

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICROCHIP TECHNOLOGY INC.,
Petitioner,

v.

APTIV TECHNOLOGIES AG AND APTIV TECHNOLOGIES LIMITED,
Patent Owners.

Case No. IPR2024-00228
U.S. Patent No. 9,619,420

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,619,420**

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LISTING OF EXHIBITS

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1001	U.S. Patent No. 9,460,037 (“’037 Patent”)
1002	Patent Prosecution History for U.S. Patent No. 9,460,037
1003	U.S. Patent No. 9,619,420 (“’420 Patent”)
1004	Patent Prosecution History for U.S. Patent No. 9,619,420
1005	U.S. Patent No. 9,645,962 (“’962 Patent”)
1006	Patent Prosecution History for U.S. Patent No. 9,645,962
1007	U.S. Patent No. 10,545,899 (“’899 Patent”)
1008	Patent Prosecution History for U.S. Patent No. 10,545,899
1009	U.S. Patent No. 11,176,072 (“’072 Patent”)
1010	Patent Prosecution History for U.S. Patent No. 11,176,072
1011	U.S. Patent No. 11,681,643 (“’643 Patent”)
1012	Patent Prosecution History for U.S. Patent No. 11,681,643
1013	Declaration of Eric Welch
1014	U.S. Patent Publication No. 2006/0206650 (“Chang”)
1015	U.S. Patent Publication No. 2009/0268743 (“Chang II”)
1016	U.S. Patent Publication No. 2004/0019732 (“Overtoom”)
1017	U.S. Patent Publication No. 2006/0195625 (“Hesse”)
1018	<i>Universal Serial Bus Specification</i> , Revision 2.0, April 27, 2000 (“USB 2.0 Specification”)
1019	<i>Universal Serial Bus Type-C Cable and Connector Specification</i> , Revision 1.2, March 25, 2016

Exhibit	Description
1020	<i>Universal Serial Bus Power Delivery Specification</i> , Rev. 3.0, V1.0a, March 25, 2016
1021	<i>Universal Serial Bus Implementers Forum Full and Low Speed Electrical and Interoperability Compliance Test Procedure</i> , Revision 1.3, February 2004
1022	<i>On-The-Go and Embedded Host Supplement to the USB Revision 2.0 Specification</i> , Revision 2.0 version 1.1a, July 27, 2012 (the “OTG Supplement”)
1023	<i>Universal Serial Bus 3.0 Specification</i> , Revision 1.0, November 12, 2008 (“USB 3.0 Specification”)
1024	Declaration of Jeffrey L. Ravenscraft re USB Specifications.
1025	U.S. Patent No. 8,683,085 (“Castleberry”)
1026	INTENTIONALLY OMITTED
1027	INTENTIONALLY OMITTED
1028	INTENTIONALLY OMITTED
1029	U.S. Patent No. 8,447,598 (“Chutorash”)
1030	U.S. Patent No. 8,694,803 (“Rafiee”)
1031	GL620USB-A: GeneLink USB PC-to-PC Networking Controller, Specification 1.6, November 17, 2000
1032	U.S. Patent Publication No. 2008/0005262 (“Wurzburg”)
1033	U.S. Patent Publication No. 2007/0255885 (“Bohm ’885”)
1034	U.S. Patent No. 7,162,566 (“Lin”)
1035	<i>PL-2501 Product Brochure</i> , Prolific Technology Inc., September 11, 2002
1036	<i>NET1080 USB TurboCONNECT Preliminary Specification</i> ,

Exhibit	Description
	Revision 0.6, NetChip Technology, Inc., January 31, 2000
1037	<i>M5632 Preliminary Product Brief</i> , ALi Corporation, September 15, 2002
1038	U.S. Patent No. 7,085,876 (“Lai”)
1039	U.S. Patent Publication No. 2009/0185559 (“Chen”)
1040	U.S. Patent No. 3,916,380 (“Fletcher”)
1041	U.S. Patent No. 7,057,413 (“Young”)
1042	U.S. Patent Publication No. 2006/0227759 (“Bohm ’759”)
1043	Oral Order, dated December 19, 2017 in <i>Microchip Technology Incorporated v. Delphi Automotive Systems, LLC et al.</i> , Case No. 1:17-cv-01194-JDW (D. Del.)
1044	INTENTIONALLY OMITTED
1045	Aptiv Technologies Limited’s Responses and Objections to Microchip Technology Inc.’s First Set of Interrogatories (Nos. 1-11), dated June 12, 2023 in <i>Aptiv Technologies AG, v Microchip Technology Inc.</i> , Case No. 1:23-cv-00307-JDW (D. Del.)
1046	U.S. Patent Publication No. 2007/0156293 (“Kellzi”)
1047	U.S. Patent No. 7,502,878 (“Wright”)
1048	INTENTIONALLY OMITTED
1049	<i>USB in Automotive: Not Just for PCs Anymore</i> , Brian Ellis, Cypress Semiconductor Corp., Electronic Product News, September 1, 2006
1050	<i>The Car Entertainment System</i> , Niels Koch (published as Chapter 23 in Part 5 (“Infotainment and Navigation Systems” of <i>New Trends and Developments in Automotive System Engineering</i> , Marcello Chiaberge (Editor), InTech, 2011 (2014 Reprint))

Exhibit	Description
1051	<i>The Car Entertainment System</i> , Niels Koch (published as Chapter 23 in Part 5 (“Infotainment and Navigation Systems” of New Trends and Developments in Automotive System Engineering, Marcello Chiaberge (Editor), IntechOpen, 2011)
1052	U.S. Patent No. 9,864,711 (“Wang”)
1053	U.S. Patent Publication No. 2004/0088449 (“Sakaki”)
1054	Anchor Chips Single-Chip EZ-Link (AN2720SC), product brochure dated November 1998
1055	<i>CMOS Circuit Design, Layout, and Simulation</i> , R. Jacob Baker, IEEE Press, 1st Edition (1998) (“Baker”)
1056	Library of Congress Catalog Record for <i>CMOS Circuit Design, Layout, and Simulation</i> , R. Jacob Baker, IEEE Press, 1st Edition (1998)
1057	U.S. Copyright WebVoyage Record for <i>CMOS Circuit Design, Layout, and Simulation</i> , R. Jacob Baker, IEEE Press, 1st Edition (1998)
1058	Declaration of Mariellen F. Calter re <i>CMOS Circuit Design, Layout, and Simulation</i> , R. Jacob Baker, IEEE Press, 1st Edition (1998)
1059	Fairchild Semiconductor USB Switch listing from October 16, 2011 printed from Internet Archive Wayback Machine
1060	Fairchild Semiconductor FSUSB63 3:1 High-Speed USB 2.0 Switch / Multiplexer, dated November, 2010
1061	Internet Archive Affidavit of Nathaniel E Frank-White re Exhibits 1031, 1035, 1037 and 1054
1062	Internet Archive Affidavit of Nathaniel E Frank-White re Exhibits 1036, 1049, 1050/1051, and 1058

Exhibit	Description
1063	Maxim 4989 Datasheet (USB 2.0 Hi-Speed 2-of-4 Crosspoint Switch), dated August 2008
1064	Cypress Semiconductor AN96527 - Designing USB Type-C Products Using Cypress's CCG1 Controllers, dated June 3, 2015
1065	Internet Archive Affidavit of Nathaniel E Frank-White re Exhibits 1059, 1063, 1064, 1068, and 1071
1066	U.S. Patent No. 9,104,821 ("Dunstan")
1067	U.S. Patent Publication No. 2010/0265179 ("Ram")
1068	Fairchild Semiconductor FSUSB30 Low-power, Two-Port, High-Speed USB2.0 Switch, dated January 2007
1069	<i>The ART of Electronics</i> , P Horowitz and W. Hill, Cambridge University Press, 2 nd Edition (1989)
1070	<i>Universal Serial Bus: Micro-USB Cables and Connectors Specification</i> , Revision 1.01, April 4, 2007
1071	Fairchild Semiconductor FSA880 / FSA881 – USB Port 2:1 Switch with Accessory and Charger Detection, dated November 2011
1072	Aptiv's Supplemental Infringement Contentions (Redline), dated November 8, 2023 in <i>Aptiv Technologies AG, v Microchip Technology Inc.</i> , Case No. 1:23-cv-00307-JDW (D. Del.) [PROTECTIVE ORDER MATERIAL - FILED UNDER SEAL]
1073	Microsoft Computer Dictionary, 4 th ed., Microsoft Press, 1999 ("Microsoft Dictionary")
1074	STMicrosystems, RM0033 Reference Manual, STM32F205xx, STM32F207xx, STM32F215xx and STM32F217xx advanced ARM-based 32-bit MCUs, Doc ID 15403 Rev 2, December 2010
1075	Joint Claim Construction Statement (Dkt. No. 115), dated December 6, 2023 in <i>Aptiv Technologies AG, v Microchip Technology Inc.</i> , Case No. 1:23-cv-00307-JDW (D. Del.)

I. INTRODUCTION

Petitioner requests *inter partes* review (“IPR”) of claims 1-12 and 15-17 (the “Challenged Claims”) of U.S. Pat. 9,619,420 (the “’420 patent,” EX1003).

The ’420 patent purports to solve the “problem” of connecting an upstream USB host via a hub to a downstream USB product that may operate in either host or device mode.¹ See EX1003, 3:18-45, 4:3-11. The Challenged Claims allegedly solve this problem by adding two well-known components (*viz.*, a “routing switch” and “bridge”) to a standard USB hub. See *id.*, claim 1. The purported novelty is routing USB communications (1) through the bridge (for a host-to-host connection) or (2) around the bridge (for a host-to-device connection), depending on whether the downstream USB product is operating in host or device mode. *Id.*, 4:13-30. Combining Chang (EX1014) and Chang II (EX1015) renders the Challenged Claims obvious.

In particular, Chang’s USB hub already added a bridge for host-to-host communications. EX1014, Fig. 3.

¹ The ’420 patent is written in the context of “dual-role” USB products, *e.g.*, a smartphone, that can operate as either host or device. See EX1003, 2:56-63.

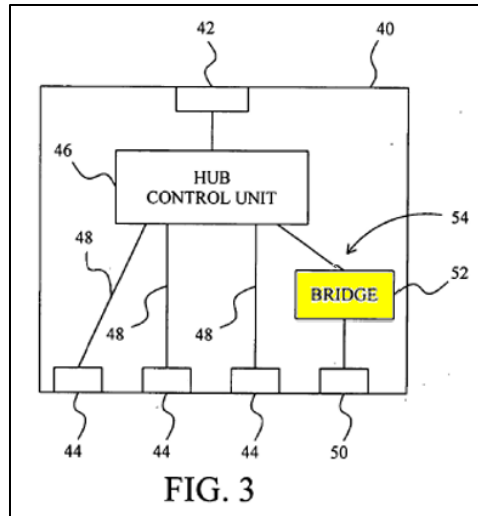


FIG. 3

CHANG

Chang did not use a bypass path (or switch), because Chang used a dedicated host port instead of a dual-role port (*i.e.*, a port supporting products that could operate in either host or device mode). *Id.*

Chang II, however, supported dual-role products and selected a bypass route based on the host/device determination of the “detection unit.” EX1015, Fig. 5.

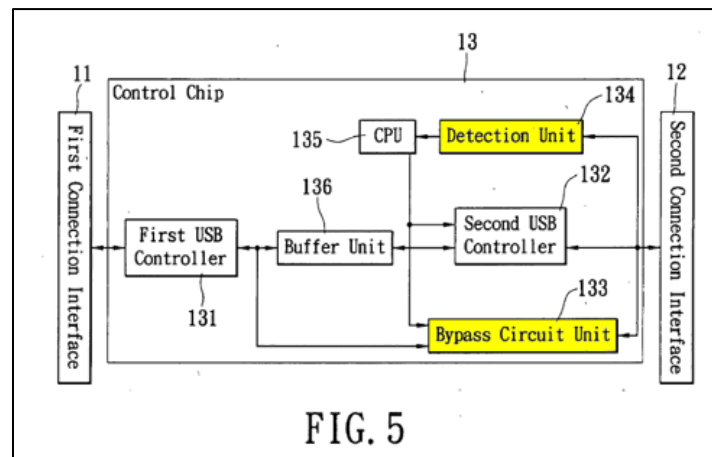


FIG. 5

CHANG II

Indeed, dual-role products were well-known to POSITAs well before the '420

patent priority date. *See id.*, 2:51-59 (leading smartphone manufacturers already “support[ed] both USB Host and USB Device roles” before 2013). Castleberry expressly teaches that dedicated ports (like Chang) “add[ed] overhead and increase[d] the cost associated with devices that are implemented with both Host and Device functionality.” EX1025, 1:41-43. Accordingly, it would have been obvious to a POSITA to apply Chang II’s teachings and the knowledge of a POSITA (*viz.*, dual-role port with bypass path) to Chang, rendering the Challenged Claims obvious. Petitioner respectfully requests that the Board find the Challenged Claims unpatentable.

II. REQUIREMENTS FOR *INTER PARTES* REVIEW

This Petition complies with all statutory requirements and 37 C.F.R. §§42.101 et seq. and should be accorded a filing date pursuant to 37 C.F.R. §42.106.

A. Certification

Petitioner certifies the ’420 patent “is available for *inter partes* review and that the petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in the petition.” 37 C.F.R. §42.104(a).

B. Identification of Challenges and Requested Relief

Under 37 C.F.R. §§42.104(b) and 42.22, Petitioner requests that the Board institute IPR on the Challenged Claims and cancel them as unpatentable. The prior

art references combined to form the Ground are:

Exhibit	Reference	Prior Art
1014	U.S. Pub. 2006/0206650 (“Chang”) ²	Post-AIA §102(a)(2)
1015	U.S. Pub. 2009/0268743 (“Chang II”) ³	Post-AIA §102(a)(2)

The asserted Ground is:

Ground	Claim(s)	Basis for Unpatentability
1	1-12 and 15-17	Obviousness over Chang in view of Chang II and POSITA Knowledge

This Petition is supported by the Expert Declaration of Eric Welch (“Welch,” EX1013).

III. TECHNOLOGY BACKGROUND

A. USB Basics

The ’420 patent provides its disclosures against the backdrop of Universal Serial Bus (“USB”) standards and related products. *See* EX1003, 1:13-3:45. USB products were ubiquitous many years before the ’420 patent’s priority date, and a

² Chang was filed August 16, 2005 and published September 14, 2006. EX1014.

³ Chang II was filed May 22, 2008 and published October 29, 2009. EX1015. The inventors on Chang II (Chi-Tung Chang) and Chang (Ming-Te Chang) are different.

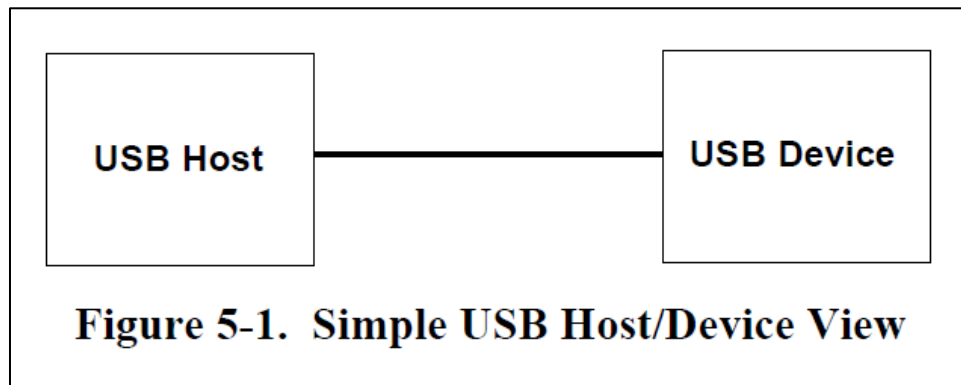
POSITA would have been intimately familiar with USB standards (*infra* §IV.C) promulgated by the USB Implementers Forum, Inc. (“USB-IF”). Among others, these included *Universal Serial Bus Specification*, Revision 2.0 (“USB 2.0 Specification,” EX1018) published in April, 2000 and *Universal Serial Bus 3.0 Specification*, Revision 1.0 published in November, 2008 (“USB 3.0 Specification,” EX1023). The USB 3.0 Specification adds higher speeds, but “has similar architectural components as USB 2.0.” EX1023, §3.1; *see also id.*, §3 (“USB 3.0 ... provides backward compatibility with USB 2.0.”). The USB industry standards contain several background concepts relevant here. Welch, ¶¶50-54.

1. Hosts and Devices

The USB specifications set forth two USB product⁴ roles: “host” and “device.” Welch, ¶55; *see also* EX1018, §4.9 (USB Host) and §5.2.2 (USB Devices). The USB architecture “connects USB devices with the USB host.” *Id.*, §4.1.1. The USB specifications employ a master/slave architecture, where the “host” (master) commands a “device” (which acts as slave). Welch, ¶¶55-58, 62-

⁴ Some literature uses the term “device” generically, referring to products that may operate as device or host. For clarity, this Petition only uses “device” to refer to USB products operating in device mode.

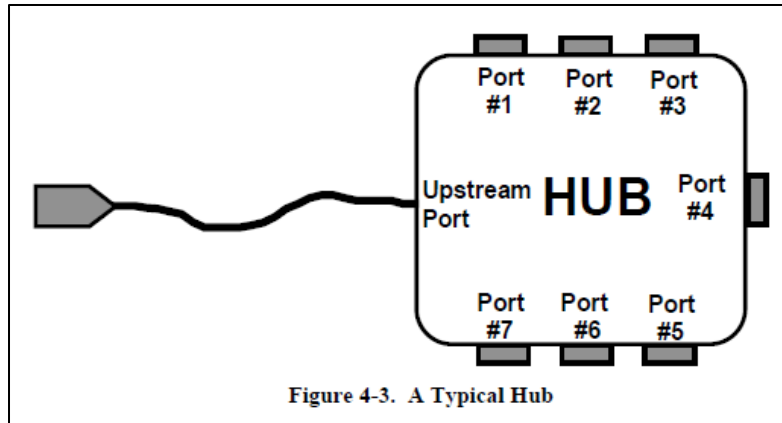
63; *see also* EX1025, 1:17-20. “The USB interconnect supports data traffic between a host and a USB device.” EX1018, 303. When first published, the USB 2.0 Specification contemplated “only one host in any USB system.” *Id.*, §4.1.1.1. In the simplest configuration, one USB host (*e.g.*, personal computer) connected to one USB device (*e.g.*, keyboard), as shown below. *Id.*, Fig. 5-1.



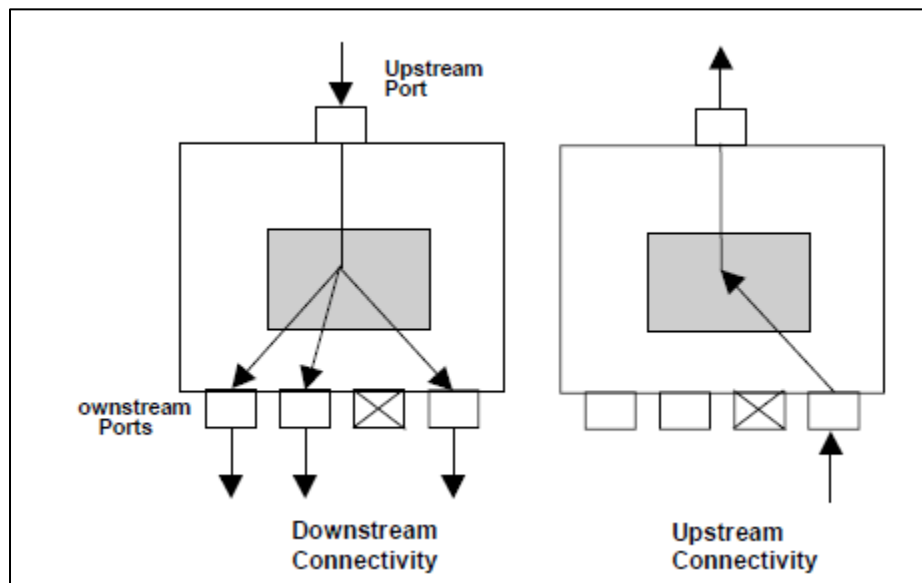
Well before 2013, other USB configurations (with additional devices and/or hosts) were both possible and well-known. *See infra* §III.A.2 (hubs) and §III.C (bridges).

2. USB Hubs

Systems with multiple USB devices have long been known. *See* EX1018, Chapter 11 (“Hub Specification”). A USB “hub” “provides additional connections to the USB.” *Id.*, 34. The hub’s attachment points are called “ports.” *Id.*, 36. “The upstream port of a hub connects the hub towards the host,” as shown in the “typical hub” below. *Id.*, 50-51. The remaining hub ports are “downstream” ports for connecting USB products. *Id.*



“In the downstream direction, hubs operate in a broadcast mode,” with upstream host communications sent to all enabled downstream devices. EX1018, 327; *see also id.*, 33, 38. USB 2.0 Specification Fig. 11-2 (below) shows both “downstream” (left) and “upstream” (right) communications.



A hub enables an upstream host (*e.g.*, PC) to simultaneously connect to multiple downstream devices (*e.g.*, keyboard, mouse, etc.). Welch, ¶¶65-68.

B. Dual-Role Products

“When the USB standard was developed, it was assumed that the Host and

Device functions were separate and permanent, meaning that a Host unit could never function as a Device unit and vice versa.” EX1025, 1:21-24. However, it was quickly recognized that certain products may sometimes act as host and other times as device. Welch, ¶¶69-73; EX1016, Abstract (discussing “dual-role devices (OTG devices)”); EX1032, [0007] (discussing “dual-role peripheral devices” such as “dual-role USB printer”), [0052] (“dual-role USB Digital Versatile Disc (DVD) read/write drive, among others.”), and [0102]; EX1033, [0040]. Thus, “the USB standard [added] the possibility of a unit that can function in either Host or Device mode.” EX1025, 1:25-27. The USB-IF standardized this functionality in *On-The-Go and Embedded Host Supplement to the USB Revision 2.0 Specification* (“OTG Supplement,” EX1022) in December, 2001. See EX1022, §1.1.

Initially called “Dual Role Device[s],” such products were later renamed “On-The-Go [OTG] Device[s].” EX1022, Revision History, 2 (replacing “Dual Role Device” with “On-The-Go Device.”). By 2009, the OTG Supplement provided for “[d]ynamic role swaps during active connections.” *Id.*; see also *id.*, §1.1. However, neither the OTG Supplement nor the USB 3.0 Specification changed the single-host architecture of USB. See EX1023, §3.1 (“The baseline structural topology ... consists of ... a single host.”). In simple terms, with OTG, one product operates as host and another as device (while the products could “swap” modes, there was always just a host-to-device connection). Welch, ¶¶59,

69-73. In contrast, the '420 patent's upstream host always operates as host regardless of whether the downstream product operates as host or device. See §IV.A.

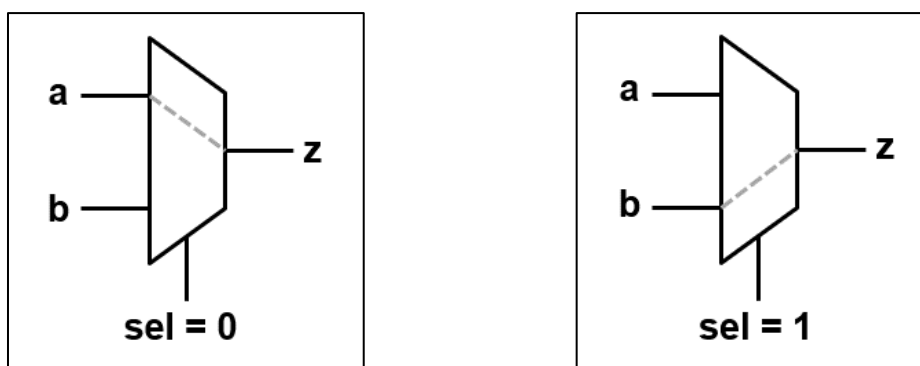
1. Host/Device Detection

Naturally, the proliferation of dual-role products was accompanied by a proliferation of dual-role ports, because dedicated ports “add[ed] overhead and increase[d] the cost associated with devices that are implemented with both Host and Device functionality.” EX1025, 1:41-43. Various prior art approaches have been used to detect host/device status. Welch, ¶¶74-87. For example, POSITAs were well aware prior to 2013 of measuring the data line pull-up/pull-down resistance values specified in the USB Specifications (*e.g.*, using a voltage divider) to determine the host/device status of connected products. *Id.*, ¶¶75-78 (discussing termination resistance requirements in USB 2.0 Specification, Chapter 7); *see also*, *e.g.*, EX1032, [0005] (explaining use of data line for host/device detection); EX1025, 7:30-52 (describing various “suitable way[s]” to detect downstream USB products).

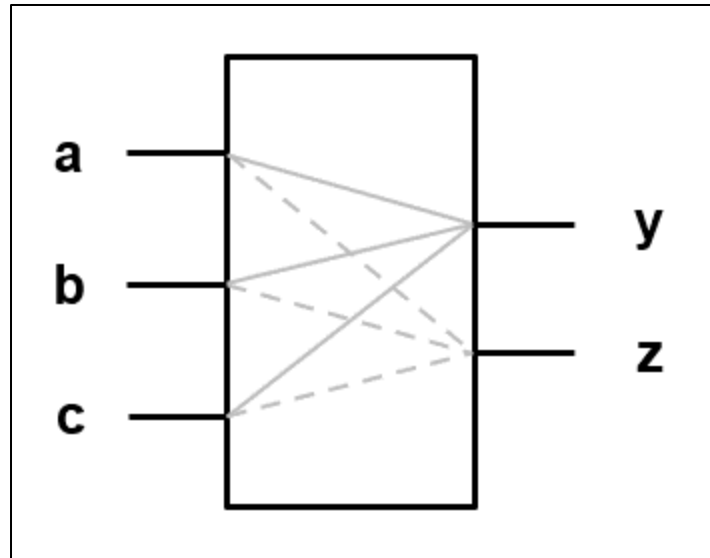
It was also well-known to POSITAs by 2013 that, in OTG implementations, the physical connector and “ID Pin” could be used to ascertain host/device status. See EX1022, §3.1.1, §4.2.4; Welch, ¶81.

2. Routing Switches

Various switches, multiplexers, and the like have existed for many decades. See, e.g., EX1040 (describing “switch controller”). Such components connect particular input and output ports, typically for signal routing purposes. Welch, ¶88. For example, the well-known 2:1 multiplexing switch, shown below, enables connecting either signal “a” or “b” to signal “z” via the “sel” (select) control signal. *Id.*, ¶89.



Commercial USB multiplexers were likewise well-known. See EX1059; EX1060; EX1068; Welch, ¶¶90-91. Where multiple input **and** multiple output ports exist, the well-known crossbar switch can route any input to any output. See, e.g., EX1040, 4:39-5:29; Welch, ¶¶91-92. An exemplary 3x2 crossbar switch (without control logic/signals shown) is illustrated below. *Id.*, ¶¶91-94.



3x2 Crossbar Switch

Note that crossbar switches are often built from multiplexers. See, *e.g.*, EX1041, 1:31-36 (showing “multiplexer implementation of the crossbar switch.”); Welch, ¶¶92-94. Of course, multiplexers and crossbars come in many shapes and sizes with different numbers of input/output ports. EX1059; see also, *e.g.*, EX1063 (MAX4989 commercial 2x4 USB crosspoint switch from Maxim Integrated Products). Multiplexers, crossbars, and related signal routing circuits were basic, easy-to-use electronic building blocks well-known to POSITAs before 2013. *Id.*; see also EX1041, 1:20-36 (crossbar switch); EX1055, 284-288; Welch, ¶¶88-96.

C. Host-to-Host Bridges

It was sometimes desirable to connect two USB hosts, *e.g.*, connecting two PCs (each a USB host) to share/transfer files. See, *e.g.*, EX1034, 5:56-59; EX1035; Welch, ¶97. While the USB 2.0 Specification did not expressly describe

host-to-host connections, such connections could still comply with the USB 2.0 Specification. *See, e.g.*, EX1034, 7:7-11 (“USB specification revision 2.0 compliant,”); EX1035 (“Full compliance with the USB Specification v2.0”); EX1037 (“USB Specification revision 2.0 Compliant”). The mechanism creating a host-to-host connection was often called a “bridge,”⁵ and prior to 2013 USB host-to-host bridges were very well-known to POSITAs. *See, e.g.*, EX1034 (filed in 2004), Abstract (“transferring information between two hosts”); EX1035 (2002 product brochure) (“USB Host-to-Host Bridge Controller”); EX1038, 1:38-40 (discussing “USB bridge” circa 2003); EX1031 (commercial prior art bridge); EX1036 (same); EX1037 (same); EX1039, [0004] (connecting hosts through “USB bridge”); EX1015, [0002] (same). Indeed, in 2005, USB bridges were so well-known that Chang called them “prior art” which need “not [be] described in detail.” EX1014, [0020]; Welch, ¶¶98-99.

IV. THE '420 PATENT

The '420 patent (EX1003) is titled “Flexible Mobile Device Connectivity to Automotive Systems with USB Hubs” and claims priority through a provisional application to September 26, 2013, making it a post-AIA patent. The '420 patent

⁵ The term “bridge” is descriptive—similar to a bridge connecting two riverbanks, a USB “bridge” connects two hosts.

contains twenty claims.

A. Patent Summary

The '420 patent "BACKGROUND" (including Figs. 1-3) reprises the roles of USB hosts, devices, and hubs, largely as described in the USB 2.0 Specification. For example, the '420 patent explains that USB employs an architecture that connects a "USB host or master" with "a USB device or slave." EX1003, 1:33-38. The '420 patent further states that additional USB ports are provided by "USB Hubs" which "allow a single USB host to connect to multiple USB devices." *Id.*, 1:66-2:2.

Similarly, the '420 patent discusses the OTG Supplement, which provides "dual-role" functionality, where USB products can "act as either USB host or USB device." EX1003, 3:18-24. Concerning smartphones in particular, the '420 specification states it is "not surprising" that "thinking has shifted towards viewing smart phones as the USB host" because "this is exactly how laptops and PCs work today." *Id.*, 2:62-66.

Against this backdrop, the '420 patent observes that traditional "USB hubs do not support OTG" and cannot support a downstream host (*viz.*, a smartphone cannot be host). EX1003, 3:28-29. The '420 patent further rejects using "custom USB hubs" that support OTG because swapping host/device roles disconnects "all other downstream ports of the USB hub[]." *Id.*, 3:46-67.

Fig. 4 illustrates the '420 patent's purported novel solution, viz., adding two components (routing switch and host-to-host bridge) to a traditional USB hub. *See, e.g.*, EX1003, 5:21-24, 5:46-6:63. The bridge enables host-to-host communications through the hub. *Id.*, 6:5-10. And because consumer products may be dual-role, the switch enables bypassing the bridge based on the operating mode of the downstream product. *Id.*, 6:5-13. This allows dual-role downstream smartphones to connect as device or host to the embedded upstream host.⁶ *See, e.g., id.* When the downstream consumer product “act[s] as USB host, the USB bridge 414 processes the USB packets from the downstream USB port ... thereby rendering the consumer device compatible with the vehicle’s embedded USB host.” *Id.*, 6:5-10. When the downstream product “act[s] as USB device, ... the switching device 416 provides the USB signaling directly to the USB hub 412, bypassing the USB bridge.” *Id.*, 6:10-13. These two operational modes are illustrated in annotated versions of Fig. 4 below, with colored lines indicating the signal paths taken based on the smartphone mode (*i.e.*, the purple lines show a device-host connection and red lines show host-to-host).

⁶ The “head unit” refers to an upstream host in a vehicle. *See* EX1003, 5:55-56.

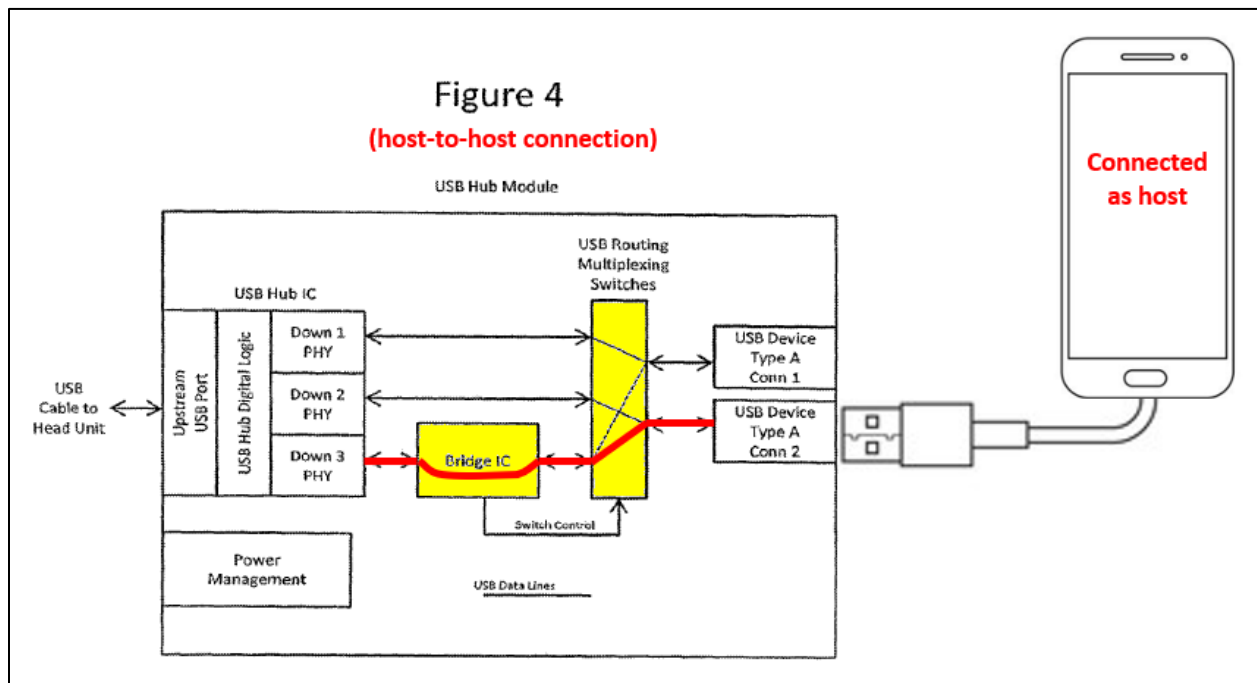
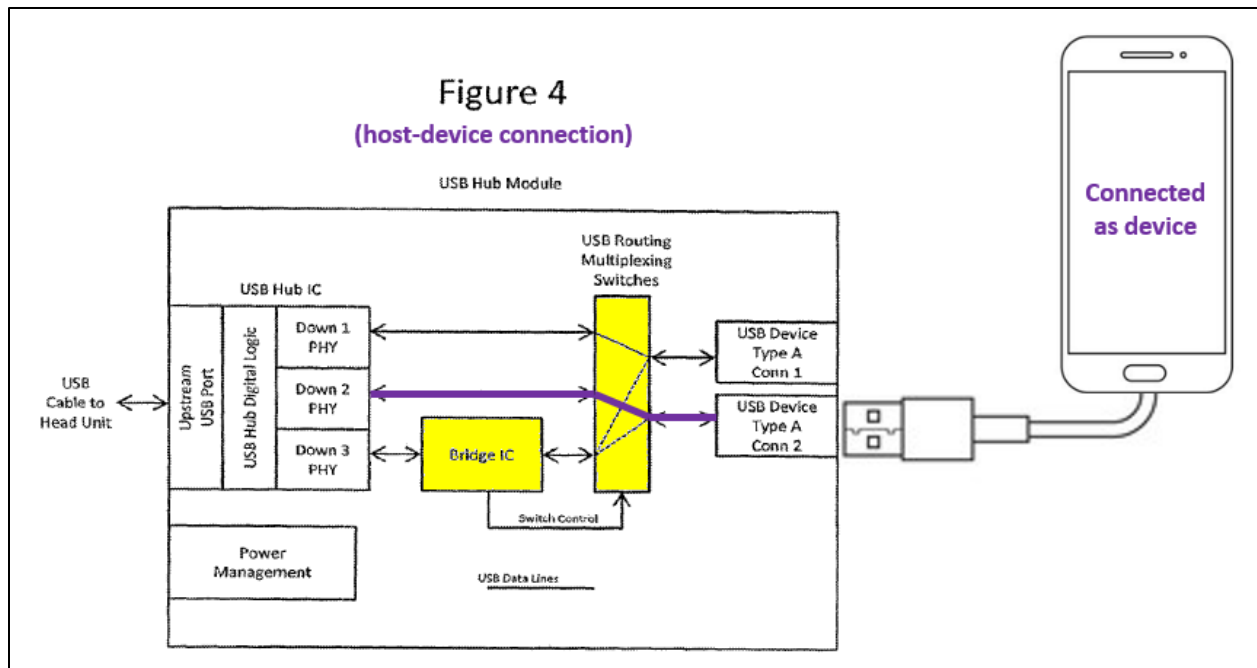


Fig. 5 is an alternate embodiment with a similar architecture, the primary difference being that the “USB routing/switching logic and a USB bridge are integrated with a USB hub in a combination USB hub/bridge integrated circuit

(IC).” EX1003, 5:25-29; *see also id.*, 7:11-17. Figs. 6-7 provide additional details regarding Fig. 5. *Id.*, 5:30-33 and 7:18-8:38. Fig. 8 shows “a head unit software architecture.” *Id.*, 6:46-47 and 8:39-9:9.

Lastly, the ’420 patent does not disclaim using downstream dual-role OTG products. Rather, the ’420 patent only states that the upstream “embedded USB host” lacks “[OTG] capability.” EX1003, 1:17-24.

B. File History

The ’420 patent file history is quite short. There were no prior art rejections, and the claims issued following an Examiner Interview and Examiner Amendment. *See* EX1004, 147-156. The stated reason for allowance was that the prior art does not teach “a peripheral device to communicate with a USB hub bidirectionally in a first mode and to communicate with the hub only uni-directionally in a second mode wherein the device is only able to respond, and wherein a respective path between the device and host is taken for each mode.” *Id.*, 154-155.

The ’420 patent is part of a 6-patent family stemming from U.S. Pat. 9,460,037 (the “’037 patent,” EX1001). Petitioner summarizes the related file histories to show that this Petition’s Ground and arguments are not cumulative to the Examiner’s. Welch, ¶¶124-147. Section VIII.B addresses §325(d) in more detail.

U.S. Pat. 9,460,037

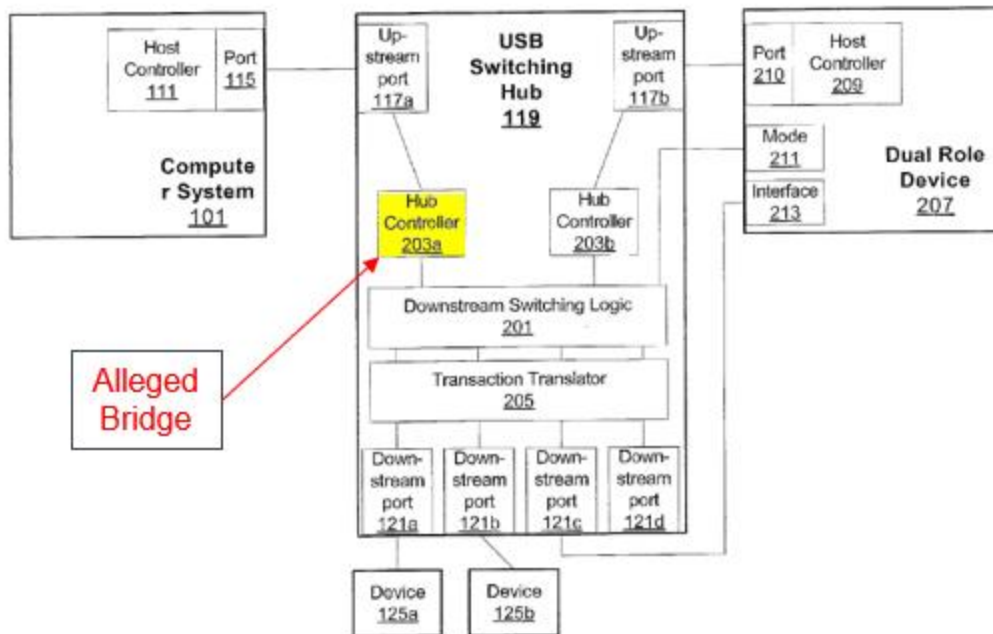
The '037 patent application was rejected over two primary references: Kellzi (U.S. Pub. 2007/0156293, EX1046) and Bohm '759 (U.S. Pub. 2006/0227759, EX1042). *See generally* EX1002.

The Examiner issued an anticipation rejection over Kellzi. EX1002, 76. In response, Applicant amended the claims to require a bridge (located between the hub and downstream port) for establishing host-to-host communications with the upstream host. *Id.*, 98. Applicant also argued various distinctions related to Kellzi's OTG implementation which:

- lacked an “embedded host”;
- lacked a host-to-host connection; and
- had limited connection and port swapping capabilities when “an intervening hub” is present.

See id., 104-108.

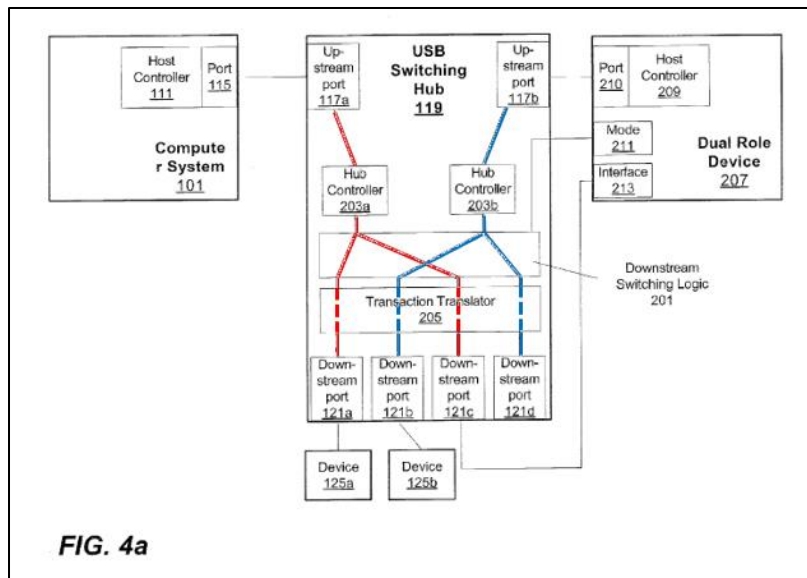
Next, the Examiner issued anticipation and obviousness rejections based on Bohm '759. EX1002, 115. Applicant argued the Examiner's reading of Bohm '759 was “not logical,” because components such as Hub Controller 203 (the alleged bridge shown in yellow below) could not be inside the hub and a “separate element ... interconnected to the [hub].” *Id.*, 163.



EX1042, Figure 3 (annotated).

An Examiner Interview, Examiner Amendment, and Notice of Allowance followed. EX1002, 185-197. Two amendments are notable here. Welch, ¶¶130-131. First, with Applicant’s consent, Examiner amended claim 1 to require the hub to “connect the embedded USB Host system to a second USB Host” (*i.e.*, create a host-to-host connection instead of a host-to-device connection like Bohm ’759). EX1002, 190-191; *see also* EX1042, [0038].

Second, the Examiner amended claim 1 to require “broadcast[ing] data from the embedded USB Host system to each USB Port in the plurality of USB Ports.” EX1002, 190-191. This distinguished Bohm ’759 Figs. 4a-b because each upstream host broadcasted to different downstream ports, as shown in annotated Fig. 4a below. *See* EX1042, Fig. 4a-b, [0040]-[0042].



U.S. Pat. 9,645,962

There were no prior art rejections. See EX1006.

U.S. Pat. 10,545,899

The '899 patent application was rejected over U.S. Pat. 7,502,878 ("Wright," EX1047). EX1008, 401. Applicant amended claim 1 to require (among other things) "a USB bridge interconnected to the USB hub, and a USB routing switch interconnected to the USB bridge, the USB hub, and the second USB port." *Id.*, 454. Applicant argued Wright lacked a bridge, and traversed Examiner's assertion that "hub logic 38" is a bridge, because "hub logic 38" is a conventional hub. *Id.*, 460.

Examiner again rejected the claims over Wright, asserting that Wright discloses a bridge because "hub logic 38 ... performs the same claimed bypass function as claimed 'USB bridge'.... If claimed 'USB bridge' is a specific

‘bridge’, the specifics have to be recited.” EX1008, 466 (emphasis in original).

Applicant then made significant claim amendments, including reciting that the bridge connects two hosts (EX1008, 488), and argued Wright does not disclose “a USB bridge interconnected to the USB hub and configured to connect the USB host to a second USB host” (*id.*, 493).

In an Examiner Interview, Applicant “described the invention as a hub to dynamically switch a device connection between USB Device mode and USB host mode when desired.” EX1008, 498. The Examiner allowed the claims, noting that the prior art does not disclose the claim language. *Id.*, 523.

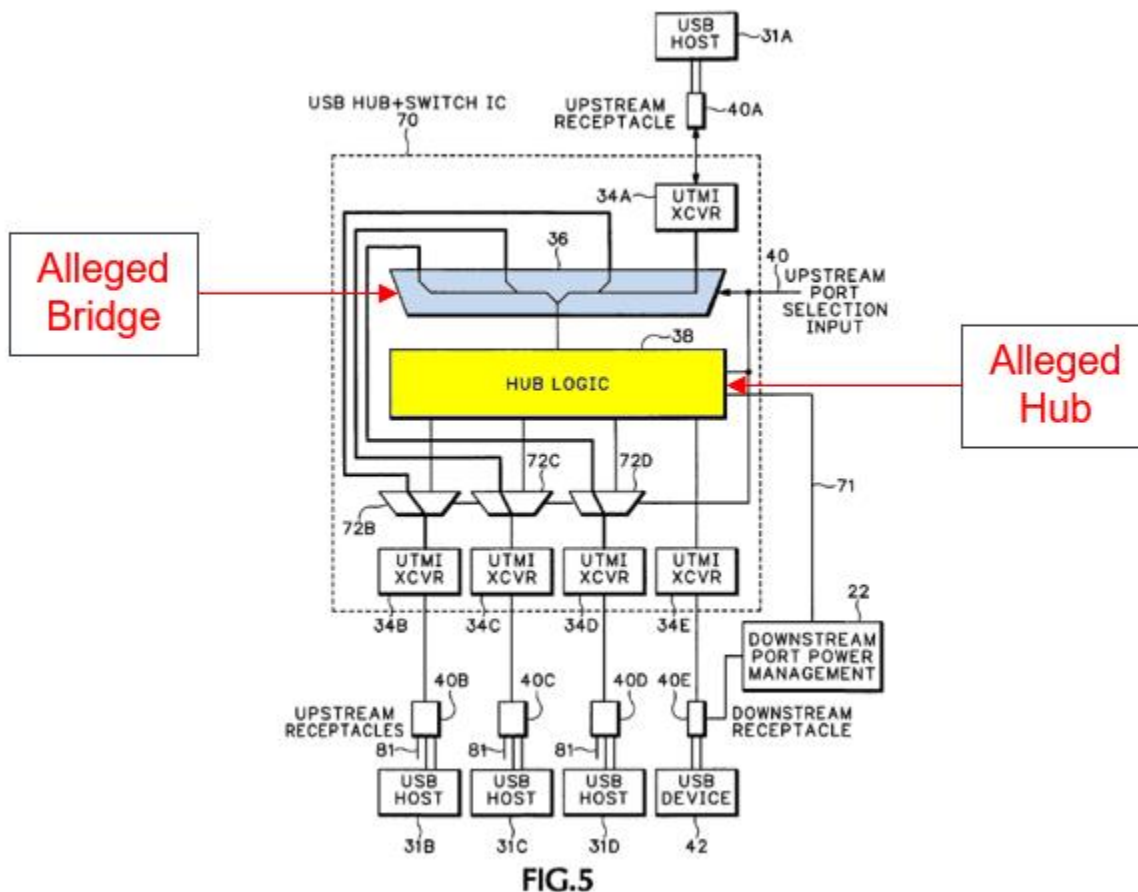
U.S. Pat. 11,176,072

The ’072 patent application was filed with 11 claims, but only claim 1 ultimately issued. EX1010, 372-373, 274. Thus, this summary focuses on claim 1.

The Examiner rejected claim 1 as anticipated by Wright and objected because the “mode change” language was unclear. EX1010, 274-281. Applicant substantially amended claim 1 (similar to its current form) in a Supplemental Amendment and Response to expressly recite “host” and “device” modes (where device mode signals “bypass[ed] the USB Bridge”). *Id.*, 352.

Applicant argued the amendments obviated the objection. EX1010, 355. Applicant traversed the anticipation rejection that mapped Wright’s “multiplexer 36” to the claimed bridge and “hub logic 38” to the claimed USB hub. *Id.*, 356.

These elements are shown below in Wright Fig. 5:



EX1047, Fig. 5 (annotated).

Applicant argued two distinctions over Wright: (1) Wright's alleged host-to-host communications (between hosts 31A and 31B) bypassed the hub entirely; and (2) Wright's host-to-device communications passed through the alleged bridge instead of bypassing it. EX1010, 356. The Examiner allowed the claims following an Examiner Interview and minor clarifying amendments. *Id.*, 371-376.

The Reasons for Allowance are generic. EX1010, 372-373. Unlike this Petition's Ground, however, Wright's alleged host-to-host communication

bypassed the hub and the host-to-device communication passed through the alleged bridge. Note that Wright **does not** disclose a host-to-host connection at all. This is evident, for example, from the fact that the alleged bridge is merely a multiplexer. Welch, ¶143. For at least these reasons, this Petition’s Ground does not present similar art to Wright, nor raise similar prosecution arguments.

U.S. Pat. 11,681,643

The Examiner issued another rejection over Wright, contending Wright’s “mux 36” was the claimed hub and “connection 74” (*i.e.*, the wire between mux 36 and mux 72B) was the claimed USB bridge. EX1012, 67. Applicant traversed this rejection. *See id.*, 89 (“[M]ultiplexer 36 of Wright cannot be fairly characterized as a USB hub.”). Following an Examiner Interview and Examiner Amendment, the claims were allowed. *Id.*, 102.

The Applicant filed an RCE and IDS that included, among other references, Chang II. EX1012, 175, 180. Following another Examiner Interview, Examiner Amendment, and Notice of Allowance, the ’643 patent issued. *Id.*, 197, 208.

C. Level of Ordinary Skill in the Art

The ’420 patent pertains generally to the field of USB connectivity (*e.g.*, USB systems/architectures/communications), though other technical fields may be relevant. *See* EX1003, 1:17-19. A POSITA at the time of the alleged invention would have been well-versed in USB standards (including the USB 2.0 and 3.0

Specifications and the OTG Supplement) and the design/deployment of USB hosts, USB devices, and USB hubs, including suitable environments for USB systems. A POSITA would also have had a working understanding of network/communication architectures (*e.g.*, master/slave) and components (*e.g.*, host-to-host bridges), computer hardware and peripherals, computer programming, and the design/implementation of communication software/firmware/drivers in standard operating systems (*e.g.*, Windows and Linux) and embedded systems. Welch, ¶¶45-49.

A POSITA would have had at least a four-year degree in electrical engineering, computer engineering, computer science, or a related field and substantial experience (*e.g.*, several years) designing USB systems, including USB hosts, USB hubs, and USB devices. A relevant advanced degree may substitute for some work experience. Welch, ¶¶45-49. Similarly, relevant work experience may substitute for formal education. *Id.*

V. CLAIM INTERPRETATION

In IPR, claim terms are construed under *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*) and its progeny. 37 C.F.R. §42.100(b). The Board, however, only construes claim terms when necessary to resolve the controversy. *See, e.g., Toyota Motor Corp. v. Cellport Sys., Inc.*, No. IPR2015-00633, Paper No. 11 at 16 (PTAB. Aug. 14, 2015). Petitioner submits that no

terms need construction for this proceeding.⁷

VI. THE PRIOR ART⁸

A. Chang Summary

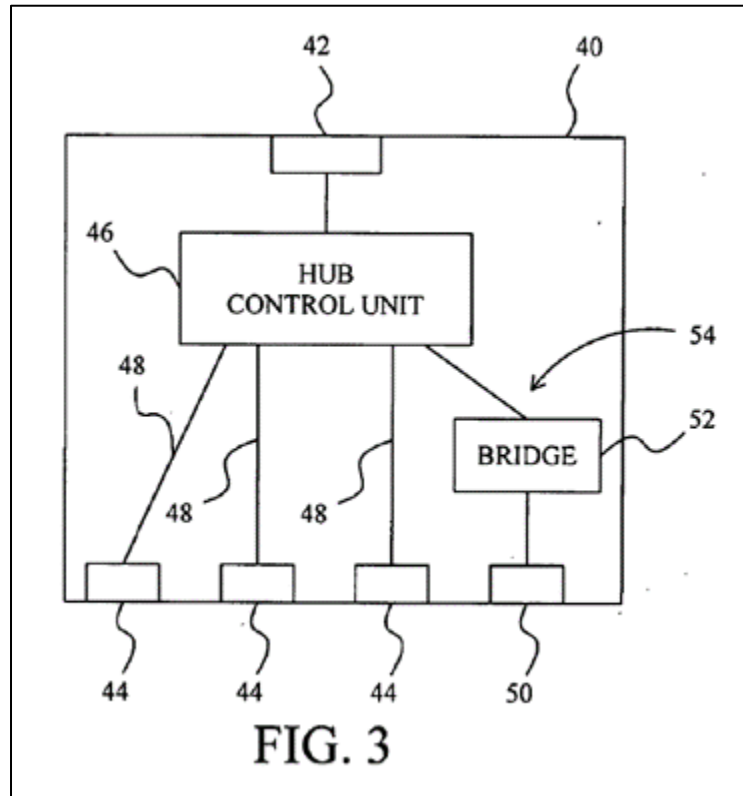
Chang is titled “Hub with a Host-to-Host Transmission Function” where “host-to-host transmission” is accomplished via “***a bridge connected between the host port and hub control unit*** for the first and second hosts to communicate.” EX1014, [0005] (emphasis added); Welch, ¶¶148-152. Chang recognizes that, even in 2005, “host-to-host transmission mechanism [viz., USB bridge] is a prior art,” and “is not described in detail.” EX1014, [0020]; *see also id.*, [0022] (referring to “conventional bridge”); [0020] (exemplary commercial chip).

Chang Fig. 3 (shown below) “shows a hub 40 [], which has, as a conventional hub, an uplink port 42 for being linked to a host, several downlink ports 44 for being linked to devices, and a hub control unit 46 for establishing several transmission paths 48 between the uplink port 42 and downlink ports 44.” EX1014, [0019]. Chang further explains, however, that hub 40 includes “host port 50 for being linked to a host, and a bridge 52 connected between the hub control

⁷ Petitioner reserves all rights to raise additional and alternative claim constructions in district court.

⁸ Section II.B establishes each reference is prior art.

unit 46 and host port 50” where “[t]he bridge 52 provides a function for host-to-host communications.” *Id.*, [0020].



Like any traditional hub, the uplink port “link[s] to a host” and “several transmission paths may be established” to “communicate with each downlink port.” EX1014, [0018].

Chang further teaches its “invention can be implemented merely by integrating or adding a bridge to a USB hub, and thus does not require too many modifications on the current hub control unit. Therefore, the derived cost is relatively low, while a multi-functional USB hub with a host-to-host transmission function is obtained.” EX1014, [0024]. Additionally, Chang teaches the bridge

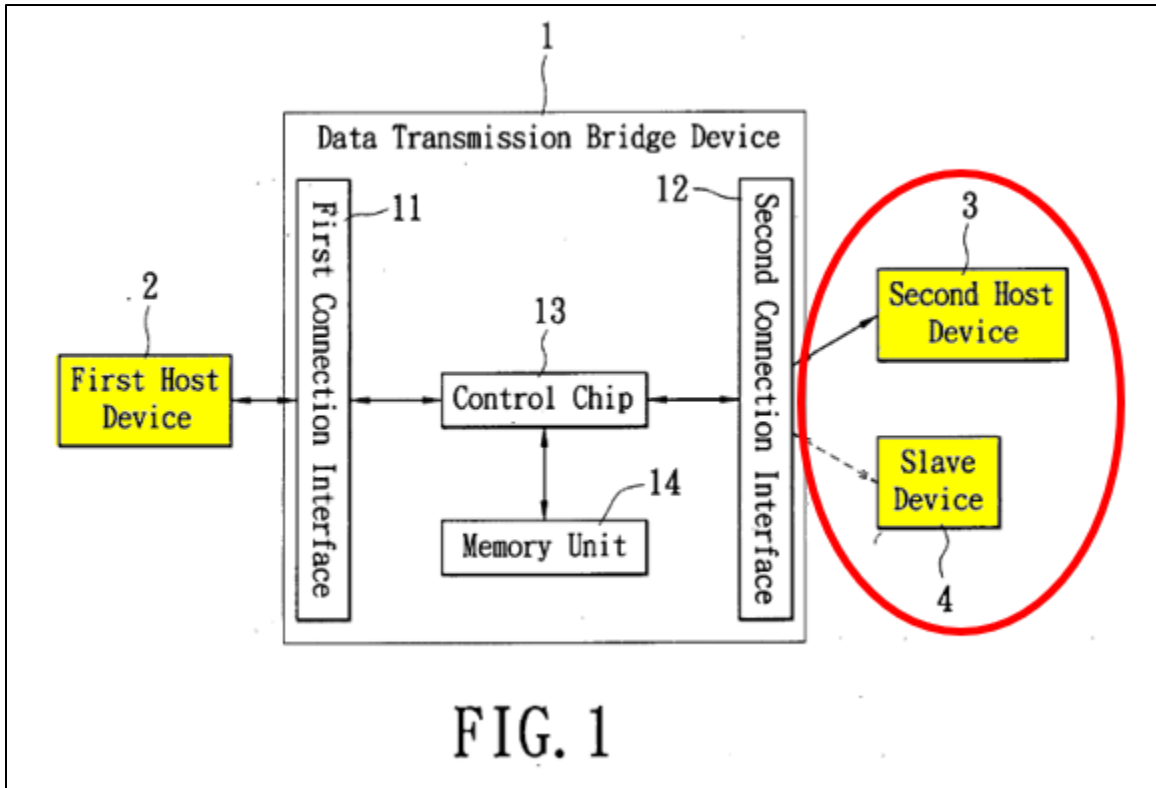
may be a discrete component (see Fig. 3) or integrated with other hub circuitry (see *id.*, [0022]).

B. Chang II Summary

Chang II is titled “Data Transmission Bridge Device and Control Chip Therefor for Transmitting Data.” Chang II discloses “a data transmission bridge device and control chip thereof for transmitting data that adopts USB specification, and can utilize switching to bridge between two host devices for transmitting data.” EX1015, [0002]; *see generally* Welch, ¶¶153-168.

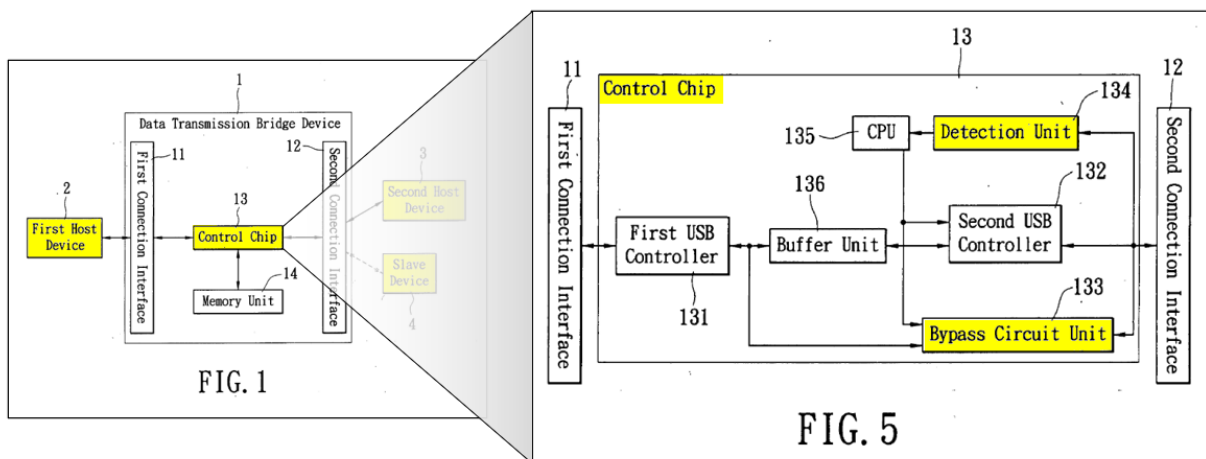
Unlike Chang’s dedicated host/device ports, Chang II discloses a single port that accepts a “Second Host Device” or “Slave Device,” as Fig. 1 shows below. *See* EX1015, [0030] (discussing “dual connector type design”); *see also id.*, [0012] (“second connection interface is for connecting to a second host device or a slave device.”).⁹

⁹ A POSITA would have understood (and certainly found it obvious) that connecting dual-role products was within Chang II’s disclosure. Welch, ¶¶157, 69-73.



The “data transmission bridge device ... automatically detect[s] the connecting device type and accordingly switch[es] between different transmission paths,” which supports “data transfer between a host device and a slave device” and “between two host devices.” *Id.*, [0011].

Fig. 5 below is “a schematic diagram for a control chip [13] of a data transmission bridge device ... which includes: a first USB controller 131, a second USB controller 132, **a bypass circuit unit 133, a detection unit 134**, a central processing unit (CPU) 135, and a buffer unit 136.” EX1015, [0034] (emphasis added).



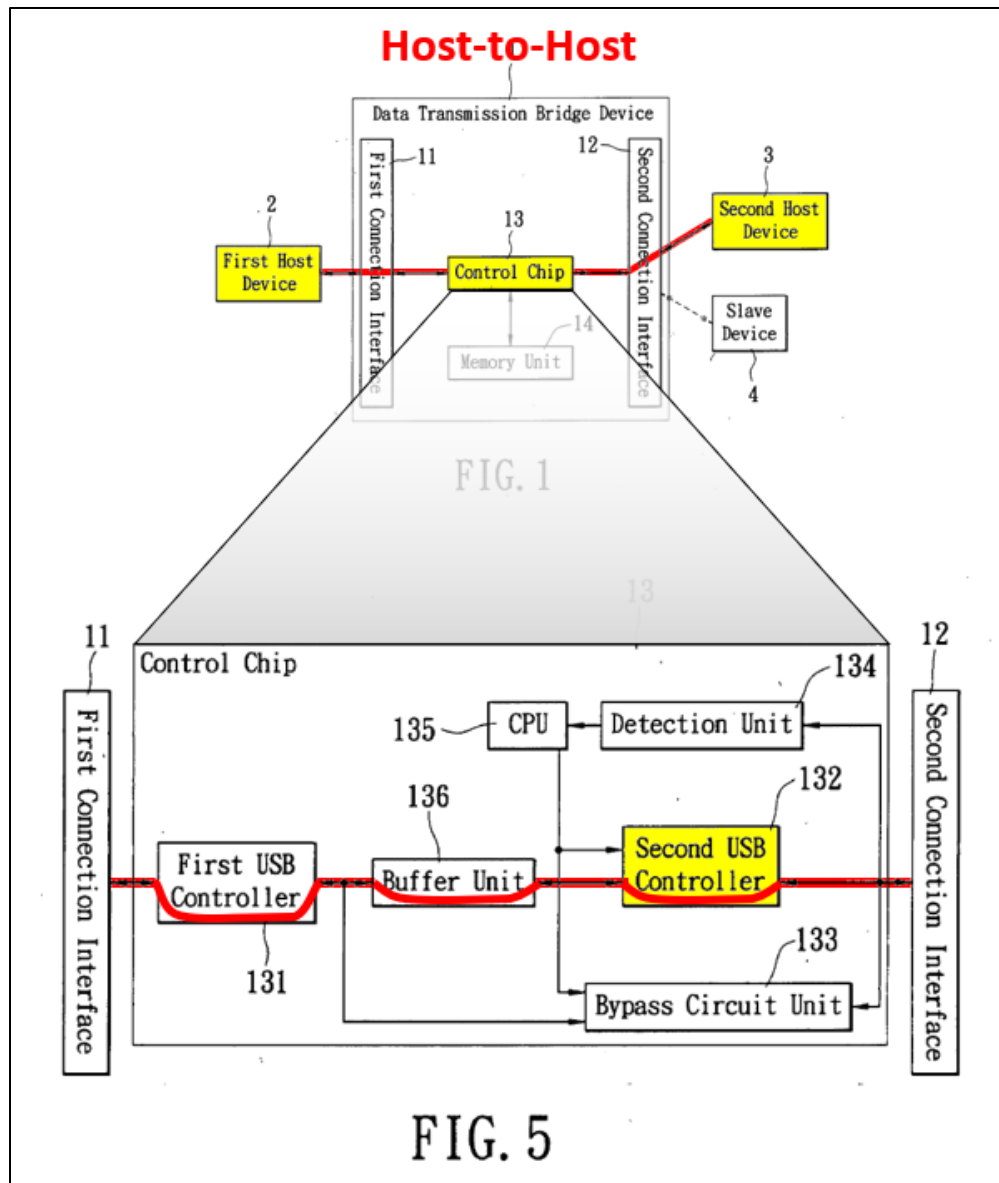
The fundamental concepts of (1) host/device detection and (2) selecting between two transmission paths (for host-to-host or host-to-device communication) are repeated throughout Chang II. *See, e.g.*, EX1015, [0024], [0046] (“automatically detect[s] the type of connected device to switch between the proper transmission path”).

Host/Device Detection. Highlighted Fig. 5 above shows “Detection Unit 134.” Paragraphs [0038]-[0040] describe operational details of detection unit 134, and Fig. 6 is an exemplary host/device detection algorithm. More generally, Chang II explains that “[f]or those skilled in the art of USB devices it is common knowledge” to use an “inquire signal” to detect host/device status of a connected USB product. EX1015, [0025]-[0027]. A POSITA would have understood this involves detecting the presence/values of resistors discussed *supra* §III.B.1. Welch, ¶159. In summary, Chang II explains that “detection unit 134 ... will automatically operate to switch between [states] ... to determine the type of device

currently connected.” EX1015, [0038]; *see also id.*, [0028]. This allows the control chip to “switch to the bridge transmission path or the bypass path.” *Id.*, [0024].

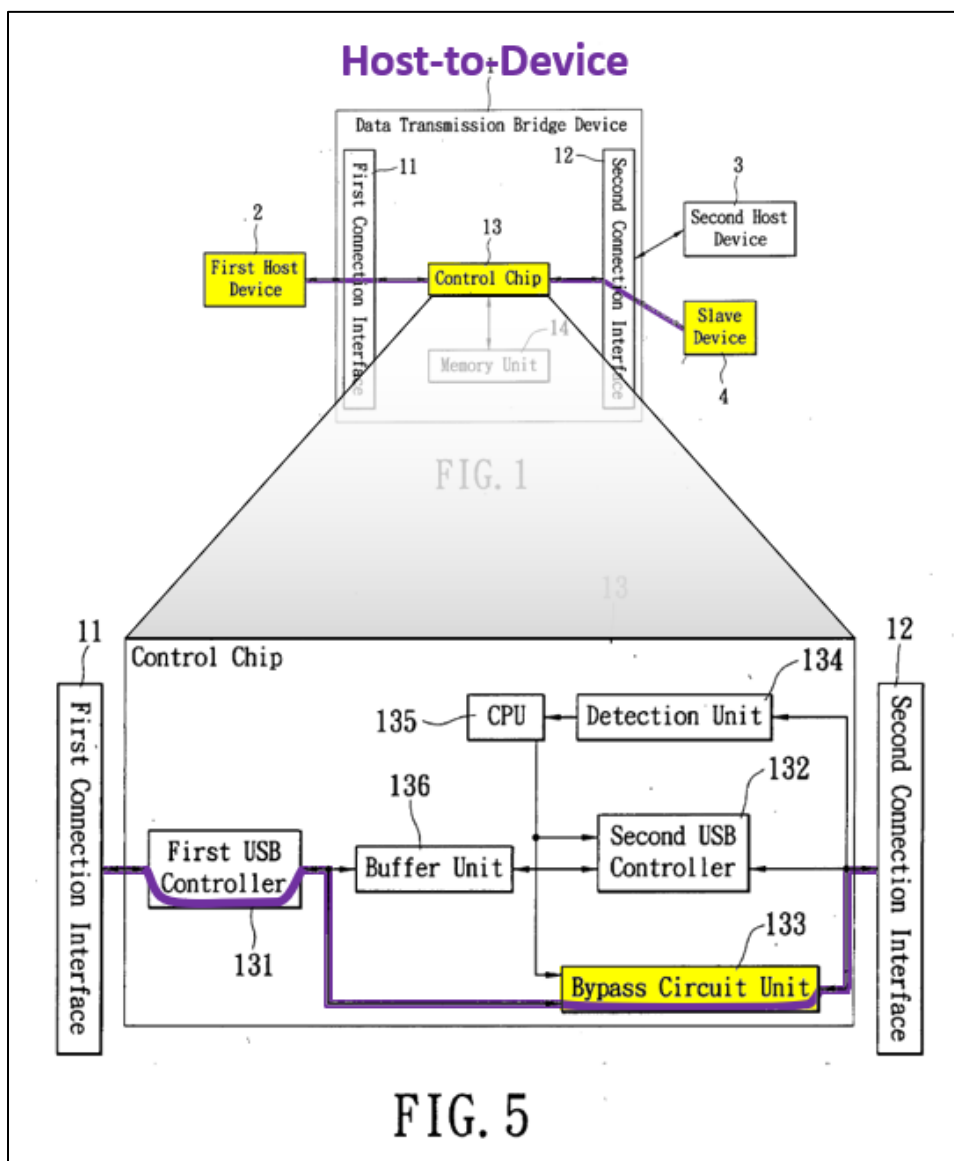
Switching Between Two Transmission Paths. Chang II discloses “***two different transmission paths, so that by automatically detecting the type of device connected (host or slave) the present invention can switch to the proper transmission path***, thus not only can host-slave operation between the host device and the slave device be supported, but direct bridging between two host device[s] for data transfer.” EX1015, [0021] (emphasis added).

The “two transmission paths” are (1) “bridge transmission path” and (2) “bypass path” shown in annotated Figs. 1 and 5 below. EX1015, [0024]. As shown by the red annotation below, the “first path is the bridge transmission path which spans first connection interface 11, first USB controller 131, buffer unit 136, second USB controller 132, and second connection interface 12.” *Id.*, [0023].



As shown by the purple annotation below, “[t]he second path is the bypass path which spans first connection interface 11, first USB controller 131, bypass circuit unit 133, and second connection interface 12.” EX1015, [0023]. “[T]he bypass circuit unit will directly connect the first USB controller and the second connection interface, [] to provide host-slave operation.” *Id.*, [0013]; *see also id.*, [0037] (describing “direct connection between the first USB controller 131 and the

second connection interface 12”).



Notably, host-to-device mode acts “similar[ly] to the commonly known USB HUB function.” EX1015, [0027]; *see also id.*, [0040] (“the control chip 13 at this time ***functions like a USB Hub chip***”) (emphasis added).

To choose between transmission paths, CPU 135 controls a switching function: “the detection signal will be received by the CPU, and the CPU will

accordingly control the second USB controller (host-to-host data transfer) or the bypass circuit unit (host-to-slave data transfer) for the appropriate operation.” EX1015, [0013]; *see also id.*, [0023], [0038]-[0040]. A POSITA would have understood this functionality to be implemented by some type of switch, mux, or crossbar. Welch, ¶165.

To recap, Chang II’s “main feature is the provision of two different transmission paths, so that by automatically detecting the type of device connected (host or slave) the present invention can switch to the proper transmission path.” EX1015, [0021]. The fundamental concepts of (1) detecting host/device type and (2) selecting/switching between two transmission paths are repeated extensively throughout the specification. *See id.*, [0012]-[0013] (“detecting the device ... [and] decide on one of the two transmission paths”), [0045].

Chang II’s bridge may be built into a cable (EX1015, Fig. 3) or “directly within a first host device” like a laptop (*id.*, [0031]). In view of this disclosure, a POSITA would have understood (or at least found it obvious) that the bridge may form part of a USB hub module or work in conjunction with a hub. *Id.*, [0027], [0040]; Welch, ¶167.

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1 (Claims 1-12 and 15-17): Chang in view of Chang II and

POSITA Knowledge

1. Motivation to Combine

As §VI.A demonstrates, Chang discloses a hub with dedicated downstream device ports (for host-device connections) and a dedicated downstream host port (for a host-host connection through a bridge). It would have been obvious to modify Chang in view of Chang II and a POSITA's knowledge to include dual-role port(s) and a switch to route the ports to the appropriate transmission path. Welch, ¶¶175-202.

Chang was filed in 2005. As the '420 patent admits, consumer products (*e.g.*, smartphones and other mobile device) with dual-role USB capabilities were gaining popularity before the 2013 priority date. EX1003, 2:38-3:3; *see also* Welch, ¶176; §III.B. The '420 patent further admits automobile manufacturers were “motivated to adapt to this changing technology,” *i.e.*, use of dual-role ports to support products dynamically switching between host/device modes. EX1003, 3:4-67. Indeed, the USB-IF promulgated the OTG Supplement beginning in 2001 for this very purpose. *See supra* §III.B. This is common sense: it would be impractical, and inconvenient at best, to require consumers to understand when to switch connections between dedicated host- and device-ports when using a dual-role product (especially when driving). Welch, ¶177. It goes without saying that dedicated ports have “a disadvantage in that it requires multiple connectors,

multiple ASIC pins and the like,” which add “overhead” and “increase[s] the costs.” EX1025, 1:36-43. Accordingly, a POSITA would have been motivated to combine Chang’s dedicated device- and host-ports to create one or more dual-role ports. Welch, ¶177.

In addition, modifying Chang to include dual-role ports would further its express goal of “easily establishing a connection between a computer and another computer.” EX1014, [0003]. Chang illustrates an upstream host PC 20 connected to downstream host PC 70—but uses a dedicated downstream host port. *Id.*, [0002], [0020], [0023], Figs. 3-4. As the ’420 patent admits, however, prior art smartphones dynamically operated as either device or host, with host operation resulting from the fact that smartphones had effectively become personal computers. EX1003, 2:40-46; *see also id.*, 2:59-66. Accordingly, a POSITA would have been motivated to include dual-role port(s) to further Chang’s goal of connecting the upstream computer to the downstream phone acting as a computer. Welch, ¶178. Specifically, dual-role ports would allow consumer products, such as smartphones, that operate as computers (in host mode) to “easily establish[] a connection” (EX1014, [0005]) to the upstream host; the smartphone would plug into the dual-role port and automatically connect to the upstream host (through the bridge) when the smart phone switches to host mode (see below regarding routing to bridge) without requiring the user to switch between dedicated host- and device-

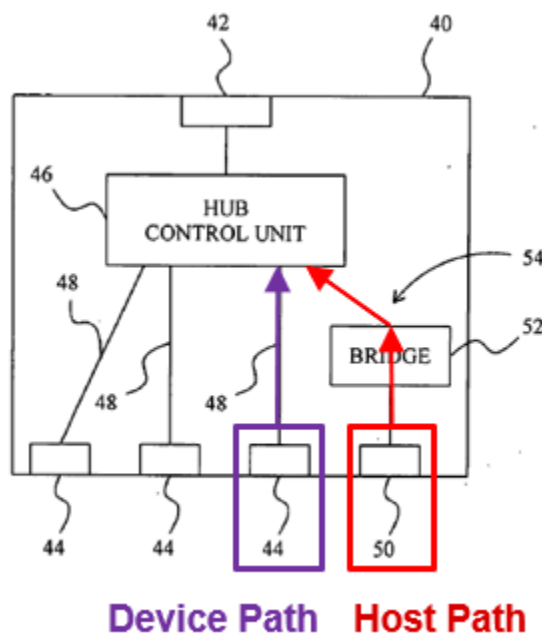
ports. Welch, ¶¶178-179. This avoids the inconvenience, hassle, and confusion of consumers having to keep track of (1) what mode their phone is operating in and (2) what mode(s) are supported by individual hub ports. *Id.*, ¶179.

Indeed, in the vehicle deployment context, this convenient host-to-host connection became further optimal because the vehicle's upstream host was often embedded (*see* EX1029, at 27:26-28, “embedded host” and EX1049, car had “become a PC on wheels”), requiring a host-to-host connection when the downstream consumer product, *e.g.*, smartphone, operates as host. *See* §§III.C, III.D; Welch, ¶180.

A POSITA would have had a high expectation of success in modifying Chang to include dual-role ports. To start, and as §III.B demonstrates, dual-role ports (*viz.*, interfaces for connecting dual-role products) and host/device detection were already well-known, and merely involved using commercially available components and well-understood signaling. *See also* EX1025, 3:10-32, 3:40-4:8, 7:34-40; EX1052, 3:21-50. Again, the '420 patent admits several solutions for supporting dual-role ports in USB systems were readily available. EX1003, 3:18-56; *see also* Welch, ¶183.

Next, a POSITA would have recognized that Chang effectively provides a roadmap to implement switching to support dual-role ports. Chang discloses separate transmission paths for host-to-host (“**host-to-host transmission path 54**”)

and host-to-device connections (“transmission paths 48”):



EX1014, Fig. 3 (annotated), [0019]-[0020]. As §VI.B demonstrates, Chang II discloses switching functionality to select the appropriate transmission path depending on the consumer product operating mode, *e.g.*, “host-to-host transmission path 54” or “transmission paths 48.” See also §III.B.2; EX1053, Fig. 1, [0031]-[0034] (switching data line connections based on host/device mode detection); EX1052, Fig. 1, 3:7-20 (“switching structure 170” controls data paths depending on operating mode); EX1017, Fig. 6, [0057] (port routing depending on unit’s configuration). Accordingly, in the context of Chang, a POSITA would have been motivated to implement dual-role ports by including a switch (*e.g.*, multiplexer or crossbar) that connects the dual-role port(s) directly to the hub’s upstream port (when the consumer product is configured as a device, *i.e.*, path 48)

or to the hub through the bridge (**when the consumer product is configured as host, i.e., path 54**). Welch, ¶¶182-187.

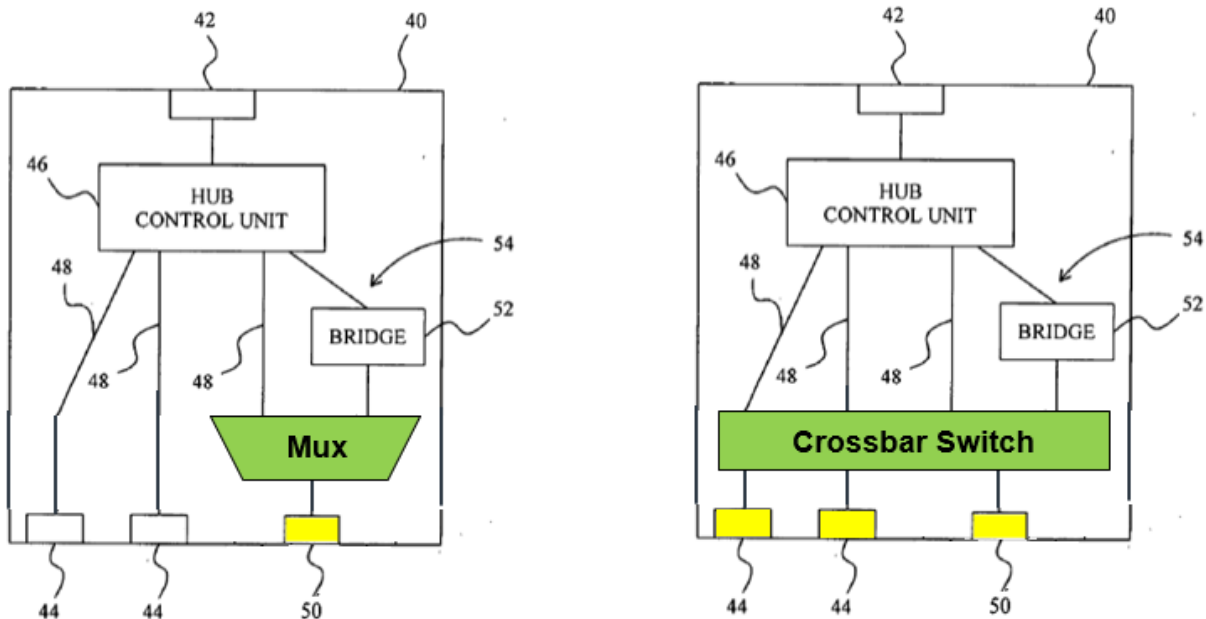
A POSITA would have been further motivated to improve Chang in view of Chang II, because Chang II expressly states its relevance to USB hubs. See EX1015, [0027] (invention performs “similar[ly] to the commonly known USB HUB function”); *see also id.*, [0040] (“control chip 13 at this time ***functions like a USB Hub chip***”) (emphasis added); Welch, ¶181.

Further, while Chang discloses little regarding its bridge (EX1014, [0020]), Chang II details various aspects of its bridge (EX1015, Title, Figs. 1-2 and 5). Importantly, Chang II further details exemplary switching for either a host- or device-product: “the main feature is the provision of two different transmission paths, so that by automatically detecting the type of device connected (host or slave) the present invention can switch to the proper transmission path.”¹⁰ EX1015, [0021]. In other words, Chang II describes “switch[ing]” to connect a “bridge” transmission path (when the product is host) or “bypass” path (when the product is device). *Id.*, Figs. 1, 5, [0013]. And Chang II further discloses “detection unit 134” for detecting whether the consumer product is host or device. *Id.*, [0038]. Accordingly, a POSITA would have been motivated, with a high

¹⁰ Chang II uses “slave” to refer to device mode. See §III.A.1; Welch, ¶62.

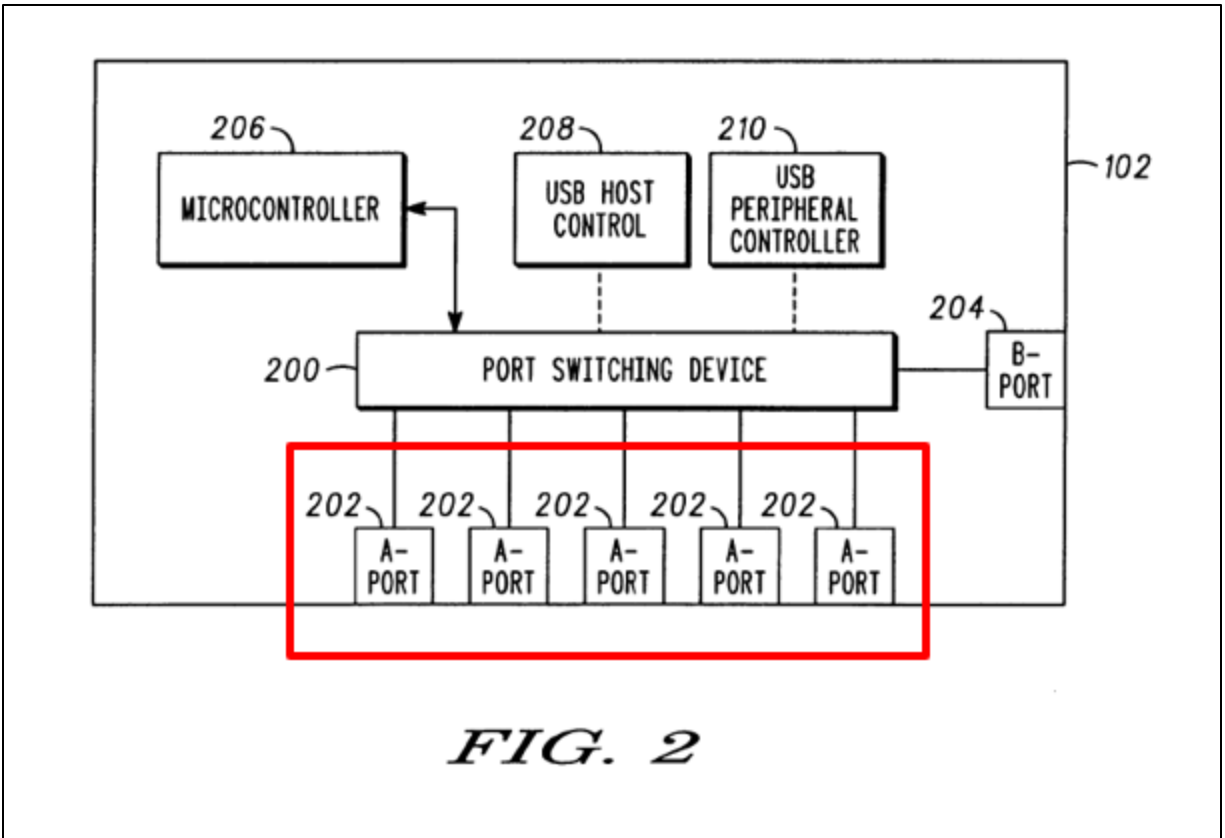
expectation of success, to route the dual-role ports (and products attached thereto) to the appropriate path using a switch.¹¹ Two obvious implementation options for modifying Chang Fig. 3 are shown below. Welch, ¶¶188-192. The implementation at left includes a 2:1 multiplexer (green) and one dual-role port (yellow). *Id.*, ¶191. The implementation at right includes a crossbar switch (green) and three dual-role ports (yellow). *Id.*

¹¹ It would have been routine and obvious for the detection unit and/or bridge to control the switching functionality. Welch, ¶¶192-193. Chang II's bridge controls routing, viz., "Bridge Device 1" in Fig. 1 includes "control chip 13" (shown in Fig. 5) with "detection unit" (134) and CPU (135). EX1015, [0022]-[0023], [0034]. Accordingly, in view of Chang II and the knowledge of a POSITA, it would have been obvious for Chang's bridge and/or detection unit to control, *e.g.*, the select lines of the switch. Welch, ¶¶192-193; *see also* §III.B.1, §III.B.2.



EX1014, Fig. 3 (modified and annotated). The primary functional difference is that the “Mux Implementation” (left) only supports a host-to-host connection through port 50 whereas the “Crossbar Implementation” (right) supports a host-to-host connection through any of ports 44 or 50. Welch, ¶191.

One common-sense reason it was desirable and obvious to a POSITA to make all downstream ports dual-role is user convenience (*viz.*, users need not know or recall which port to use for host-mode operation or keep track of whether their product is in device- or host-mode). Welch, ¶179. Moreover, it was well-known and obvious to include multiple dual-role hub ports. *Id.*, ¶¶195-197. Overtom, for example, discloses a hub with five dual-role ports:



EX1016, Fig. 2, [0024], [0027] (products on ports 202 may act as device or host), [0005] (A-type ports start as host). Similarly, U.S. Pub. 2006/0195625 (“Hesse,” EX1017) discloses ports that may assume various modes, including host or device mode:

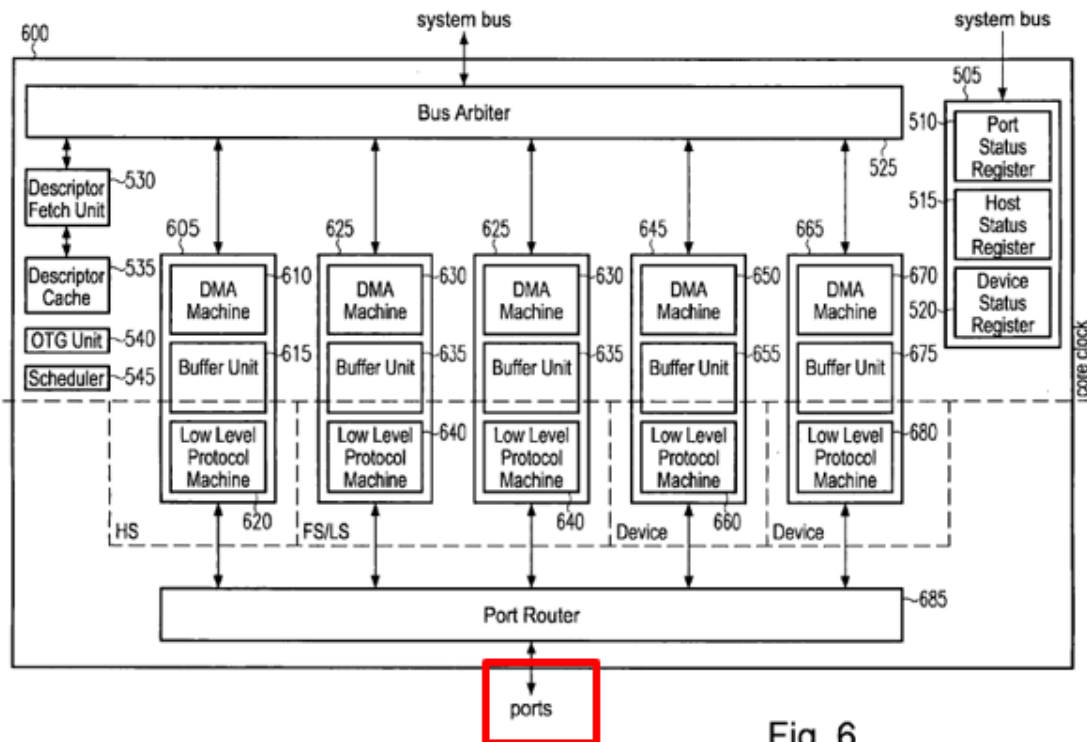


Fig. 6

EX1017, Fig. 6, [0055]-[0056] (ports support “high speed (HS) host mode,” “device modes,” etc.).

When multiple ports are dual-mode, it was well-known and obvious to a POSITA to include basic switching functionality to route each port to the appropriate transmission path. See §III.B.2. As §III.B.2 demonstrates, one well-known routing solution was a crossbar switch that would route any port to any transmission path. Hesse discloses that “Port Router” may be a “crossbar switch for assigning each physical port to the respective port handler”:

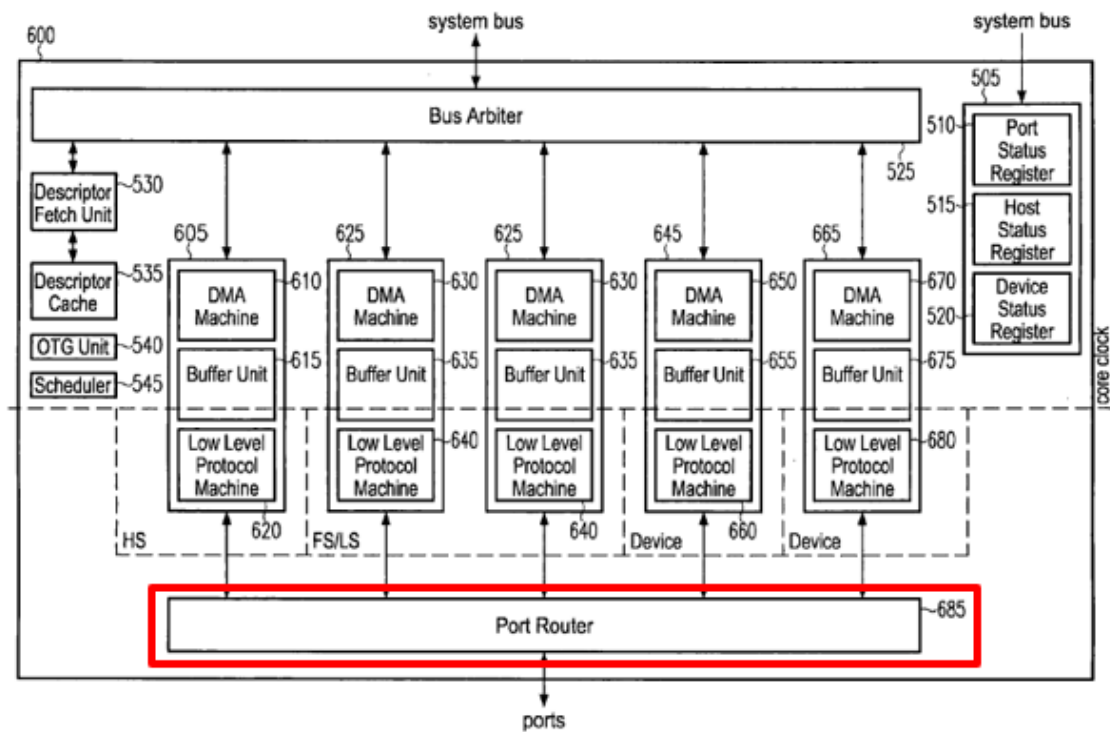


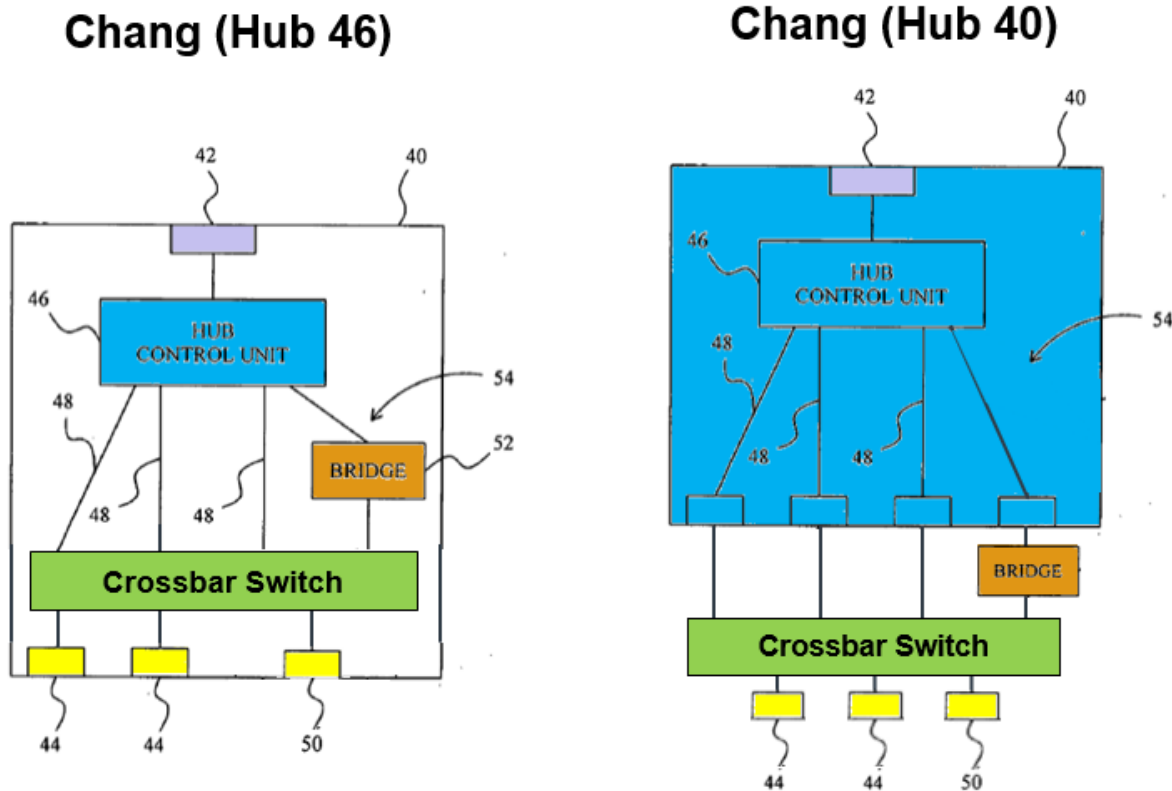
Fig. 6

EX1017, Fig. 6, [0055]-[0056].

A POSITA would have been motivated to implement each of Chang's downstream consumer ports as dual-role ports with a high expectation of success. Indeed, the typical consumer product was often a dual-role product, the implementation was well-known and routine, and doing so reduced the cost and footprint of the hub and was more convenient to the user. Welch, ¶¶194-199, 69-73.

The Crossbar Implementation of Chang Fig. 3 comes in two variations (shown below) relevant to Ground 1. The lefthand version has the bridge and

crossbar inside hub 40. In the righthand version, the bridge and crossbar are located outside hub 40. For reasons explained *infra* §VII.A.2.d, these are called “Chang (Hub 46)” and “Chang (Hub 40),” respectively.



The placement of the bridge and crossbar inside/outside of hub 40¹² is

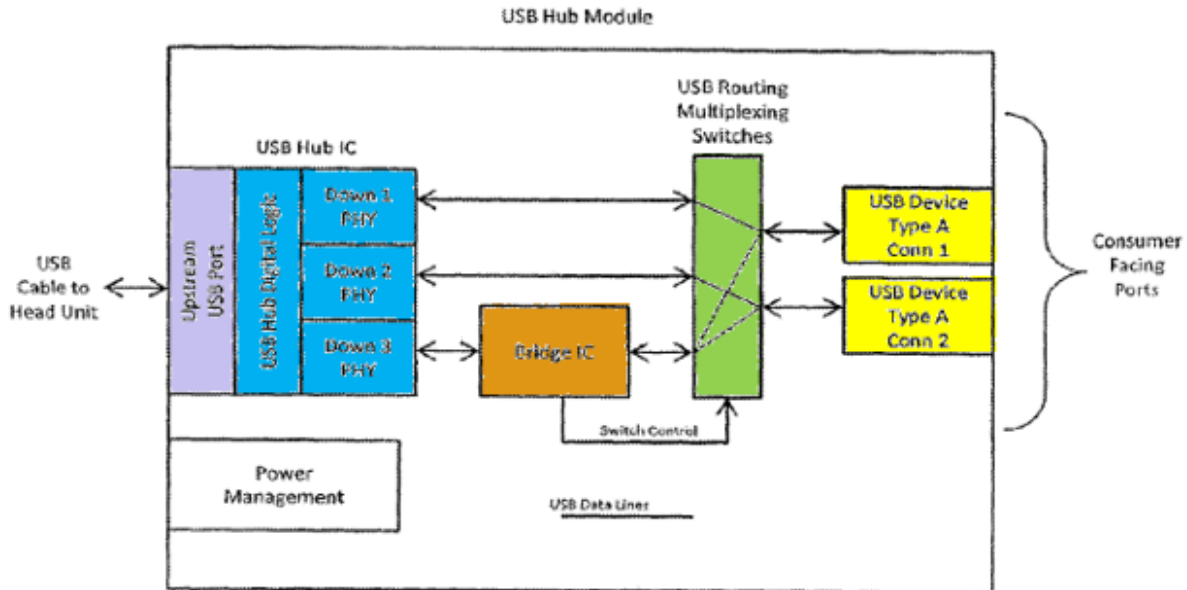
¹² For example, a separate “hub module” may encase the components (see, e.g., EX1067 (U.S. Pat. Pub. 2010/0265179), [0210], Fig. 16 (“hub/bridge module 232”)) or they could be inside cabling (e.g., EX1015, [0029] (“USB bridge transmission line 5”)).

merely a design choice, and motivations exist for each choice. Welch, ¶¶198-202. Indeed, given the limited locations relative to hub 40 where the components could be placed, a POSITA would have had motivations for each. *Id.* One benefit of placing the components outside hub 40 is the ability to use a conventional off-the-shelf hub, resulting in faster development and quicker time to market. *Id.*, ¶201. This allows for minimal modifications to legacy designs and easy sourcing of components (*e.g.*, the conventional hub). *Id.* Alternatively, integrating the components inside hub 40 results in a more compact design and lower manufacturing/assembly costs. *Id.*, ¶202. Chang discloses adding host-to-host functionality to the hub “merely by integrating or adding a bridge to a USB hub,” which “does not require too many modifications on the current hub control unit.” EX1014, [0024]. Thus, “the derived cost is relatively low, while a multi-functional USB hub with a host-to-host transmission function is obtained.” *Id.*; *see also id.*, [0022] (noting it is “possible” to integrate the bridge into the hub control unit; and one could “integrate” the bridge with a “conventional hub.”).

For comparison, the claimed embodiment of '420 patent Fig. 4 is shown below, with corresponding components identified using the same colors.

'420 Patent

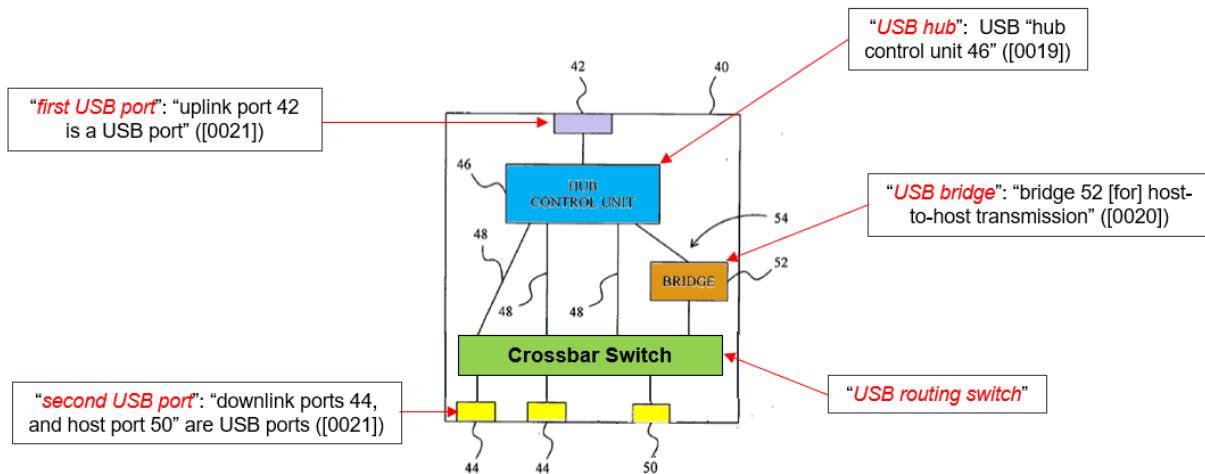
Figure 4

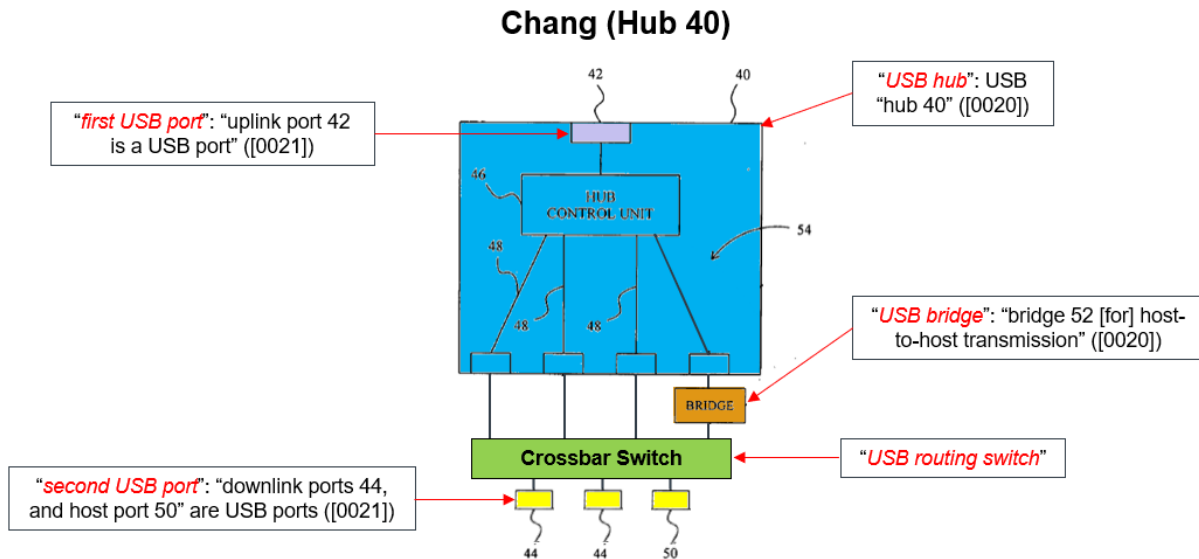


2. Claim 1

For reference, annotated figures mapping claim 1 to each modified Crossbar Implementation are below.

Chang (Hub 46)





EX1014, Fig. 3 (modified and annotated).

a. [Preamble]: “A Universal Serial Bus (USB) hub module, comprising:”

If the preamble is limiting, Ground 1 satisfies it. As defined by the claim itself, the “*hub module*”¹³ comprises various USB ports, a “USB hub,” “USB routing switch,” and “USB bridge,” which Chang teaches could be discrete components. See EX1014, [0022] (discussing “conventional bridge,” “conventional hub”), [0020] (commercial “bridge chip”); see also §III.B.2 (off-the shelf multiplexers/crossbars). This accords with the ’420 specification which generically uses “hub module” as a collection of components without reference to

¹³ For convenience, this Petition highlights claim language using red italics.

any specific structure, such as a single encasing/body. EX1003, Figs. 4-5, 5:49-58, 6:2-10. Both Crossbar Implementations disclose a “[USB] hub module,” viz., the collection of components recited in the claim body. Welch, ¶¶221-224; *see also* EX1014, Fig. 3; [0021] (disclosing embodiment where “uplink port 42 and host port 50 are both USB ports” and “downlink port 44 is a USB port.”); [0016] (“[A] bridge ... is integrated within a conventional ... USB hub.”).

If Aptiv argues “*module*” requires physically encasing the components, this Ground renders obvious that interpretation. To start, Chang discloses the bridge can be built into the hub. EX1014, [0022]. And Chang II discloses switching functionality built into the same component housing the bridge. EX1015, Figs. 1, 5, [0034], [0037]-[0038], [0040]. Moreover, Hesse discloses a USB “crossbar switch” on the same SoC (System-on-Chip) as the USB controller and other components. EX1017, [0057]. Chang, in fact, recognizes “an integrated circuit (IC) designer” would know about integrating the bridge within the hub logic. EX1014, [0022]. This is because the benefits (*e.g.*, lower costs, smaller footprint, reusing logic blocks, etc.) of integrating components into a single IC, or at least a single board, were well-known. Accordingly, a POSITA would have been motivated to include these components in the same enclosure. Welch, ¶¶221-224.

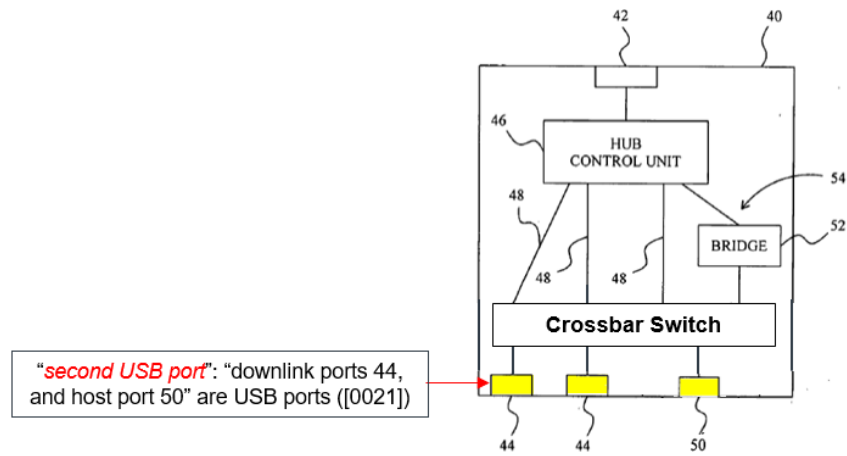
b. 1[a] “a first USB port configured to be connected to a USB host;”

Both Crossbar Implementations disclose “*a first USB port configured to be connected to a USB host.*” Chang discloses “the uplink port 42” in Chang Fig. 3 “is a USB port.” EX1014, [0021]. Chang further discloses that “uplink port 42 [is] for being linked to a host.” *Id.*, [0019]. Thus, Chang discloses this element under both Crossbar Implementations. Welch, ¶225.

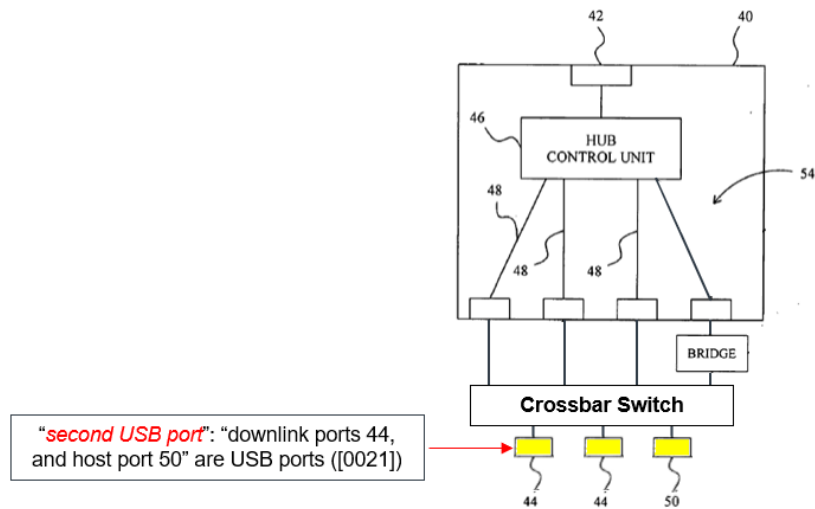
c. 1[b] “a second USB port configured to be connected to a consumer device;”

Chang discloses “*a second USB port configured to be connected to a consumer device.*” Note that “*consumer device*” recited here refers generically to a USB product, regardless of host/device operating mode. Welch, ¶226. In each Crossbar Implementation the “*second USB port*” is any of “downlink ports 44” or “host port 50” (which in the Crossbar Implementations are dual-mode ports). EX1014, [0021] (referring to “downlink ports 44, and host port 50”); *see also id.* [0019]-[0020] (discussing “several transmission paths” between uplink port 42 and downlink ports 44 and 50); Welch, ¶226. Chang discloses that “ports 44 [are] for being linked to devices.” EX1014, [0019]; *see also id.*, [0009]; [0017] (“USB hub 10 has ... several downlink ports 14 for being linked to devices”). And Chang’s “port 50 [is] for being linked to a host.” *Id.*, [0020]. Thus, both Crossbar Implementations satisfy element 1[b].

Chang (Hub 46)



Chang (Hub 40)



EX1014, Fig. 3 (modified and annotated).

d. 1[c]: “a USB hub interconnected¹⁴ to the first USB port and the second USB port;”

Ground 1 renders this limitation obvious. Petitioner provides two mappings (one for each Crossbar Implementation) depending on whether the claimed “**USB hub**” is Chang’s “hub control unit 46” or “hub 40.” Each alternative mapping meets element 1[c] and is discussed below. Welch, ¶¶227-229.

Hub Control Unit 46

While Chang also discloses a “hub 40” (discussed *infra*), hub control unit 46 itself satisfies the claimed “**USB hub**.” EX1014, [0019] (“hub control unit 46” establishes “several transmission paths” between “uplink port 42 and downlink ports”). A “**USB hub**” does not require a physical enclosure around the component(s) comprising the hub. This is consistent with the ’420 specification, file history, and USB 2.0 Specification.

’420 Specification. ’420 patent Fig. 5 illustrates a hub, bridge, and switch on one IC. See EX1003, 5:25-29. Fig. 5’s “hub” is simply the logic that performs the hub functionality of broadcasting upstream communications downstream (and

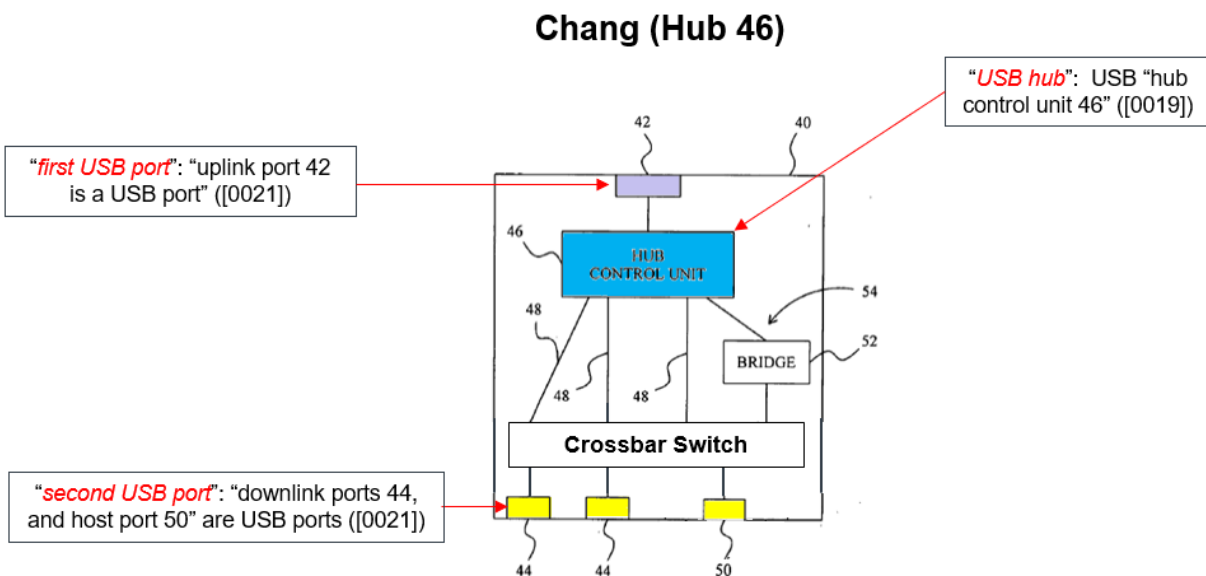
¹⁴ ’420 patent Figs. 4-5 show the hub “interconnected” through the routing switch/logic to the downstream USB ports. Petitioner applies this interpretation herein.

vice versa). *Id.*, 7:11-17, Fig. 5 (defining “hub” by drawing box around “USB hub digital logic”); Welch, ¶228.

File History. During prosecution of the parent ’037 patent, the Examiner defined “hub” functionally. See EX1002, 141 (“USB switching hub 119 of Bohm discloses *the function of claimed hub*”) (emphasis added).

USB Specification. The USB 2.0 Specification describes “hub” as “[a] USB device that provides additional connections to the USB.” EX1018, 34. That is precisely what hub control unit 46 does. Welch, ¶228.

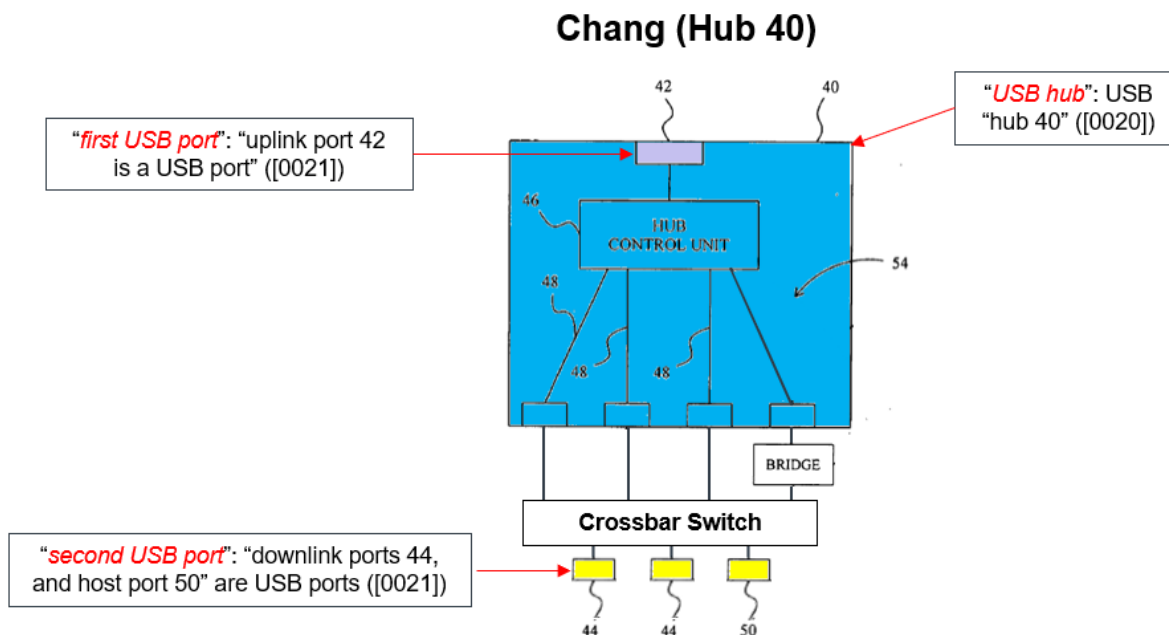
Thus, Chang’s hub control unit 46 is the claimed “*USB hub*” and Ground 1 renders obvious “*a USB hub* [hub control unit 46] *interconnected to the first USB port* [port 42] *and the second USB port* [any of USB ports 44 and/or 50]” as shown below. Welch, ¶228.



EX1014, Fig. 3 (modified and annotated).

Hub 40

Chang's hub 40 also qualifies as the claimed "**USB hub**." Welch, ¶229.



EX1014, Fig. 3, [0019]-[0021] (modified and annotated). Regardless of whether the claimed "first USB port" is inside or outside the hub, placing port 42 in either location would have been trivial and obvious for a POSITA. Welch, ¶229.

Accordingly, Ground 1 renders obvious "**a USB hub [hub 40] interconnected to the first USB port [port 42] and the second USB port [any of USB ports 44 and/or 50]**" as shown above. Welch, ¶¶227-229.

e. 1/d/ "a USB bridge interconnected to the USB hub; and"

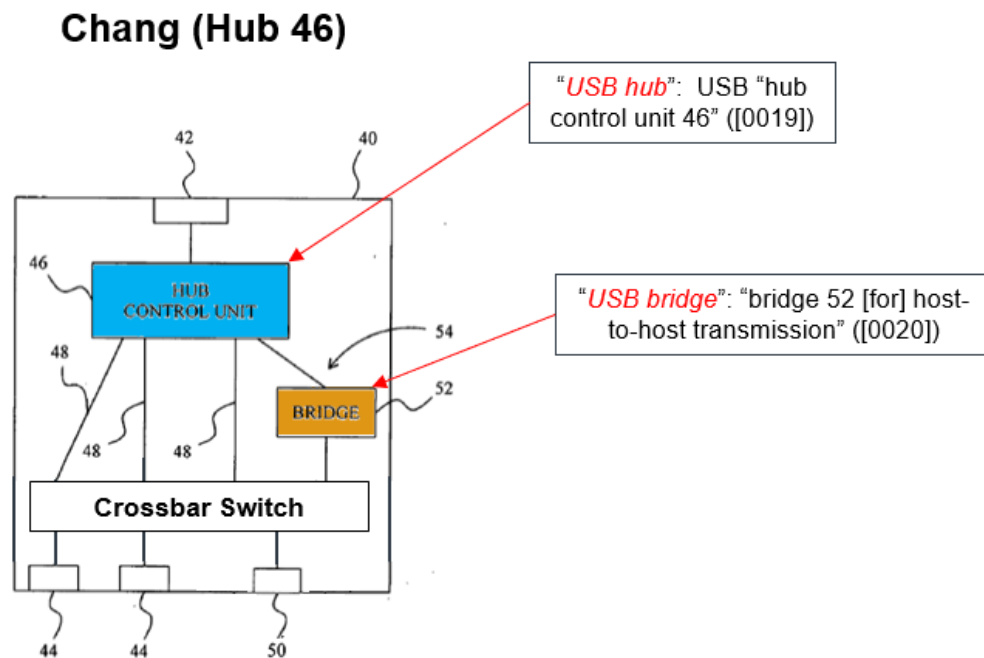
Ground 1 renders this limitation obvious. Welch, ¶¶230-232. Chang's

“bridge 52” “provides a function for host-to-host communications” between the upstream host (on port 42) and downstream host (on port 50) through the hub.

EX1014, [0020]. Again, Petitioner shows obviousness under either “*USB hub*” interpretation (*i.e.*, hub control unit 46 or hub 40).

Hub Control Unit 46

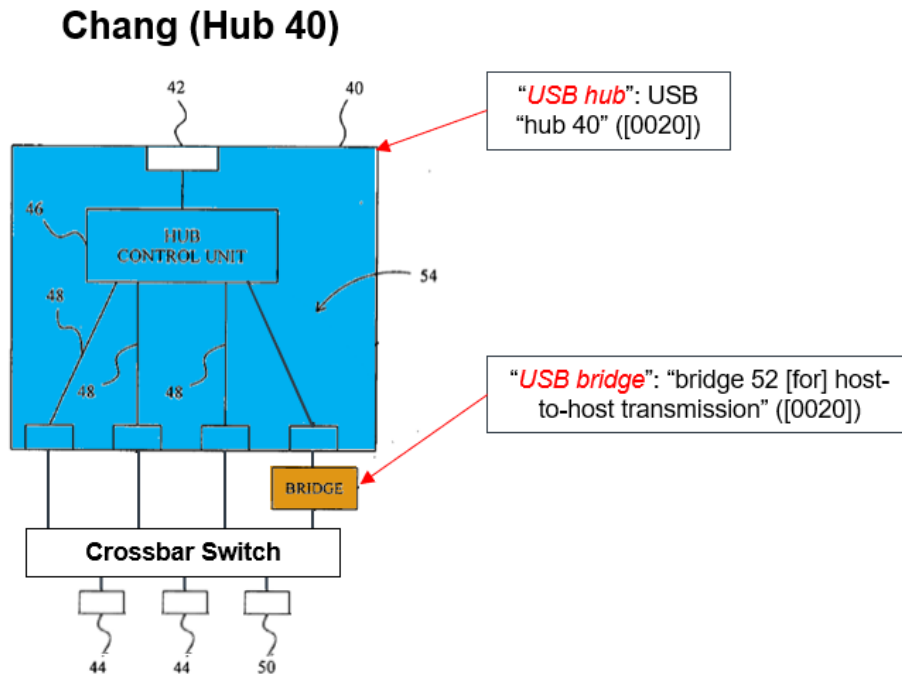
As shown below, Chang discloses “*a USB bridge* [bridge 52] *interconnected to the USB hub* [hub control unit 46].” Welch, ¶231.



EX1014, Fig. 3 (modified and annotated).

Hub 40

As shown below, Chang (with hub 40 as “*USB hub*”) discloses “*a USB bridge* [bridge 52] *interconnected to the USB hub* [hub 40].” Welch, ¶232.



EX1014, Fig. 3 (modified and annotated); [0020] (“uplink port 42 can communicate with the host [on] port 50.”).

f. 1/e/ “a USB routing switch interconnected to the USB bridge, the USB hub, and the second USB port,”

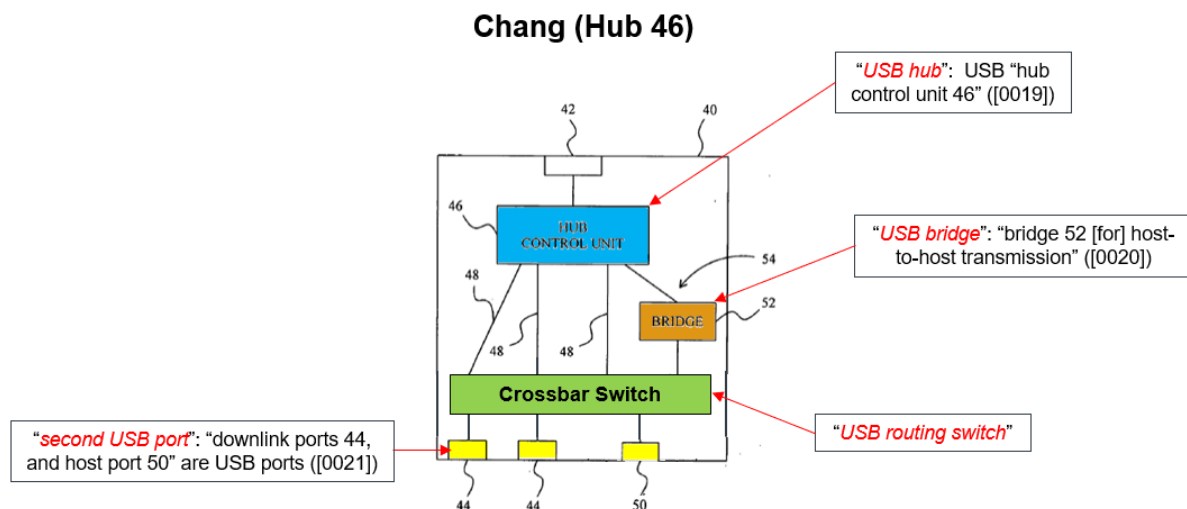
Both Crossbar Implementations render this limitation obvious. As §VII.A.1 demonstrates, Ground 1 modifies Chang to include dual-role USB ports and routing capabilities (*e.g.*, crossbar switch) to provide host-to-host and host-to-device connection paths. The ’420 patent illustrates crossbar functionality as an exemplary routing switch (*see* EX1003, Fig. 4) optionally formed from USB multiplexers (*id.*, 4:37-40).

Recall that Chang II’s “main feature” is providing “two different transmission paths” (EX1015, [0021]), *i.e.*, “bypass” and “bridge transmission”

paths (*id.*, [0024]). “[B]y automatically detecting the type of device connected (host or slave) the present invention can switch to the proper transmission path.” EX1015, [0021]; *see also* §VI.B. Sections VII.A.1 and III.B.2 demonstrate that switching transmission paths was highly predictable, being both well-known and routine to implement using readily available off-the-shelf components. *See, e.g.*, EX1059; EX1060; EX1068 (USB analog mux offerings). In view of these teachings, it would have been obvious to employ crossbar switching in Chang to switch between the bridge path (when a host connects) or bypass path (when a device connects). Welch, ¶¶233-236.

Hub Control Unit 46

The Crossbar Implementation with Chang's hub control unit 46 as the *USB* *hub* is shown below:

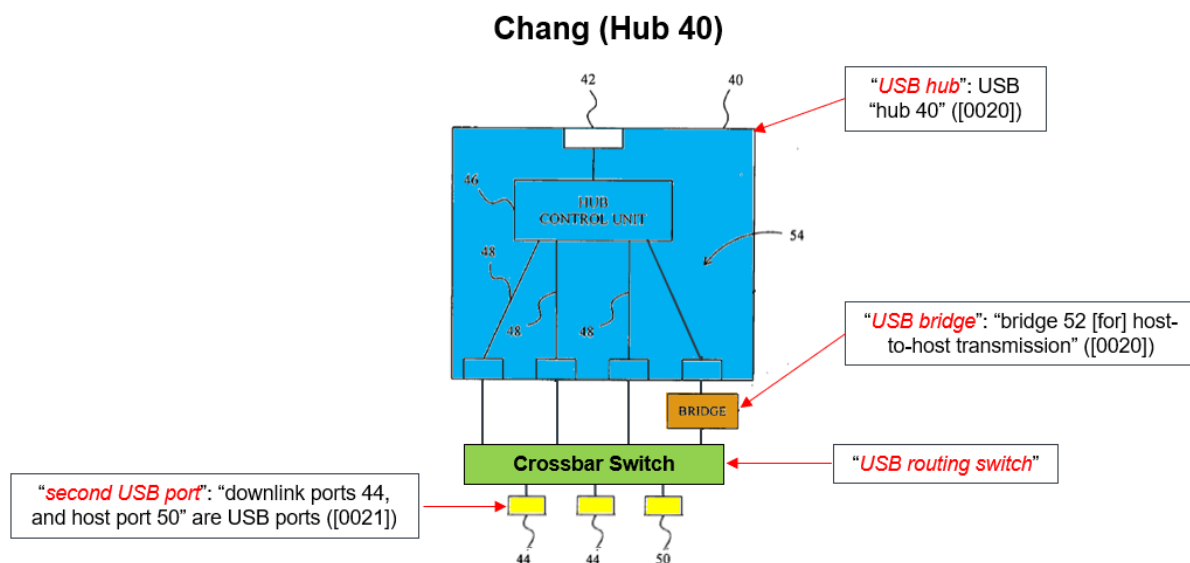


EX1014, Fig. 3 (modified and annotated). This obvious modification to Chang

(discussed *supra* §VII.A.1) discloses “*a USB routing switch* [the crossbar switch] *interconnected to the USB bridge* [bridge 52], *the USB hub* [hub control unit 46], *and the second USB port* [any of ports 44 and/or 50].” Welch, ¶235.

Hub 40

The Crossbar Implementation with Chang’s hub 40 as the *USB hub* is shown below:



EX1014, Fig. 3 (modified and annotated). This obvious modification to Chang (discussed *supra* §VII.A.1) discloses “*a USB routing switch* [the crossbar switch] *interconnected to the USB bridge* [bridge 52], *the USB hub* [hub 40], *and the second USB port* [any of ports 44 and/or 50].” Welch, ¶236.

- g. 1[f]: “[1][f][i] wherein the USB routing switch is configured to connect the second USB port to the first USB port through the USB bridge, [1][f][ii] thereby providing bidirectional initiation of communication between the USB*

host and the consumer device when the consumer device connected to the second USB port is in a USB host mode and”

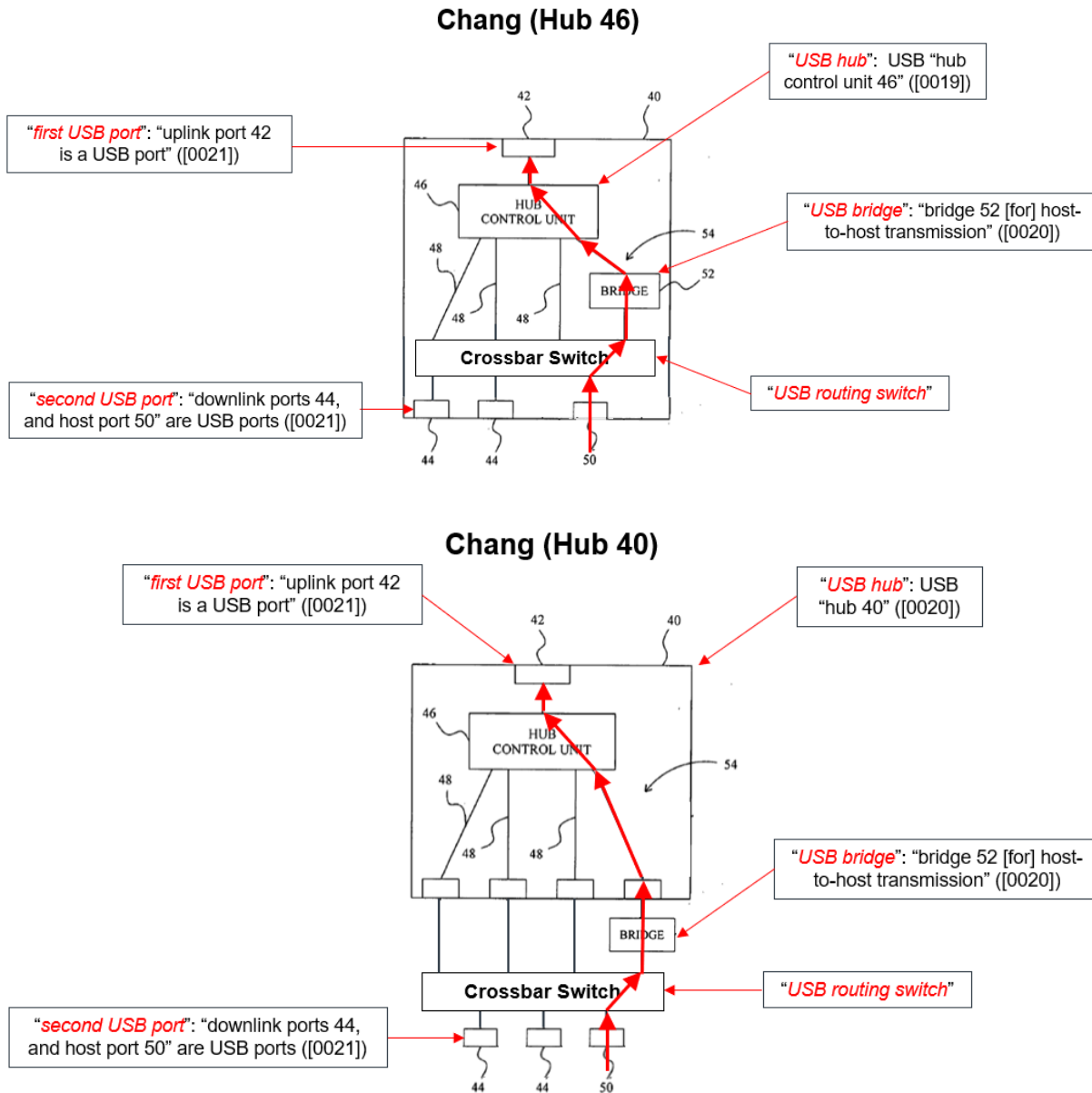
Both Crossbar Implementations render this limitation obvious. Taking sub-element 1[f][i] first, the crossbar is configurable via control signals, similar to the MAX4989 “Control Input[s].” See EX1063, 7 (“[T]hree control logic inputs, C0, C1, and C2, [] control the switch.”); EX1060, 1; Welch, ¶¶237-245, 88-96.

The host-to-host transmission paths in the Crossbar Implementations are discussed *supra* §VII.A.1. As discussed, it was obvious to connect the appropriate transmission path upon detecting the downstream consumer product’s operating mode (*i.e.* device/host). Upon detection, asserting the appropriate crossbar control signals connects the consumer product to the bridge (for host-to-host transmission path 54) or directly to the hub (for host-to-device transmission path 48).¹⁵ Welch, ¶¶237-239. The crossbar controls correspond to “Switch Control” in ’420 patent Fig. 5. As noted *supra* fn.11, it was routine and obvious for the detection circuit

¹⁵ Chang II discloses a “bridging detection signal” that “controls the operation of either the second USB controller 132 or the bypass circuit unit 133.” EX1015, [0038]. Applying this teaching to Chang, the crossbar would connect the downstream port to the bridge upon detecting a downstream host (*see supra* §III.B.1). Welch, ¶¶238-239.

and/or bridge to control switching functionality. Welch, ¶193.

This results in the following obvious configurations:



EX1014, Fig. 3 (modified and annotated); Welch, ¶¶238-239. The red arrows show the host-to-host communication path established by configuring the crossbar when a downstream host is connected to port 50, in satisfaction of sub-element

1[f][i] (“*wherein the USB routing switch [crossbar] is configured to connect the second USB port [e.g., port 50] to the first USB port [port 42] through the USB bridge [bridge 52] ... when the consumer device connected to the second USB port is in a USB host mode.*”).

Sub-element 1[f][ii] recites “*thereby providing bidirectional initiation of communication between the USB host and the consumer device when the consumer device ... is in a USB host mode.*” As reflected by the term “*thereby*,”¹⁶ and as recited in sub-element 1[f][i], this is accomplished by a “routing switch” that connects the two USB hosts through a “bridge.” Regardless, it makes no difference which component(s) (viz., routing switch, bridge, or downstream host) must “*provid[e] bidirectional initiation of communication*” because both Crossbar Implementations satisfy this limitation in the same way disclosed by the ’420 patent. Welch, ¶¶240-244.

The ’420 specification describes “bi-directional communication” as a host-to-host connection. EX1003, 7:54-8:38 (“[T]he Bridge hardware ... form[s] a *bidirectional* bridge that passes USB traffic between two USB hosts.”). It was

¹⁶ See, e.g., <https://dictionary.cambridge.org/us/dictionary/english/thereby>

(defining “thereby” as “because of this; as a result of this action”).

well-known that hosts initiate communication requests, and therefore host-to-host connections involve bidirectional communication, because each host may initiate communication requests. EX1025, 1:17-20 (“To communicate, one of the units operates as a USB Host which initiates communication requests ... and the other operates as a USB Device which responds to those requests.”). Ground 1’s host-to-host communication is bidirectional communication because each host is a standard USB host that may initiate host communications. EX1014, [0020], EX1015, [0026]; Welch, ¶242.

Both the crossbar and bridge also provide bidirectional initiation of communication in the same way disclosed by the ’420 patent. Welch, ¶¶243-244. The ’420 patent discloses that, upon detecting a downstream host, the routing switch connects the consumer product (in host mode) to the bridge, and thereby enables the consumer product (downstream host) to “detect a USB Device [in the bridge] is connected” and “begin the standard USB enumeration sequence.”¹⁷ EX1003, 6:19-28. As shown and discussed for Fig. 7, the bridge “forward[s]

¹⁷ The USB 2.0 Specification defines “Bus Enumeration” as “[d]etecting and identifying USB devices.” EX1018, 31; *see also id.*, §4.6.3 (“Bus enumeration...identifies and assigns unique addresses to devices.”). The ’420 patent admits enumeration is “standard” USB process. EX1003, 6:28-30.

messages back and forth between the two hosts continues until the enumeration process is complete,” after which “the two hosts may begin to use the IN and OUT endpoints to transfer application data and services.” *Id.*, 8:33-38.

Ground 1 discloses the same. Recall that Chang II’s control chip sends an “inquire signal.” EX1015, [0026]. A POSITA would have understood this “inquire signal” to determine connection type (*i.e.*, host/device). Welch, ¶244. Chang II’s control chip then selects the bridge transmission path upon detecting the downstream product is in host mode and a bridge connection is made to “complete the bridging.” EX1015, [0026], [0021], [0038]. A POSITA would have understood this to refer to enumerating a device interface in the bridge. Welch, ¶244. This was well-known bridge functionality, and Chang states its bridge may be a suitable commercial bridge. EX1014, [0020]; *see also* EX1054 (describing enumeration for USB bridging). Thus, Ground 1 renders obvious sub-element 1[f][ii]: “*providing bidirectional initiation of communication between the USB host and the consumer device [is host mode]* [switch connecting downstream host to bridge, which enumerates the device interface to establish host-to-host connection with upstream host].” Welch, ¶¶240-245.

- h. 1[g]: “[1][g][i] wherein the USB routing switch is configured to connect the second USB port directly to the first USB port through the USB hub, [1][g][ii] thereby only responding to communication initiated by the USB Host***

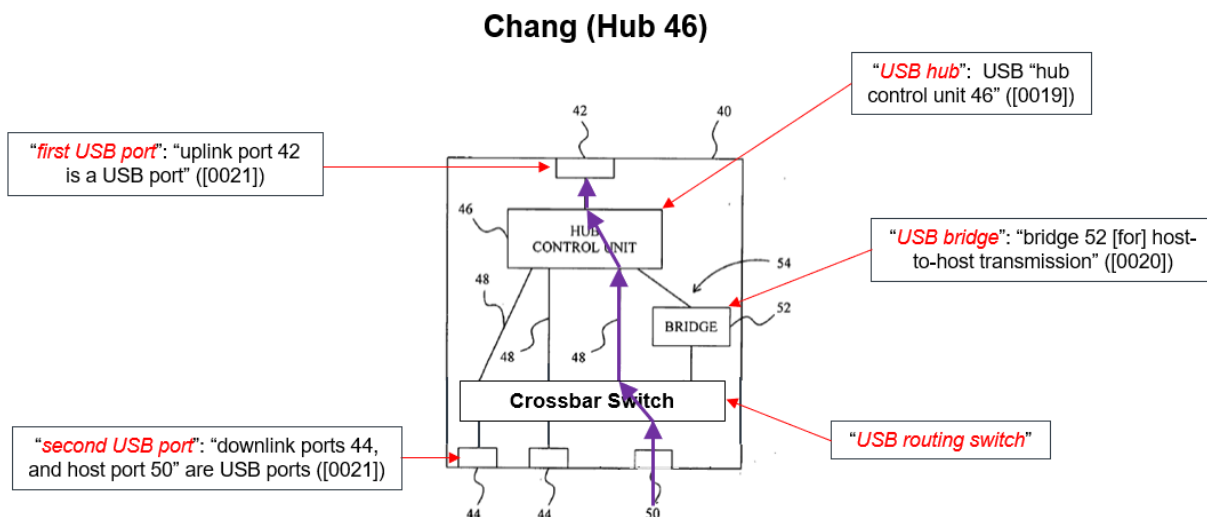
when the consumer device connected to the second USB port is in a USB device mode.”

Both Crossbar Implementations render this limitation obvious. Welch, ¶¶246-248.

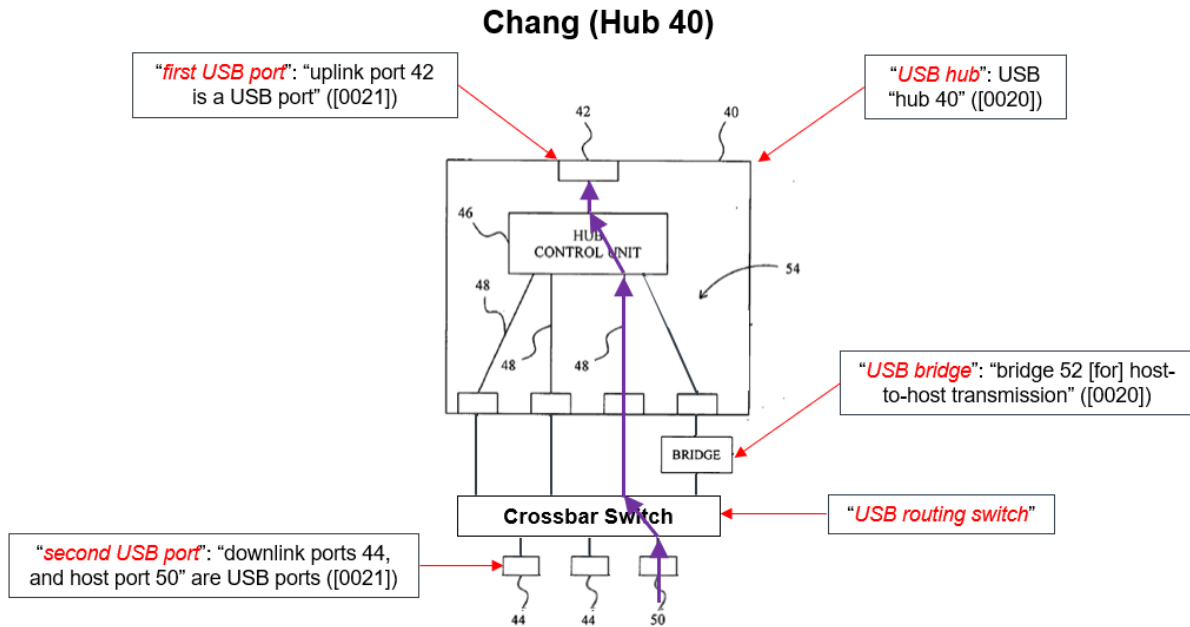
As an initial matter, element 1[g] applies “*when the consumer device connected to the second USB port is in a USB device mode.*” Ground 1 discloses connecting a USB product in device mode to a dual-role port. *See, e.g.*, EX1015, Fig. 1 (“Slave Device 4”); Welch, ¶246. For example, port 50 is dual-role in both Crossbar Implementations of modified Chang Fig. 3. *See* §VII.A.1. Although various Chang II embodiments contemplate connecting a dedicated host or dedicated device to the dual-role port, Chang II also discloses that “other combinations and other connector types are too numerous to list, but those connector types covered under USB specification is all within the scope of the present invention.” EX1015, [0030]. This would include, for example, the well-known “Micro-AB” connector (and other known connectors) that accepted host, device, and/or dual-mode products. EX1022, 13 (OTG product “provides both host and peripheral capabilities over a single Micro-AB receptacle”); Welch, ¶246. Thus, a POSITA would have understood (and certainly found it obvious) that connecting a dual-role product was within the scope of Chang II’s disclosure. *Id.*, ¶246; *see also* §VII.A.1 (motivation to include dual-mode USB ports for dual-mode USB products) and §III.B (demonstrating proliferation of dual-mode

products and corresponding ports).

Element 1[g][i] is satisfied when a product in device mode connects to port 50. Welch, ¶247. In particular, Chang discloses host-to-device communication through “several transmission paths 48.” EX1014, [0019]-[0020]. Host/device detection is discussed *supra* §III.B.1 and crossbar routing is discussed *supra* §III.B.2. These concepts, applied to the Crossbar Implementations, are discussed *supra* §VII.A.1. The resulting obvious configurations (with purple arrows indicating host-to-device paths bypassing the bridge)¹⁸ are shown below.



¹⁸ Chang discloses that the upstream host may bypass the bridge and communicate with a downstream device through the hub (*i.e.*, traditional USB host-to-device connection). EX1014, [0019], [0023]; Welch, ¶247.



EX1014, Fig. 3 (modified and annotated). As shown, in each Crossbar Implementation, *“the USB routing switch [crossbar switch] is configured to connect the second USB port [e.g., port 50] directly to the first USB port [port 42] through the USB hub [hub 40 or hub control unit 46]”* in satisfaction of sub-element 1[g][i]. Welch, ¶247.

Regarding 1[g][ii], the '420 patent explains “the USB Device responds to messages initiated by the USB Host.” EX1003, 1:36-38. This is traditional USB host/device operation (see §III.A.1) and it was well-known USB devices only respond to host communication (EX1025, 1:17-20). Thus, when port 50 is connected to a consumer product in device mode, Ground 1 satisfies element 1[g][ii]’s requirement that the downstream product *“only respond[s] to communication initiated by the USB Host.”* Welch, ¶248.

3. Claim 2

Claim 2 depends from claim 1 and further requires “[a] wherein the USB routing switch is configured to connect the second USB port to the first USB port through the USB bridge thereby providing bidirectional initiation of communication between the USB host and the consumer device when the consumer device connected to the second USB port is in the USB host mode and [b] wherein the USB routing switch is configured to simultaneously connect another second USB port directly to the first USB port through the USB hub, thereby only responding to communication initiated by the USB Host when another consumer device connected to the another second USB port is in the USB device mode.”

In summary, claim 2 requires two downstream consumer products (one host and one device) simultaneously communicating with the upstream host. Welch, ¶250. To begin, providing simultaneous downstream connections is a primary purpose of conventional hubs. See §III.A.2. And simultaneously connecting a downstream host and downstream device to an upstream host is a primary purpose of Chang. EX1014, Fig. 3, [0019]-[0020]. Indeed, Chang Fig. 4 (an extension of Fig. 3) shows three downstream devices 60 and one host device 70 simultaneously connected to an upstream host. *Id.*, [0023].

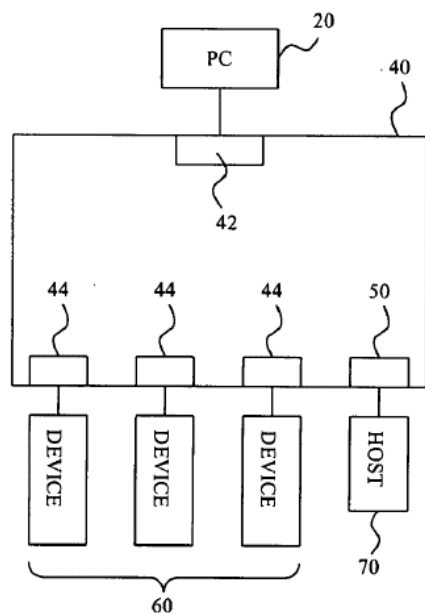
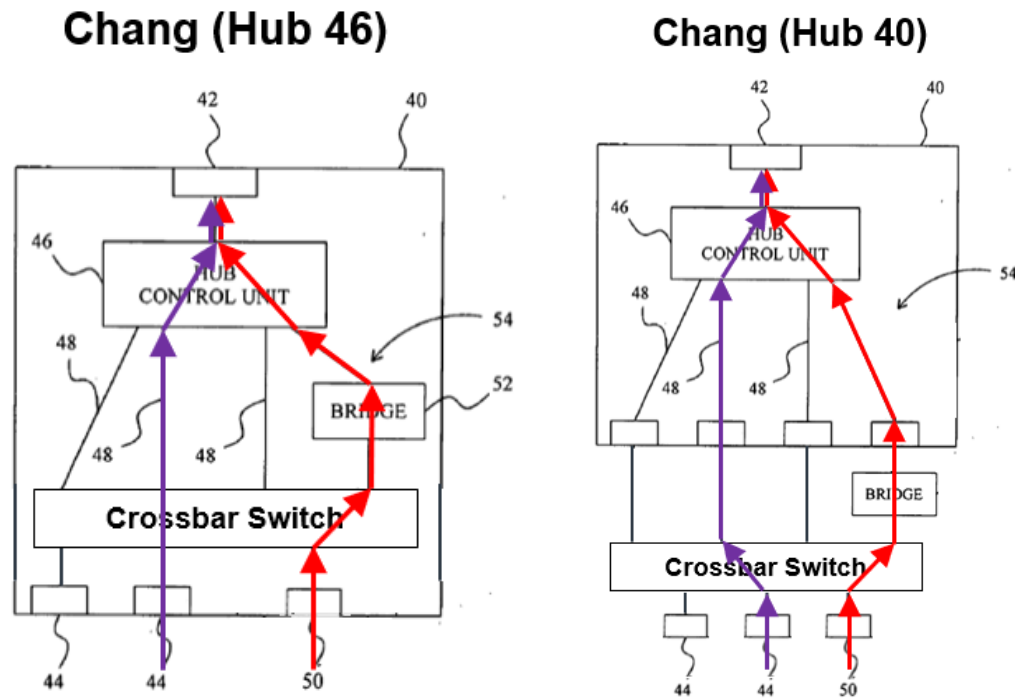


FIG. 4

Both Crossbar Implementations render claim 2 obvious. To begin, elements 2[a] and 1[f] are identical and met for the same reasons (*viz.*, the *USB routing switch* (crossbar) is configured (*e.g.*, via control signals) to establish host-to-host communication through the bridge). Further, the crossbar can route each consumer port (including all at the same time) directly to the hub or route any particular port to the hub through the bridge. Welch, ¶253. Because Chang's upstream port is always host, this maintains downstream connections to other device ports when establishing host-to-host communication. Compare EX1014, [0020], [0023] with EX1003, 3:52-64; Welch, ¶¶253-254. As shown below, the crossbar is easily configured (using its control signals) to simultaneously route a downstream host

(e.g., on port 50) and downstream device (e.g., on port 44) to the upstream host:



EX1014, Fig. 3 (modified and annotated). Thus, both Crossbar Implementations satisfy element 2[a] (“*the USB routing switch [crossbar] is configured to connect the second USB port [e.g., port 50] to the first USB port [port 42] through the USB bridge [bridge 52] thereby providing bidirectional initiation of communication between the USB host and the consumer device when the consumer device connected to the second USB port is in the USB host mode [host-to-device connection shown by red arrows]*”) and 2[b] (“*the USB routing switch [crossbar] is configured to simultaneously connect another second USB port [e.g., port 44] directly to the first USB port [port 42] through the USB hub [hub 40 or hub control unit 46], thereby only responding to communication initiated by the USB Host*

when another consumer device connected to the another second USB port is in the USB device mode [host-to-device connection shown by purple arrows]”). Welch, ¶¶249-254.

4. Claim 3

Claim 3 depends from claim 1 and further requires “*the USB hub module is configured to recognize whether the consumer device connected to the second USB port is in the USB host mode or in the USB device mode and control the USB routing switch accordingly.*”

As §III.B.1 demonstrates, host/device detection for dual-role ports was routine and well-known, and a POSITA would have been motivated with a high expectation of success to implement detection functionality for dual-role products in this Ground. Welch, ¶256. For example, Chang II discloses “Detection Unit” 134:

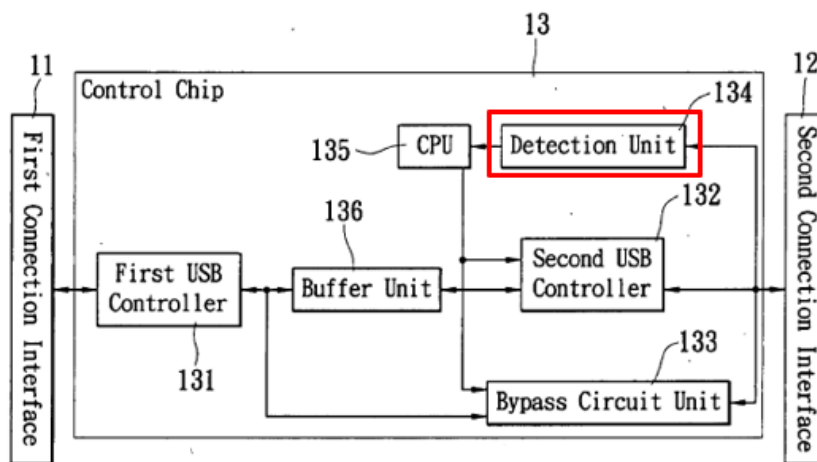


FIG. 5

EX1015, Fig. 5 (annotated).

Chang II's "detection unit" "automatically operate[s] to ... determine the type of device" connected to the port. EX1015, [0038]. Applying these teachings to Ground 1, the detection results control crossbar control signals, similar to the MAX4989 "Control Input[s]." See EX1063, 7 ("[T]hree control logic inputs, C0, C1, and C2, [] control the switch."); EX1060, 1; Welch, ¶¶257-259, 88-96.

The detection unit would be part of the "hub module," *e.g.*, forming part of the hub, bridge, switch, or a separate component. See, *e.g.*, EX1015, Fig. 5 (detection unit part of bridge "control chip"). Chang discloses its bridge could be part of the hub. EX1014, [0022]. A POSITA would naturally integrate detection functionality into the hub, bridge, or switch to utilize an existing encasing and leverage existing logic or CPU functionality. Welch, ¶259.

5. Claim 4

Claim 4 depends from claim 1 and further requires "*the USB hub module is configured to dynamically switch operation of the second USB port between supporting the consumer device in the USB device mode or the USB host mode.*"

Chang II discloses host/device detection and associated routing when a USB product is plugged in. See EX1015, Fig. 6., [0042]-[0045]. Indeed, Chang II discloses "automatically detect[ing] the connecting device type and accordingly switch between different transmission paths." *Id.*, [0011]; see also *id.*, [0021],

[0038].

Chang II discloses and/or renders obvious “*dynamically switch[ing]*” between host/device paths during an active session. Chang II discloses “automatically and periodically” checking for a host/device so “control chip 13 can respectively switch to the bridge transmission path or the bypass path.” EX1015, [0024]. Indeed, Chang II discloses that “checking whether the user has exchanged for other external device **would occur constantly**.” *Id.*, Fig. 6 (step 613 and 625), [0043] (emphasis added).

At a minimum, in view of Chang II’s disclosure re “automatic[],” “periodic[],” and “constant[]” checking for a connected host/device and the numerous dual-role products (§III.B) that “change roles dynamically” (EX1003, 3:18-56; *see also* EX1025, 4:17-22), a POSITA would have found it obvious to periodically check the device/host mode and “*dynamically switch*” paths based on the current mode. Welch, ¶¶263-265. A POSITA would have been motivated to support this functionality to improve user experience and avoid unplugging/replugging products to change modes. *Id.*, ¶263.

Moreover, a POSITA would have had a reasonable expectation of success as doing so would involve minimal changes to Chang II’s algorithm in Fig. 6 (*viz.*, adjusting steps S613 and S625 to check for a mode change regardless of whether the user plugged in another USB product). Welch, ¶¶264-265. Indeed, such

dynamic switching was well-known in the art, and could be accomplished using “standard hardware components.” See, e.g., EX1025, 4:17-35; see also *id.* (“USB unit 202 can be configured to *switchably alternate, in a dynamic fashion*, between [Host/Device] mode ... when one of the devices is a portable device, such as a PDA or hand-held device, whose role may change To accomplish *switching in a dynamic fashion*, a signal can be provided ... to enable switch 212 to select a particular mode.”) (emphasis added). Further, Castleberry discloses dynamic mode switching “at power up or more frequently during operation.” *Id.* (emphasis added); Welch, ¶265.

Thus, this Ground renders obvious “*the USB hub module* [i.e., collection of all claimed components] *is configured to dynamically switch operation* [crossbar switching between host-device and host-host paths for the same product] *of the second USB port* [port 50] *between supporting the consumer device in the USB device mode or the USB host mode* [dual-role product changing roles].” Welch, ¶¶260-266; see also analysis under limitations 1[f]-1[g].

6. Claim 5

Claim 5 depends from claim 1 and further requires “*the USB routing switch is configured to connect the consumer device to either the USB bridge or the USB hub based on whether the consumer device attached to the second USB port is configured to act as the USB host or a USB device.*”

As §§VII.A.1, III.B, elements 1[f]-[g], and claim 2 analysis demonstrate, it would have been obvious to make port 50 a dual-role port and include crossbar routing that connects the downstream product on port 50 directly to the hub or route it to the hub through the bridge. Welch, ¶268. Doing so involves detecting host/device status of each downstream product, which was well-known and obvious (see §III.B.1). *Id.* Accordingly, Ground 1 renders claim 5 obvious. *Id.*

7. Claim 6

Claim 6 depends from claim 1 and further requires “*the USB bridge is configured to control the USB routing switch.*”

Ground 1 renders this limitation obvious. Chang II discloses that its bridge chip controls routing. Specifically, “Bridge Device 1” in Fig. 1 includes “control chip 13” (shown in Fig. 5) which includes detection unit 134 and CPU 135. EX1015, [0022]-[0023], [0034]. The detection unit and CPU control switching; namely, the detection unit “determine[s] the type of device currently connected” (host/device) and sends the CPU a “detection signal” which switches (connects) the appropriate path. EX1015, [0038]-[0039]. Applying this teaching to Chang, Chang’s bridge would be configured to control the crossbar via its control inputs. Welch, ¶¶270-271; *see also* EX1068, 2 (truth table for select line); EX1063, 7 (“control logic inputs, C0, C1, and C2, [] control the switch connections.”); EX1060, 1 (discussing multiplexer select lines); EX1055, 284-288. Indeed,

Chang’s bridge would have been understood to include a controller, CPU, or similar logic (like Chang II) to control routing (and certainly it would have been obvious and advantageous to use existing logic to save costs). Welch, ¶271.

8. Claim 7

Independent claims 1 and 7 are substantially similar and met for the same reasons. *See* §VII.A.2; *see also* Welch, ¶¶272-278 (side-by-side claim comparison). The primary difference is the preamble: claim 1 recites “A Universal Serial Bus (USB) hub module” and claim 7 recites “An integrated circuit.” EX1003. If the preamble is limiting, Chang recognizes that integrating the bridge and hub logic was a known “possib[ility]” to “an integrated circuit (IC) designer.” EX1014, [0022]. Including the switch on the same IC was well-known. Welch, ¶¶276-277. For example, Hesse discloses a “crossbar switch” on the same SoC (System-on-Chip) as the USB controller. EX1017, [0057]. A POSITA would have been motivated to include these components on the same device or chip because it was well-known that doing so reduced size/footprint and lowered manufacturing costs. Welch, ¶276. Thus, claim 7 is rendered obvious by the same art and for the same reasons as claim 1. *Id.*, ¶¶272-278.

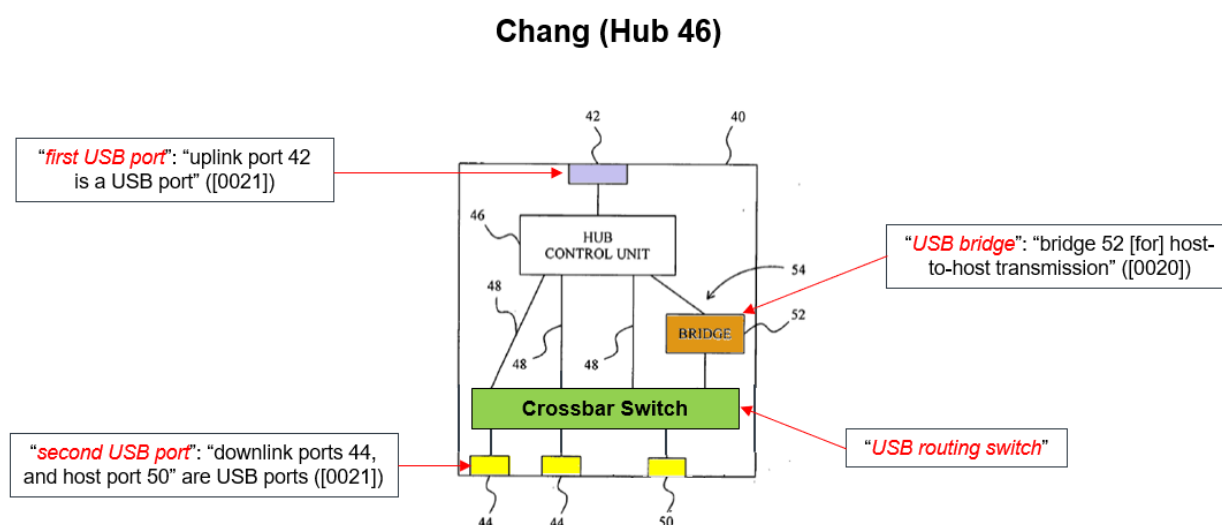
9. Claims 8-12

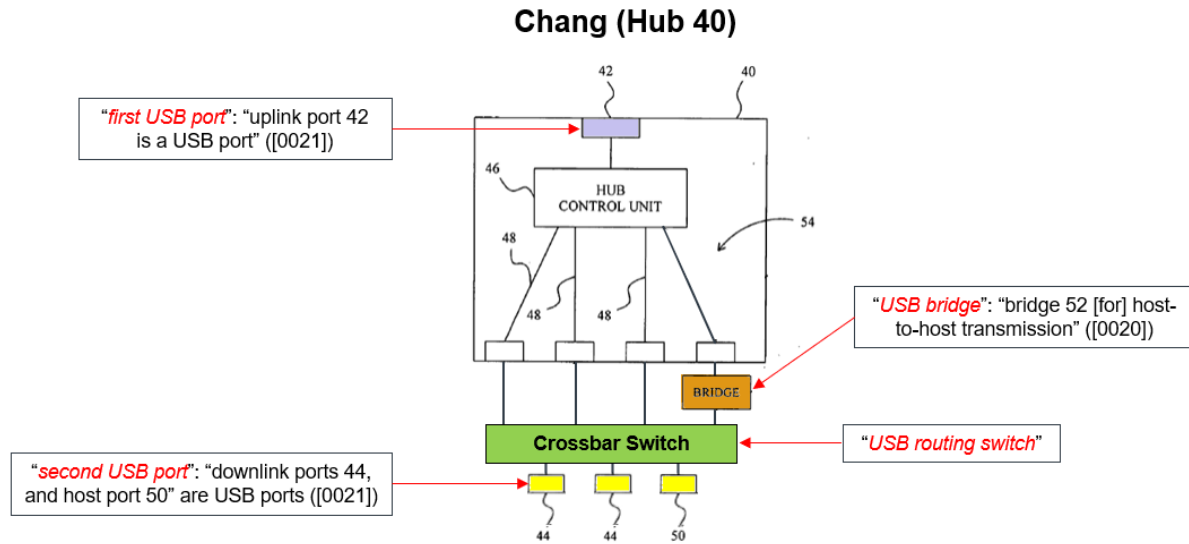
The additional limitations of dependent claims 8-12 are present in claims 2-6, respectively, and met for the same reasons. Welch, ¶¶279-283 (side-by-side

claim comparison).

10. Claim 15

Independent claim 15 bears many similarities to claims 1 and 7, and the modified Crossbar Implementations satisfy claim 15 for largely the same reasons. Welch, ¶284. The primary difference is that claim 15 does not require a “hub.” Claim 15, however, is a “comprising” claim, which allows a hub to be present. *See, e.g., Genentech, Inc. v. Chiron Corp.*, 112 F.3d 495, 501 (Fed. Cir. 1997). Moreover, the entire context of the ’420 specification (including all embodiments) are about USB hubs. *See, e.g., EX1003*, Title, Abstract, Background, Summary, Detailed Description. Indeed, claim 15 reads on ’420 patent Figs. 4 and 5, which have a hub. Welch, ¶284. Accordingly, Petitioner applies the Crossbar Implementations previously discussed to claim 15, except that the “hub” element is not called out:





EX1014, Fig. 3 (modified and annotated).

a. [Preamble]: “A Universal Serial Bus (USB) connectivity module, comprising:”

If the preamble is limiting, the Crossbar Implementations satisfy it for substantially the same reasons as the claim 1 preamble. Welch, ¶285. The only difference is that claim 1 recites a USB “*hub module*” and claim 15 recites a USB “*connectivity module*.” But a hub module (which connects an upstream port with multiple downstream ports) is an example of a connectivity module. *Id.*, ¶285; see also EX1003, 1:17-24 (describing “connectivity” achieved using a “USB hub”).

b. 15[a] “a first USB port;”

Both Crossbar Implementations satisfy this limitation for the same reasons as element 1[a]. Welch, ¶286. In particular, port 42 is the “*first USB port*.” See EX1014, [0019] (discussing “uplink port 42 for being linked to a host”).

c. 15[b] “a second USB port;”

Both Crossbar Implementations satisfy this limitation for the same reasons as element 1[b]. Welch, ¶287. In particular, each of dual-role ports 44 and 50 in the Crossbar Implementations is a “*second USB port*.” See EX1014, [0019] (“several downlink ports 44 for being linked to devices”); [0020]-[0021] (“port 50 is a USB port”).

d. 15[c]: “a USB host-to-host bridge connected to said first USB port;”

Both Crossbar Implementations satisfy element 15[c]. Welch, ¶288. Chang’s “bridge 52 provides a function for host-to-host communications” (*i.e.*, is a “*USB host-to-host bridge*”). EX1014, [0020]. Chang explains that its bridge is “*connected to said first USB port*”: “[w]ith the hub control unit 46 and bridge 52, a host-to-host transmission path 54 may be established such that the uplink port 42 may communicate with the host port 50.” *Id.* This is the same way the ’420 patent depicts its “Bridge IC” being “connected to” the upstream USB port. See, *e.g.*, EX1003, Fig. 4. Indeed, element 1[g] recognizes that an upstream and downstream port can be connected to each other “*through the USB hub*.” Element 1[g] even calls this a “*direct[]*” connection. Here, where element 15[c] does not even recite a “direct” connection, bridge 52 in the Crossbar Implementations is “*connected to*” upstream port 42 through the hub. Welch, ¶288.

- e. 15[d]: “a USB routing switch connected to said first USB port, said second USB port and said USB host-to-host bridge,”***

Element 15[d] is substantially similar to element 1[e]. Welch, ¶¶289-290.

Element 15[d] recites “*connected to*” whereas element 1[e] recites “*interconnected to*,” but this linguistic difference does not change the analysis. *Id.*, ¶289.

Additionally, element 15[d] says the routing switch connects to the “*first USB port*” whereas element 1[e] says the routing switch connects to the “*USB hub*.” In the Crossbar Implementations, the routing switch connects to the first port in the same way the bridge does as discussed for element 15[c] (switch connects to first port through the hub). *Id.*, ¶290. Thus, the Crossbar Implementations satisfy element 15[d] for the same reasons as element 1[e]. *Id.*, ¶¶289-290.

- f. 15[e]: “wherein said USB routing switch is configured to provide a communication link between said first USB port and said second USB port through said USB host-to-host bridge, thereby providing bidirectional initiation of communication between the USB host and the consumer device when a first consumer device connected to said second USB port is operating in a USB host mode and”***

Element 15[e] is substantially similar to element 1[f]. Welch, ¶¶291-292.

Element 15[e] refers to providing a “*communication link*” between the first and second USB ports, whereas element 1[f] refers to “*connect[ing]*” the first and second USB ports. The “*connect[ing]*” forms a “*communication link*” and thus the analysis under 1[f] applies equally here. *Id.*, ¶292. Thus, the Crossbar

Implementations satisfy element 15[e] for the same reasons as element 1[f]. *Id.*, ¶¶291-292.

- g. 15[f]: “wherein said USB routing switch is configured to provide another communication link between said first USB port and said second USB port that bypasses said USB host-to-host bridge, thereby only responding to communication initiated by the USB host when the first consumer device connected to said second USB port is operating in a USB device mode.”***

Element 15[f] is substantially similar to element 1[g]. Welch, ¶¶293-294.

Element 15[f] refers to providing a “*communication link*” between the first and second USB ports, whereas element 1[g] refers to “*connect[ing]*” the first and second USB ports. The “*connect[ing]*” forms a “*communication link*” and thus the analysis under 15[e] applies equally here. *Id.*, ¶294. Additionally, element 1[g] refers to “*directly*” connecting the first and second USB ports “*through the USB hub*,” whereas element 15[f] recites “*bypass[ing] said USB host-to-host bridge*.” Because the analysis and Crossbar Implementation mappings provided for element 1[g] show that the “*direct[]*” host-to-device connection goes around the bridge (i.e., “*bypasses*” the bridge), this linguistic difference does not affect the prior art analysis of the Crossbar Implementations. *Id.* Accordingly, the Crossbar Implementations satisfy element 15[f] for the reasons explained in connection with element 1[g]. *Id.*, ¶¶293-294.

11. Claim 16

Claim 16 depends from claim 15 and further requires “[16][a] a third USB port, [16][a][i] wherein said USB routing switch is configured to provide a first communication link between said first USB port and said second USB port through said host¹⁹ host-to-host bridge, thereby providing bidirectional initiation of communication between the USB host and the consumer device when the first consumer device connected to said second USB port is operating in the USB host mode and [16][a][ii] wherein said USB routing switch is configured to provide simultaneously provide a second communication link between said first USB port and said third USB port that bypasses said USB host-to-host bridge, thereby only responding to communication initiated by the USB Host when a second consumer device connected to said third USB port is operating in the USB device mode.”

In substance, claim 16 adds another downstream port (called the “*third USB port*”)²⁰ and requires two downstream consumer products (one host and one

¹⁹ This appears to be a typographical error that should read “*USB host-to-host bridge*” instead of “*host host-to-host bridge*.”

²⁰ The “*third downstream port*” could be any of ports 44 or 50 in the Crossbar Implementations. EX1014, [0019]-[0021]; Welch, ¶297. As shown in the

device) simultaneously communicating with the upstream host. Welch, ¶296. This is substantively similar to claim 2 and is met for the same reasons. *Id.*; see also element 15[e] (corresponding to 17[a][ii]) and 15[f] (corresponding to 17[a][iii]). Instead of reciting a “*third USB port*” as claim 16 does, claim 2 refers to this additional downstream port as “*another second USB port*,” but this makes no difference. *Id.*, ¶297. Claim 16 refers to providing first and second “*communication link[s]*” between the respective ports, whereas claim 2 refers to “*connect[ing]*” the relevant ports to one another. Once again, the “*connect[ing]*” forms “*communication links*.” *Id.* Lastly, the same disclosure in the Crossbar Implementations that satisfies element 2[b]’s requirement of a “*direct[]*” host-device connection meets the element 16[a][ii] requirement of a host-device connection that “*bypasses said USB host-to-host bridge*.” Accordingly, the Crossbar Implementations meet claim 16 for the same reasons as claim 2. *Id.*, ¶¶295-297.

12. Claim 17

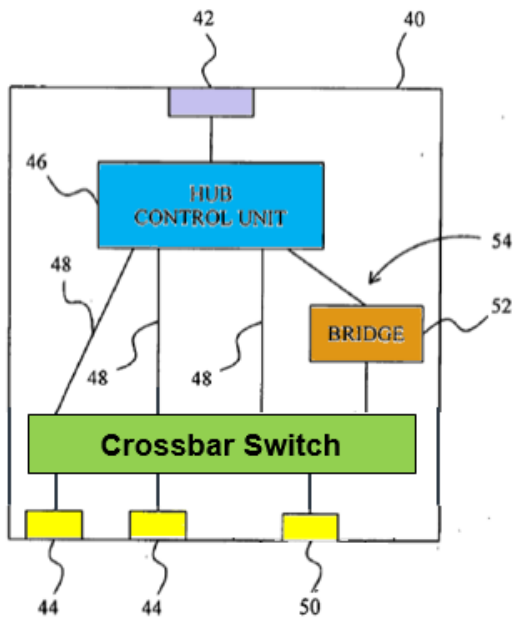
Claim 17 depends from claim 15 and further requires “*[17][a] a third USB port, [17][a][i] wherein said USB routing switch is further connected to the third*

Crossbar Implementations, these ports are all connected to the crossbar switch as required by element 17[a][i].

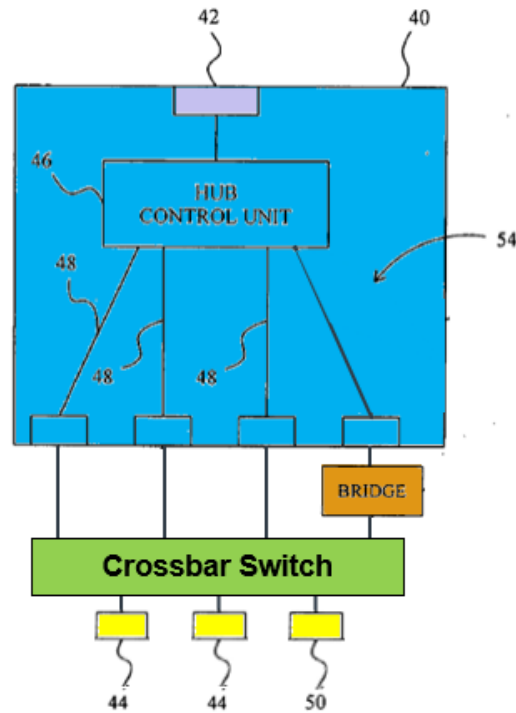
USB port, [17][a][ii] wherein said USB routing switch is configured to provide a first communication link between said first USB port and said second USB port through said USB host-to-host bridge, thereby providing bidirectional initiation of communication between the USB host and the consumer device when the first consumer device connected to said second USB port is operating in the USB host mode, and [17][a][iii] wherein said USB routing switch is configured to provide a second communication link between said first USB port and said third USB port that bypasses said USB host-to-host bridge, thereby only responding to communication initiated by the USB host when a second consumer device connected to said third USB port is operating in the USB device mode without interrupting the first communication link between said first USB port and said second USB port.”

Claims 17 and 16 are quite similar. Elements 16[a] and 17[a] (“*third USB port*”) are identical. So, too, are elements 16[a][i] and 17[a][ii] (host-to-host connection). Thus, elements 17[a] and 17[a][ii] are met for the same reasons as elements 16[a] and 16[a][i], respectively. Welch, ¶¶299-300. Element 17[a][i] requires that the “*USB routing switch is further connected to the third USB port.*” This requirement is readily met as shown by the Crossbar Implementations below where ports 44 and 50 are all connected to the crossbar. *Id.*, ¶300.

Chang (Hub 46)



Chang (Hub 40)



EX1014, Fig. 3 (modified).

Elements 17[a][iii] and 16[a][ii] are identical, except that element 17[a][iii] requires providing the second (host-device) communication link “*without interrupting the first communication link between said first USB port and said second USB port*” instead of “*simultaneously*” providing the second (host-device) communication link, as element 16[a][ii] recites. Welch, ¶¶299, 301. The Crossbar Implementations satisfy this requirement. *Id.*, ¶301. This is due to (1) the nature of USB hubs (whose primary purpose is to simultaneously support multiple host-device connections without interrupting existing connections as additional USB devices are added or removed), and (2) the nature of USB bridges

which are design to present a USB device interface to each connected host. *Id.*, ¶301; *see also* §§III.A.2, III.C; EX1054 (explaining that “inherent[] incompatib[ility]” of host-to-host communications is overcome by presenting “two USB device[] [interfaces], one for each [host].”). Thus, the Crossbar Implementations (which utilize a bridge and hub) meet element 17[a][iii]’s additional requirement. Welch, ¶¶298-301.

B. Secondary Considerations of Nonobviousness

No secondary considerations of nonobviousness were identified during prosecution. *See generally* EX1010. And Petitioner is unaware of any that apply here. Welch, ¶¶302-319. Aptiv is the plaintiff in related district court litigation against Petitioner asserting six related patents, including the ’072 patent. *See infra* §IX.B. In an interrogatory response, Aptiv contends the following secondary considerations support nonobviousness: “commercial success, industry praise for Aptiv’s innovative products, failure by Microchip to develop a solution like Aptiv’s innovative products, and copying by Microchip of Aptiv’s innovative products.” EX1045, 11.

Commercial Success. Aptiv relies heavily on its so-called “Dual Role Hub” that it contends “embodies the claimed inventions,” but it provides no evidence of commercial success, let alone that any such purported success had the required nexus due to practicing the Challenged Claims. *See, e.g., Bos. Sci. SciMed, Inc. v.*

Iancu, 811 F. App’x 618, 623, 627-629 (Fed. Cir. 2020); Welch, ¶¶307-311.

Should Aptiv proffer any such evidence, Petitioner can rebut it with evidence demonstrating the lack of nexus between the alleged success and the claims.

Aptiv contends its Dual Role Hub was the first USB hub that “provided all the features sought by the vehicle manufacturers: (1) accommodating the head unit as a first host and the iPhone as a second host while running CarPlay; (2) providing persistent USB; and (3) using a single lane configuration.” EX1045, 11. Aptiv’s assertion fails. Chang’s hub plainly disclosed: (1) a host-to-host connection; (2) persistent USB (*i.e.*, a host-to-host connection does not affect functionality of other downstream devices); and (3) a single lane configuration (*viz.*, single connection between the hub and upstream host). *See supra* §VI.A. As such, any Aptiv (or Aptiv PLC) product that merely provides these features cannot form the basis for secondary considerations. Moreover, the Challenged Claims say nothing about “CarPlay,” “single lane configuration,” etc. Welch, ¶¶303, 306, 310.

Industry Praise. Aptiv cites a single award, which touts Apple CarPlay compatibility. EX1045, 11. But, as noted, CarPlay is not recited in the Challenged Claims and host-to-host communication in USB hubs was already known. Welch, ¶¶304-306. And the article mentions other reasons (*e.g.*, “lower cost”) contributing to the award. www.autonews.com/awards/2016-winner-delphi-automotive-dual-role-hub.

Failure by Others and Copying. Aptiv’s bare-bones allegations of copying by Microchip and failure by others are unsubstantiated and do not support a finding of nonobviousness. Welch, ¶¶312-313.

Other Secondary Considerations. The secondary considerations of “long-standing problem or need” and “unexpected results / skepticism” do not favor a finding of nonobviousness. Welch, ¶¶315-318. If anything, the ease and speed with which Apple CarPlay requirements in 2013 spurred activity suggests just the opposite. *Id.* Nor has Aptiv showed commercial acquiescence from any entity either seeking or taking a license to the ’420 patent. EX1045, 11; Welch, ¶319.

* * *

Even if Aptiv’s district court allegations had merit, they would not overcome this Petition’s strong showing of obviousness. Microchip reserves the right to request a preliminary reply to rebut any purported secondary considerations should Aptiv raise them in a Preliminary Response.

VIII. DISCRETIONARY DENIAL IS NOT WARRANTED

Discretionary denial is unwarranted under 35 U.S.C. §314(a) and §325(d).

A. Section 314(a)

“Consistent with *Sotera Wireless, Inc.*, the PTAB will not discretionarily deny institution in view of parallel district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or

any grounds that could have reasonably been raised before the PTAB.” Interim Procedure for Discretionary Denials in AIA Postgrant Proceedings with Parallel District Court Litigation, June 21, 2022, 3 (citing *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) (precedential as to §II.A)). Petitioner hereby stipulates that, if the PTAB institutes this *inter partes* review, Petitioner will not pursue invalidity of the Challenged Claims in a parallel district court proceeding on the same grounds or any grounds that could have reasonably been raised before the PTAB in this Petition. Accordingly, the Board should not discretionarily deny Institution of this Petition under §314(a).

B. Section 325(d)

Discretionary denial under 35 U.S.C. §325(d) is not warranted because neither prong from *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (Feb. 13, 2020) is satisfied. *See also Becton, Dickinson and Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17-18 (PTAB Dec. 15, 2017) (precedential as to §III.C.5, first paragraph) (the “*Becton, Dickinson* factors”).

With respect to prong one (corresponding to *Becton, Dickinson* factors (a), (b), and (d)), neither Chang nor Chang II was submitted to or cited by the

Examiner during the '420 patent prosecution. *See generally* EX1004.²¹ Petitioner does not believe any prior art before the Patent Office during the '420 patent prosecution is “substantially the same prior art,” “cumulative,” or materially “similar.” *See Becton, Dickinson* factors (a), (b). For example, no prior art of record in the '420 patent disclosed a host-to-host USB bridge in the context of a USB hub as does Chang, let alone in combination with a dual-role port having a “bypass” path as does Chang II. *See supra* §IV.B. Certainly, the Examiner did not consider this Petition’s argument that it would have been obvious to modify Chang (in view of Chang II and a POSITA’s knowledge) to include dual-role ports and a bypass around the bridge. *See Becton, Dickinson* factors (d); §§IV.B, VII.A.1.

Because *Advanced Bionics* prong one is not met, prong two (corresponding to *Becton, Dickinson* factors (c), (e), and (f)) is inapplicable. Regardless, *Becton, Dickinson* factor (c) strongly weighs against denying institution since no art that forms the Ground herein was the basis of rejection during prosecution. *See generally* §IV.B. Moreover, had the Examiner known of Chang or Chang II (or

²¹ Chang and Chang II were submitted via IDS during prosecution of a child and great-grandchild applications, respectively. This is irrelevant to §325(d) because the Examiner was unaware of Chang and Chang II when examining the Challenged Claims.

their teachings) during '420 patent prosecution, Petitioner respectfully asserts the Examiner misapprehended important teachings of Chang and Chang II.

For example, the Examiner never addressed Chang, much less its important disclosure of connecting a permanent upstream host to a downstream host (through a bridge) and downstream devices (not through the bridge). *See* §§IV.B, VII.A.1. Nor did the Examiner consider modifying Chang—*e.g.*, in view of Chang II's bridge path and bypass path disclosure—to include dual-role ports. *Id.* Thus, even if *Advanced Bionics'* second prong applied, respectfully, the Patent Office erred or misapprehended the teachings of Chang and Chang II. *See Becton, Dickinson* factor (e).

Moreover, the Petition presents important “additional evidence and facts.” *See Becton, Dickinson* factor (f). For example, this Petition demonstrates that implementing dual-role ports was advantageous and routine. *See* §§III.B, VII.A.1 (*e.g.*, Examiner was unaware of Castleberry, which expressly provides motivation to modify Chang with dual-role ports). Thus, even if *Advanced Bionics'* second prong applied, this Petition warrants reconsideration of Chang and the teachings of Chang II. *See Becton, Dickinson* factor (f).

Accordingly, both *Advanced Bionics'* prongs favor institution.

IX. MANDATORY NOTICES

A. Real Party-in-Interest

Petitioner Microchip Technology Inc. and its subsidiaries are the real parties-in-interest.

B. Related Proceedings

No previous IPR or post-grant proceeding has been filed challenging the '420 patent. The '420 patent has been asserted by Aptiv in the following district court action: *Aptiv Technologies AG v. Microchip Technology Inc.*, Case No. 1:23-cv-00307-JDW (D. Del., March 20, 2023). In addition to the '420 patent, the district court action asserts U.S. Patent Nos. 9,460,037; 9,645,962; 10,545,899; 11,176,072; and 11,681,643 from the same patent family. PTAB proceedings on the related patents are listed below:

Patent	PTAB Proceeding
9,645,962	IPR2024-00229
11,176,072	IPR2024-00230
11,681,643	PGR2024-00011

C. Counsel Information

Petitioners designate the following counsel:

Lead Counsel	Back-Up Counsel
Travis Jensen Registration No. 60,087 tjensen@orrick.com ;	Jeremy Jason Lang Registration No. 73,604 jjlang@orrick.com ;

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D. Electronic Service

Petitioners consent to email service at the email addresses above.

X. FEES

The required fee is being paid electronically through P-TACTS.

XI. CONCLUSION

Petitioner respectfully requests institutions and a final written decision finding the Challenged Claims unpatentable.

Respectfully submitted,

Dated: December 27, 2023

/Travis Jensen/

Travis Jensen, Reg. No. 60,087

CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Petition with the word count limits set forth in 37 C.F.R. §42.24(a)(1)(i). Excluding the parts of the Petition exempted by 37 C.F.R. §42.24(a)(1), this Petition contains 13,880 words as determined using the word count feature in Microsoft Word, which was used to prepare this Petition.

Dated: December 27, 2023

By: /Travis Jensen/

CERTIFICATE OF SERVICE

The undersigned hereby confirms that the foregoing Petition for *Inter Partes* Review and associated exhibits were caused to be served on December 27, 2023 via overnight courier on the Patent Owner at the correspondence address of record for U.S. Pat. No. 9,619,420:

David Ford
Daniel Brock
22851 - Aptiv Technologies (2) S.à r.l.
5725 Innovation Drive
Troy, MI 48098

Courtesy copies were also served via email on Patent Owner's counsel of record in a related district court action styled *Aptiv Technologies AG v. Microchip Technology Inc.*, Case No. 1:23-cv-00307-JDW (D. Del., March 20, 2023):

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