "conceptually illustrate **the logic**; [though] the particular computer language used to implement **the logic** may vary, depending on the programmer's preference." Yung, ¶33. Yung further discloses that the features of the invention can be implemented in "a general purpose or special purpose processor[, which] could be realized using an ASIC, a logic array, or other special purpose circuitry. Alternatively, the functions could be accomplished using hard-wired **logic circuits**, custom circuits, and the like." Yung, ¶43.

- d) **[12(c)] a transmitter, the transmitter to transmit the data packets to the receiving device on the first control bus; and**

231. It is my opinion that Yung discloses and/or renders obvious this element for the reasons set forth above for [1(f)]. It is also my opinion that a POSITA would have understood that Yung's "content playback device 10₁" in Fig. 1B includes a transmitter because of its transmitting function.

- e) **[12(d)] logic to arbitrate use of the first control bus, the logic to arbitrate use being operable to: determine whether the control bus is in use by the receiving device, and**

232. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner's position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation for the reasons set forth above for [1(b)], [1(c)], and [1(d)].

233. For example, Yung explains that its flowcharts (including Figures 5-8, which illustrate the arbitration process) "conceptually illustrate the logic; the particular computer language used to implement the logic may vary, depending on the programmer's preference." Yung, ¶33. As explained above for [12(b)], Yung discloses that the features of the invention, such as the disclosed arbitration, can be implemented in "a general purpose or special purpose processor[, which] could be

realized using an ASIC, a logic array, or other special purpose circuitry. Alternatively, the functions could be accomplished using hard-wired logic circuits, custom circuits, and the like.” Yung, ¶43.

- f) **[12(e)] if the first control bus is not in use by the receiving device, conduct arbitration for control of the first control bus, and**

234. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner’s position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation for the reasons set forth above for [1(c)].

- g) **[12(f)] wherein the receiving device is a device utilizing the standard protocol and the transmitting device is a mobile device utilizing a modified protocol, the modified protocol being a modification of the standard protocol that is not included in the standard protocol.**

235. It is my opinion that Yung in view of HDMI 1.3’s HDMI-C protocol renders obvious this element for the reasons set forth above for [1(g)].

7. Claim 15

- a) **[15] The transmitting device of claim 12, further comprising a switchable pull-up circuit coupled with the first control bus.**

236. It is my opinion that Yung in view of HDMI 1.3 renders obvious this element.

237. HDMI 1.3 discloses that a “pull-up circuit” can be “disconnected from the CEC line when the device is off.” HDMI 1.3, at CEC-6; *see also* HDMI 1.3, at 52. Accordingly, it is my opinion that a POSITA would have understood that the pull-up circuit connected with the CEC line (“*pull-up circuit coupled with the first control bus*”) is switchable between being a pull-up circuit and a pull-down circuit, as disclosed in the ’520 patent. *See* ’520 patent, 4:4-9.

8. Claim 18

- a) **[18] The transmitting device of claim 12, wherein the logic to arbitrate use of the first control bus is further operable to take control of the first control bus if the transmitting device and the receiving device arbitrate use of the first control bus at the same time.**

238. It is my opinion that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner’s position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation for the reasons set forth above for [1(c)] with regard to the second arbitration scenario taught by Yung in which the transmitting device and receiving device arbitrate use of the first control bus at the same time.

239. Further, it is my opinion that Yung discloses that the transmitting device can win the arbitration and take control of the first bus in this second scenario, as

explained above for [1(c)]. Yung further discloses that the features of the invention can be implemented in “a general purpose or special purpose processor[, which] could be realized using an ASIC, a logic array, or other special purpose circuitry. Alternatively, the functions could be accomplished using hard-wired logic circuits, custom circuits, and the like.” Yung, ¶43.

9. Claim 19

a) [19(pre)] A receiving device comprising:

240. It is my opinion that Yung discloses and/or renders obvious this element for the reasons set forth above for 1[a]. It is also my opinion that Yung discloses a “*receiving device*” as a “display device 105” in Fig. 1B. Yung, ¶27.

b) [19(a)] a connection to a single first control bus, the first control bus being a bi-directional, single-line bus wherein the receiving device is operable for coupling with a transmitting device via the first control bus;

241. It is my opinion that at least under UCT’s interpretation of this limitation for purposes of infringement, Yung discloses and/or renders obvious this element for the same reasons set forth above for [12(a)] and [1(a)]. Like [12(a)], UCT maps “single first control bus” of [19(a)] to the USB CC bus in either HDMI Alt Mode or DisplayPort Alt Mode over USB-C. Thus, for purposes of infringement, UCT proposes that “single first control bus” does not require a connection to one and only one control bus. It is my opinion that, at least as interpreted by UCT for purposes of infringement, the CEC bus of Yung and/or HDMI 1.3 is a “single first control bus.”

- c) **[19(b)] a receiver to receive one or more data packets on the first control bus, each of the one or more data packets representing one of a plurality of different types of control signals;**

242. It is my opinion that Yung discloses and/or renders obvious this element, and, in addition, Yung in view of HDMI 1.3 also renders obvious this element for the reasons set forth above for [1(e)] and [1(f)].

- d) **[19(c)] logic to convert each of the one or more data packets into a control signal; and**

243. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner's position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation for the reasons set forth above for [1(e)].

244. Further, Yung teaches that the command blocks of the CEC frames (*data packets*) are received by the receiver/follower, which "strips off the acknowledge bit and end of message bit" of the blocks and then "combines and converts them into a command after all blocks are received, and sends it to the host control unit" (*the receiver . . . convert[ing] each of the one or more data packets into a control signal*). Yung, ¶39, Fig. 9. Yung explains that its flowcharts and description (including Figures 8-9, for example) "conceptually illustrate the logic; the particular computer language

used to implement the logic may vary, depending on the programmer's preference."

Yung, ¶33. Yung further discloses that the features of the invention can be implemented in "a general purpose or special purpose processor[, which] could be realized using an ASIC, a logic array, or other special purpose circuitry. Alternatively, the functions could be accomplished using hard-wired logic circuits, custom circuits, and the like." Yung, ¶43.

- e) **[19(d)] logic to arbitrate use of the first control bus, the logic to arbitrate use being operable to: determine whether the control bus is in use by the transmitting device, and**

245. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner's position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation for the reasons set forth above for claim elements [1(b)], [1(c)], and [1(d)].

246. Further, Yung discloses and/or renders obvious that the second device or receiver may determine whether the control bus is in use by the transmitting device, such as by the receiver receiving "an interrupt" indicating the bus is in use by the transmitter and switching to a follower mode. Yung, ¶¶36, 37. In addition, Yung discloses that the command control units 26 of its HDMI nodes 10 can operate as both

transmitters and receivers (or initiators and followers). Yung, ¶¶26, 28, 35. As such, it is my opinion that Yung's disclosures with regard to the arbitration performed by its command control units and the determining of whether the CEC bus is in use, including that for element [1(c)] above, applies to both receivers and transmitters operating as initiators and followers, respectively, and vice versa. Yung, ¶¶36-38.

247. Yung explains that its flowcharts (including Figures 5-8, which illustrate the arbitration process) "conceptually illustrate the logic; the particular computer language used to implement the logic may vary, depending on the programmer's preference." Yung, ¶33. Yung further discloses that the features of the invention can be implemented in "a general purpose or special purpose processor[, which] could be realized using an ASIC, a logic array, or other special purpose circuitry. Alternatively, the functions could be accomplished using hard-wired logic circuits, custom circuits, and the like." Yung, ¶43.

f) [19(e)] if the first control bus is not in use by the transmitting device, conduct arbitration for control of the first control bus, and

248. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner's position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders

obvious this limitation for the reasons set forth above for [1(c)].

249. Further, it is my opinion that a POSITA would have understood that either or both of the receiving and transmitting devices can conduct arbitration for the control of the command bus if the bus is not in use by the other, as discussed above for [19(d)]. Yung explains that its flowcharts (including Figures 5-8, which illustrate the arbitration process) “conceptually illustrate the logic; the particular computer language used to implement the logic may vary, depending on the programmer’s preference.” Yung, ¶33. Yung further discloses that the features of the invention can be implemented in “a general purpose or special purpose processor[, which] could be realized using an ASIC, a logic array, or other special purpose circuitry. Alternatively, the functions could be accomplished using hard-wired logic circuits, custom circuits, and the like.” Yung, ¶43.

- g) [19(f)] wherein the receiving device is a device utilizing the standard protocol and the transmitting device is a mobile device utilizing a modified protocol, the modified protocol being a modification of the standard protocol that is not included in the standard protocol.**

250. It is my opinion that Yung in view of HDMI 1.3’s HDMI-C protocol renders obvious this element for the reasons set forth above for [1(g)].

10. Claim 25

- a) **[25] The receiving device of claim 19, wherein the logic to arbitrate use of the first control bus is further operable to allow the transmitting device to take control of the first control bus if the transmitting device and the receiving device arbitrate use of the first control bus at the same time.**

251. I understand that Patent Owner has proposed in the co-pending litigation against Dell that this limitation requires no construction and is not governed by 35 U.S.C. 112(6). In my opinion, under Patent Owner's position that this limitation is not a means-plus-function limitation and instead encompasses any form of logic, which Petitioners adopt for purposes of this proceeding only, Yung discloses and/or renders obvious this limitation for the reasons set forth above for [1(c)] and [18] with regard to the second arbitration scenario taught by Yung in which the transmitting device and receiving device arbitrate use of the first control bus at the same time.

252. Further, it is my opinion that Yung discloses that the transmitting device can win the arbitration and take control of the first bus in this second scenario, as explained above for [1(c)]. Yung explains that its flowcharts (including Figures 5-8, which illustrate the arbitration process) "conceptually illustrate the **logic**; the particular computer language used to implement the **logic** may vary, depending on the programmer's preference." Yung, ¶33. Yung further discloses that the features of the invention can be implemented in "a general purpose or special purpose processor[, which] could be realized using an ASIC, a **logic** array, or other special purpose

circuitry. Alternatively, the functions could be accomplished using hard-wired **logic** circuits, custom circuits, and the like.” Yung, ¶43.

B. Ground II: Claim 2, 13, and 20 Are Obvious Under 35 U.S.C. § 103 over Yung in View of HDMI 1.3 in further view of Al-Alawi

1. Claim 2

- a) [2] **The method of claim 1, wherein the signaling for transmitting the one or more generated data packets on the first control bus utilizes bi-phase mark encoding.**

253. It is my opinion that Yung discloses and/or renders obvious this element, and, in addition, Yung in view of Al-Alawi renders obvious this element.

254. Yung discloses and/or renders obvious *transmitting the one or more generated data packets on the first control bus* for the same reasons as set forth above for [1(f)], because Yung teaches transmitting CEC frames over the CEC bus from a transmitter, such as playback device 10₁ in Fig. 1B, to a receiver, such as display device 10₅. Yung, ¶¶4, 11, 34, 27, 38. Further, when transmitting CEC frames comprised of command blocks, Yung teaches converting command blocks of CEC frames to “*signaling*” and transmitting that signaling onto the command bus (*signaling for transmitting the one or more generated data packets on the first control bus*). Yung, ¶38, Fig. 8 (blocks 126 and 128, which “convert[] the header block [or] data block to signaling” and blocks 127 and 134, which “transmit[] the signaling” onto the CEC bus).

255. In addition, Yung discloses that its “10-bit command block[s]” are

“converted to command signaling by converting 0s into logical 0s, and 1s into logical 1s (block 128).” Yung, ¶38, Fig.8. Yung teaches that logical 0s can be distinguished from logical 1s using the CEC protocol’s approach of using “durations of high and low voltages” (also known as “bit timing”) or they can be distinguished by using different voltage levels to represent logical 0s and logical 1s. Yung, ¶¶38-39. However, Yung teaches that this is flexible as “[t]he implementation of logical 0s and logical 1s can be defined by the designers, providing the implementation is recognizable by both initiators and followers.” Yung, ¶38.

256. It is my opinion that a POSITA would have understood from the CEC protocol as it existed prior to Yung’s filing that the CEC approach of using “bit timing” as taught by Yung would have involved defining the starting point of data bits “by a high to low transition” such that “[t]he high to low transition at the end of a data bit is the start of the next data bit.” HDMI 1.0 at CEC-6. In my opinion, this approach is similar to and consistent with the ’520 patent’s description of “bi-phase mark encoding,” in which “each bit of data is represented by two logical states, such as a “logical ‘0’” and a “logical ‘1,’” and in which “the first state of a symbol is always different from the last state of a previous symbol.” Ex.1001, 3:23-31.

257. Therefore, it is my opinion that Yung discloses or at least renders obvious *utiliz[ing] bi-phase mark encoding* for the signaling for transmitting Yung’s CEC frames (*packets*) comprised of bits.

258. In my opinion, in the event it is argued that Yung does not disclose *utiliz[ing] bi-phase mark encoding*, this would have been obvious over Yung in view of Al-Alawi. Al-Alawi discloses a data transmission system, which includes a “Bi-Phase encoder circuit that can handle the change in the baseband encoding scheme.” Al-Alawi, Sec. 1. Al-Alawi’s Bi-Phase encoder circuit can use “Bi- Φ -M,” which it describes as “Bi-Phase Mark” encoding, which “belong[s] to the Bi-Phase code family which is characterized by having at least one transition per bit time.” *Id.*, Sec. 1.

259. Al-Alawi describes this “Bi- Φ -M” (Bi-Phase Mark) code as a code in which “a transition is present at the start of every transmitted bit, with ‘1’ represented by an additional transition at the middle of the bit period.” *Id.*, Sec. 2. Therefore, it is my opinion that Al-Alawi discloses *utiliz[ing] bi-phase mark encoding*.

260. For at least the reasons explained for above at Sec. VIII.B.2, it is my opinion that a POSITA would have been motivated to implement Al-Alawi’s Bi-Phase Mark encoding into Yung as a means of implementing Yung’s logical 1s and 0s, which Yung teaches can be implemented by designers. Yung, ¶4, 38; Al-Alawi, Sec. 1.

2. Claim 13

- a) **[13] The transmitting device of claim 12, wherein the transmitter is to drive the first control bus in a bi-phase mark signaling manner.**

261. It is my opinion that Yung discloses and/or renders obvious this element, and, in addition, Yung in view of Al-Alawi renders obvious this element for the same

reasons as set forth for claim [2] above.

3. Claim 20

- a) **[20] The receiving device of claim 19, wherein the receiver is operable to decode the one or more received data packets according to bi-phase mark encoding.**

262. *See* claim [2] above. It is my opinion that a POSITA would have understood that upon receipt of Bi-Phase Mark encoded data, the receiving device must decode the data as received in data packets using the Bi-Phase Mark decoding technique so that a playback device such as a TV can display video data and reproduce audio data.

X. AVAILABILITY FOR CROSS-EXAMINATION

263. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during a time as mutually agreed between the parties.

XI. RIGHT TO SUPPLEMENT

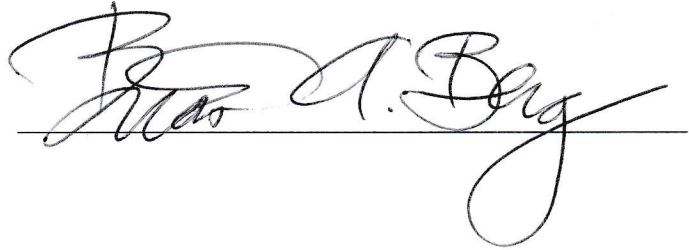
264. I reserve the right to supplement my opinions in the future to respond to any arguments that the Patent Owner raises. This declaration represents only those opinions that I have formed to date. I reserve the right to revise, supplement,

and/or amend my opinions stated herein based on new information that becomes available to me and on my continuing analysis of the materials already provided.

XII. JURAT

265. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

I, BRIAN A. BERG, declare under penalty of perjury
under the laws of the United States of America that the foregoing is true and
current.

A handwritten signature in cursive script, reading "Brian A. Berg", is written over a horizontal line.

Executed on 1 October 2024