

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. PGR2024-00011
U.S. Patent No. 11,681,643

**PETITION FOR *POST-GRANT* REVIEW
OF U.S. PATENT NO. 11,681,643**

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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, Rev. 3.0, V1.0a, March 25, 2016</i>
1021	<i>Universal Serial Bus Implementers Forum Full and Low Speed Electrical and Interoperability Compliance Test Procedure, Revision 1.3, February 2004</i>
1022	<i>On-The-Go and Embedded Host Supplement to the USB Revision 2.0 Specification, Revision 2.0 version 1.1a, July 27, 2012 (the “OTG Supplement”)</i>
1023	<i>Universal Serial Bus 3.0 Specification, Revision 1.0, November 12, 2008 (“USB 3.0 Specification”)</i>
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, Prolific Technology Inc., September 11, 2002</i>
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.)

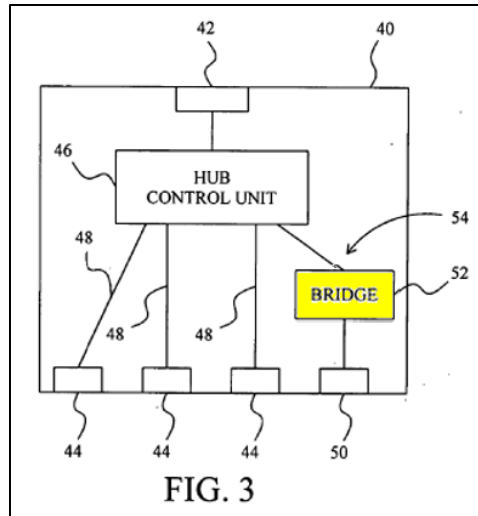
I. INTRODUCTION

Petitioner requests *post-grant* review (“PGR”) of claims 1-15 (the “Challenged Claims”) of U.S. Pat. 11,681,643 (the “’643 patent,” EX1011). The Board should institute PGR, because it is more likely than not that at least one Challenged Claim is unpatentable.

The ’643 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 EX1011, 3:21-48, 4:7-15. The ’643 patent specification allegedly solves this problem by adding two well-known components (*viz.*, a “routing switch” and “bridge”) to a standard USB hub. See *id.*, Fig. 4. 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.*, 4:16-33. Combining Chang (EX1014) and Chang II (EX1015) renders the Challenged Claims obvious.

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

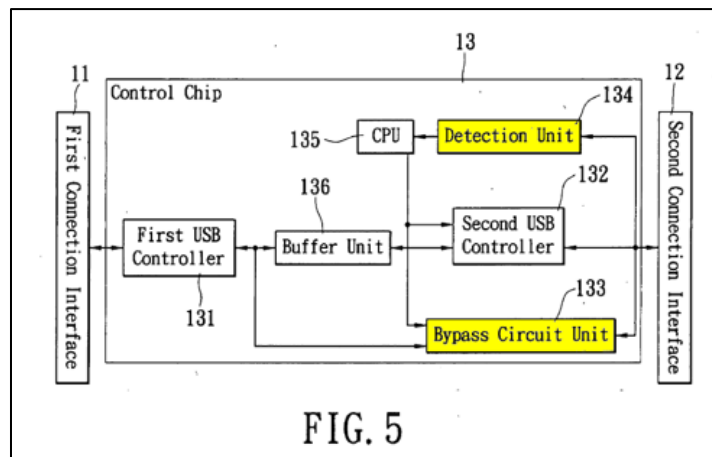
¹ The ’643 patent is written in the context of “dual-role” USB products, *e.g.*, a smartphone, that can operate as either host or device. See EX1011, 2:60-66.



CHANG

Chang did not use a bypass path (or routing 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.



CHANG II

Indeed, dual-role products were well-known to POSITAs well before the '643

patent priority date. See EX1011, 2:56-63 (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 a POSITA’s knowledge (viz., dual-role port with bypass path) to Chang, rendering the Challenged Claims obvious.

All Challenged Claims are also indefinite on multiple grounds.² And dependent claims 4 and 9 lack written description support. Petitioner respectfully

² While the outer bounds of the claims are not reasonably certain, the Board can nevertheless find the Challenged Claims unpatentable as obvious. See *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 812-14 (Fed. Cir. 2021) (“The indefiniteness of a limitation ... precludes a patentability determination only when the indefiniteness renders it logically impossible for the Board to reach such a decision On remand, the Board must decide one or both of two issues. One is whether it can resolve the prior-art challenge to the patentability of claims 16 and 17 despite the potential indefiniteness of the means-plus-function terms. The other is whether those terms are actually indefinite.”).

requests that the Board find the Challenged Claims unpatentable as being obvious and for failing the requirements of §112.

II. REQUIREMENTS FOR POST-GRANT REVIEW

This Petition complies with all statutory requirements and 37 C.F.R. §§42.201 et seq. and should be accorded a filing date pursuant to 37 C.F.R. §42.206.

A. Grounds for Standing

Petitioner certifies that the '643 patent “is available for post-grant review and that the petitioner is not barred or estopped from requesting a *post-grant* review challenging the patent claims on the grounds identified in the petition.” 37 C.F.R. §42.204(a); *see also* 35 U.S.C. §325(e)(1).

The present Petition is being filed less than 9 months after the issue date of the '643 patent (June 20, 2023). 37 C.F.R. §42.202; 35 U.S.C. §321(c).

B. The '643 Patent Is an AIA Patent and Therefore Eligible for PGR

The '643 patent claims priority to several continuation applications with the earliest possible priority date being September 26, 2013. EX1011 (claiming priority to provisional application No. 61/882,915).

C. Identification of Challenges and Requested Relief

Under 37 C.F.R. §§42.204(b) and 42.22, Petitioner requests that the Board institute PGR on the Challenged Claims and cancel them as unpatentable. The

prior art³ references combined to form the Grounds are:

Exhibit	Reference	Prior Art
1014	U.S. Pub. 2006/0206650 (“Chang”) ⁴	Post-AIA §102(a)(2)
1015	U.S. Pub. 2009/0268743 (“Chang II”) ⁵	Post-AIA §102(a)(2)
1029	U.S. Pat. 8,447,598 (“Chutorash”) ⁶	Post-AIA §102(a)(2)

The Grounds asserted are:

Ground	Claim(s)	Basis for Unpatentability
1	1-15	Obviousness over Chang in view of Chang II and POSITA Knowledge
2	2, 7, 13	Obviousness over Chang in view of Chang II, Chutorash, and POSITA Knowledge
3	1-15	§112(b) Indefinite

³ The ’643 patent claims priority to September 26, 2013. EX1011.

⁴ Chang was filed August 16, 2005 and published September 14, 2006. EX1014.

⁵ 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.

⁶ Chutorash was filed January 14, 2011 and claims priority through various continuation applications and a provisional application to December 5, 2007. EX1029.

Ground	Claim(s)	Basis for Unpatentability
4	1-15	§112(b) Indefinite
5	1-9	§112(f) Indefinite
6	4, 9, 15	§112(b) Indefinite
7	4, 9, 15	§112(a) Written Description

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

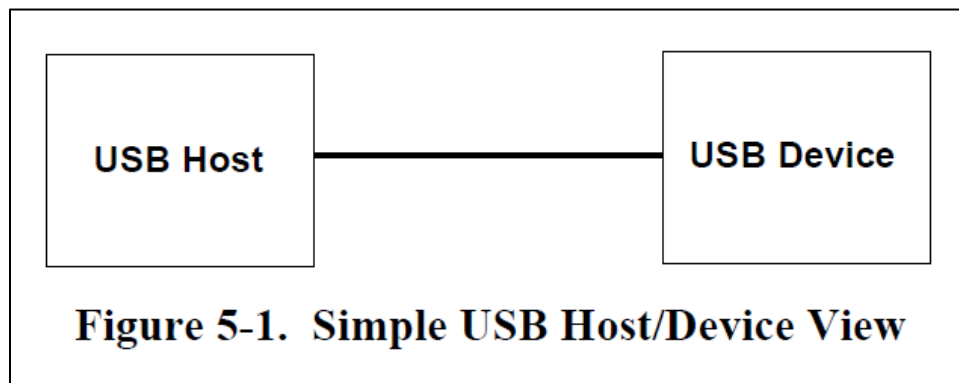
III. TECHNOLOGY BACKGROUND

A. USB Basics

The ’643 patent provides its disclosures against the backdrop of Universal Serial Bus (“USB”) standards and related products. *See* EX1011, 1:22-3:48. USB products were ubiquitous many years before the ’643 patent’s earliest priority date, and a POSITA would have been intimately familiar with USB standards (*infra* §IV.C) promulgated by the USB Implementers Forum, Inc. (“USB-IF”). 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 supports higher speeds, but “has similar architectural components as USB 2.0” and is backward compatible. EX1023, §3.1; *see also id.*, §3. The USB industry standards contain several background concepts relevant here. Welch, ¶¶51-54.

1. Hosts/Devices

The USB specifications set forth two USB product⁷ 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, 62-63; *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) connects to one USB device (*e.g.*, keyboard), as shown below. *Id.*, Fig. 5-1.



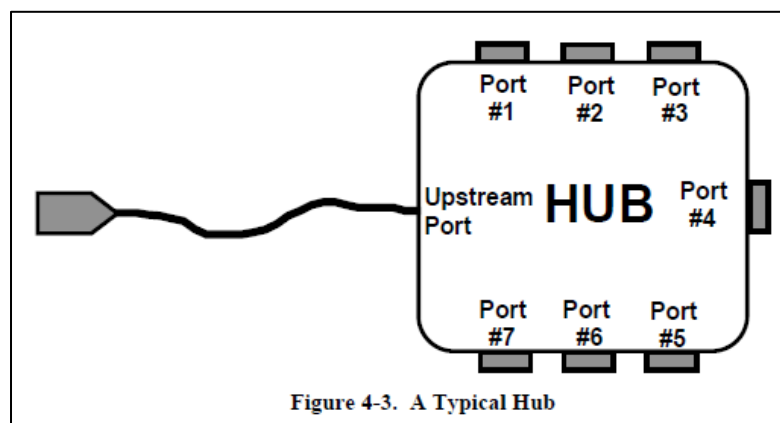
⁷ Some literature uses the term “device” generically, referring to products that may operate as device or host. For clarity, this Petition only uses “device” to refer to USB products operating in device mode.

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).

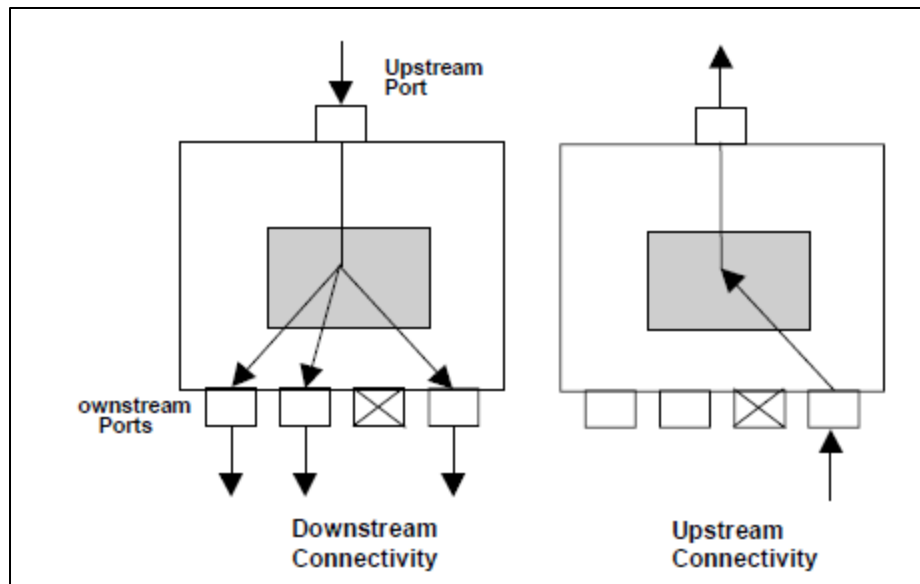
2. USB Hubs

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 device[s]” such as “dual-role USB printer”), [0052] (“dual-role USB Digital Versatile Disc (DVD) read/write drive”); 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. In contrast, the ’643 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 whether a host or device was connected. Welch, ¶¶74-87. For example, POSITAs were well aware by 2013 of measuring the data line pull-

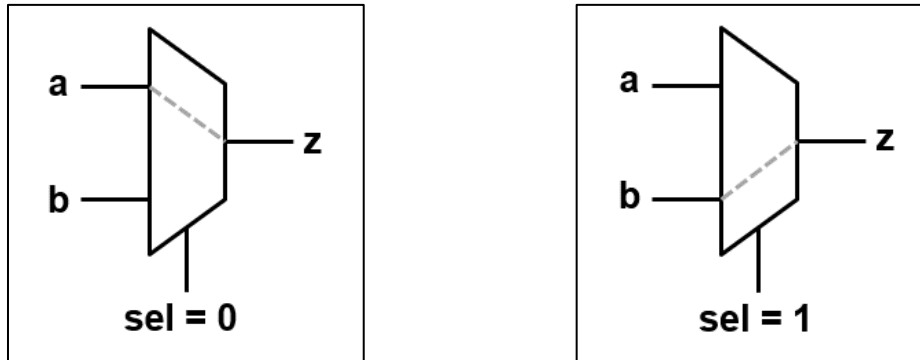
up/pull-down resistance values specified in the USB Specifications (*e.g.*, using a voltage divider) to determine the host/device status of connected products. Welch, ¶¶75-78 (discussing termination resistance requirements in USB 2.0 Specification, Chapter 7); *see also, e.g.*, EX1032, [0005] (explaining use of data line for host/device detection); EX1025, 7:30-52 (various “suitable way[s]” to detect downstream USB products). The pull-up/pull-down mechanism produces signals on the data lines that the detection circuit detects. For example, Chang II discloses a “detection unit 134” for detecting whether the consumer product is host or device. EX1015, [0038]. The detection unit detects the connection of either a host or device by (1) sending an “inquire signal” and receiving a response (when a host connects) or (2) receiving an “inquire signal” (when a device connects). *Id.*, [0038]-[0040]; Welch, ¶80.

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.

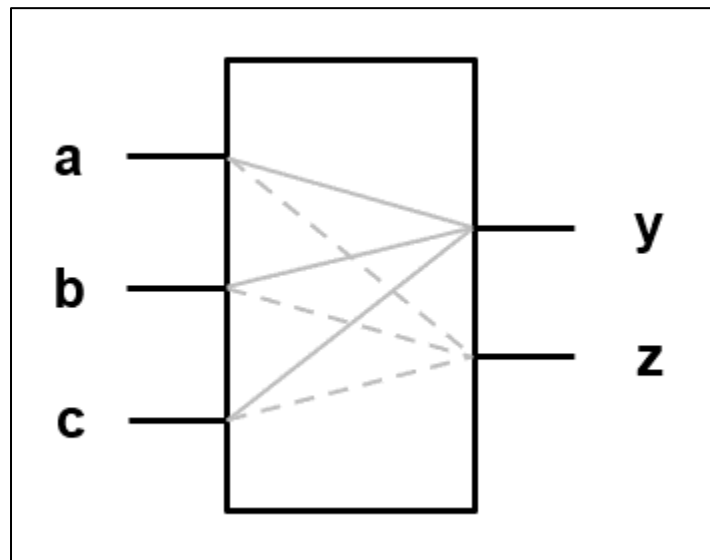
2. Routing Switches

Various switches, multiplexers, and the like have existed for decades. 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, 93. 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.



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.

It was further well-known to use these switches for the specific purpose of routing USB communications emanating from a product to the appropriate path upon detecting the host/device mode of the product. For example, Hesse discloses a “port router” (crossbar switch) that routes ports to the appropriate “port handler” depending on the USB product’s host/device mode. EX1017, Fig. 6, [0056]-[0057] (port routing depending on unit’s configuration). Similarly, Wang discloses a “switching structure” to route USB ports to the appropriate path depending on host/device detection. EX1052, Fig. 1, 3:7-20; *see also* EX1053, Fig. 1, [0031]-[0034]; Welch, ¶95.

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,” 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.

D. Automotive/Infotainment USB Applications

The ’643 patent describes prior art USB deployments in automobiles where the USB host is embedded into an infotainment system. EX1011, 1:50-2:41. Indeed, while USB technology originated with the proliferation of PCs in the 1990s, USB technology is not limited to any particular device type or environment. Welch, ¶100. By 2008, “USB [was] the most successful PC peripheral interconnect ever defined and it has migrated heavily into the [consumer

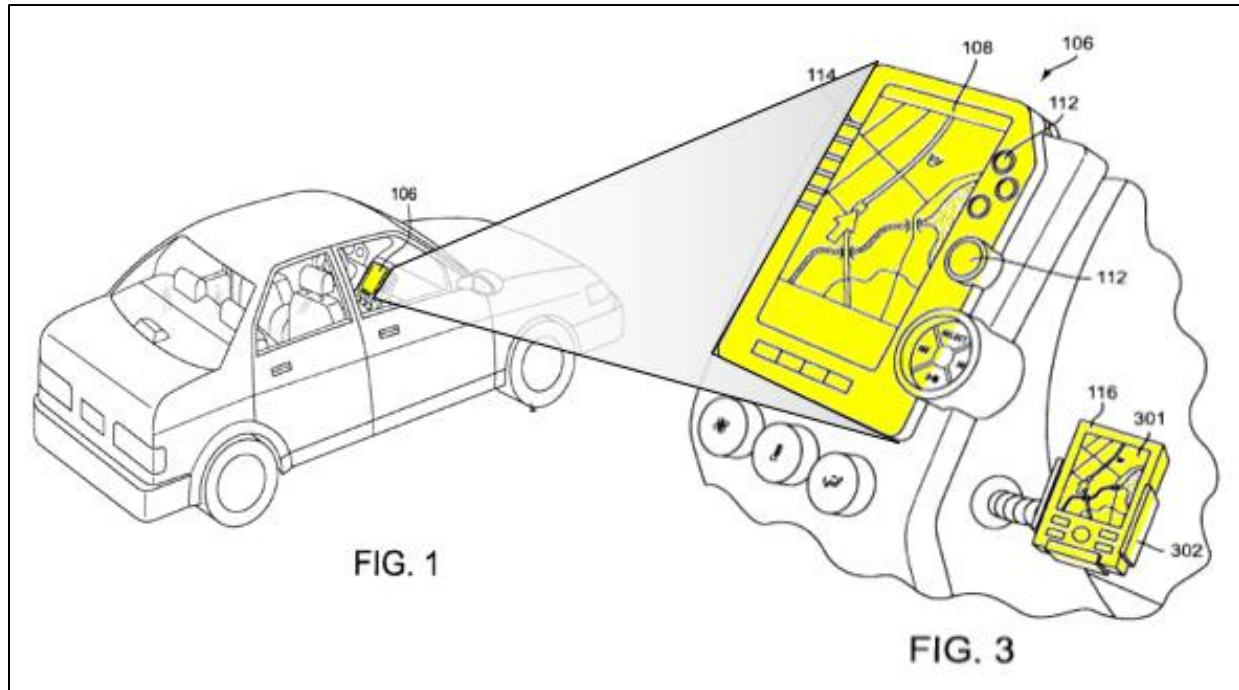
electronics] and Mobile segments.” EX1023, §1.1. And “USB has gone beyond just being a way to connect peripherals to PCs,” with devices like PDAs and smartphones acting as hosts. *Id.*

USB automotive/infotainment applications were well-known⁸ and a natural fit for USB technology for at least two reasons. Welch, ¶101. First, by 2013, many vehicles included USB-compatible embedded host computers (similar to PCs in many respects) in the form of infotainment systems. *See, e.g.*, EX1029, Figs. 1, 3, and 27-30; 1:20-5, 14:40-53, and 27:4-55. Second, numerous portable consumer products (like GPS/navigation, smartphones, and media players) with USB ports had entered the market. *Id.*

Indeed, by 2002, USB hubs were already used in automobile entertainment systems. *See* EX1016, Title, Fig. 1 (describing a “Dual-Role Compatible USB Hub” for “vehicle entertainment systems”). A 2006 article titled “USB In Automotive: Not Just For PCs Anymore!” explained that because “the car has become a PC on wheels” and “consumer electronics are PC dependent,” employing USB in the automobile will avoid “reinvent[ing] the wheel.” EX1049, 1. The article states that USB hosts can be located in “either the portable consumer device or the infotainment system.” *Id.*

⁸ The ’643 patent essentially admits this. EX1011, 1:50-2:41.

U.S. Pat. 8,447,598 (“Chutorash,” EX1029) (discussed *infra* §VI.C) provides another automotive USB example. Chutorash discloses a “vehicle control system 106 (e.g., media system ...)” shown in Figs. 1 and 3 below, viz., an infotainment system. EX1029, 5:31-33. Chutorash’s vehicle control system includes “a USB connector or interface 2728, 2744” that is “within vehicle 100” for connecting “mobile phone 2734,” “PDA 2746,” “media player 2752,” etc. to an “embedded host.” *Id.*, 27:4-29; see also Fig. 27.



Such vehicle deployments were “straight forward and easy to implement.” EX1050, 19; Welch, ¶¶102-04.

IV. THE '643 PATENT

The '643 patent (EX1011) claims priority through a provisional application to September 26, 2013, making it a post-AIA patent. The '643 patent contains

fifteen claims.

A. Patent Summary

The '643 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 '643 patent explains that USB employs an architecture that connects a "USB host or master" with "a USB device or slave." EX1011, 1:38-43. The '643 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.*, 2:4-7.

Similarly, the '643 patent discusses the OTG Supplement, which provides "dual-role" functionality, where USB products can "act as either USB host or USB device." EX1011, 3:21-27. Concerning smartphones in particular, the '643 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.*, 2:66-3:3.

Against this backdrop, the '643 patent observes that traditional "USB hubs do not support OTG" and cannot support a downstream host (*viz.*, a smartphone cannot be host). EX1011, 3:31-32. The '643 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.*, 3:49-4:43.

Fig. 4 illustrates the '643 patent's purported novel solution, viz., adding two components (routing switch and host-to-host bridge) to a traditional USB hub. *See, e.g.*, EX1011, 6:33-36, 6:62-8:16. The bridge enables host-to-host communications through the hub. *Id.*, 7:23-28. And because consumer products may be dual-role, the switch enables bypassing the bridge based on the operating mode of the downstream product. *Id.*, 7:23-32. This allows dual-role downstream smartphones to connect as device or host to the embedded upstream host.⁹ *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.*, 7:23-28. 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.*, 7:28-32. 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).

⁹ The “head unit” refers to an upstream host in a vehicle. *See* EX1011, 7:4-6.

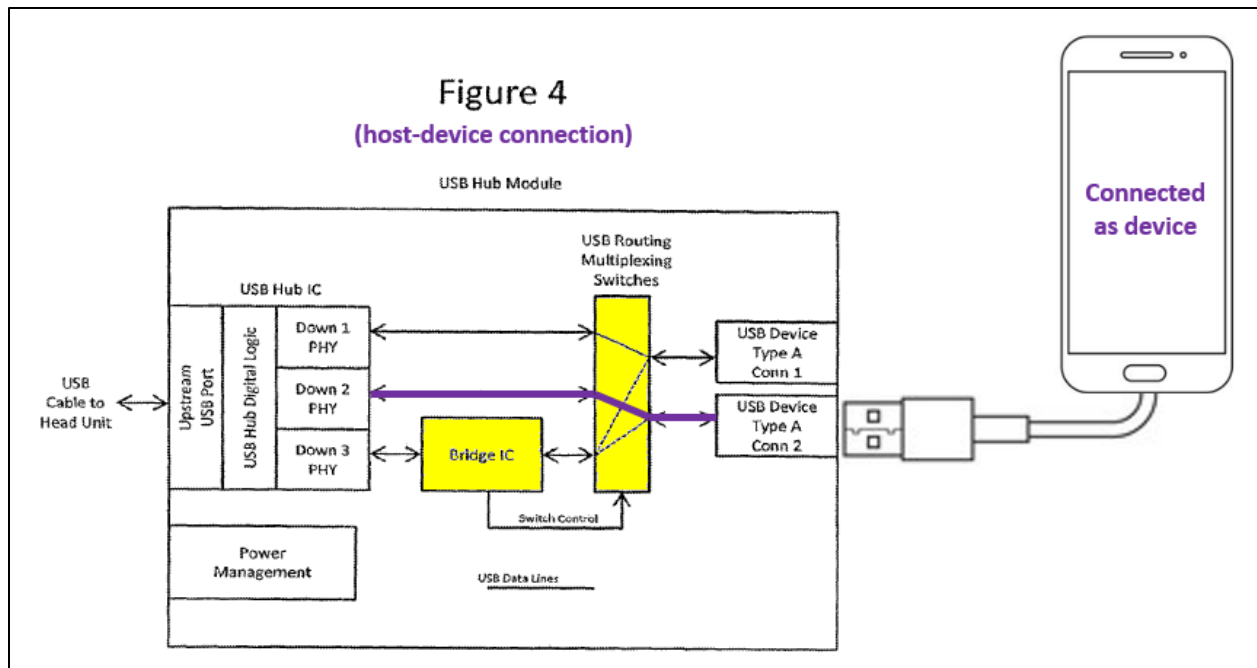
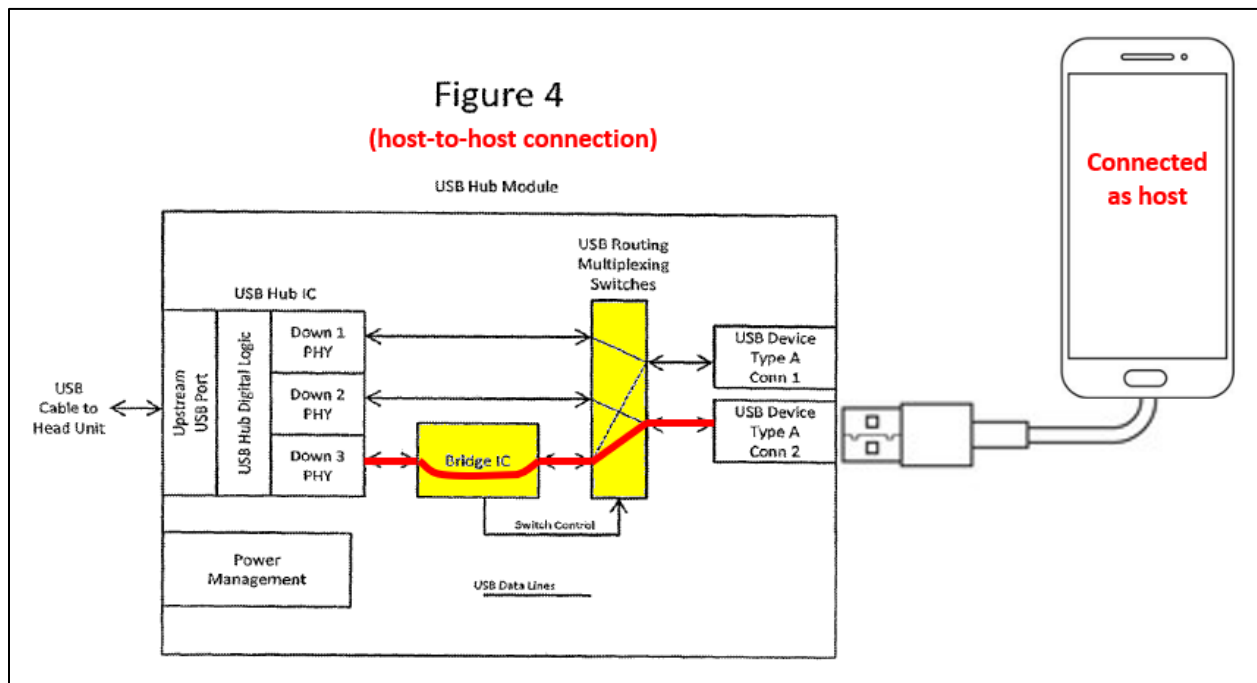


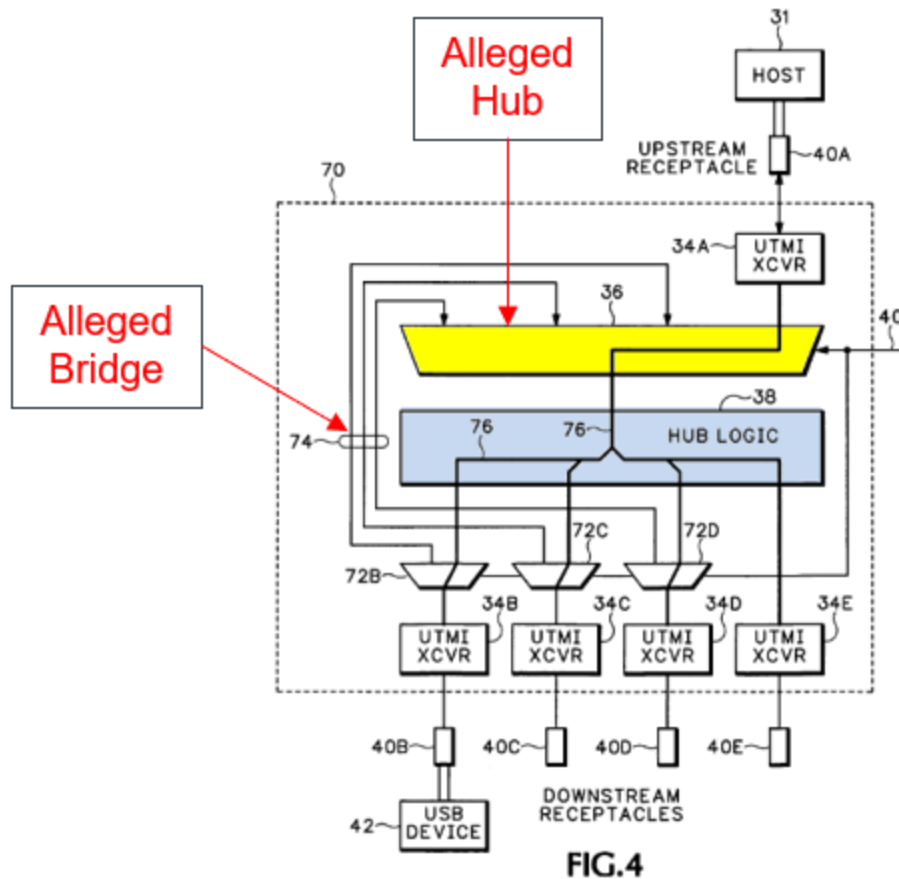
Fig. 5 is an alternate embodiment with a similar architecture, the primary difference being that the “USB routing/switching logic and a USB bridge are integrated with a USB hub in a combination USB hub/bridge integrated circuit

(IC).” EX1011, 6:37-41; *see also id.*, 8:32-39. Figs. 6-7 provide additional details regarding Fig. 5. *Id.*, 6:42-45 and 8:40-9:63. Fig. 8 shows “a head unit software architecture.” *Id.*, 6:46-47 and 9:64-10:35.

Lastly, the ’643 patent does not disclaim using downstream dual-role OTG products. Rather, the ’643 patent only states that the upstream “embedded USB host” lacks “[OTG] capability.” EX1011, 1:22-29.

B. File History

The Examiner issued a rejection over U.S. Pat. 7,502,878 (“Wright,” EX1047), 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.



EX1047, Fig. 4 (annotated). Applicant traversed this rejection. See EX1012, 89 (“[M]ultiplexer 36 of Wright cannot be fairly characterized as a USB hub.”).

Following an Examiner Interview and Examiner Amendment, namely, that the “USB bridge includes a bridge controller, buffers, and a plurality of ports,” the claims were allowed. EX1012, 102-110.

Wright is nothing like the prior art in this Petition. For example, a “mux” is not a hub, the wire is not a bridge, and Wright **does not** disclose a host-to-host connection. This is evident from the fact that the alleged bridge is only a wire. Welch, ¶146. For at least these reasons, this Petition’s Grounds do not present

similar art to Wright, nor raise similar prosecution arguments.

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. The amendments add that routing occurs via a “routing logic circuit connected directly to a USB bridge,” the USB hub is “connected to the USB bridge,” and “the USB hub and USB bridge have different components and functionality.” *Id.*, 201-208. To the extent the Examiner considered Chang II specifically, this Petition does not rely on any alleged hub in Chang II, and for at least this reason, this Petition’s Grounds do not present similar prosecution arguments.

The '643 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 Grounds 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.

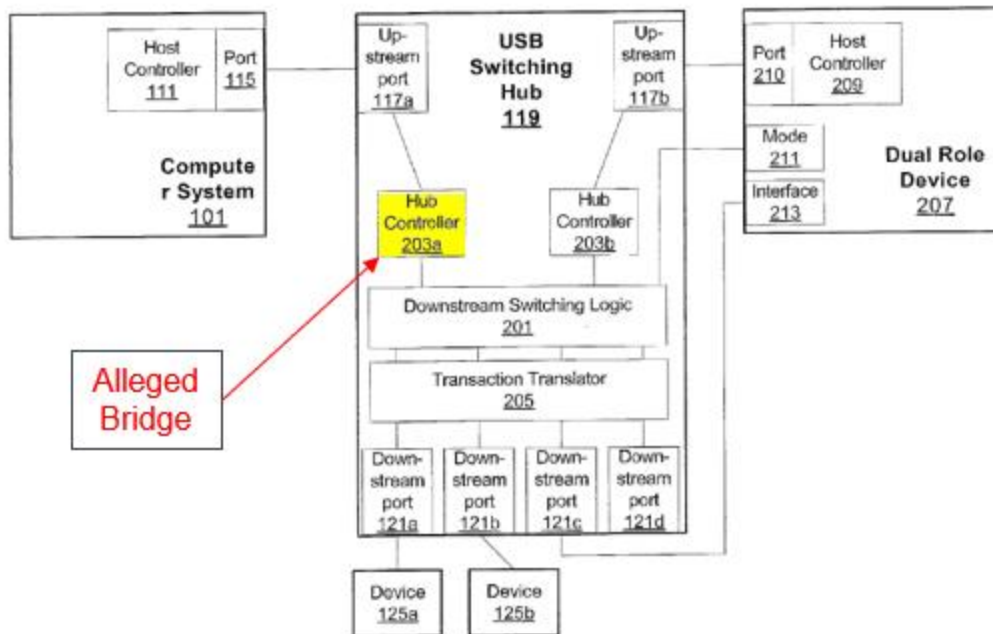
The Examiner issued an anticipation rejection over Kellzi. EX1002, 76. In

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.

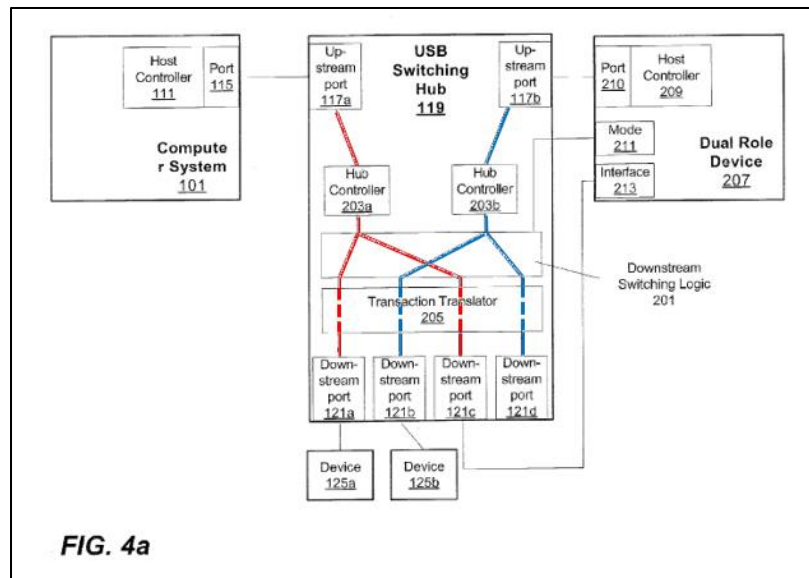
Next, the Examiner issued anticipation and obviousness rejections based on Bohm '759. EX1002, 115. Applicant argued the Examiner's reading of Bohm '759 was “not logical,” because components such as Hub Controller 203 (the alleged bridge shown in yellow below) could not be inside the hub and a “separate 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, ¶¶130-31. 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. 9,619,420

There were no prior art rejections, and the claims issued with an Examiner Amendment following an Examiner Interview. *See* EX1004, 148.

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

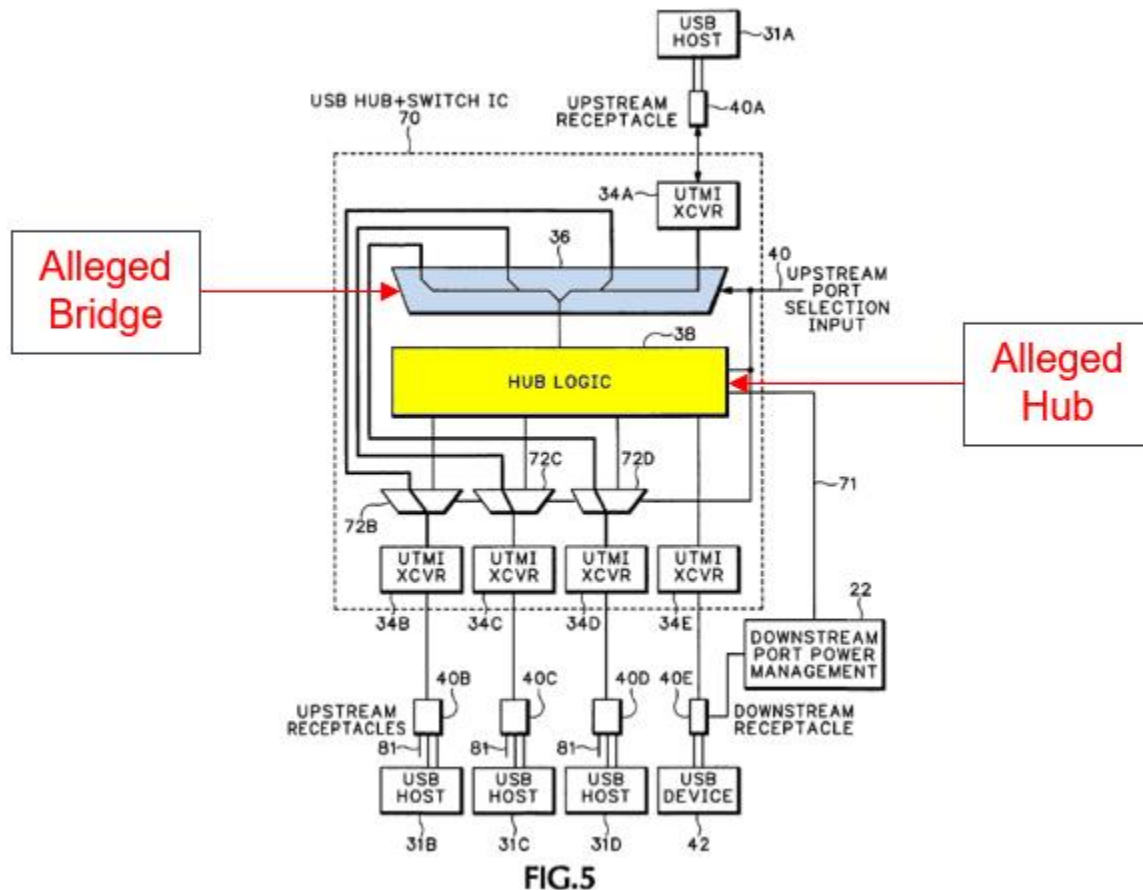
The ’072 patent application was filed with 11 claims, but only claim 1 ultimately issued. EX1010, 372-373, 274. Thus, this summary focuses on claim 1.

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 Grounds, 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 from the fact that the alleged bridge is merely a multiplexer. Welch, ¶143.

C. Level of Ordinary Skill in the Art

The '643 patent pertains generally to the field of USB connectivity (*e.g.*, USB systems/architectures/communications), though other technical fields may be relevant. *See* EX1011, 1:22-24. 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 PGR, 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. §42.200(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 only the terms addressed in Grounds 3-6 (regarding indefiniteness) require construction for this proceeding.¹⁰

VI. THE PRIOR ART

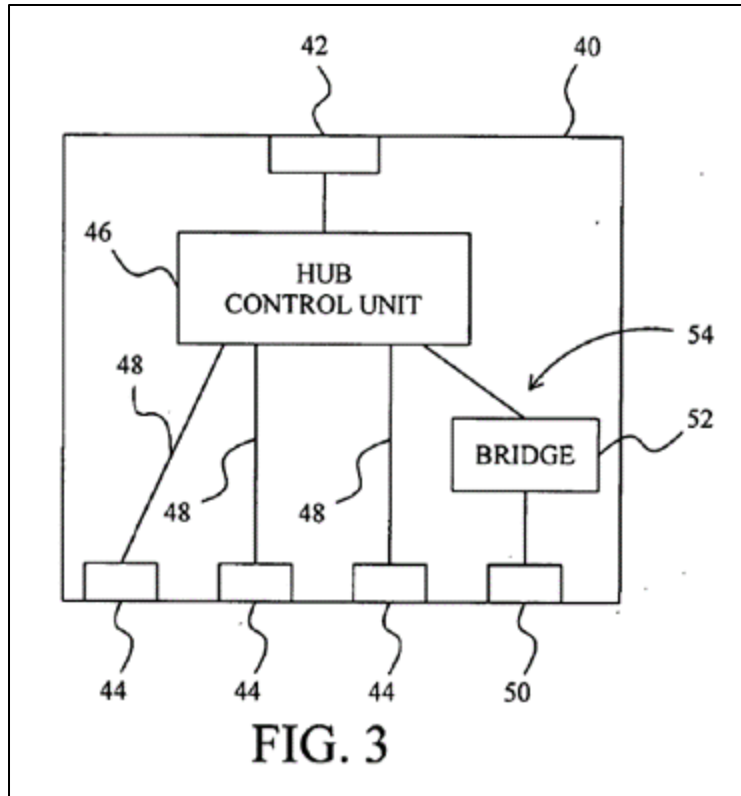
A. Chang Summary

Chang is titled “Hub with a Host-to-Host Transmission Function.” The “SUMMARY OF THE INVENTION” explains that “host-to-host transmission” is

¹⁰ Petitioner reserves all rights to raise additional and alternative claim constructions in district court.

accomplished via “**a bridge connected between the host port and hub control unit** for the first and second hosts to communicate with each other.” EX1014, [0005] (emphasis added); Welch, ¶¶148-152. Chang expressly recognizes that, even in 2005, the “host-to-host transmission mechanism [viz., USB bridge] is a prior art,” and thus “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 unit 46 and host port 50” where “[t]he bridge 52 provides a function for host-to-host communications.” *Id.*, [0020].



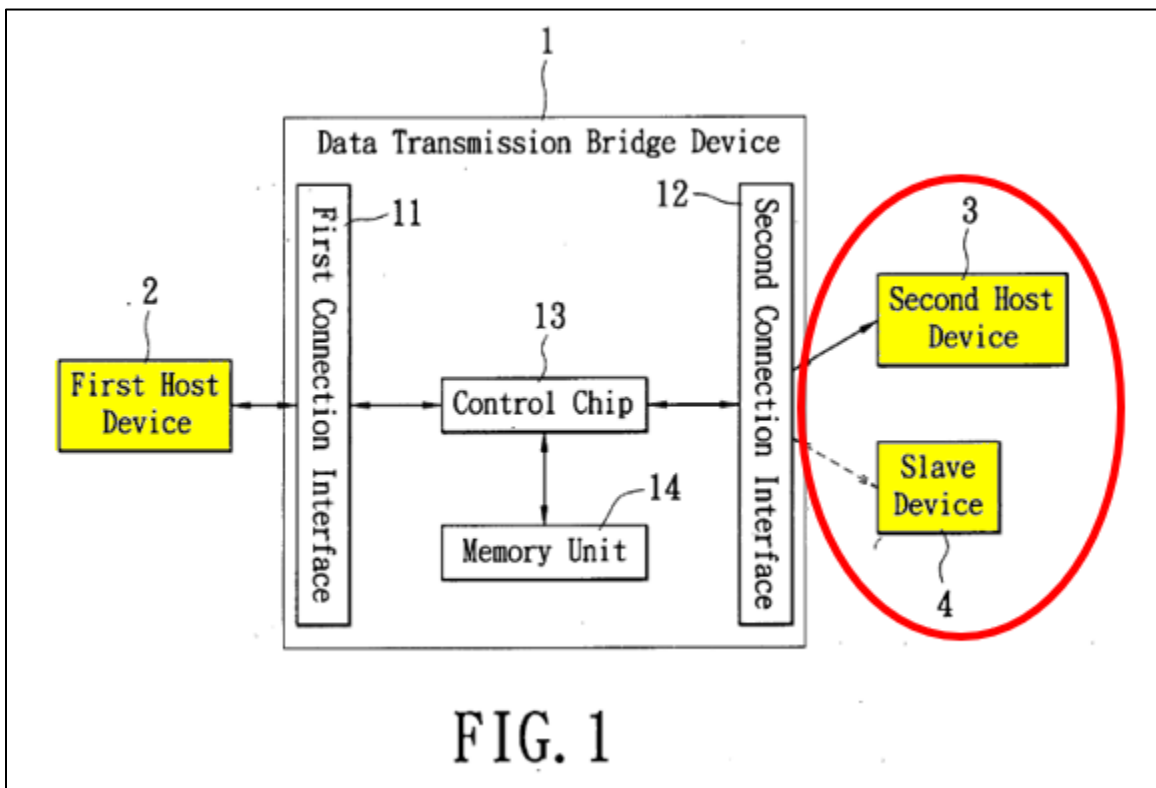
Like any traditional hub, the uplink port “link[s] to a host” and “several transmission paths may be established” to “communicate with each downlink port.” EX1014, [0018].

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 allowing a connected USB product to act as a “Second Host Device” or “Slave Device,” as shown in Fig. 1 below. *See* EX1015, [0030] (second connection interface 12 is a “dual connector type design”); *see also id.* [0012] (“second connection interface is for connecting to a second host device or a slave device.”).

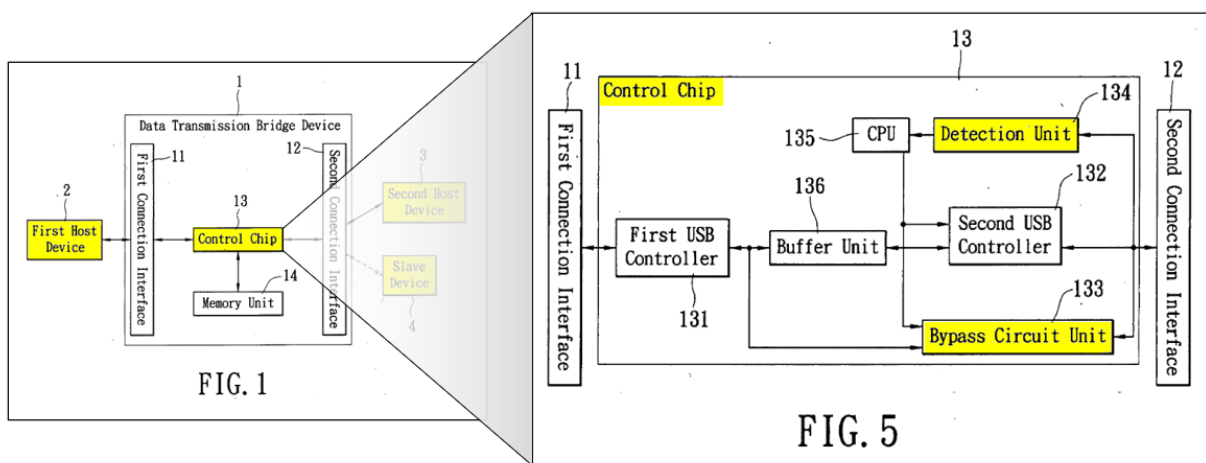


The “data transmission bridge device ... automatically detect[s] the connecting device type and accordingly switch[es] between different transmission paths,” which “allow[s] for support of data transfer between a host device and a slave device” and “between two host devices.” *Id.*, [0011].

Although various embodiments of Chang II contemplate connecting a dedicated host product or dedicated device product to the second interface, 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, ¶157. Thus, a POSITA would have understood (and certainly found it obvious) that connecting dual-role products to the second interface was within the scope of Chang II’s disclosure. *Id.*, ¶157; *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).¹¹

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

¹¹ Note that because Chang II discloses “automatically detect[ing] the connecting device type,” Change II fully supports a dual-role product that dynamically switches between modes. Welch, ¶157.

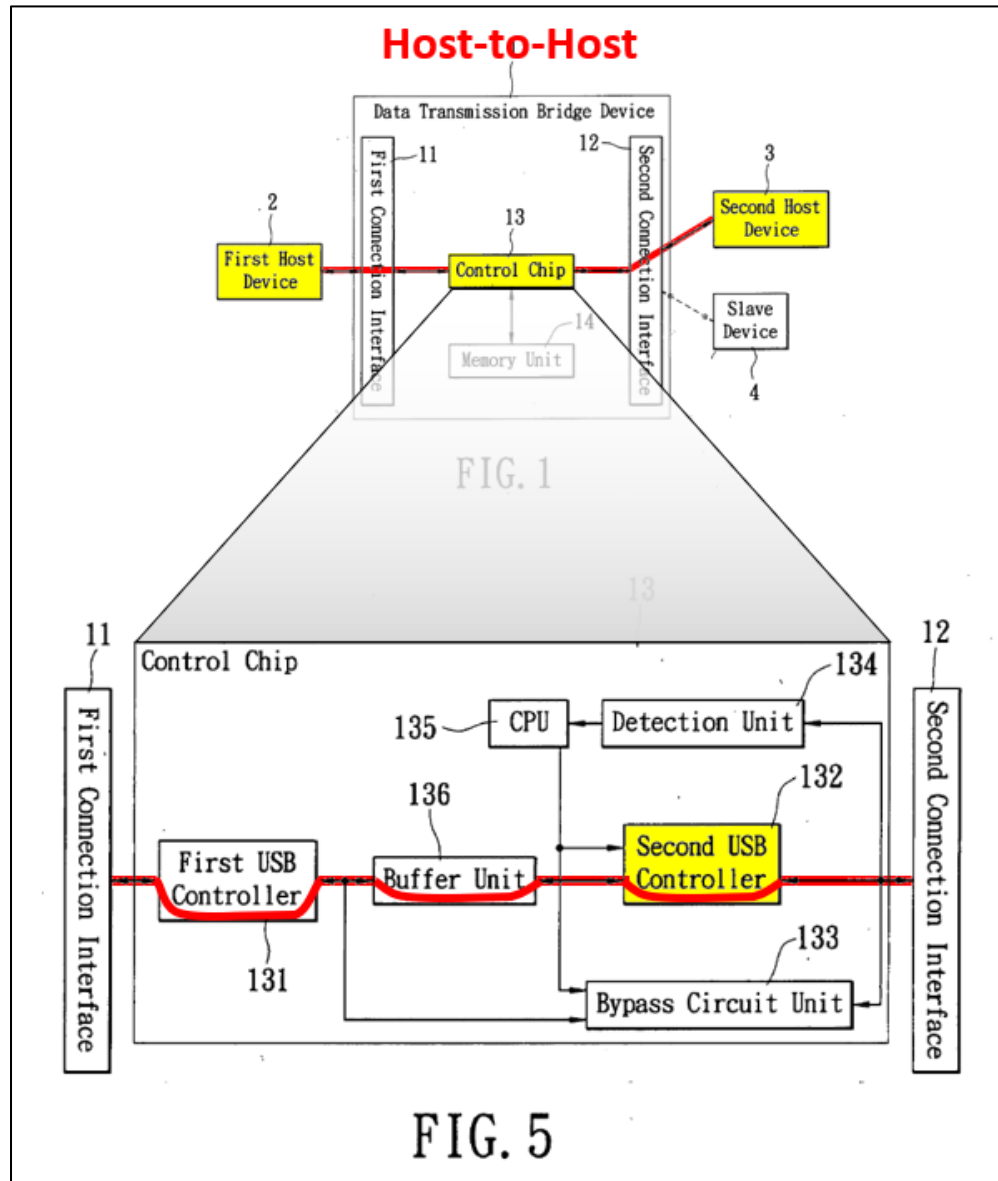
transmission path”).

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.” *Id.*, [0021] (emphasis added).

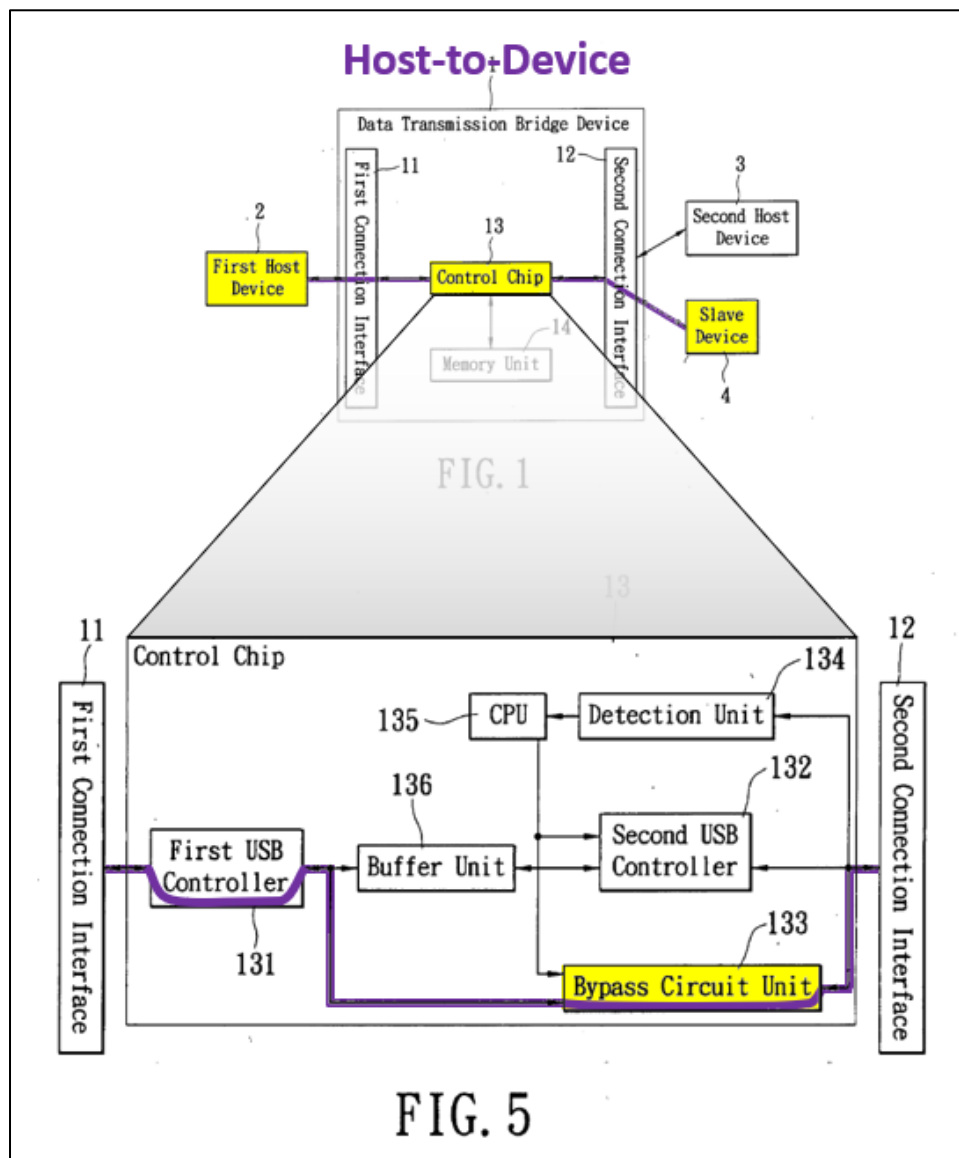
The “two transmission paths” are (1) “bridge transmission path” and (2)

“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.” EX1015, [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, in order 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 the 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” such as a laptop (*id.*, [0031]). In view of this disclosure, a POSITA would have understood (or at least found it obvious) that the bridge may

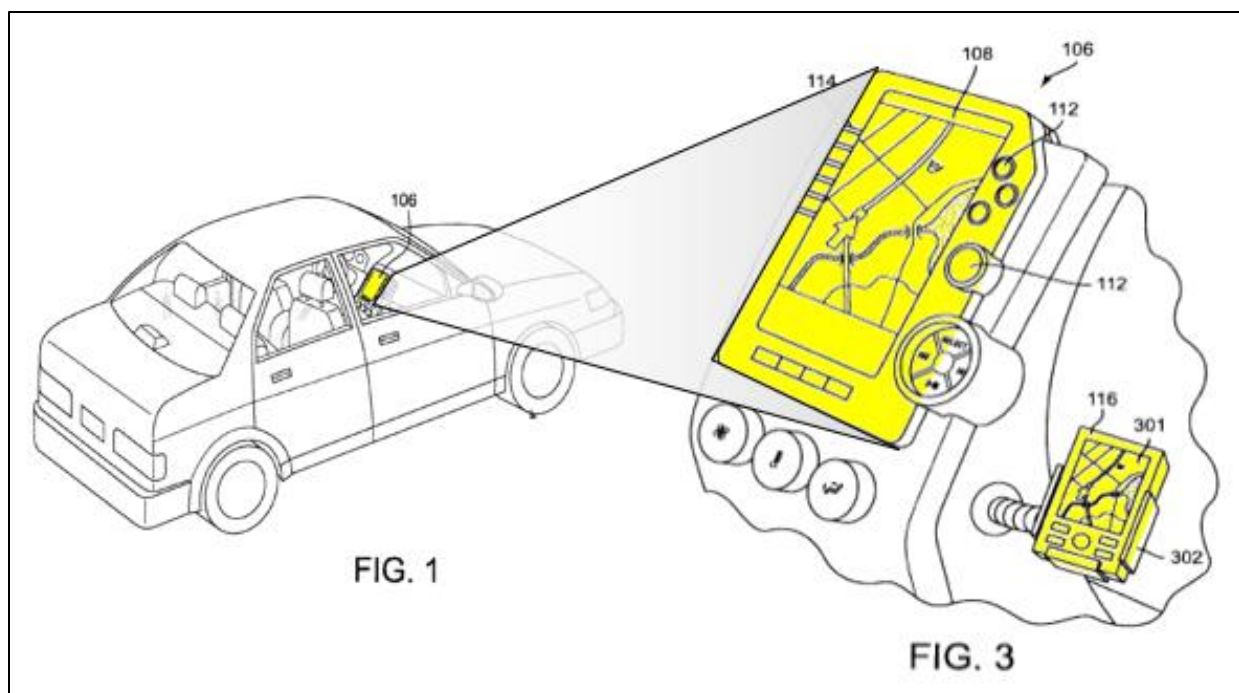
form part of a USB hub module or work in conjunction with a hub. *Id.*, [0027], [0040]; Welch, ¶167.

C. Chutorash Summary

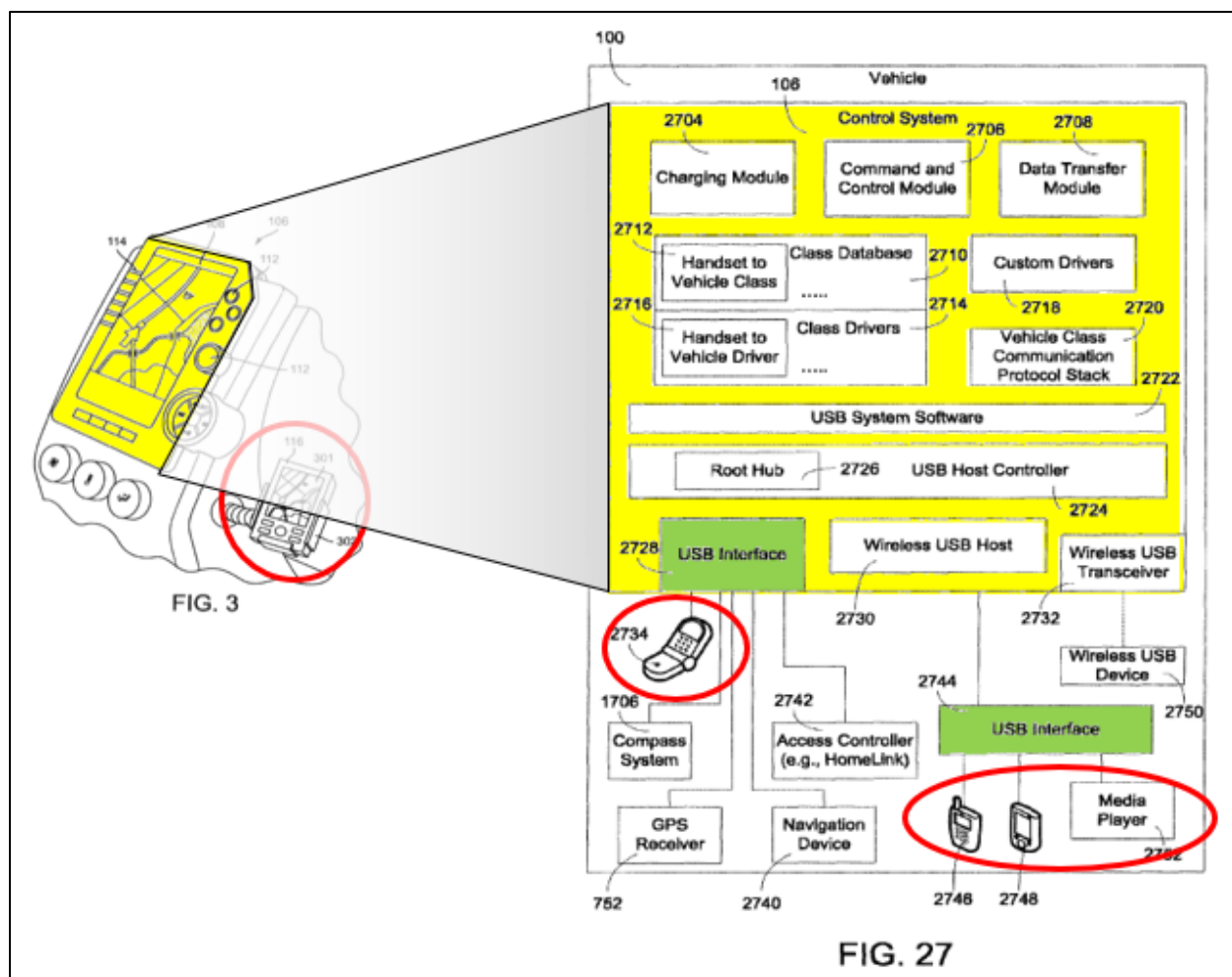
Chutorash is titled “Vehicle User Interface Systems and Methods.”

Chutorash recognizes that “[v]ehicles typically include a number of electronics systems and subsystems” such as “an in-vehicle entertainment system,” but such systems “typically do not interface well with remote sources and portable devices such as cellular phones.” EX1029, 1:20-28. As such, there exists “a need for improved user interface features and/or connectivity features relating to vehicle control systems, remote sources, and/or portable devices.” *Id.*, 1:34-36.

Against this backdrop, Chutorash discloses a “vehicle control system 106 (e.g., media system, navigational system, entertainment system, display system, communications systems, etc.)” connected to “a portable electronic device 116” as shown in Figs. 1 and 3 below. EX1029, 5:31-33 and 6:51-7:10. The “portable electronic device 116 can provide information to vehicle control system 106 for processing.” *Id.*, 7:8-10.



Relevant here, Chutorash discloses “various embodiments for a vehicle control system connecting via a USB interface to various remote sources” in Figs. 27-30. EX1029, 27:1-3. Chutorash’s vehicle control system 106 includes “a USB connector or interface 2728, 2744” inside the car. *Id.*, 27:4-10. These USB interfaces (connected to “mobile phone 2734,” “PDA 2746,” and “media player 2752”) are illustrated in Fig. 27 below. The availability of USB ports in vehicle 100 is unsurprising, given that vehicle control and entertainment system 106 is essentially a built-in computer that “could be classified as an embedded host.” *Id.*, 27:26-28.



The “USB interface 2728, 2744 may facilitate operative connection of a mobile phone 2734” useful “for charging, **command and control**, and/or data transfer.” EX1029, 27:12-24; *see also id.*, 14:40-53; 14:62-67. A POSITA would have recognized (or at least found it obvious) that “USB Interface[s]” 2728 and/or 2744 would be USB hubs given that each has multiple connected USB products. Welch, ¶173.

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1 (Claims 1-15): 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 one or more dual-role ports along with a switch and detection circuit to route the port(s) to the appropriate transmission path. Welch, ¶¶175-202.

To start, Chang was filed in 2005. As the '643 patent admits, consumer products like smartphones with dual-role USB capabilities were gaining popularity before the 2013 priority date. EX1011, 2:42-3:7; *see also* Welch, ¶176; §III.B. The '643 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. EX1011, 3:11-4:3. Indeed, the USB-IF promulgated the OTG Supplement 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. Welch, ¶177. It goes without saying 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.

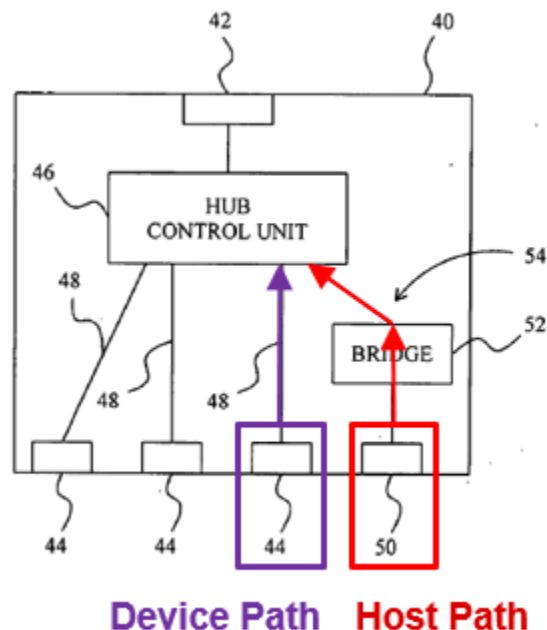
Additionally, modifying Chang to include dual-role ports would further its express goal of “easily establishing a connection between a computer and another computer.” EX1014, [0003]. Chang illustrates an upstream host PC 20 connected to downstream host PC 70—but uses a dedicated downstream host port. *Id.*, [0002], [0020], [0023], Figs. 3-4. As the ’643 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. EX1011, 2:44-50; *see also id.*, 2:62-3:2. Accordingly, a POSITA would have been motivated to include a dual-role port to further Chang’s goal of connecting the upstream computer to the downstream phone acting as a computer. Welch, ¶178. Specifically, a dual-role port 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 smartphone switches to host mode (*see below regarding routing to bridge*) without requiring the user to switch ports. Welch, ¶¶178-79. 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 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 '643 patent admits several solutions for supporting dual-role ports in a USB system were readily available. EX1011, 3:22-60; see also Welch, ¶183.

Next, a POSITA would have recognized Chang effectively provides a roadmap to implement the necessary switching to support dual-role ports. Chang discloses separate transmission paths for a host-to-host connection ("host-to-host transmission path 54") and host-to-device connections ("transmission paths 48"):



EX1014, Fig. 3 (annotated), [0019]-[0020]. As §§III.B.2 and VI.B demonstrate, it was already well-known to include switching functionality, *e.g.*, using mux(es), 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 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) to connect a dual-role port directly to the hub’s upstream port (when the consumer product is in device mode, *i.e.*, path 48) or to the hub through the bridge (when the consumer product is in host mode,

i.e., path 54). Welch, ¶184.

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” for host-to-device communication); *see also id.*, [0040] (“the control chip 13 at this time ***functions like a USB Hub chip***, merely acting with intermediate transmission function”) (emphasis added); Welch, ¶181.

Further, while Chang discloses few details 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.”¹² *Id.*, [0021]. In other words, Chang II describes using “switch[ing]” to either connect the port (and corresponding product) to a “bridge” transmission path (when the product is a host) or a “bypass” path (when the product is a 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].

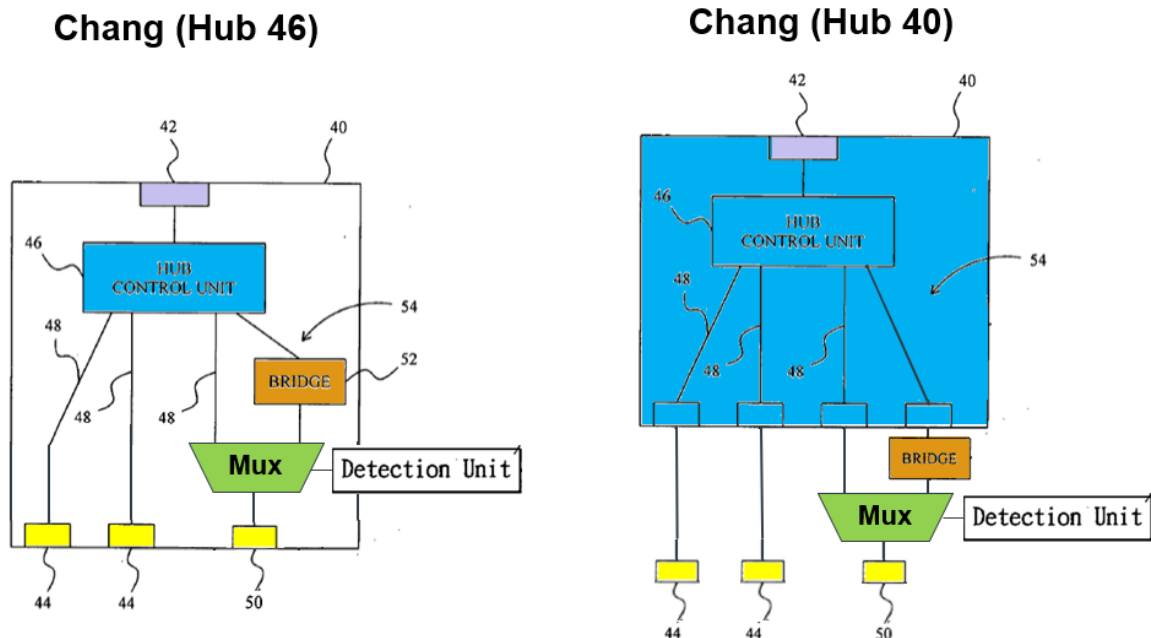
¹² Chang II uses “slave” to refer to device mode. *See* §III.A.1; Welch, ¶62.

“[D]etection unit 134” is part of the bridge’s “control chip.” EX1015, Figs. 1, 5, [0034]. The detection unit detects a host/device connection by (1) sending an “inquire signal” and receiving a response (when a host connects) or (2) receiving an “inquire signal” (when a device connects). *Id.*, [0038]-[0040]. The detection unit then produces either a “bridging detection signal” (after detecting a host) or “slave detection signal” (after detecting a device). *Id.* These signals, in turn, cause switching to the appropriate transmission “path” (to use bridge or bypass bridge). *Id.*, [0042]-[0044]; Welch, ¶¶189-90; *see also* §III.A.2. Accordingly, a POSITA would have been motivated, with a high expectation of success, to route the dual-role ports (and products attached thereto) to the appropriate path using a signal detection circuit and switch. An obvious implementation for modifying Chang Fig. 3 is shown below which includes a 2:1 multiplexer (green), a detection unit,¹³ and one dual-role port (yellow). Welch, ¶191.

¹³ In the figure below, due to space restrictions, the detection unit is depicted as partially outside of hub 40, but should be understood to be within hub 40.

host/device detection ultimately controls the mux's select line.¹⁴

This Mux Implementation of Chang Fig. 3 comes in two variations (shown below) relevant to Ground 1. The lefthand version has the bridge and mux inside hub 40. In the righthand version, the bridge and mux are located outside hub 40. For reasons explained *infra*, these are called “Chang (Hub 46)” and “Chang (Hub 40),” respectively.



¹⁴ As claim 4 discusses, it was also known to locate the detection unit proximate to (or integrated with) the switch to receive the incoming USB signals from the USB product connected on the downstream port. See EX1015, Fig. 5 (detection unit receives signals from “second connection interface”).

EX1014, Fig. 3 (modified and annotated).

The placement of the bridge and mux inside/outside hub 40¹⁵ is merely a design choice, and motivations exist for each choice. Welch, ¶200. Indeed, given the limited locations relative to hub 40 where the components can 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 bridge into hub control unit; and one could “integrate” the bridge with

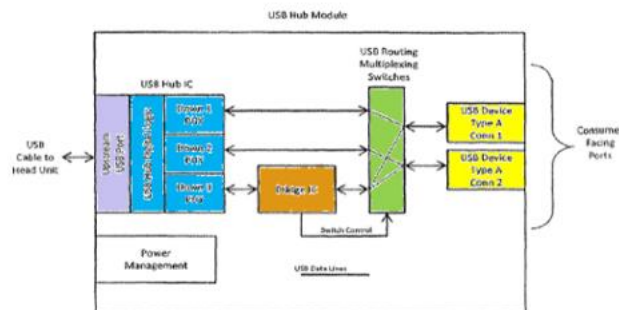
¹⁵ For example, a separate “hub module” may encase the components (*e.g.*, EX1067, [0210], Fig. 16 (“hub/bridge module 232”)) or they could be located in cabling (*e.g.*, EX1015, [0029] (“USB bridge transmission line 5”)).

a “conventional hub.”).

The “Hub 40” Mux Implementation figure above shows extended vertical lines connecting ports 44 to hub 40. This simply reflects that the ports can be connected via wires, providing flexibility in port placement (*e.g.*, in a vehicle’s backset) depending on deployment context. Welch, ¶199.

For comparison, the claimed embodiment of ’643 patent Fig. 4 is shown below, with corresponding components identified using the same colors.

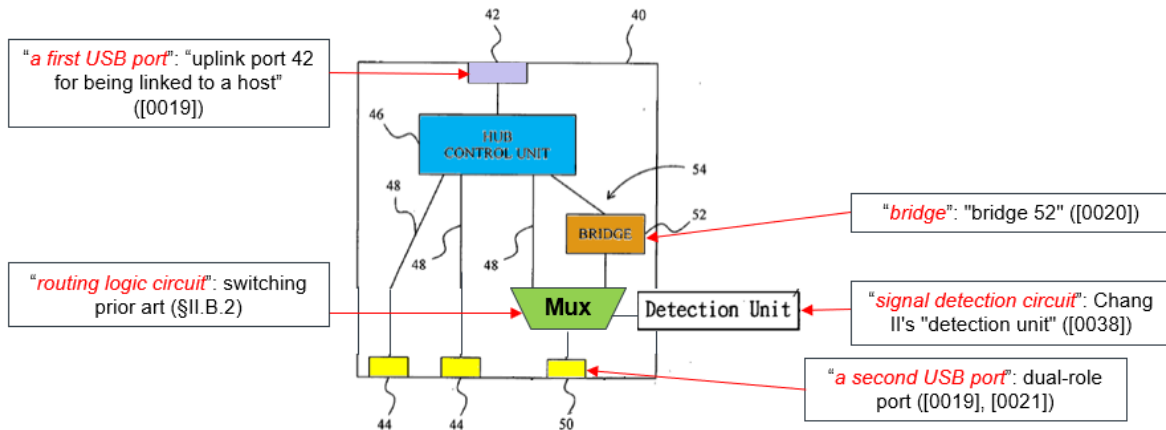
'643 Patent



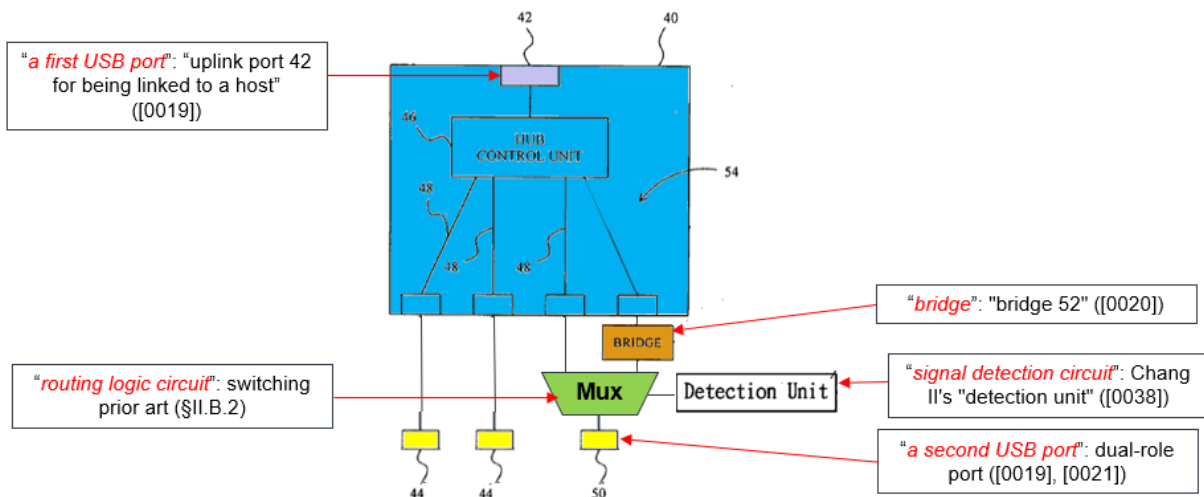
2. Claim 1

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

Chang (Hub 46)



Chang (Hub 40)



EX1014, Fig. 3 (modified and annotated).

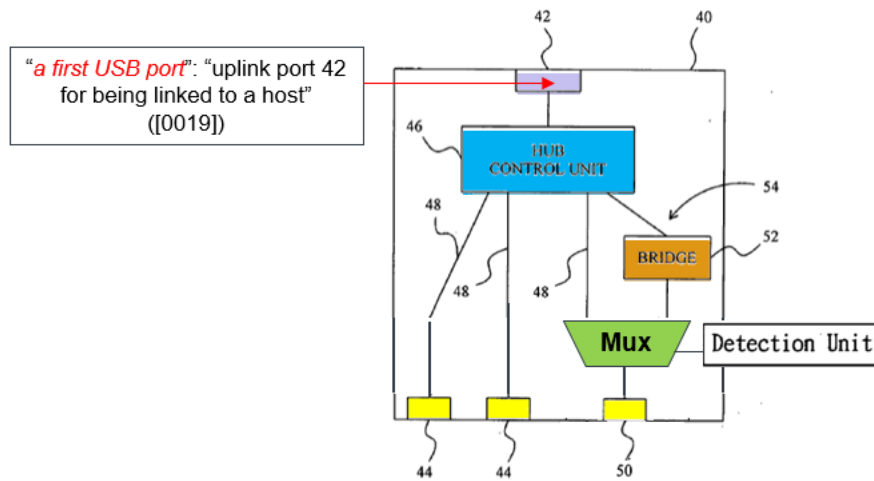
a. [Preamble]: "A method, comprising:"

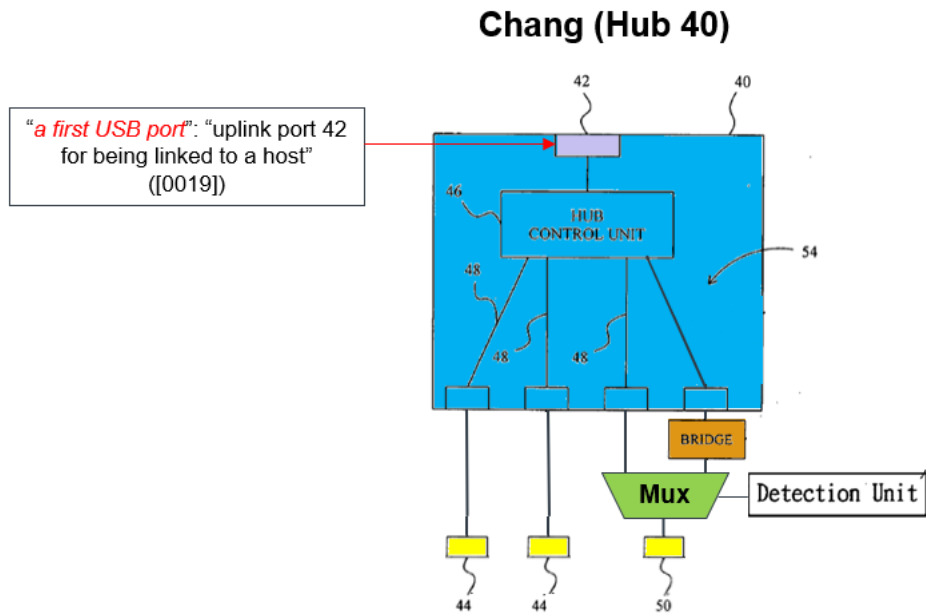
If the preamble is limiting, Ground 1 renders it obvious as the substantive analysis below shows.

- b. 1[a] “providing a first USB port for communication with a USB host;

Both Mux Implementations render obvious the provision of “*a first USB port for communication with a USB host.*” Chang discloses “an uplink port 42 for being linked to a host.” EX1014, [0019]; *see also id.*, [0021] (“the uplink port 42 is a USB port”); Welch, ¶222.

Chang (Hub 46)





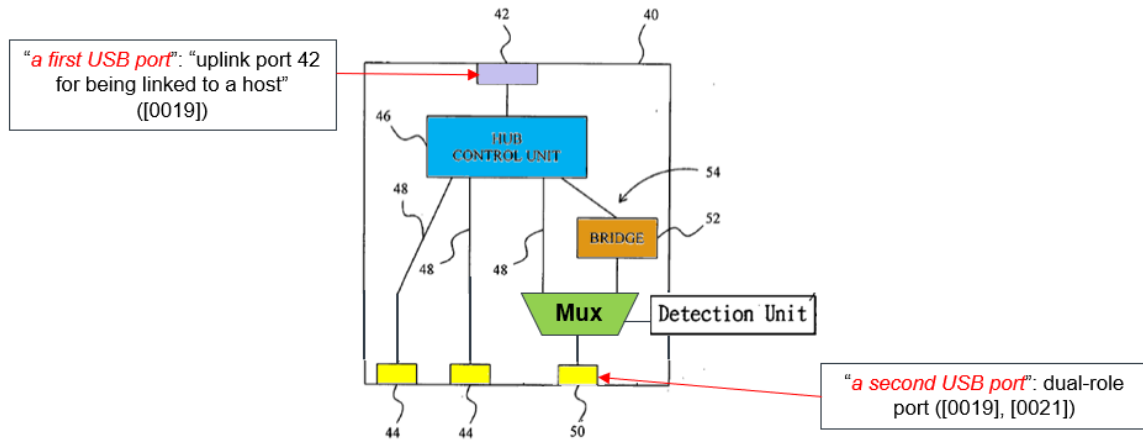
EX1014, Fig. 3 (modified and annotated).

c. 1[b] “providing a second USB port for communicating with a consumer USB device;”

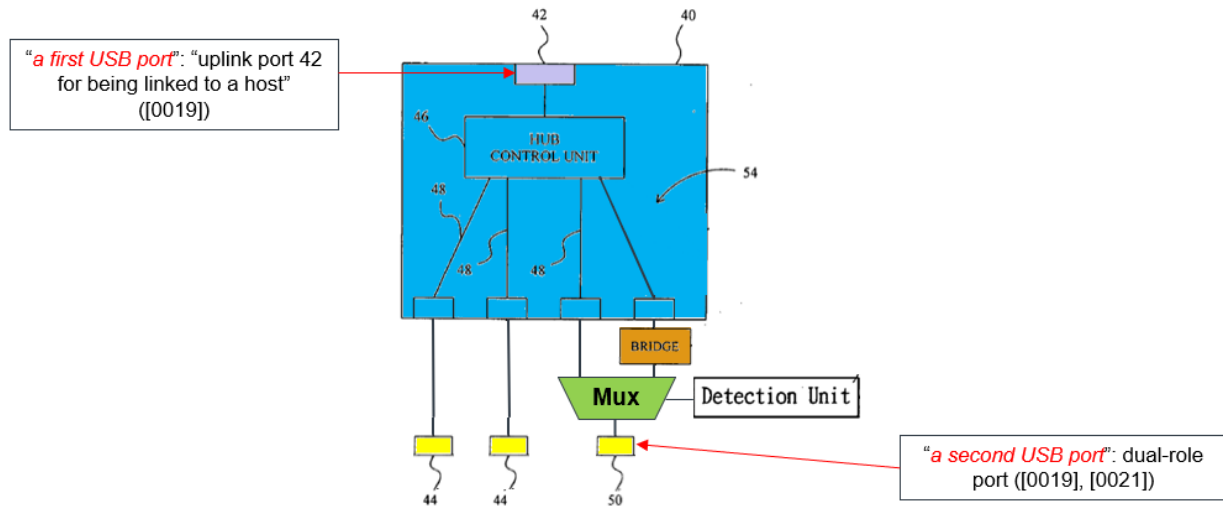
Both Mux Implementations render this limitation obvious. Note that “*consumer USB device*” recited here refers generically to a USB product, regardless of host/device operating mode. Welch, ¶223. The “*second USB port*” is a dual-role port, which as §VII.A.1 demonstrates, would be obvious to implement Chang’s downlink host port 50 as a dual-role port. EX1014, [0021]; *see also id.* [0019]-[0020] (“hub control unit 46 for establishing several transmission paths 48 between the uplink port 42 and downlink ports 44 ... [and] host-to-host transmission path 54”); §VII.A.2; Welch, ¶224. Chang’s downstream ports are for communication with USB products (a “*device*”). *Id.* As §VII.A.1 demonstrates, in the obvious dual-role port modification, a USB product operating in either host or

device mode would connect to the downstream port 50. See §VII.A.1; see also EX1015, Fig. 1, [0042]-[0044] (selecting appropriate transmission path for USB downstream port).

Chang (Hub 46)



Chang (Hub 40)



EX1014, Fig. 3 (modified and annotated); Welch, ¶225.

- d. 1[c]: “providing a signal detection circuit for receiving USB signals from the consumer USB device via the second USB port;”

Both Mux Implementations render this limitation obvious. Chang II discloses a “Detection Unit” (134):

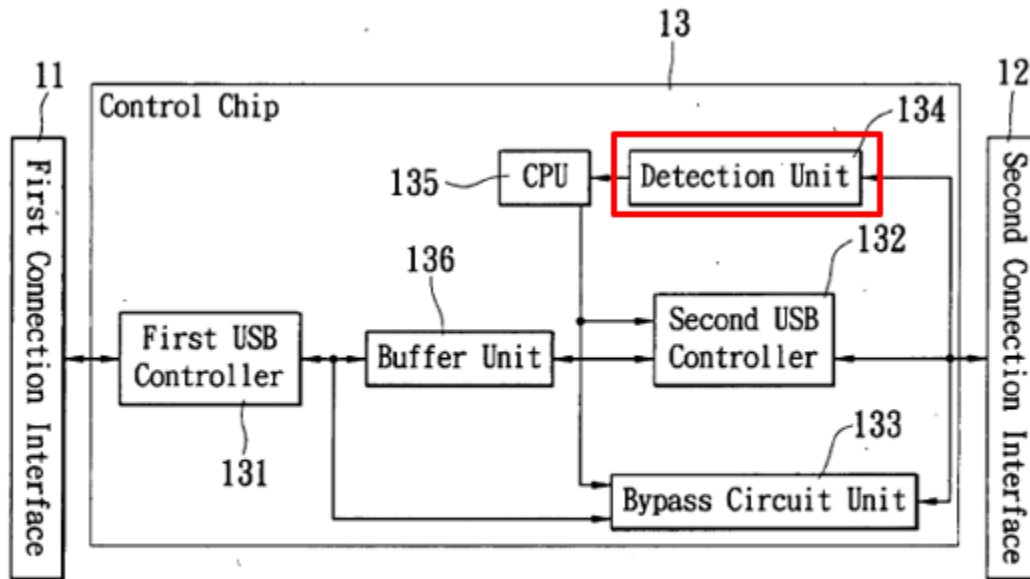


FIG. 5

EX1015, Fig. 5.

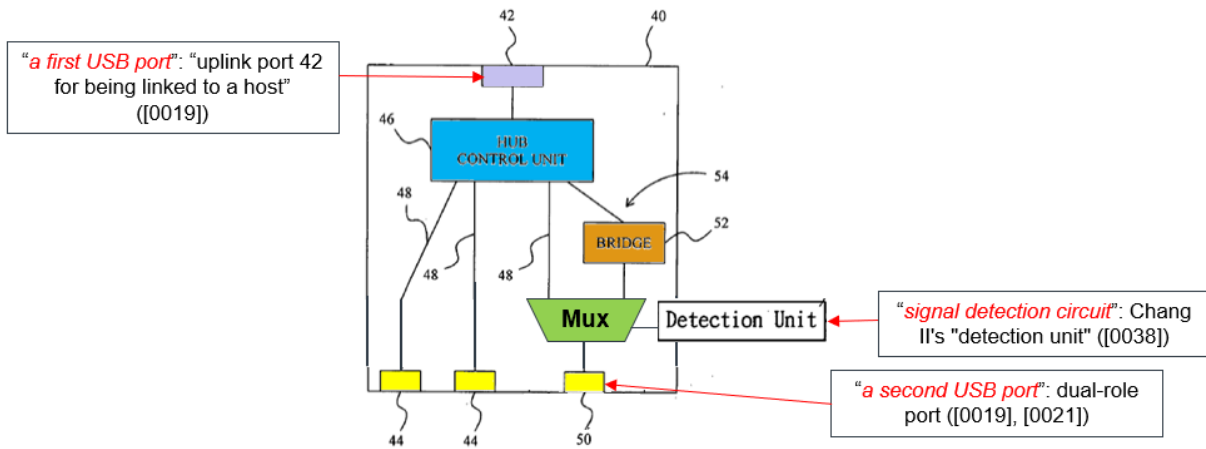
Chang II’s “detection unit” “automatically operate[s] to ... determine the type of device currently connected” to the port. EX1015, [0038]. The “detection unit 134” is part of Chang II’s “control chip.” *Id.*, Figs. 1, 5, [0034]. The detection unit receives a signal from the second interface (downstream port) and performs host/device detection by (1) sending an “inquire signal” and receiving a response (when a host connects) or (2) receiving an “inquire signal” (when a

device connects). *Id.*, [0038]-[0040]. The detection unit then produces either a “bridging detection signal” (after detecting a host) or “slave detection signal” (after detecting a device). *Id.* These signals, in turn, cause switching to the appropriate transmission “path” (*i.e.*, the bypass path or bridge path). *Id.*, [0042]-[0044]; Welch, ¶¶226-30; *see also* §III.B.2.

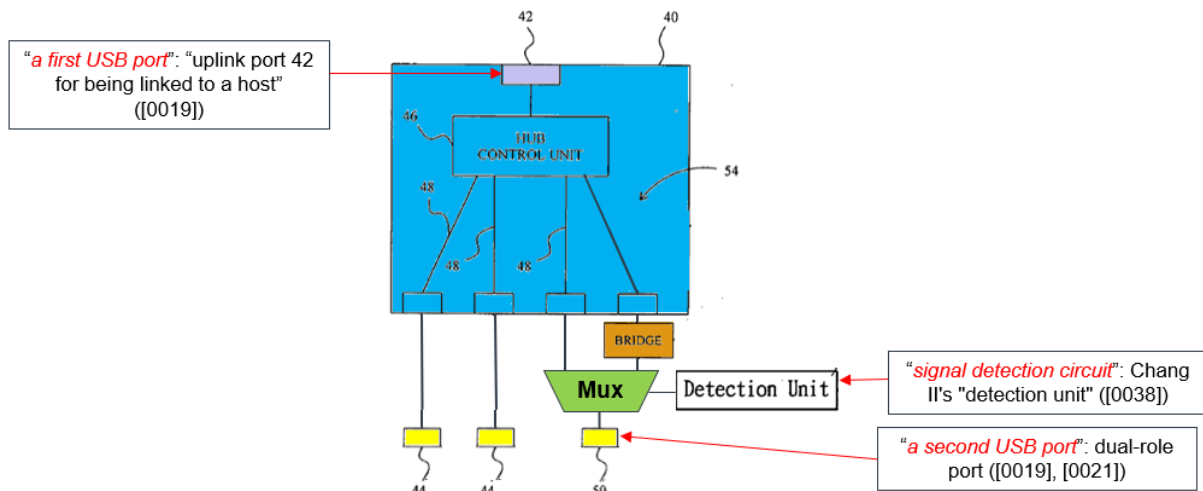
Applying these teachings to Ground 1, the detection results would control the mux select line. Welch, ¶231. In particular, and as Chang II teaches, the detection circuit would “*receiv[e] USB signals from the consumer USB device via the second USB port*” to detect either a host or device connection. EX1015, [0038]-[0040].

Claim 1 does not require any particular location for the signal detection circuit, but (as claim 4’s analysis demonstrates) one obvious location is to co-locate the mux and detection circuit, *e.g.*, on a common IC, because the detection circuit and mux would typically receive the same input signals. Welch, ¶232.

Chang (Hub 46)



Chang (Hub 40)



EX1014, Fig. 3 (modified and annotated); Welch, ¶232.

- e. ***1[d] “[1][d][i] routing the USB signals emanating from the consumer USB device to the first USB port via a routing logic circuit connected directly to a USB bridge and a USB hub connected to the USB bridge in accordance with a determination by the signal detection circuit that the consumer device is operating in a USB host mode, [1][d][ii] wherein the USB bridge includes a bridge controller, buffers, and a plurality of ports; and”***

Both Mux Implementations of Ground 1 render this limitation obvious.

Ground 4 demonstrates “*routing logic circuit*” is indefinite, because the bounds of the claim are not reasonably certain. See §VII.D. Nevertheless, while the outer bounds are unclear, the Board can find the Challenged Claims obvious. See *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 812-14 (Fed. Cir. 2021). In particular, the Board can find the claims unpatentable if the prior art discloses or renders obvious a switch, such as a mux, that performs the claimed “*routing logic circuit*” functions, because this is all the ’643 specification discloses. See EX1011, 4:34-57, 5:65-6:17, 7:15-21 (disclosing “switch device (such as USB analog multiplexing switches)” that performs said functions). Accordingly, both Mux Implementations render sub-element 1[d][i] obvious. Welch, ¶¶233-246.

Regarding the structural aspects of 1[d][i], the mux is a “*routing logic circuit*.” Welch, ¶234. As §§VI.B, III.B.2, and VII.A.1 demonstrate, it would have been obvious to include a switching structure, such as a mux, to select the appropriate transmission path. *E.g.*, EX1052, Fig. 1, 3:7-50 (“switching structure 170” controls data paths depending on operating mode); EX1017, Fig. 6, [0057]

(“port router”); §III.B.2 (exemplary switches); Welch, ¶234. Chang discloses a “*USB bridge*.” EX1014, [0020] (disclosing a “bridge 52” that “provides a function for host-to-host communications” between the upstream and downstream hosts); Welch, ¶235.

Petitioner provides two mappings (one for each Mux Implementation) depending on whether the claimed “*USB hub*” is Chang’s “hub control unit 46” or “hub 40.” Each meets element 1[d]. Welch, ¶236.

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) and ports comprising the hub. This is consistent with the ’643 specification, file history, and USB 2.0 Specification.

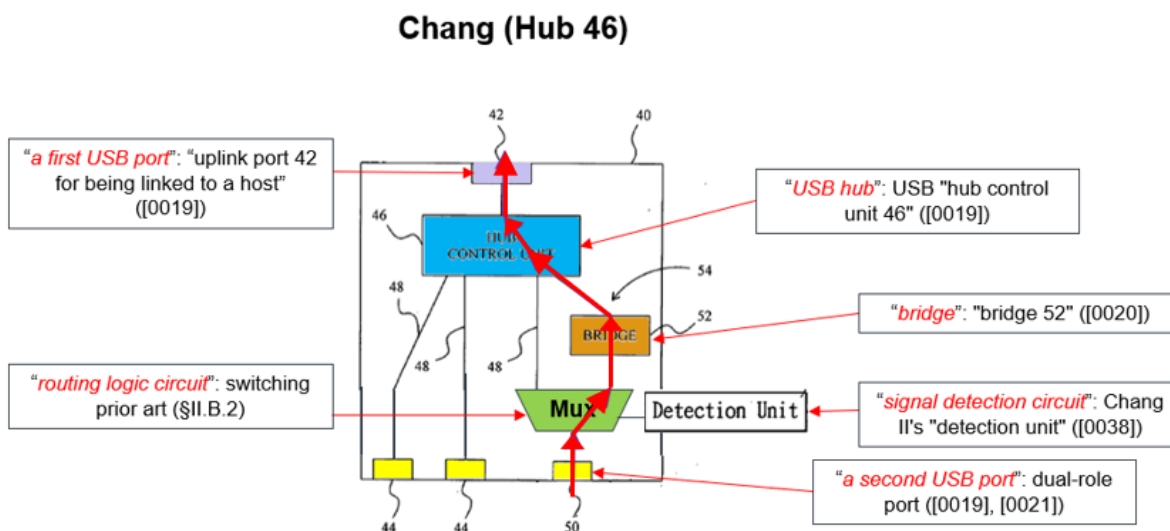
’643 Patent Specification. ’643 patent Fig. 5 illustrates a hub, bridge, and switch on one IC. See EX1011, 5:28-32. Fig. 5’s “hub” is simply the logic that performs the hub functionality of broadcasting upstream communications downstream (and vice versa). *Id.*, 7:15-21, Fig. 5 (defining “hub” by drawing box around “USB hub digital logic”); Welch, ¶237.

File History. During prosecution of the parent ’037 patent, the Examiner

also defined “hub” functionally. See EX1002, 141 (“the USB switching hub 119 of Bohm discloses *the function of claimed hub*”) (emphasis added); Welch, ¶237.

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, ¶237.

Thus, as shown below, Chang’s hub control unit 46 is the claimed “*USB hub*.” Welch, ¶237.



EX1014, Fig. 3 (modified and annotated).

Note the “*routing logic circuit*” (mux) is “*connected directly to a USB bridge*” in this obvious modification, consistent with steering the USB product signals to the bridge or bypassing the bridge to provide Chang’s host-to-host or host-to-device connection. Welch, ¶238. As Chang discloses, the host port directly connects to the bridge. EX1014, Fig. 3. Thus, when including a mux to

route the host port to the bridge, the mux would directly connect to the bridge in this obvious modification. Also, the “*USB hub*” is “connected to the USB bridge,” which also is consistent with Chang’s teaching of its bridge connecting to hub control unit 46. *Id.*

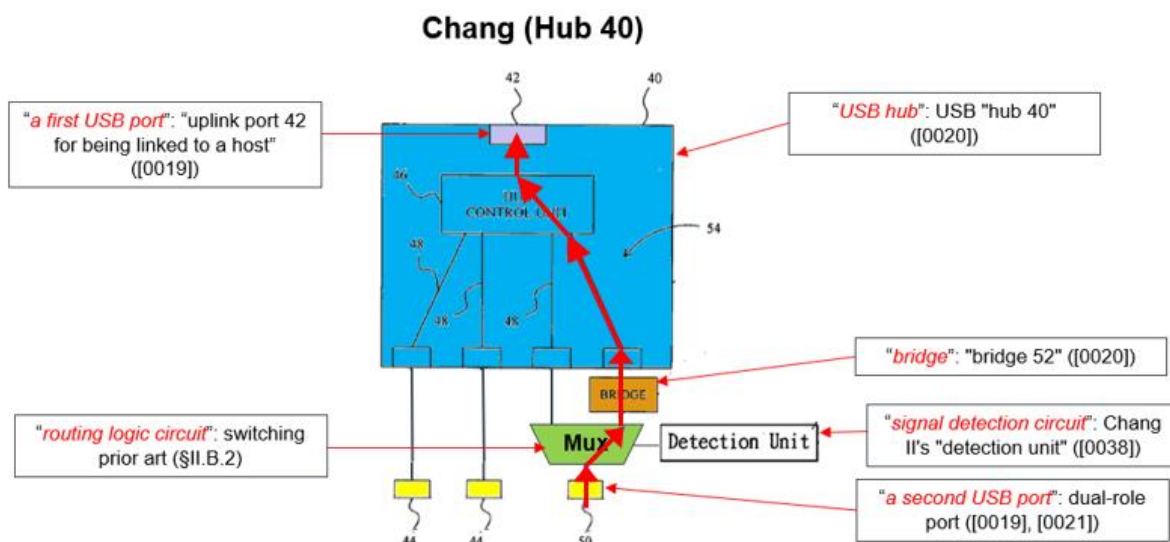
Concerning the functional aspects of sub-element 1[d][i], the claim requires routing “*in accordance with a determination by the signal detection circuit that the consumer device is operating in a USB host mode.*” Section VII.A.1 demonstrates this determination, *i.e.*, connecting a USB product in host mode, would be obvious in view of Chang II and a POSITA’s knowledge. *E.g.*, EX1015, [0021] (“automatically detecting the type of device connected (host or slave)” and “switch[ing] to the proper transmission path”), [0038]-[0040] (“detection unit 134” for detecting whether the consumer product is host or device). With this determination, the limitation requires “*routing the USB signals emanating from the consumer USB device to the first USB port via a routing logic circuit connected directly to a USB bridge and a USB hub connected to the USB bridge.*” In the Mux Implementation above, red arrows show this routing path. Welch, ¶¶240-242.

Section VII.A.1 demonstrates providing a host-to-host connection through these components would be obvious in view of Chang, Chang II, and a POSITA’s knowledge. For example, Chang II discloses that the detection unit produces a “bridging detection signal” (after detecting a host) and activates the bridging

function (viz., the second controller). EX1015, [0039]. In other words, this signal causes switching to the appropriate transmission “path” (here, the bridge path). *Id.*, [0042]-[0044]; Welch, ¶¶240-242. In the Mux Implementations, it would have been obvious for the detection circuit (alone or in conjunction with other logic such as CPU, microcontroller, or other processing logic) to control the mux. *E.g.*, EX1068, 2 (“Truth Table” re select line controlling 2:1 USB switch); EX1052, Fig. 1, 3:7-37 (“mode switch manager 180” performing detection and controlling “switching structure 170”); Welch, ¶234.

Hub 40

Chang’s hub 40 also qualifies as the claimed “**USB hub**” because it performs the same function of broadcasting upstream communications downstream (and vice versa). EX1014, [0019] (“hub 40”); Welch, ¶243.



EX1014, Fig. 3 (modified and annotated). In this mapping (*i.e.*, Chang’s hub 40 is

the claimed “*USB hub*”), the hub is connected to the bridge and the “*routing logic circuit*” (mux) is “*connected directly to a USB bridge*,” consistent with steering the USB product signals to the bridge or bypassing the bridge to provide Chang’s host-to-host or host-to-device connection. As Chang discloses, the host port directly connects to the bridge. EX1014, Fig. 3. Thus, when including a mux to route the host port to the bridge, the mux directly connects to the bridge in this obvious modification. Welch, ¶¶243-244.

With respect to sub-element 1[d][i]’s functional requirements (*i.e.*, host/device detection and host-to-host routing), the analysis for the Mux Implementation with hub 40 as the claimed “*USB hub*” is the same as the Mux Implementation with hub control unit 46 as the claimed “*USB hub*” described in the previous section. In the figure immediately above for the “hub 40” mapping, red arrows illustrate the host-to-host routing path. Welch, ¶245.

The Mux Implementations also render obvious sub-element 1[d][ii] which requires “*wherein the USB bridge includes a bridge controller, buffers, and a plurality of ports*.” Welch, ¶¶247-252.

First, the ’643 patent describes the “*bridge controller*” as the functionality that processes USB messages to enable USB communication, and Chang and Chang II disclose the same. EX1011, 7:22-29, 8:6-14. Chang refers to a “host-to-

host transmission chip” that establishes “a host-to-host transmission path.”

EX1014, [0020]. Chang II provides more detail on its host-to-host bridging

“control chip,” which includes CPU 135 and buffer unit 136:

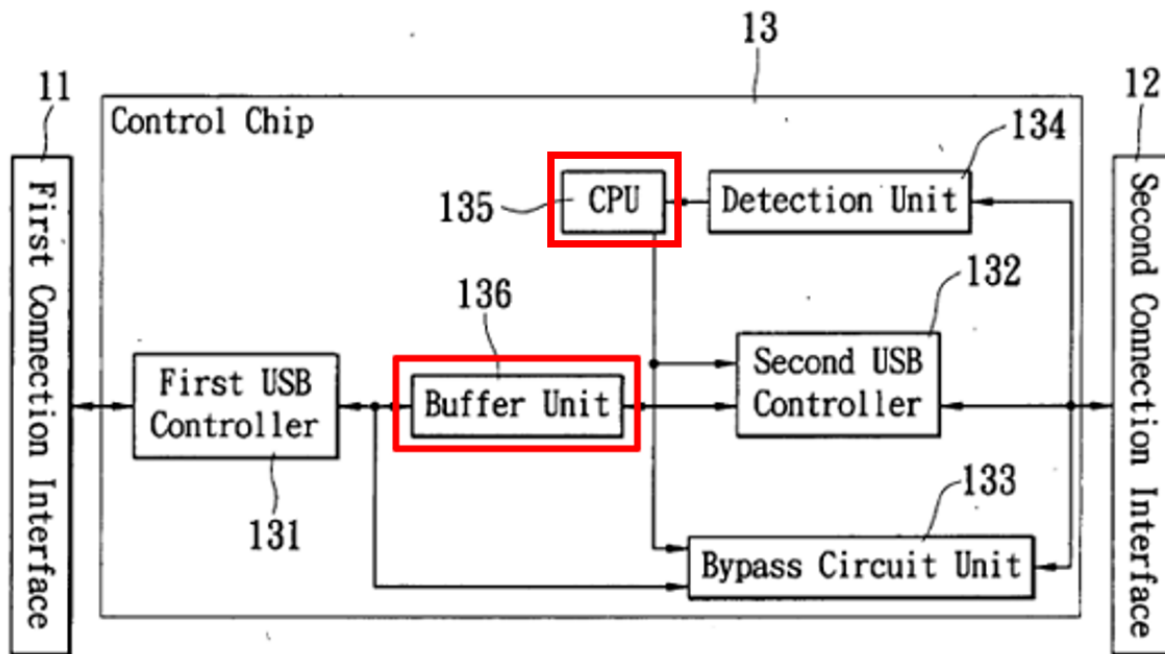


FIG. 5

EX1015, Fig. 5. Chang II’s “control chip,” including its digital logic (e.g., the CPU and controllers 131/132), is a “*bridge controller*,” as it enables USB messaging. *Id.*, [0034]-[0036]; Welch, ¶¶248-50.

Second, Chang II discloses its bridge includes a “*buffer*.” EX1015, Fig. 5 (“Buffer Unit 136”). Buffer 136 “buffer[s] and stor[es] temporary data that passes between the two controllers” to avoid data loss. *Id.*, [0041]. It was well-known to include, specifically, endpoint buffers in bridges. For example, the GL620USB-A

“single-chip solution” USB bridge provides endpoint buffers (e.g., the “8 Bytes FIFO”). EX1031, 6. Welch, ¶¶250-251.

Third, Chang and Chang II disclose, and certainly render obvious, that the bridge includes “*a plurality of ports*.” Chang, for example, discloses its bridge may be a commercial chip. Such chips include ports for each host connection. EX1031, 6 (“two full-speed USB ports”); Welch, ¶252. Chang II discloses two “interfaces” that are ports for USB connections. EX1015, [0023]; Welch, ¶252.

f. 1[e] “[1][e][i] routing the USB signals emanating from the consumer USB device to the first USB port via the routing logic connected directly to the USB hub and thereby bypassing the USB bridge in accordance with a determination by the signal detection circuit that the consumer device is operating in a USB device mode, [1][e][ii] wherein the USB hub and USB bridge have different components and functionality.”

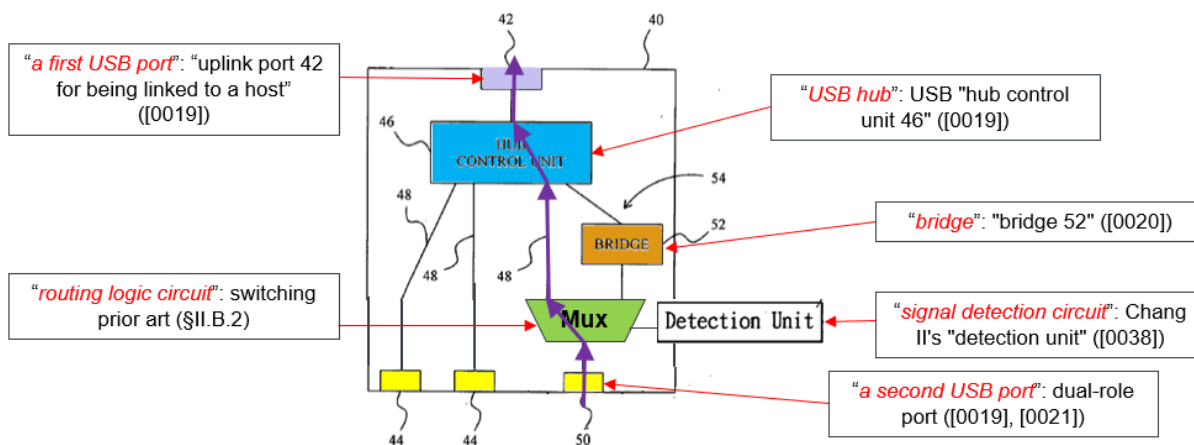
Both Mux Implementations of Ground 1 render this limitation obvious. Welch, ¶¶253-259.

With respect to 1[e][i], the claim requires routing “*in accordance with a determination by the signal detection circuit that the consumer device is operating in a USB device mode*.” Section VII.A.1 demonstrates determining the USB product is operating in device mode would be obvious in view of Chang II and a POSITA’s knowledge. E.g., EX1015, [0021] (“automatically detecting the type of device connected (host or slave)” and “switch[ing] to the proper transmission

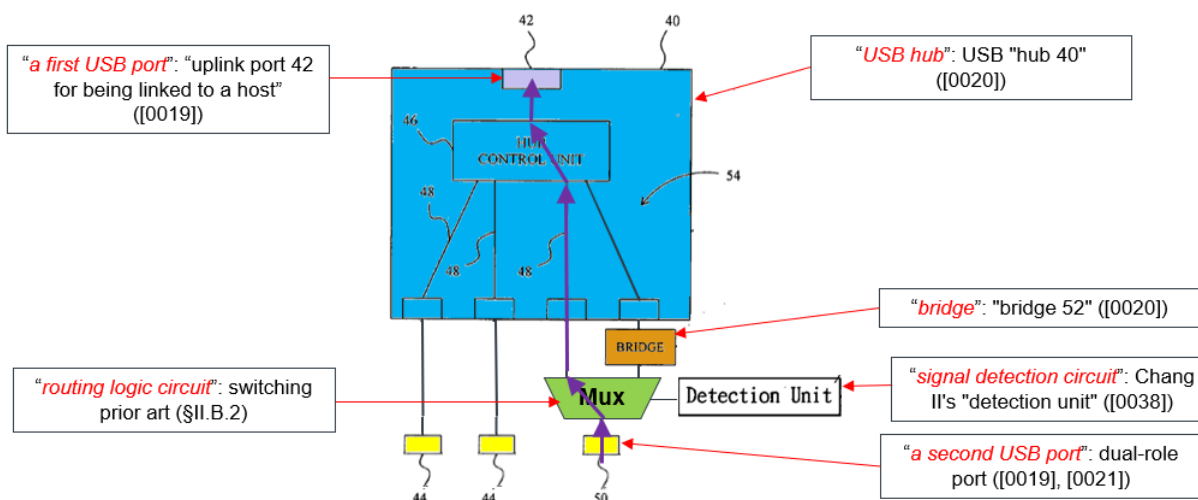
path”), [0038]-[0040] (“detection unit 134” for detecting whether the consumer product is host or device); Welch, ¶253.

With this determination made, the limitation requires “*routing the USB signals emanating from the consumer USB device to the first USB port via the routing logic connected directly to the USB hub and thereby bypassing the USB bridge.*” Section VII.A.1 demonstrates this routing, *i.e.*, providing a host-to-device connection through these components, would be obvious in view of Chang, Chang II, and a POSITA’s knowledge. For example, Chang II discloses the detection unit “will produce a slave detection signal, which causes the CPU 135 to activate the bypass circuit unit 133 for operation according to the slave detection signal.” EX1015, [0040]. In other words, this signal causes switching to the appropriate transmission “path” (here, the bypass path). *Id.*, [0042]-[0044]; Welch, ¶254. In the Mux Implementations shown below, it would have been understood the detection circuit controls mux switching to the appropriate path. *E.g.*, EX1068, 2 (“Truth Table” re select line controlling 2:1 USB switch); EX1052, Fig. 1, 3:7-37 (“mode switch manager 180” performing detection and controlling “switching structure 170”); Welch, ¶255.

Chang (Hub 46)



Chang (Hub 40)



EX1014, Fig. 3 (modified and annotated) (purple arrows show host-to-device path).

Ground 3 demonstrates the sub-element 1[e][ii] “*wherein the USB hub and USB bridge have different components and functionality*” is indefinite because the bounds of the claim are not reasonably certain. See §VII.C. While the outer

bounds of this term are unclear, the Board can nevertheless find the Challenged claims obvious if the hub and bridge are “discrete components” that perform (at a high level) different functions, because this is all the ’643 specification discloses. See EX1011, 1:63-2:20, 5:24-27, 7:22-8:42, and Figs. 4-5 (describing hub and bridge conceptually with only high-level block diagrams). Both Mux Implementations render sub-element 1[e][ii] obvious. Welch, ¶255.

As shown above, Chang’s hub unit 46 is a separate/discrete component from bridge 52. EX1014, [0020] (bridge chip), [0022] (conventional hub); Welch, ¶¶256-57. Similarly, in the hub 40 mapping, the bridge is external to hub 40, and both the bridge and hub are discrete components. *Id.* In both Mux Implementations the hub’s function is to connect the upstream host to multiple downstream products. EX1014, [0023]. The bridge provides a bridging function between two hosts (which occurs outside the hub). *Id.*, [0020]; see also Ex. 1015, [0013]; EX1031, 6 (exemplary bridge with device interfaces and endpoint buffers); Welch, ¶¶256-259.

3. Claim 2

Claim 2 depends from claim 1 and further requires “*wherein the USB host is embedded in an infotainment system.*” Both Mux Implementations of Ground 1 render this limitation obvious.

To start, the ’643 patent admits embedding a USB host in a vehicle

infotainment system was already known: “[t]he USB Host function is often embedded into a component of the vehicle infotainment system, such as into the radio or other control module.” EX1011, 1:52-54. Indeed, using USB hubs to support vehicle infotainment systems connecting to downstream consumer devices was ubiquitous. *See supra* §III.D. What’s more, the ’643 patent admits there was a need for the vehicle infotainment system to connect to downstream hosts. EX1011, 2:42-3:20. Chang’s host-to-host bridge addresses this specific need. Welch, ¶261. Accordingly, it would have been obvious to connect Chang’s system (and Ground 1’s modified Chang/Chang II hub) to a vehicle infotainment system embedded host.

Further, Chang discloses a “host” is “linked to the uplink port 42.” EX1014, [0019]. Indeed, this link is merely a standardized USB connection. While Chang’s disclosure is more general than the ’643 patent, Chang does not limit its disclosure to any particular type of host. Instead, Chang broadly discloses its invention in the USB hub context that allows for a host-to-host connection, without restriction as to the type of host which will connect to uplink port 42. *Id.*, [0001], [0003], [0020]. Accordingly, a POSITA would have recognized Chang is applicable to any system employing a USB hub, and in particular, where a host-to-host connection would be advantageous. Welch, ¶¶261-262.

Moreover, vehicle infotainment systems are effectively host computer

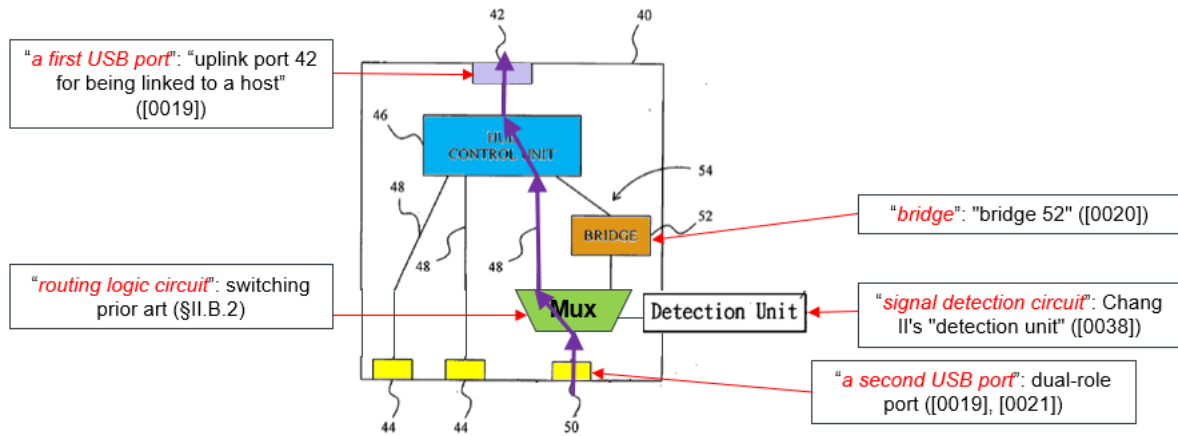
systems connected to smartphones (which have effectively become computer systems themselves) via downstream ports. EX1011, 1:63-3:7; EX1029, 5:27-7:34 (describing “vehicle control system 106,” *e.g.*, a vehicle infotainment system); EX1049, 1 (“the car has become a PC on wheels”); Welch, ¶263. And Chang provides an example of an upstream host PC (analogous to a vehicle infotainment system) connecting to a downstream port (analogous to a phone), expressly suggesting application to the vehicle environment (*viz.*, an embedded host in an infotainment system). EX1014, Fig. 4, [0024]. Such an implementation was highly predictable: simply arranging the hub, *e.g.*, in the front of the vehicle, with wiring to downstream ports throughout the vehicle. Welch, ¶264.

4. Claim 3

Claim 3 depends from claim 1 and further requires “*wherein the bypassing the USB bridge is performed by a USB routing switch.*” Both Mux Implementations of Ground 1 render this limitation obvious. Welch, ¶¶265-266. The analysis under 1[e][i] demonstrates the “*USB routing switch*” (a mux in the Mux Implementations) performs bypassing:

Hub Control Unit 46

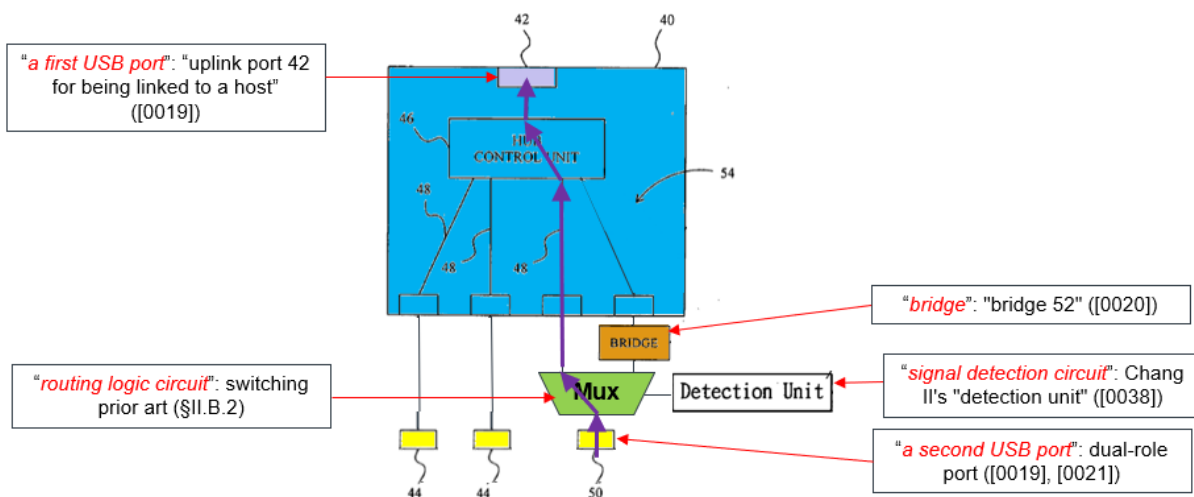
Chang (Hub 46)



EX1014, Fig. 3 (modified and annotated).

Hub 40

Chang (Hub 40)



EX1014, Fig. 3 (modified and annotated).

5. Claim 4

Claim 4 depends from claim 3 and further requires “*wherein the USB routing switch includes the signal detection circuit.*”

Grounds 6-7 demonstrate this limitation is indefinite and lacks adequate written description support. For prior art analysis purposes, Petitioner applies an interpretation in which a single IC or chip containing the routing switch and signal detection circuit is within the claim scope.¹⁶ Both Mux Implementations render this interpretation obvious.

The analysis under §VII.A.1 element 1[c], and element 1[d][i] demonstrate both Mux Implementations render obvious a switch and signal detection circuit. It would further be obvious to include these on a single IC. Welch, ¶¶268-274. First, Chang teaches integrating additional components onto a single IC. EX1014, [0022] (“To an integrated circuit (IC) designer, it is possible to integrate the bridge 52 within the hub control unit 46, and thereby the hub control unit after integration will comprise both of a conventional hub control unit and a conventional bridge.”). Second, Chang II discloses including the switching functionality and detection circuit on a single control chip. EX1015, Fig. 2 (showing “control chip 13” implemented on a single chip), Fig. 5 (“Detection Unit 134” and “Bypass Circuit

¹⁶ Petitioner applies this interpretation because, even though the ’643 patent specification is completely silent regarding a “signal detection circuit, the specification does disclose combining components on a single IC (*see* EX1011, 7:15-21) and a POSITA would have known how to easily do so (Welch, ¶268).

Unit 133”). Third, including these elements on a common IC was well-known. *See, e.g.*, EX1071 (mux chip with detection circuitry); EX1017 (“crossbar switch” on same SoC (System-on-Chip) as detection circuitry (OTG controller for host-device negotiation), [0046] (OTG controller), [0057] (crossbar switch), [0063] (SoC), [0070] (SoC); Welch, ¶272.

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 and assembly costs. Welch, ¶273. Indeed, because the detection circuitry typically receives the signals from the downstream USB port for detection, co-locating the detection circuitry with the switching circuitry is common sense. *Id.* For example, Wang discloses “mode switch manager 180” and “switching structure 170” as part of the same physical layer and locate the functionally next to each other. EX1052, Fig. 1. And the mode switch manager receives the inputs into the switching structure, detects whether a host or device connects, and controls the switch accordingly. *Id.*, 3:7-37. Moreover, Aptiv admits in its infringement contentions that “[a] person of ordinary skill in the art would understand that the step of determining whether the consumer device is operating in the USB host mode or in the USB device mode is performed by the USB routing switch.” EX1072, 597.

As the above references demonstrate, doing so was routine, and a POSITA

would have had a high expectation of success. Welch, ¶¶268-274. Integrating two circuits on an IC was well understood and routine long before the priority date. Welch, ¶273; EX1017, [0046] (OTG controller), [0057] (crossbar switch), [0063] (SoC), [0070] (SoC).

6. Claim 5

Independent claim 5 bears many similarities to independent claim 1 and both Mux Implementations satisfy it for largely the same reasons as claim 1 as further explained below.

a. [Preamble]: “A USB communication management method for interconnecting sources of USB signals, the method comprising:”

If the preamble is limiting, Ground 1 renders it obvious. Chang’s hub manages the upstream host connection to downstream USB products (sources of USB signals). EX1014, [0023]. Similarly, Chang II discloses managing interconnected sources of USB signals through its transmission bridge. EX1015, Abstract. Both Mux Implementations combine these teachings to manage the upstream host signal sources vis-a-vis the downstream signal sources. Welch, ¶¶276-277.

b. 5[a] “receiving first USB host signals from a first USB host;”

Element 1[a]’s analysis demonstrates Ground 1 renders this limitation

obvious. Welch, ¶278. In particular, both Mux Implementations render obvious receiving host signals from the first port of claim 1 (a host connects to the first port, *i.e.*, upstream port). *See also* claim 2 analysis (infotainment system host connected to upstream port).

c. 5[b] “receiving second USB signals from a second USB signal source;”

Element 1[b]’s analysis demonstrates Ground 1 renders this limitation obvious. Welch, ¶279. In particular, both Mux Implementations render obvious receiving signals from the second port of claim 1 (a USB product connects to the second port, *i.e.*, downstream port).

d. 5[c] “determining, via a signal detection circuit, whether the second USB signals emanate from a second USB host;”

Element 1[c]’s analysis demonstrate Ground 1 renders this limitation obvious. Welch, ¶280. That analysis demonstrates that in view of, *e.g.*, Chang II’s “detection circuit” that is a “*signal detection circuit*,” both Mux Implementations detect when the consumer product is a host (and thus emanates host signals).

e. 5[d] “routing the second USB signals emanating from the second USB host via a routing logic circuit connected directly to a USB bridge and a USB hub connected to the USB bridge to the first USB host, wherein the USB bridge includes a bridge controller, buffers, and a plurality of ports; and”

This limitation is substantially the same as 1[d]. Here, element 5[d] refers to

“*second USB signals*” from “*the second USB host*,” which are the same “*USB signals*” of 1[d] because, there, “*the consumer device is operating in a USB host mode*.” Element 5[d] is broader than 1[d] because element 5[d] also lacks the requirement of “*a determination by the signal detection circuit*.”

Ground 1 renders this limitation obvious for the same reasons as element 1[d]. Welch, ¶¶281-282.

f. 5[e] “*routing the second USB signals not determined to emanate from a USB host via the routing logic connected directly to the USB hub to the first USB host and thereby bypassing the USB bridge, wherein the USB hub and USB bridge have different components and functionality*.”

This limitation is substantially the same as 1[e]. Here, element 5[e] refers to “*second USB signals not determined to emanate from a USB host*,” which are the same “*USB signals*” of 1[e] because, there, “*the consumer device is operating in a USB device mode*.” Element 5[e] is broader than 1[e] because element 5[e] lacks the requirement of “*a determination by the signal detection circuit*.”

Ground 1 renders this limitation obvious for the same reasons as element 1[e]. Welch, ¶¶283-284.

7. Claim 6

Claim 6 depends from claim 5 and further requires “*determining whether the second USB signals emanate from a USB device; and routing the second USB signals determined to emanate from the USB device via a USB hub to the first USB*

host.” Both Mux Implementations of Ground 1 render this limitation obvious for the reasons stated for elements 1[c] and 1[e][i]. Welch, ¶¶285-286. That analysis demonstrates that in view of, *e.g.*, Chang II’s “detection circuit” (*viz.*, a “*signal detection circuit*”) and “path” selection, both Mux Implementations detect when the consumer product is a device (and thus emanates signals as a device), and as a result of that determination, route the USB signals from the downstream port through the hub to the upstream host (bypassing the bridge).

8. Claim 7

Dependent claim 7 (“*wherein the first USB host is embedded in an infotainment system*”) is met by the Mux Implementations for the same reasons as claim 2. Welch, ¶287.

9. Claim 8

Claim 8 depends from claim 5 and further requires “*wherein the routing of the second USB signals is performed by a USB routing switch.*” Both Mux Implementations of Ground 1 render this limitation obvious. Welch, ¶¶288-289.

As the claim 3 analysis demonstrates, in both Mux Implementations, the routing of the downstream port signals (“*the routing of the second USB signals*”) is performed by the mux (“*a USB routing switch*”).

10. Claim 9

Dependent claim 9 (“*wherein the USB routing switch includes the signal detection circuit*”) is met by the Mux Implementations for the same reasons as

claim 4. Welch, ¶290.

11. Claim 10

Independent claim 10 bears many similarities to independent claims 1 and 5 and is satisfied by both Mux Implementations for largely the same reasons as noted below.

a. [Preamble]

The preamble is identical to 5[preamble] and met for the same reasons. Welch, ¶292.

b. 10[a] “receiving a first USB host signal from a first USB host;”

This limitation is substantially the same as 5[a] (here, it recites “*signal*” instead of “*signals*”) and is met for the same reasons. Welch, ¶¶293-294.

c. 10[b] “receiving a second USB signal from a second USB signal source;”

This limitation is substantially the same as 5[b] (here, it recites “*signal*” instead of “*signals*”) and is met for the same reasons. Welch, ¶¶295-296.

d. 10[c] “determining whether the second USB signal emanates from a second USB host;”

Element 10[c] is the same as 5[c], except element 10[c] does not require “*a signal detection circuit*” (i.e. element 10[c] is broader than 5[c]). Thus, both Mux Implementations meet element 10[c] for at least the same reasons as 5[c]. Welch,

¶¶297-298.

- e. 10[d] “[10][d][i] *establishing a first communication path via a routing logic circuit connected directly to a USB bridge and a USB hub connected to the USB bridge to the first USB host and the second USB signal source in accordance with the second signal emanating from the second USB host, [10][d][ii] wherein the USB bridge includes a bridge controller, buffers, and a plurality of ports; and*”

Element 10[d] is substantially similar to 1[d] and is met for the same reasons. Element 10[d] refers to “*establishing a first communication path*” between the first and second host, whereas claim 1[d] refers to routing signals between these hosts. As 1[d] demonstrates, such routing occurs via the routing logic circuit to create a host-to-host connection, which is “*establishing a first communication path*” among these elements. Welch, ¶¶299-300. Claim 10 refers to “*first USB host*,” whereas claim 1 refers “*a first USB port*” that connects to a host (“*a first USB port for communication with a USB host*”). Thus, claim 1’s showing with respect to the “*first USB port*” satisfies “*first USB host*.” Finally, claim 10 refers to “*the second USB signal source*” that “*emanat[es]*” signals from the “*second USB host*,” whereas claim 1 refers to “*the consumer device*” that is “*operating in a USB host mode*.” Thus claim 1’s showing with respect to routing signals from the two hosts equally applies to claim 10’s requirement of establishing a communication path between the two hosts. Welch, ¶¶301-302.

- f. 10[e] “establishing a second communication path via the routing logic connected directly to the USB hub to the first USB host to the first USB host¹⁷ and the second USB signal source and thereby bypassing the USB bridge in accordance with the second USB signal not to¹⁸ emanating from the second USB host, wherein the USB hub and USB bridge have different components and functionality.”***

Element 10[e] is substantially similar to 1[e] and is met for the same reasons. Claim 10 refers to “*first USB host*,” whereas claim 1 refers “*a first USB port*” that connects to a host (“*a first USB port for communication with a USB host*”). Thus, claim 1’s showing with respect to the “*first USB port*” satisfies “*first USB host*” in claim 10. Claim 10 refers to “*the second USB signal source*,” which corresponds to “*the consumer [USB] device*” in claim 1. Thus, claim 1’s showing with respect to the “*the consumer [USB] device*” satisfies “*the second USB signal source*” in claim 10. Welch, ¶¶303-306.

¹⁷ This limitation recites “*to the first USB host*” twice, which is nonsensical.

Omitting one instance results in establishing a communication path between the first USB host and second USB signal source. Welch, XIV.A.10.f, n.13.

¹⁸ This limitation inadvertently includes the word “to” in the phrase “not to emanating.” Omitting “to” clarifies that the limitation refers to establishing a communication path when the “second USB signal” is not a host signal (*i.e.*, the “second USB signal” comes from a device). Welch, XIV.A.10.f, n.14.

Element 10[e] refers to “*establishing a second communication path*” between the “*first host*” and “*the second USB signal source*” (i.e., downstream USB product) when “*the second USB signal not to emanating from the second USB host.*” Although the grammar is awkward, a POSITA would understand this to refer to establishing a host-device connection when the “*the second USB signal source*” is in device mode. Welch, ¶306. This corresponds to element 1[e]’s requirement of performing host-device routing “*in accordance with a determination by the signal detection circuit that the consumer device is operating in a USB device mode.*” *Id.*, ¶306. Thus, element 10[e] is met for the same reasons as 1[e]. *Id.* In particular, element 1[e]’s showing with respect to routing signals from the first host to the downstream device equally applies to element 10[e]’s requirement of establishing a communication path between the first host and a downstream signal source from a product operating in device mode. *Id.*

12. Claim 11

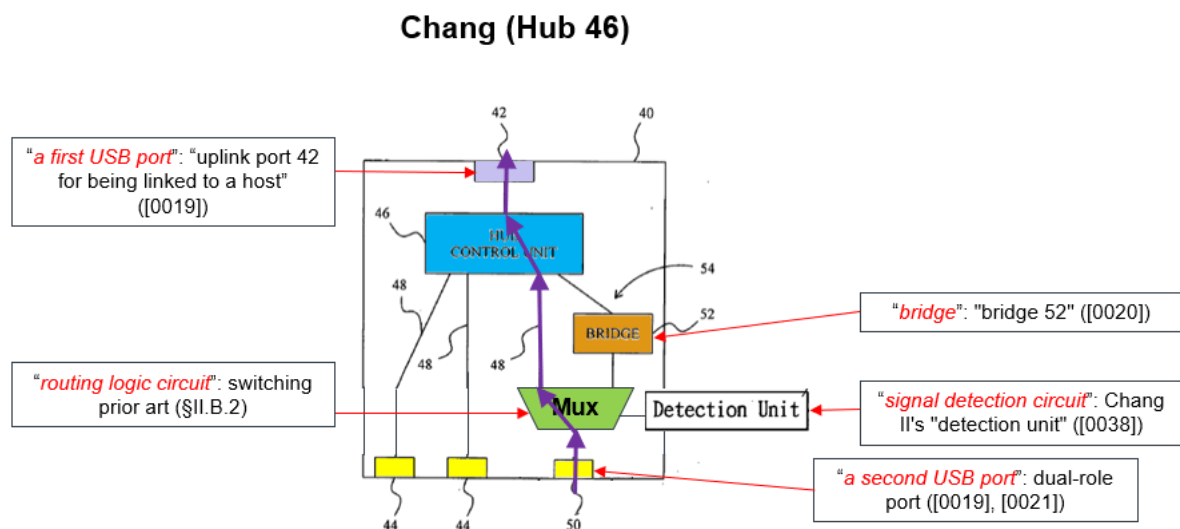
Claim 11 depends from claim 10 and further requires “*determining whether the second USB signal emanates from a USB device; and establishing the second communication path via a USB hub between the first USB host and the second USB signal source which bypasses the USB bridge in accordance with the second USB signal emanating from the USB device.*”

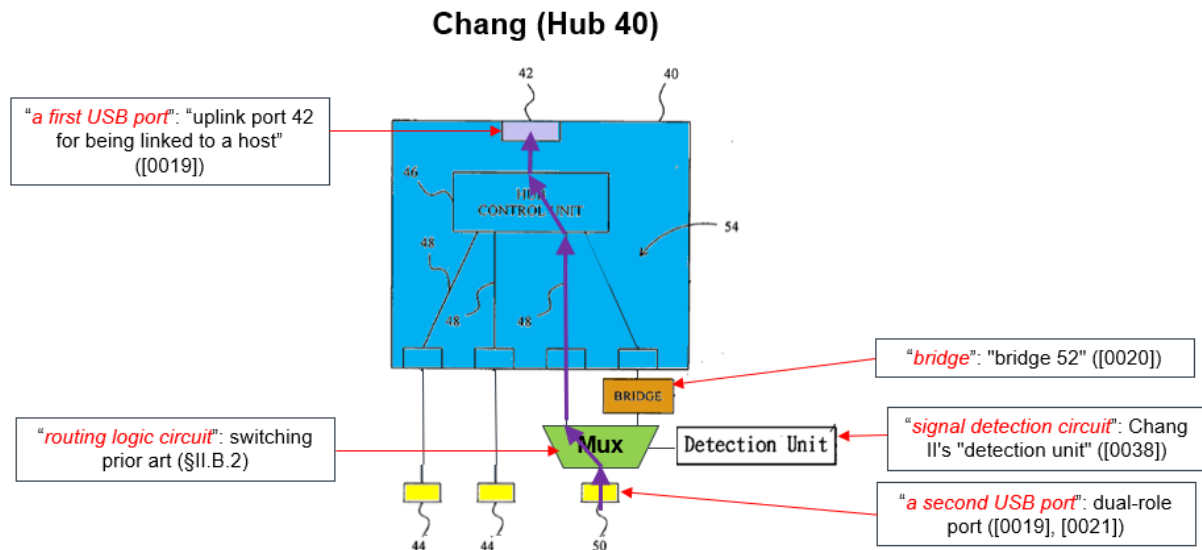
Claim 11 is substantially similar to claim 6 and element 10[e] and met for

the same reasons. Welch, ¶¶307-309. Consistent with claim 10, claim 11 refers to “*establishing the second communication path*” instead of routing signals. Again, such routing establishes a communication path. See 10[e].

13. Claim 12

Claim 12 depends from claim 10 and further requires “*wherein the second communication path does not include the USB bridge.*” The analysis for 1[e][i] and 10[e] demonstrates the “*second communication path*” does not include the “*USB bridge*”:





EX1014, Fig. 3 (modified and annotated); Welch, ¶310.

14. Claim 13

Claim 13 depends from claim 10 and further requires “*wherein the first USB host is embedded in an infotainment system.*” This limitation is identical to claim 2 and is met for the same reasons. Welch, ¶311.

15. Claim 14

Claim 14 depends from claim 10 and further requires “*wherein the establishment of the second communication path is performed by a USB routing switch.*” As the claim 3 analysis demonstrates, in both Mux Implementations, the routing of the downstream port signals (“*the routing of the second USB signals*”) is performed by the mux (“*a USB routing switch*”). Welch, ¶¶312-313.

16. Claim 15

Claim 15 depends from claim 14 and further requires “*wherein the USB*

routing switch determines whether the second USB signal emanates from a USB device.”

Claim 15 is substantially similar to claim 4 and is met for the same reasons. Welch, ¶¶314-315. Claim 4 recites the “*USB routing switch includes the signal detection circuit*,” whereas claim 15 recites the “*routing switch*” determines whether USB signals are from a “*USB device*,” e.g., a consumer product operating in device mode (and not in host mode). As claim 4 demonstrates, Ground 1 renders obvious including the signal detection circuit in the routing switch. Thus, the analysis under that claim likewise demonstrates the routing switch, which includes the signal detection circuit, would perform claim 15’s “determining” requirement (which is the specific function of the signal detection circuit). *Id.*, ¶314.

B. Ground 2 (Claims 2, 7, and 13) Chang in view of Chang II, Chutorash, and POSITA Knowledge

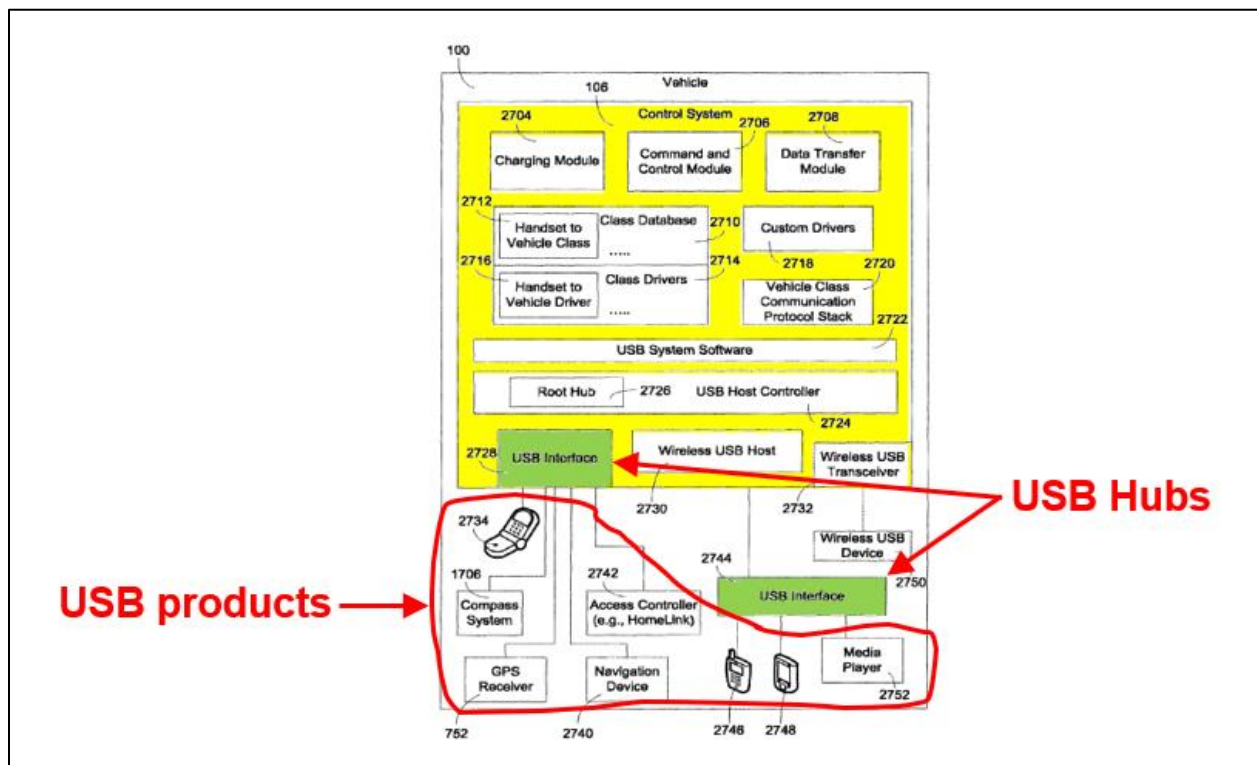
The only difference between Grounds 1 and 2 is the express addition of Chutorash, and Ground 1’s analysis applies equally to Ground 2.

1. Motivation to Combine

The motivation to combine Chutorash with Ground 1 is quite simple. Ground 1 (*i.e.*, Chang, Chang II, and a POSITA’s knowledge) discloses a USB hub with a host-to-host bridge and one dual-role port. *See* §VII.A.1. Chutorash expressly discloses using a USB hub in a vehicle control/infotainment system. *See*

§VI.C.

As described in §VI.C, Chutorash discloses a vehicle control/infotainment system with “USB interfaces 2728, 2744” that “facilitate operative connection of a mobile phone 2734, a compass system 1706, a GPS receiver 752, ... a PDA 2746, a media player 2752, [or other portable USB devices].” EX1029, 27:1-30; *see also id.*, Figs. 1, 3, and 27-30; 5:29-33 (“vehicle 100 may include ... vehicle control system 106 (e.g., media system, navigational system, entertainment system, display system, communications systems, etc.).”). Indeed, Fig. 27 shows at least 8 separate USB products connected to control system 106’s USB interfaces.



Chutorash does not describe USB interfaces 2728 or 2744 in detail.

However, given the number of connected USB products and the car

implementation, a POSITA would have understood the “USB Interface[s]” to be USB hubs, or at least found it obvious to use USB hubs. Welch, ¶¶173, 204-05. Moreover, a POSITA would have been motivated to use a USB hub with host-to-host capabilities because “[v]ehicle control system 106 could be classified as an embedded host” and mobile phone 2734, media player 2752, etc. are precisely the types of products that typically act as USB hosts. EX1029, 27:1-30; Welch, ¶206. Further, “[v]ehicle control system 106 may use the USB interface 2728” for host functions like “command and control.” EX1029, 27:12-25; *see also id.*, 13:22-24.

Given the ubiquity of USB products in 2013, the similarities of embedded vehicle control/infotainment systems to PCs, and the well-established usage of USB hubs for connecting multiple USB products to an embedded host, a POSITA would have had more than a reasonable expectation of success using Ground 1’s hub in Chutorash’s vehicle control system. Welch, ¶209. Moreover, the desirability of connecting a smartphone (or other USB product) to any USB port in the car (including the passenger seat or backsets) would also have motivated a POSITA to use a hub with dual-role ports. *Id.*, ¶208. Indeed, Ground 2 further addresses Chutorash’s “need for improved user interface features and/or connectivity features relating to vehicle control systems, remote sources, and/or portable devices.” EX1029, 1:34-36. *See also* §III.D.

2. Claims 2, 7, and 13

To the extent Aptiv argues Ground 1 lacks sufficient support for claims 2, 7, and 13, which recite “*wherein the USB host is embedded in an infotainment system,*” Chutorash discloses a “vehicle control system 106” (which includes a “media system” and “entertainment system”) located within “vehicle 100.” EX1029, 5:27-33; Figs. 1-3, and 27-30. Welch, ¶318.

C. Ground 3 (Claims 1-15): Indefiniteness (“the USB hub and USB bridge have different components and functionality”)

A patent claim is indefinite and therefore invalid under §112(b) if, when “read in light of the specification delineating the patent, and the prosecution history, [the claim] fail[s] to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014).

Each independent claim (1, 5, and 10) recites “*the USB hub and USB bridge have different components and functionality,*” and is therefore indefinite. See *Prolifiq Software Inc. v. Veeva Sys.*, No. C 13-03644 SI, 2014 U.S. Dist. LEXIS 108630, at *13-28 (N.D. Cal. Aug. 6, 2014) (invalidating claims as indefinite for reciting “differently versioned” claim language); Welch, ¶¶319-326. Basic claim construction tenets hold that “USB hub” and “USB bridge” “connote different meanings.” See *Applied Med. Res. Corp. v. U.S. Surgical Corp.*, 448 F.3d 1324, 1333 n.3 (Fed. Cir. 2006). When a claim recites two separate elements and

includes the term “different” to qualify one of the elements, “different” connotes something more than just that the two elements are, in fact two elements, *i.e.*, there is some type of difference in the construction of the elements. IPR2018-01230, Paper 7, 8-10 (noting for claims reciting “first end surface” and “second different end surface,” different “must mean something more than not being the first end wall because ‘that difference was already addressed by the use of the word ‘second’”).

But what that difference is depends on the context of the specification. For example, it may be that two elements are structurally “different.” *Id.* Or the specification could indicate the difference may be “in any respect.” IPR2014-00393, Paper 16, 7 (construing “different” to mean “different in any respect” based on examples in the specification). Or the specification could refer to very specific differences, *e.g.*, a “different bank” means “different financial institution.” *PPS Data, LLC v. Jack Hentry & Associates, Inc.*, 2:18-CV-00007 (E.D. Tex. 2019), 12-17 (when construing terms “bank(s) of first deposit” and “different bank(s) of first deposit,” finding that “different” in view of the intrinsic evidence refers to the fact that the banks are “different” with respect to being “different financial institutions,” not “different” routing numbers). But here, the specification provides no guidance on what the claimed difference(s) must be.

As an initial matter, the claim language does not say the USB hub and USB

bridge “are” different components, only that they “have” different components. Thus, it is necessary to consider what lies *inside* the hub and bridge. On the one hand, “have different components” could mean the hub and bridge are made with different component types, *e.g.*, while the hub is made with bipolar transistors the bridge is made with CMOS transistors. But even if the limitation were read to refer to the “type” of component, it still begs the question whether the limitation requires only the hub and the bridge have one different component or must have all different components (mutually exclusive sets). Welch, ¶¶321-322.

On the other hand, “have different components” could mean the hub and bridge are made with different physical components. For example, while the hub and bridge are made with the same type of components (*e.g.*, the same model of controller), each is made with discrete sets of these components and do not both use the same physical controller. But again, even if this were the case, it still begs the question whether the limitation requires only that the hub and the bridge have one different physical component or that each must have its own complete set of physically different components. Welch, ¶323.

That the hub and bridge must also have “different ... functionality” is even more indefinite. One function of a hub is connecting an upstream port to a downstream port(s), and one function of a bridge is also connecting two ports. Thus, from one perspective, the hub and bridge both function to connect ports. Of

course, drilling down on how the hub and bridge function to connect ports will result in some differences. But at what level of detail does the claim require defining the “functionality”? Further, like the issues above with respect to “components,” the same uncertainty exists over whether the claim requires that the hub and bridge must perform different types of functions or whether the claim requires that the hub and bridge must perform different, physically distinct actions (*e.g.*, separate operations that do not operate jointly on the same signals or data). Welch, ¶324.

Rather than providing any certainty, the specification only adds to the confusion. The specification describes the well-known USB hub and USB bridge at a high level. EX1011, 1:63-2:20, 7:22-8:42. But the specification provides no component level detail of the USB hub and only a high-level summary of functional blocks and components that “may” be used in a bridge. *Id.*, Fig. 7. There are no schematics, bills of material (*i.e.*, parts list), or fabrication process description. Thus, a POSITA cannot reasonably discern whether the specification discloses that the hub and bridge are made with different component types. Nor is it reasonably discernible whether the claim, in view of the specification, requires that the hub and bridge must be made with different sets of physical components (which could be the same types of components). For example, in one embodiment (*viz.*, Fig. 4), the bridge and hub are “discrete components.” *Id.*, 5:24-27. But in

another embodiment (viz., Fig. 5), the bridge and hub are both part of the same IC, and the specification contrasts this with using “discrete components.” *Id.*, 7:15-21, Figs. 4-5. For this embodiment, the specification only depicts these hub and bridge components and functionality at a conceptual level. *Id.* It was known, for example, that different circuit blocks on an IC might share the same circuitry for various circuits, *e.g.*, power circuits and memory elements. Whether this sharing occurs in the specification is unclear and unknown. Welch, ¶325.

The file history provides no certainty either. The amendment adding this limitation was in response to an Examiner Interview, so there is no context that could provide clarity. See §IV.B. Accordingly, claim 1-15 are indefinite.

D. Ground 4 (Claims 1-15): Indefiniteness (“routing logic circuit”)

“[R]outing logic circuit” (in independent claims 1, 5, and 10) is a coined term without a well-understood meaning. Welch, ¶329. Many different circuits are used in USB devices. And the qualifier “routing logic” does nothing to clarify the type of circuit claimed since *any* circuit routing USB signals necessarily has logic for doing so. *Id.* For example, a USB hub has routing logic that routes a signal from a host to the enabled ports in the hub. *Id.*

The intrinsic evidence fails to provide objective boundaries to the scope of the term. See *IQASR LLC v. Wendt Corp.*, 825 F. App’x 900, 904 (Fed. Cir. 2020); Welch, ¶¶330-333. The claims recite two functions the “routing logic circuit”

performs: (1) “routing the USB signals ... directly to a USB bridge and a USB hub connected to the USB bridge” and (2) “routing the USB signals ... directly to the USB hub,” depending on the consumer device operating mode.¹⁹ But the recited functions do not clarify the boundaries/structure of that circuit.

Dependent claim 3 only confuses the matter further by reciting “a USB routing switch” performs the claimed routing. It is unclear whether (or to what extent) a “routing logic circuit” is the same as, or different than, a “USB routing switch.” That Aptiv claimed something besides a switch is confirmed by its choice to use “routing logic circuit” in the ’643 claims, but “routing switch” in the ’037, ’420, ’962, and ’899 claims. See *Karlin Technology, Inc. v. Surgical Dynamics, Inc.*, 177 F. 3d 968, 971-72 (Fed. Cir. 1999) (“different words or phrases used in separate claims are presumed to indicate that the claims have different meanings and scope”).

The specification provides no clarity. It never uses the term “routing logic **circuit**.” Figs. 5-6 contain black boxes labeled “USB Routing Logic,” and the specification states the bridge may be configured to “negat[e] the need for **switches and/or routing logic**.” EX1011, 7:2-3 (emphasis added). But nothing in the

¹⁹ A POSITA would have understood the antecedent basis for “the routing logic” is “routing logic **circuit**.” Welch, ¶330, n. 14.

specification explains what circuit implements the logic. Like the claims, the quoted specification language is ambiguous regarding the relationship between “routing logic circuit” and “switch.” Because the intrinsic evidence provides no objective boundaries for the coined term “routing logic circuit,” it is indefinite.

E. Ground 5 (Claims 1-9): Indefiniteness (“signal detection circuit”)

Independent claims 1 and 5 both recite “a signal detection circuit” that receives USB signals from an attached consumer product and “determin[es]” if the product is in host or device mode. *See* EX1011, claim 1 (“determin[ing] by the signal detection circuit that the consumer device is operating in a USB host mode ... [or] is operating in a USB device mode”); claim 5 (“determining ... whether the second USB signals emanate from a second USB host”).

The term “signal detection circuit” is a means-plus-function claim term under §112(f) because it recites a nonce term—but no structure—to perform the functions of receiving signals and “determin[ing]” whether a connected USB product is in host or device mode. Because the ’643 specification fails to describe *any* corresponding structure, claims 1 and 5 (and their dependent claims) are indefinite.

In *Williamson*, the Federal Circuit expressly overruled prior case law that terms without the word “means” enjoyed a “strong” presumption against means-plus-function treatment. *See Williamson v. Citrix Online, LLC*, 792 F.3d 1339,

1349 (Fed. Cir. 2015) (en banc). Instead, §112(f) applies where “the claim term fails to recite sufficiently definite structure” or recites “function without reciting sufficient structure for performing that function.” *Id.* (internal quotation marks omitted). This is the case here, because the claims recite the above function of the “signal detection circuit,” but fail to recite any corresponding structure.

In holding “distributed learning control module” was a means-plus-function term, the *Williamson* court analyzed several factors demonstrating how the presumption against application of §112(f) can be overcome. First, the court noted the term was drafted in a format consistent with traditional means-plus-function limitations. *Williamson*, 792 F.3d at 1350. Second, the term “module” did not provide structure because it sets forth the same “black box recitation of structure” for providing a specified function as if the word “means” had been used. *Id.* Third, “module” was simply a generic term for software or hardware that performed a specified function, much like generic terms such as “mechanism,” “element,” “device,” and other “nonce words that reflect nothing more than verbal constructs.” *Id.* Fourth, the prefix “distributed learning control” did not impart any structure into to the term “module.” *Id.* at 1351. Finally, nothing in the remaining claim language described how the “distributed learning control module” interacted with other components to inform a POSITA of the structure. *Id.*

Applying the Federal Circuit’s reasoning in *Williamson*, “signal detection

circuit” is a means-plus-function limitation. If the word “means” is substituted for “signal detection circuit” in claim 1, the means-plus-function format is apparent, as the clause would recite “[means] for receiving USB signals from the consumer USB device” and making “a determination ... that the consumer device is operating in a USB host mode ... [or] is operating in a USB device mode.” Claim 5 similarly recites the function of the means (“determining ... whether the second USB signals emanate from a second USB host”).

“[S]ignal detection circuit” is a generic term providing no indication of structure. *See MLR, LLC v. Kyocera Wireless Corp.*, No. 05-CV-0935-BAJB, 2006 WL 6143076, at *1, Ex. B (S.D. Cal. Oct. 27, 2006) (finding “adaptive control circuit” is a means-plus-function term). Even viewing the words “signal detection” and “circuit” separately, there is insufficient structure. There are various ways to perform “signal detection,” and nothing about “signal detection” connotes a specific structure. Welch, ¶336 (explaining the “signal detection” in the ’643 patent could involve different structures, ranging from using resistor techniques to using an extra pin on the USB interface). In *Koninklijke Philips N.V. v. ZOLL Lifecor Corp.*, the court found insufficient structure when “circuit” was used in a generic sense. No. 2:12-CV-1369, 2015 WL 12781199, at *14 (W.D. Pa. Aug. 28, 2015). In the term “signal detection circuit,” both “signal detection” and “circuit” are used generically and do not connote structure, only indicating some

type of detection function. Welch, ¶336.

The remainder of the claim language fails to describe any structure. To the contrary, it only reiterates the functional requirement of determining host/device status. Welch, ¶337. There is nothing in the claim language describing how the “signal detection circuit” receives signals and detects the particular mode of the USB consumer product, or what structure would accomplish these functions.

Applying the *Williamson* factors shows “signal detection circuit” fails to recite a sufficiently definite structure. This conclusion accords with other cases that found similar terms, such as “adaptive control circuit” and “activation control circuit,” to be means-plus-function limitations. *See MLR, LLC*, 2006 WL 6143076, *1, Ex. B; Claims Construction Order (Dkt. 242), *Limestone Memory Sys. LLC v. Micron Tech., Inc. et al.*, No. 8:15-cv-00278, 36-40 (C.D. Cal., Sept. 11, 2019).

Because §112(f) applies, claims 1-9 are indefinite unless the ’643 specification discloses sufficient corresponding structure to perform the claimed function. *Williamson*, 792 F.3d at 1351-52. A structure qualifies as a “corresponding” structure only if “the specification or the prosecution history ‘clearly links or associates that structure to the function recited in the claim.’” *Noah Sys. Inc. v. Intuit Inc.*, 675 F.3d 1302, 1311 (Fed. Cir. 2012) (internal cite omitted).

Here, the '643 patent fails to disclose **any structure whatsoever** for determining host/device status, much less link that structure to the “signal detection circuit” means-plus-function term. The '643 patent specification states: “In use, the Head Unit controls the switching device via the USB Bridge hardware or any other convenient means of control. The [Head Unit] software application may choose to enable, for example, a phone on any one of the consumer USB ports, by requesting, commanding or otherwise knowing the phone is required to be in USB Host mode and commanding the routing of the specific USB port the phone is attached to the USB Bridge.” EX1011, 6:23-30. At most, this language hints that a host/device determination was made, but falls far short of indicating what structure (if any)²⁰ performed the function. Welch, ¶338. Accordingly,

²⁰ To the extent Aptiv argues the specification identifies head unit software as performing the function, this fails as a matter of law. If “signal detection circuit” refers to software (contradicting the use of “circuit”), “the structure disclosed in the specification [must] be more than simply a general-purpose computer or microprocessor.” *Aristocrat Techs. Australia Pty Ltd. v. Int’l Game Tech.*, 521 F.3d 1328, 1333 (Fed. Cir. 2008). The specification describes nothing specific about the headend software or hardware regarding the unknown structure of “signal detection circuit.”

claims 1-9 are indefinite because the specification fails to disclose corresponding structure for “signal detection circuit.”

If the Board finds “signal detection circuit” is not a means-plus-function term, it would simply refer to any circuit that performs the claimed functions. This Petition applies that interpretation for purposes of prior art analysis. Similarly, if the Board finds the term is means-plus-function but there is a corresponding structure, this Petition assumes corresponding structure is merely a circuit that performs the functions of the claims, because the specification discloses no structure.

F. Ground 6 (Claims 4, 9, and 15): Indefiniteness (“wherein the USB routing switch includes the signal detection circuit”)

Dependent claims 4 and 9 each recite “wherein the USB routing switch includes the signal detection circuit.” Claim 15 similarly recites that “the USB routing switch determines whether the second USB signal emanates from a USB device.” Claim 15 would be understood to require that the switch includes the signal detection circuit, and is treated jointly with claims 4 and 9 unless noted. Welch, ¶341. The claim language, specification, and file history do not provide reasonable clarity on what it means for the “routing switch” to include “the signal detection circuit.” Claims 4, 9, and 15 are indefinite. *Id.*, ¶¶340-346.

To start, the claim language (namely, “includes”) indicates that the “signal detection circuit” is inside the “switch” or that the “switch” uses the same circuitry

as the “signal detection circuit.” This makes little sense to a POSITA, because the “switch” and “signal detection circuit” would be understood to be two separate, physical collection of transistors. Welch, ¶342. Does the claim language mean that the “routing switch” and “signal detection circuit” are simply on the same IC? Or that the transistors that comprise the “switch” and “signal detection circuit” must be intermingled? Or that the switch transistors themselves must also function as a “signal detection circuit”? None of this is reasonably certain to a POSITA.

Id.

If “includes” means the switch and detection circuit are on the same IC, one could equally refer to this IC as a “signal detection circuit that includes the USB routing switch” (instead of the other way around). Put another way, both the switch and detection circuit would be understood to be two separate circuits, and it makes little sense to say one includes the other, or vice versa. Indeed, such a characterization would be arbitrary. Welch, ¶343.

Claim 15 is additionally nonsensical because it refers to the “routing switch” performing the function of “determin[ing] whether the second USB signal emanates from a USB switch.” But a detection circuit performs this function, not a switch. If a structure performs both switching and detection functions, what significance is it that this would be a “switch” versus, for example, a “detection circuit” or a “combo switch and detection circuit.” A POSITA would not have

understood the significance of deeming this structure a “routing switch” even though it performs a detection function. Welch, ¶344.

The specification provides no structural description of any “signal detection circuit,” let alone how a switch might include it or perform a detection function. The specification merely states “[t]he HU software application may choose to enable, for example, a phone or any one of the consumer USB ports, by requesting, commanding or *otherwise knowing the phone is required to be in USB Host mode*” EX1011, 6:23-30 (emphasis added). And the sparse structural description of the routing switch further renders the limitation uncertain. The specification discloses the “routing switch” may be a discrete device (*id.*, 4:35-38) or “USB analog multiplexing switches” (*id.*, 4:40-43). But either way, there is no description of it including a detection circuit. Welch, ¶345.

The file history provides no clarity either. The Examiner cited U.S. Pat. 7,502,878 (Wright) as satisfying this limitation. EX1012, 67-68. The alleged switch was “the combination of hub logic 38, mux 72B and transceiver 34B.” *Id.*, 67. For the limitation “bypassing the USB bridge is performed by a USB routing switch,” the Examiner identified “hub logic 38 combined with mux 72B.” *Id.*, 68. The Applicant, however, did not address the rejection vis-a-vis claim 4. The Examiner’s rejection implies that the limitation requires part of the switch to also form part of the detection circuit (*e.g.*, mux 72B). But nothing in the ’643

specification suggests the switch and detection circuit share a common element. Welch, ¶346.

At bottom, how “the switch includes the signal detection circuit” is not reasonably certain to a POSITA and the specification and file history fail to provide the requisite clarity.

G. Ground 7 (Claims 4, 9, and 15): Lack of Written Description (“wherein the USB routing switch includes the signal detection circuit”)

The written description requirement under §112(a) requires that the specification “reasonably conveys to those skilled in the art that the inventor had possession of” and “actually invented” the claimed subject matter. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc). This requirement ensures the claims do “not overreach the scope of the inventor’s contribution to the field of art as described in the patent specification.” *Reiffin v. Microsoft Corp.*, 214 F.3d 1342, 1345. The test for adequate written description “requires an objective inquiry into the four corners of the specification from the perspective of a [POSITA]. Based on that inquiry, the specification must describe an invention understandable to that skilled artisan and show that the inventor actually invented the invention claimed.” *Ariad*, 598 F.3d at 1351.

As §VII.F demonstrates, the specification (1) only sparsely describes the claimed “switch,” (2) provides no structural description of the claimed “signal

detection circuit,” (3) provides no description of the “switch” including the “signal detection circuit,” and (4) a POSITA, including with reference to extrinsic evidence, would not have understood what it means for a “switch [to] include[] the signal detection circuit.” Claims 4 and 9 nevertheless claim a “switch [that] includes the signal detection circuit.” *See also* EX1011, claim 15. For these reasons, the specification fails to demonstrate the inventor possessed a “switch [that] includes the signal detection circuit.” *See Ariad Pharms., Inc.*, 598 F.3d at 1351.

What’s more, the written description must support the full claim scope. *Eli Lilly & Co. v. Teva Pharms. USA, Inc.*, 619 F.3d 1329, 1344 (Fed. Cir. 2010) (affirming lack of written description under patentee’s broad claim interpretation). Here, the full claim scope includes the scenario where the signal detection circuit physically resides inside the switch (or is part of the switch) and also functions as the signal detection circuit. Putting aside that this makes little sense (*see* §VII.F), there certainly is no specification support for such a structure. *Welch*, ¶347. Here, the claims “overreach the scope of the inventor’s contribution to the field of art.” *Reiffin v. Microsoft Corp.*, 214 F.3d 1342, 1345.

H. Secondary Considerations

No secondary considerations of nonobviousness were identified during prosecution. *See generally* EX1012. And Petitioner is unaware of any that apply

here. Welch, ¶¶348-365. Aptiv is the plaintiff in related district court litigation against Petitioner asserting six related patents, including the '643 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 provides no evidence of commercial success, let alone that any such purported success had the required nexus due to practicing the Challenged Claim. *See, e.g., Bos. Sci. SciMed, Inc. v. Iancu*, 811 F. App’x 618, 623, 627-629 (Fed. Cir. 2020); Welch, ¶¶353-357. 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.*, the host-to-host connection does not affect functionality of

other downstream devices); and (3) a single lane configuration (viz., a single connection between the hub and the 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, ¶349.

Industry Praise. Aptiv cites a single award, which touts Apple CarPlay compatibility. EX1045, 11. But, as noted, the Challenged Claims do not recite CarPlay and host-to-host communication in USB hubs was already known. Welch, ¶¶350-352. 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 nonobviousness. Welch, ¶¶358-359.

Other Secondary Considerations. The secondary considerations of “long-standing problem or need” and “unexpected results / skepticism” do not favor nonobviousness. Welch, ¶¶361-364. 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 ’643 patent. EX1045, 11; Welch, ¶365.

* * *

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 §324(a) and §325(d).

A. Section 324(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 *post-grant* 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 §324(a).

B. Section 325(d)

Discretionary denial under §325(d) is not warranted because at least the second prong from *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (Feb. 13, 2020) is not 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)), Chang and Chang II were submitted during the ’643 patent prosecution. The Examiner issued no rejections in view of Chang or Chang II. *See generally* EX1012. It appears Chang II was possibly discussed during an interview. *Id.*, 207-08. Following the interview, amendments were made requiring that routing occurs via a “routing logic circuit connected directly to a USB bridge,” the USB hub is “connected to the USB bridge,” and “the USB hub and USB bridge have different components and functionality.” *Id.*, 201-206. It is hard to discern the basis for these amendments, because there was no formal rejection over Chang II. Notably, however, Chang II does not expressly disclose a discrete “routing logic” chip (*e.g.*, *see* Chang II, Fig. 5), which the Examiner may have viewed as distinguishing Chang II.

Importantly, there is no indication the Examiner considered combining

Chang and Chang II. Chang already includes a hub, bridge, paths for host-device and host-to-host connections. §VI.A. And there is no indication the Examiner considered this Petition's argument regarding modifying Chang (in view of Chang II and a POSITA's knowledge) to include a dual-role port, which as a corollary, calls for a mux to steer USB signals to/from either Chang's host-to-device path (bypassing the bridge) or Chang's host-to-host path (through the bridge). See *Becton, Dickinson* factors (d); §§IV.B, VII.A.1. As this Petition demonstrates, Chang in view of Chang II and a POSITA's knowledge renders obvious such a modification and Chang effectively provides a roadmap for such a modification. §VII.A.1. Indeed, this Petition further demonstrates that routing circuits for routing USB ports to the appropriate path were extremely well-known. §§III.B.2, VII.A.1.

Respectfully, the Examiner erred in not considering Chang in view of Chang II (or if there was any consideration, erred in not issuing a rejection). *Becton, Dickinson* factor (c) strongly weighs against denying institution since Chang and Chang II were never a basis of rejection. See generally §IV.B. At a minimum, Petitioner respectfully asserts the Examiner misapprehended important teachings of Chang and Chang II.

In fact, 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, the Patent Office erred or misapprehended Chang and the teachings of Chang II. See *Becton, Dickinson* factor (e).²¹

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 (EX1025, 1:41-43), which expressly provides motivation to modify Chang with dual-role ports). Thus, this Petition warrants reconsideration of Chang and Chang II, especially in combination.

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

Moreover, none of Petitioner’s §112 arguments were addressed during the

²¹ Ground 2 relies on Chutorash, which was submitted in an IDS during the ’037 patent prosecution and is cited on the face of the ’643 patent. Chutorash was never cited or discussed by the Examiner. Moreover, Petitioner relies on Chutorash for the limited purpose of certain dependent claims reciting “an infotainment system,” a limitation not at issue during prosecution. Chutorash’s citation has no bearing on Petitioner’s §325(d) arguments regarding Chang and Chang II.

'643 patent prosecution. See EX1012.

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 post-grant proceeding has been filed challenging the '643 patent. The '643 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 '643 patent, the district court action asserts U.S. Patent Nos. 9,460,037; 9,619,420; 9,645,962 10,545,899; 11,176,072 from the same patent family. PTAB proceedings on the related patents are listed below:

Patent	PTAB Proceeding
9,619,420	IPR2024-00228
9,645,962	IPR2024-00229
11,176,072	IPR2024-00230

C. Counsel Information

Petitioners designate the following counsel:

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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 that the Board institute PGR and enter 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)(ii). Excluding the parts of the Petition exempted by 37 C.F.R. §42.24(a)(1), this Petition contains 18,695 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 Post-Grant 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. 11,681,643:

171991 - Billion & Armitage - Aptiv
7401 Metro Blvd.
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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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