

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICROCHIP TECHNOLOGY INC.,
Petitioner,

v.

APTIV TECHNOLOGIES AG,
Patent Owner.

Case No. IPR2024-00495
Patent No. 9,619,420

PATENT OWNER'S RESPONSE

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Exhibit List for *Inter Partes* Review of U.S. Patent No. 9,619,420

Exhibit #	Exhibit Description
2001	Declaration of Henry Houh (“Houh Decl.”)
2002	Trial Transcript Excerpts, <i>Microchip Tech. Inc. v. Aptiv Servs. US, LLC</i> , No. 17-cv-1194 (D. Del. Apr. 6-13, 2022) – Testimony of Mitch Obolsky
2003	Trial Transcript Excerpts, <i>Microchip Tech. Inc. v. Aptiv Servs. US, LLC</i> , No. 17-cv-1194 (D. Del. Apr. 6-13, 2022) – Testimony of Robert Voto
2004	Complaint, <i>Aptiv Technologies Ltd. v. Microchip Technology, Inc.</i> , No. 23-cv-307-JDW (DED)
2005	Trial Exhibit No. 58 - Jun. 18, 2014, Mark Orlosky and Brigham Steele Email Chain re: CarPlay and forced DCP to external ports
2006	Trial Exhibit No. 62 - Oct. 1, 2014, Stefan Saenger, Chris Behal, and Ray Kamps Email Chain re: CarPlay - Fiat
2007	Trial Exhibit No. 66 - Nov. 26-Dec. 1, 2014, David Sroka, Eric Kawamoto, and Sal Canu Email Chain re: Media Hub Interim Update
2008	Trial Exhibit No. 246 - Jul. 20, 2014, Don Perkins Email re: UNG Detroit Sales Meeting and Training July 15 – 18
2009	Trial Exhibit No. 252 Aug. 11, 2014, David Sroka, Don Perkins, and Sal Canu Email Chain re: CarPlay compliance Strategy
2010	Trial Exhibit No. 262 - Sal Canu Dec. 2, 2014, Email re: Microchip Position for the Thursday Chrysler Meeting
2011	Declaration of Eric Welch in IPR2024-00228 (U.S. Patent No. 9,619,420)
2012	Declaration of Eric Welch in IPR2024-00229 (U.S. Patent No. 9,645,962)
2013	Declaration of Eric Welch in IPR2024-00230 (U.S. Patent No. 11,176,072)

Exhibit #	Exhibit Description
2014	Declaration of Eric Welch in PGR2024-00011 (U.S. Patent No. 11,681,643)
2015	<i>Intentionally Omitted</i>
2016	Declaration of Robert Dezmelyk in Support of Microchip’s Responsive Claim Construction Brief, <i>Aptiv Technologies Ltd. v. Microchip Technology, Inc.</i> , No. 23-cv-307-JDW (DED)
2017	Trial Transcript Excerpts, <i>Microchip Tech. Inc. v. Aptiv Servs. US, LLC</i> , No. 17-cv-1194 (D. Del. Apr. 6-13, 2022) – Testimony of Michael Dreon
2018	Redacted Version of Jury Verdict Form, <i>Microchip Tech. Inc. v. Aptiv Servs. US, LLC</i> , No. 17-cv-1194 (D. Del.), D.I. 357
2019	Supplemental Declaration of Henry Houh (“Suppl. Houh Decl.”)
2020	Corrected Joint Claim Construction Brief, <i>Aptiv Techs. AG. v. Microchip Tech. Inc.</i> , No. 1:23-cv-00307 (D. Del)
2021	Deposition Transcript of Eric Welch (Oct. 10, 2024)
2022	Trial Exhibit No. 5 – Oct. 23, 2013 Presentation Entitled “Digital iPod Out OTG Solution Dual Role USB HUB”
2023	Trial Exhibit No. 6 – Boston USB Hub with SD Card Port ASIC, Product Specification
2024	Trial Exhibit No. 7 – Functional Diagram of Boston 2 Chip
2025	Trial Exhibit No. 12 – Nov. 10, 2014 Presentation Entitled “Delphi/Unwired USB Hub Apple CarPlay Overview”
2026	Trial Exhibit No. 25 – Product Business Plan for Sandia
2027	Trial Exhibit No. 124 – Jun. 9, 2017 Presentation Entitled “Delphi Data Connectivity”

Exhibit #	Exhibit Description
2028	Trial Exhibit No. 143 – Oct. 7, 2015 Presentation Entitled “Delphi Data Connectivity”
2029	Trial Exhibit No. 192 – Jan. 2013 Presentation re: Apple Digital iPod Out Support
2030	Trial Exhibit No. 236 – USB4916 Product Specification
2031	Trial Exhibit No. 248 – Jul. 23, 2014 David Sroka, Brigham Steele, Andrew Rogers, Don Perkins Email Chain re: Debunking Unwired
2032	Trial Exhibit No. 268 – Jan. 5, 2015 David Sroka, Santosh Shetty, Mark Bohm Email Chain re: USB Multi Host Bridge Questions
2033	Trial Exhibit No. 273 – Jan. 12, 2015 Davis Sroka, Mike Pennell, Mark Bohm, Eric Kawamoto Email Chain re: Sparta and Tecvox
2034	Trial Exhibit No. 275 – Jan 26, 2015 Mitchel Obolsky, Steve Sanghi, Ganesh Moorthy Email Chain re: Initial Proposal for Tecvox (Chrysler and Fiat, too) with Attachment
2035	Trial Exhibit No. 287 – Jan. 21, 2016 Mark Bohm, Mitchel Obolsky Email Chain re: Analysis of Unwired Media Connectivity Module
2036	Declaration of Michael Dreon
2037	Dreon Decl. Ex. A – Trial Exhibit No. 18 – Jan. 27, 2016 Presentation Entitled “PACE Award Finalist Dual Role Hub”
2038	Dreon Decl. Ex. B – PACE Award Judge’s Citation
2039	Dreon Decl. Ex. C – PACE Award Video Transcript
2040	Trial Transcript (Vol. 2)
2041	Trial Transcript (Vol. 3)
2042	Trial Transcript (Vol. 4)

I. INTRODUCTION

Patent Owner Aptiv Technologies AG (“Aptiv”) provides this Patent Owner Response to Petitioner Microchip Technology Inc.’s (“Microchip”) Petition (Paper 1). All claims of the ’420 patent are not unpatentable, as the grounds in the Petition are meritless, as set forth herein and supported by the Declaration and Supplemental Declaration of Dr. Henry Houh (EX2001; EX2019).

First, the Petition’s aspirational combination of the references is structurally incapable of operating as described in the Petition or required by the claims. As Petitioner’s expert, Mr. Welch, cautions: “the detection unit *must connect* to the downstream port to detect the mode, as shown in Chang II.” (EX1013, ¶193¹.) But as described further herein, the Petition’s proposed combination ignores Mr. Welch’s own warning: once the proposed combination detects a USB device mode, and routes the downstream port accordingly, the routing switch electrically *bypasses* the detection unit—cutting it off from all downstream ports. Unable to detect any further downstream port modes, the proposed combination is incapable of providing the control signals necessary to reconnect the detection unit or control the routing switch. The Petition fails to meet the claimed switching limitations, and thus fails to establish a *prima facie* case of obviousness.

¹ All emphases added by Patent Owner unless otherwise specified.

Second, the Petition’s combination of Chang and Chang II with POSITA knowledge improperly relies on a POSITA’s unexplained common knowledge, rather than reasoned analysis and evidentiary support, to supply a claim limitation (the USB routing switch) that is missing from the references. The alleged POSITA knowledge is based on testimony from Mr. Welch that is conclusory, contradictory, and rebutted by Patent Owner’s expert, Dr. Houh. The Federal Circuit held in *Arendi S.A.R.L. v. Apple Inc.*, and confirmed in *Koninklijke Philips N.V. v. Google LLC*, that such reliance on such “conclusory statements and unspecific expert testimony” cannot support a finding of unpatentability as a matter of law. *Arendi*, 832 F.3d 1355, 1366 (Fed. Cir. 2016); *Koninklijke Philips*, 948 F.3d 1330, 1337-38 (Fed. Cir. 2020).

Third, the Petition is the product of admitted hindsight reconstruction, and fails to demonstrate that the POSITA would have been motivated to combine Chang and Chang II with the POSITA’s knowledge to meet the claim limitations with any reasonable expectation of success. The proposed combinations would not perform as described by Petitioner; to the contrary, the proposed combinations are technically unsound, would render the references inoperable for their intended purposes, and would undermine core USB design goals. The combinations further would have introduced complexity, inefficiency, and additional costs—drawbacks that the POSITA would have sought to avoid.

Fourth, numerous secondary considerations of non-obviousness further support that the claims are patentable. Aptiv patented its innovative solution to a long-standing but unsolved problem in the automotive industry: how to meet automakers' unique USB requirements for integrating smartphones supporting Apple's "CarPlay" feature. As described herein, Aptiv succeeded where others, including Petitioner, offered only skepticism and failure. Aptiv's commercial success, along with industry acclaim and the emergence of copycat efforts, further undermine Petitioner's challenge to Aptiv's patent.

II. THE '420 PATENT

The '420 Patent is generally directed to devices, systems, and methods for facilitating host-to-host and host-to-device communications through a USB hub. (EX1003, Abstract.) The '420 Patent contains claims directed to a USB hub module (claims 1-6) (not challenged in this proceeding), an integrated circuit (claims 7-12) (not challenged in this proceeding), a method of operating a USB hub module (claims 13-14), a USB connectivity module (claims 15-17) (not challenged in this proceeding), and a communication system (claims 18-20).

III. LEVEL OF ORDINARY SKILL IN THE ART

At the time of the invention, a POSITA would have had a bachelor's degree in computer science, electrical engineering, or an equivalent, and two years of professional experience working with computer network protocols such as USB.

(EX2019, ¶27.) Lack of work experience can be remedied by additional education, and vice versa. (EX2019, ¶27.)

Petitioner proposes an elevated and specific level of ordinary skill that requires fluency with specialized documents and technologies, including particular USB standards documents, and with “the design/deployment of USB hosts, USB devices, and USB hubs, including suitable environments for USB systems.” (Petition, 22-23.) Petitioner also proposes that the POSITA would have a “working understanding” of specific technologies, including “host-to-host bridges.” (Petition, 22-23.)

Petitioner’s artificially heightened definition of the level of ordinary skill should be rejected. Petitioner’s proposal does not reflect the actual level of ordinary skill, but instead inflates the scope of the “POSITA Knowledge” on which the Petition relies to fill evidentiary gaps left by the prior art. Petitioner’s definition lacks evidentiary support, relying only on conclusory statements from its expert, who concedes—contrary to Petitioner’s insertion of specific required USB documents and systems into its definition—that the challenged patents pertain “generally” to the field of USB connectivity, and that “other technical fields may be relevant.” (EX1013, ¶47.)

The Board should adopt Patent Owner’s definition of the level of ordinary skill, as it did in the Decision on Institution. Patent Owner’s definition is

supported by Dr. Houh’s testimony and, as the Board recognized, is “consistent with what is reflected by the content of the applied prior art references.” (DI (Paper 13), 18 (citing *Okajima v. Bourdeau*, 261 F.3d 1350, 1354-55 (Fed. Cir. 2001)).)

IV. CLAIM CONSTRUCTION

The Petitioner requested institution of the Petition contingent on the adoption of Aptiv’s proposed constructions of claims 13, 18, and 19 in the district court proceeding, and based on those constructions. (Petition, 23 (“But if the district court sides with Aptiv, Petitioner requests institution of this IPR *based on the district court construction.*”).) Those proposed constructions are as follows:

Claim	Claim Language	Aptiv’s Proposed Construction
13	connecting the consumer device via the second USB port to the USB <u>hub</u> via the first USB port through the USB routing switch and the USB [bridge/hub]	connecting the consumer device via the second USB port to the USB <u>host</u> via the first USB port through the USB routing switch and the USB [bridge/hub]
18	a USB hub <u>including</u> a first USB port and a second USB port	a USB hub <u>interconnected to</u> a first USB port and a second USB port
19	wherein the USB hub <u>includes</u> a third USB port	wherein the USB hub <u>is interconnected to</u> a third USB port

The proposed constructions for claim 13 were adopted by the district court and further adopted by the Board for this proceeding. (DI (Paper 13), 14-15.) With respect to claims 18 and 19, these claims were dismissed in the district court proceeding, and the Board did not adopt the proposed constructions of those claims for this proceeding. (DI, 15.) The Board determined that no additional claim terms require express construction. (DI, 15.)

For the purposes of this proceeding, Patent Owner does not contend that any further claim construction is required. The claims are not obvious under any reasonable interpretation of the claims.

V. PRIORITY DATE

The challenged claims are entitled to the patent's claimed priority date of September 26, 2013. (EX1003.)

VI. PETITIONER'S REFERENCES

A. Chang

Chang is a U.S. patent application that discloses a USB hub for implementing host-to-host USB transmission through a dedicated host port connected to a bridge. (EX1014, Abstract, [0020]; EX2019, ¶53.) Chang's hub addresses the express goal of "easily establishing a connection between a computer and another computer." (EX1014, [0003]; EX2019, ¶53.) In Chang's hub, a USB host device (such as a computer) can connect to a dedicated host port (50), and

communicate via a bridge (52) and hub control unit (46) to another USB host device—such as a second computer—connected to an uplink port (42). (EX1014, [0020]; EX2019, ¶53.) FIG. 3 illustrates:

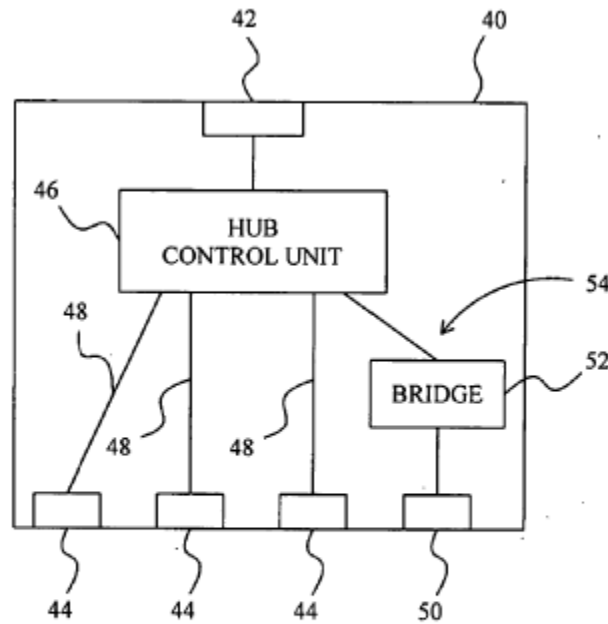


FIG. 3

(EX1014, FIG. 3; EX2019, ¶53.)

The Chang hub also comprises a number of downlink ports (44) for linking devices connected to the downlink ports to the uplink port. (EX1014, [0019]; EX2019, ¶54.) The downlink ports allow for host-to-device transmission between USB devices (in a device mode) connected to the downlink ports and a host device connected to the uplink port. (EX1014, [0019]; EX2019, ¶54.)

B. Chang II

Chang II is a U.S. patent application that discloses a data transmission bridge device. (EX1015, Abstract.) The Chang II bridge device (1) has a first connection interface (11) and a second connection interface (12) connected by a control chip (13) in communication with a memory unit (14). (EX1015, [0023]; EX2019, ¶55.) The bridge device permits data transmission between a first USB host device (2) connected to the first connection interface, and a second USB device connected to the second connection interface; the second USB device may be a device in a host mode (3) or a slave mode (4) (elsewhere referred to as a device mode). (EX1015, [0021]-[0022]; EX2019, ¶55.) FIG. 1 illustrates:

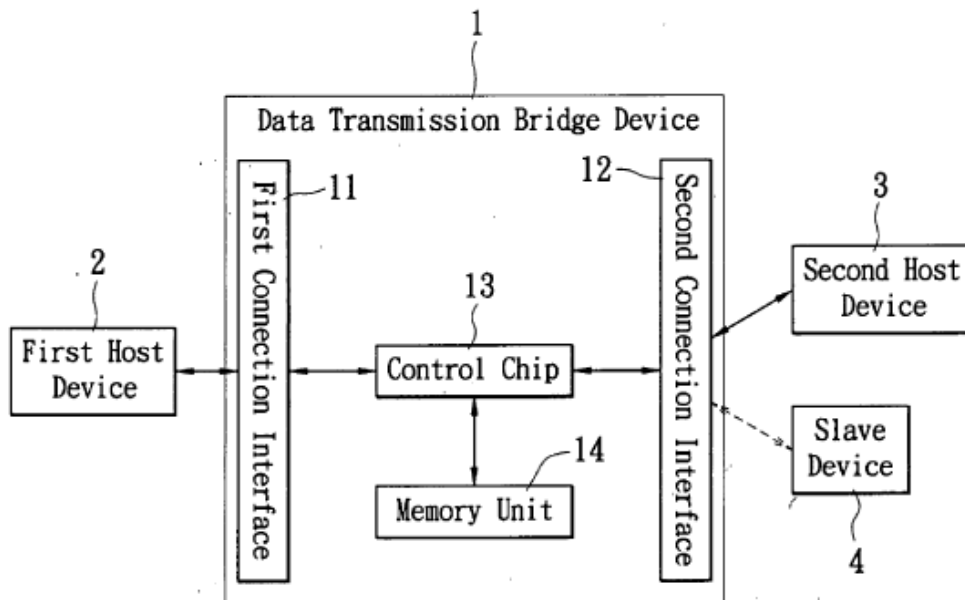


FIG. 1

(EX1015, FIG. 1.)

Chang II's "main feature" is providing two different transmission paths, automatically detecting whether a host or "slave" USB device is connected to the second connection interface, and selecting one of two different transmission paths between the first and second connection interfaces accordingly. (EX1015, [0021]; EX2019, ¶56.) Chang II's control chip implements this feature via a process shown in FIG. 6:

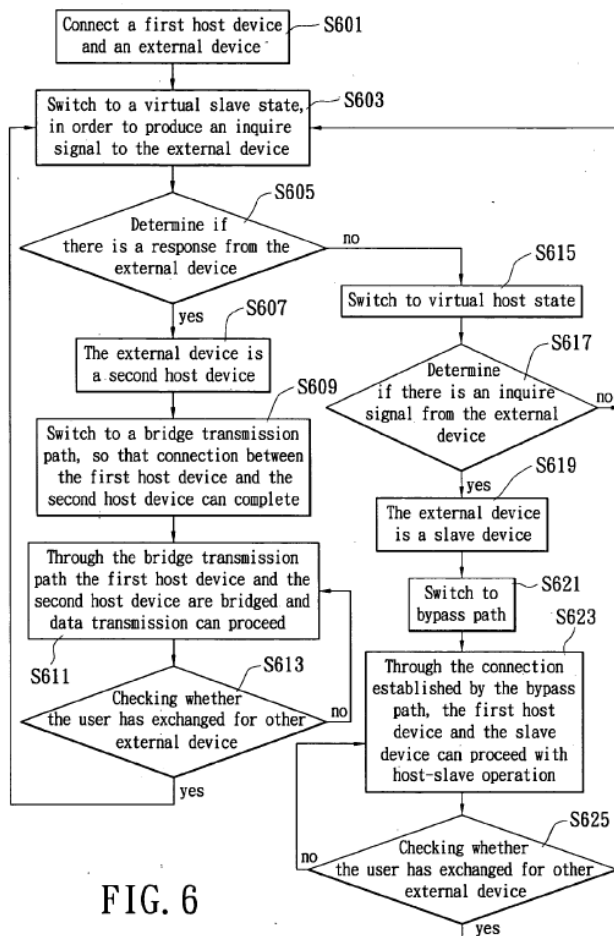


FIG. 6

(EX1015, [0023], [0042], FIG. 6; EX2019, ¶56.)

As shown in the figure, upon connection of an external device to the second connection interface (S601, S613, S625), a detection unit 134 of the control chip 13 switches to a virtual slave state (S603) and/or a virtual host state (S615), and detects a signal from the external device (S605, S617) on the second connection interface to determine whether the external device is a host device (S607) or a slave device (S619). (EX1015, [0042]-[0046], FIG. 6; EX2019, ¶57.) If the external device is a host device, a CPU 135 of the control chip switches the device to the first connection interface via a bridge transmission path, which includes a first USB controller 131, a buffer unit 136, and a second USB controller 132. (EX1015, [0023]; EX2019, ¶57.) FIG. 5 illustrates:

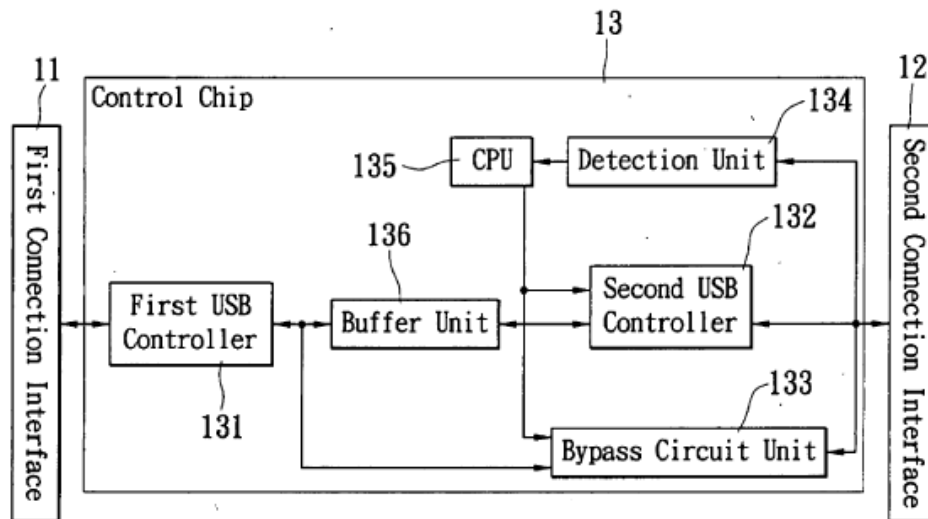


FIG. 5

(EX1015, FIG. 5; EX2019, ¶57.)

Conversely, if the external device is a host device, CPU 135 switches the device to the first connection interface via a bypass path, which includes the first USB controller 131 and a bypass circuit unit 133, bypassing the buffer unit 136 and the second USB controller 132. (EX1015, [0023]; EX2019, ¶58.)

Upon connecting either the bridge transmission path or the bypass path, the control chip waits for the user to insert a different external device (S613, S625) before performing any additional detection or switching. (EX1015, FIG. 6; EX2019, ¶59.)

VII. GROUND I: CLAIMS 13-14 AND 18-20 ARE NOT RENDERED OBVIOUS BY CHANG IN VIEW OF CHANG II AND POSITA KNOWLEDGE

The Petition proposes in Ground I that claims 13-14 and 18-20 are met by combining the electronic circuit of Chang with the electronic circuit of Chang II; and by further modifying that combination by inserting circuit elements not found in or suggested by either reference, but allegedly within the knowledge of the POSITA. (*See, e.g.*, Petition, 36-48; EX2019, ¶60.)

As explained below, the challenged claims are not rendered obvious by the Petition's proposed combination because the proposed combination fails to meet all limitations of the challenged claims. (EX2019, ¶61) The proposed combination is additionally improper for relying on conclusory statements and unspecific expert testimony to supply missing claim elements, defying Federal

Circuit precedent. (EX2019, ¶61.) Furthermore, the hindsight-driven combination is technically unsound and would render the references more costly and inoperable for their intended purposes, thus failing to motivate the POSITA to make the proposed combination with any reasonable expectation of success. (EX2019, ¶61.)

A. The Petition’s Proposed Combination

The Petition proposes three separate implementations of combining Chang, Chang II, and the POSITA’s knowledge. (Petition, 36-49; EX2019, ¶62.) Each proposed implementation offers a modification of Chang by Chang II, plus a switching element—either a multiplexer (mux) or a crossbar—inserted downstream of the purported bridge. (Petition, 36-49; EX2019, ¶62.)

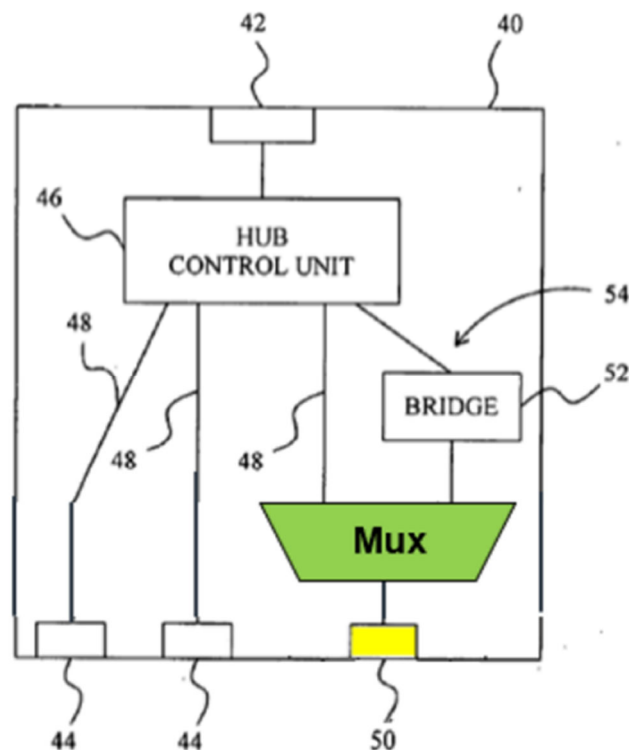
Asked to explain why multiple implementations are proposed, Mr. Welch testified: “It was about if a specific claim had language which could be interpreted in order to have one of these rather than the other.” (EX2021, 220:11-221:11; EX2019, ¶63.) This admitted claims-first approach to combining the prior art is precisely the type of hindsight reconstruction that is prohibited. Even so, the proposed combination is fundamentally defective and fails to meet the claim limitations. (EX2019, ¶63.)

1. The Mux Implementation

The Petition discloses a proposed implementation (the “mux implementation”), that inserts a multiplexer within Chang’s USB hub 40.

(Petition, 42-43.) Notably, the Petition does not identify the mux implementation as a basis for challenging any claim. (See Petition, 36-87; EX2021, 216:5-217:24 (Petitioner's expert explaining that he chose not to rely on the mux implementation for his claim analysis of a related patent).) The mux implementation is thus outside the scope of Ground I. (See 35 U.S.C. § 312(a)(3).)

In the Petition's mux implementation, Chang is modified by replacing its ports with dual-role ports; and inserting a 2:1 multiplexer between Chang's port 50 and bridge 52. (Petition, 37-45; EX2019, ¶65.) Chang's transmission paths 48 are rewired such that host port 50 is connected to the input of the multiplexer; and the multiplexer can connect host port 50 to either Chang's bridge 52 (Chang II's bridge device 1) or Chang's hub control unit 48, depending on its select lines:

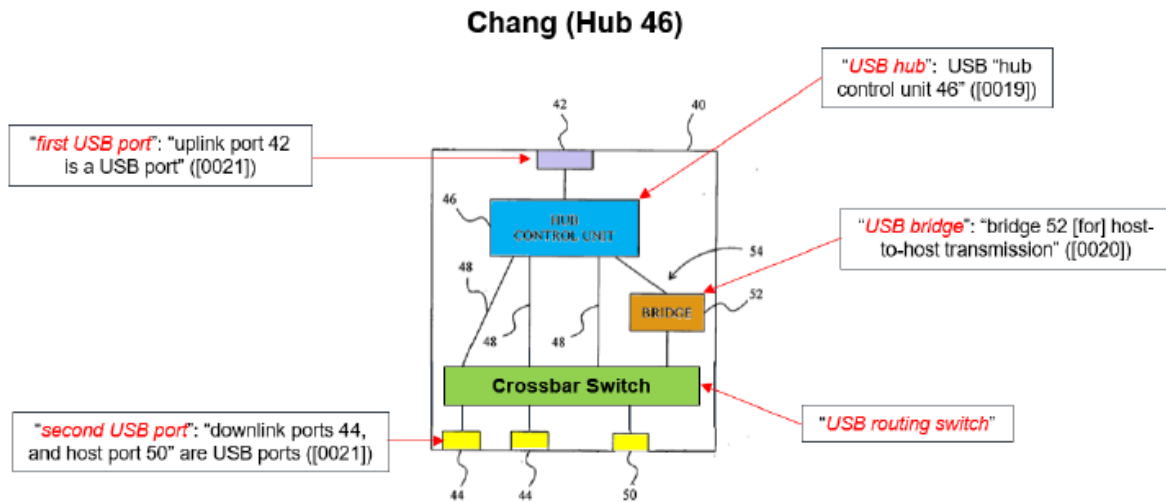


(Petition, 42; EX2019, ¶65.)

The Petition then modifies the combination further to incorporate Chang II's bridge device 1; the Petition supposes that Chang II's detection unit/bridge would generate signals that control the multiplexer's switching, surmising that doing so "would have been routine and obvious." (Petition, 41-42 n. 11; EX2019, ¶66.) However, the implementation does not utilize Chang II's switching, relying instead on the mux for switching paths as described above.

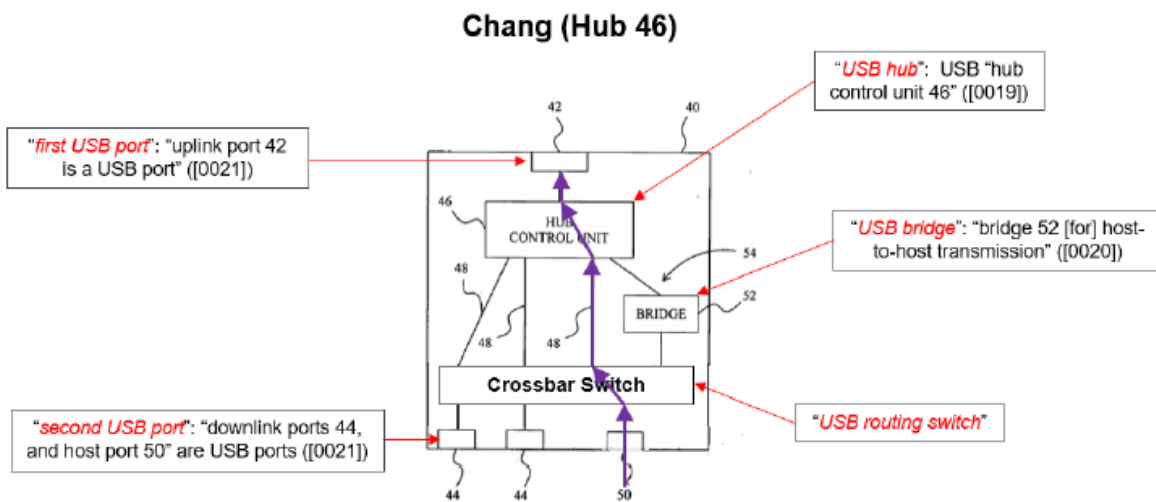
2. The Internal Crossbar Implementation

In two other proposed implementations (the "Crossbar Implementations"), Chang and Chang II are modified by inserting a crossbar switch. (Petition, 45-49; EX2019, ¶67.) In the "internal crossbar implementation," or "Hub 46 implementation," the crossbar is inserted within Chang's USB hub 40. (Petition, 45-46; EX2019, ¶67.) Various additional modifications are made to the combination of Chang and Chang II. Chang's host port 50 and downlink ports 44 are transformed into dual-role USB ports and connected to inputs of the crossbar; Chang's bridge 52 is decoupled from USB port 50 and instead connected to a first output of the crossbar; and Chang's transmission paths 48 are decoupled from their respective downlink ports 44 and instead connected to additional outputs of the crossbar:



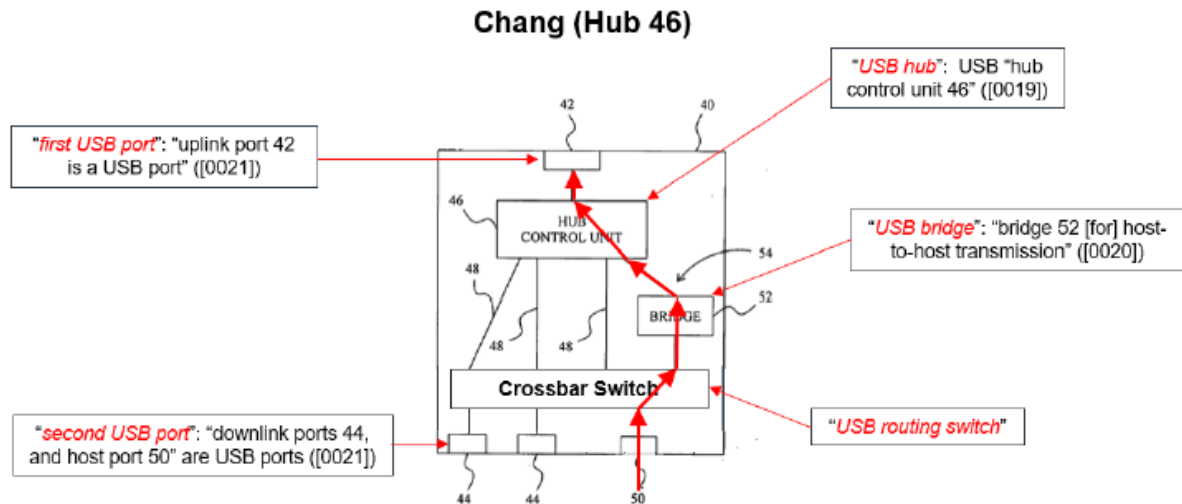
(Petition, 45-48, 57-58; EX2019, ¶67.)

This implementation does not utilize Chang II's internal switching between the bridge path and the bypass path. (EX2019, ¶70.) Instead, according to the Petition, the crossbar can switch a downstream USB port (44, 50) to the hub control unit 46 directly, bypassing bridge 52 (if a connected device is in device mode):



(Petition, 68; EX2019, ¶68.)

Alternatively, the crossbar can switch the downstream USB port to the hub control unit 46 through bridge 52 (if the connected device is in host mode):



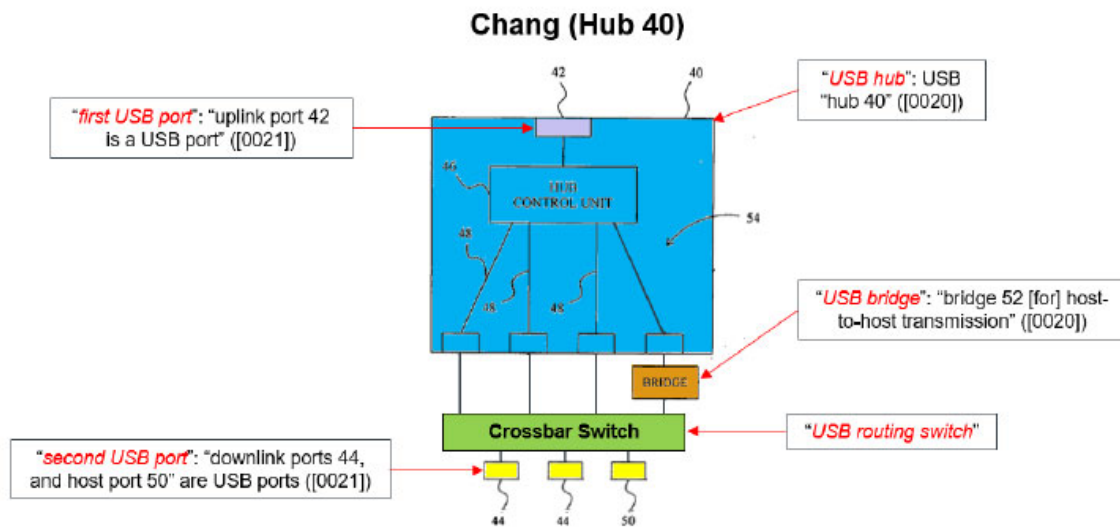
(Petition, 62; EX2019, ¶69.)

According to the Petition, “asserting the appropriate crossbar control signals connects the consumer product to the bridge (for host-to-host path 54) or directly to the hub (for host-device path 48).” (Petition, 41-42 n. 11, 58-65; EX1013, ¶189; EX2019, ¶70.) The Petition apparently relies on signals generated by Chang II’s “bridge and/or detection unit” to meet these crossbar control signals, speculating that this proposed modification “would have been routine and obvious.” (Petition, 41-42 n. 11; EX2019, ¶70.)

3. The External Crossbar Implementation

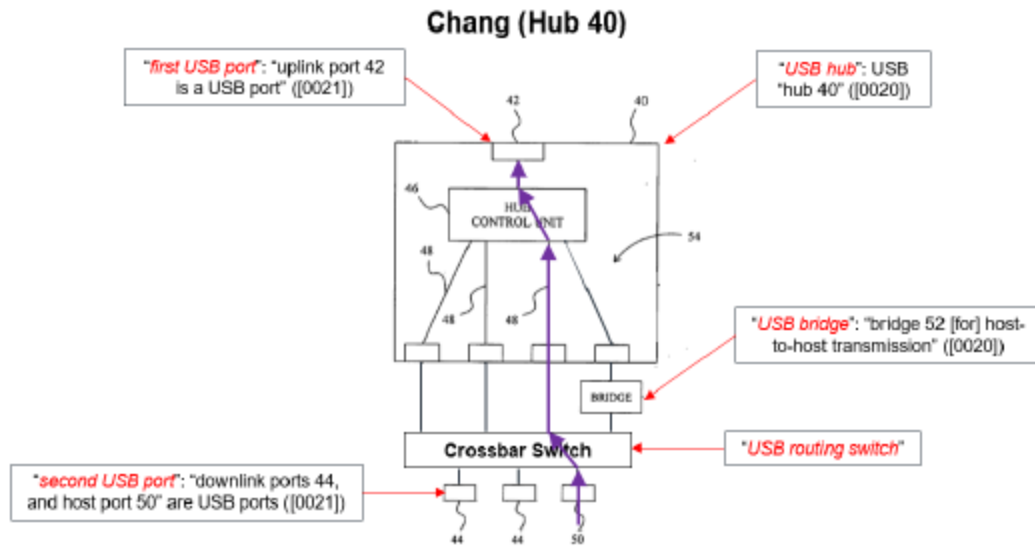
In the “external crossbar implementation,” or “Hub 40 implementation,” the crossbar is inserted external to Chang’s USB hub 40. (Petition, 42-43 EX2019, ¶71.) Chang and Chang II are further modified by relocating Chang’s bridge 52

outside the USB hub 40; adding new dual-role USB ports (44, 50) outside the USB hub 40; inserting a crossbar between the dual-role USB ports and the bridge 52; and connecting the outputs of the crossbar to the hub control unit 46:



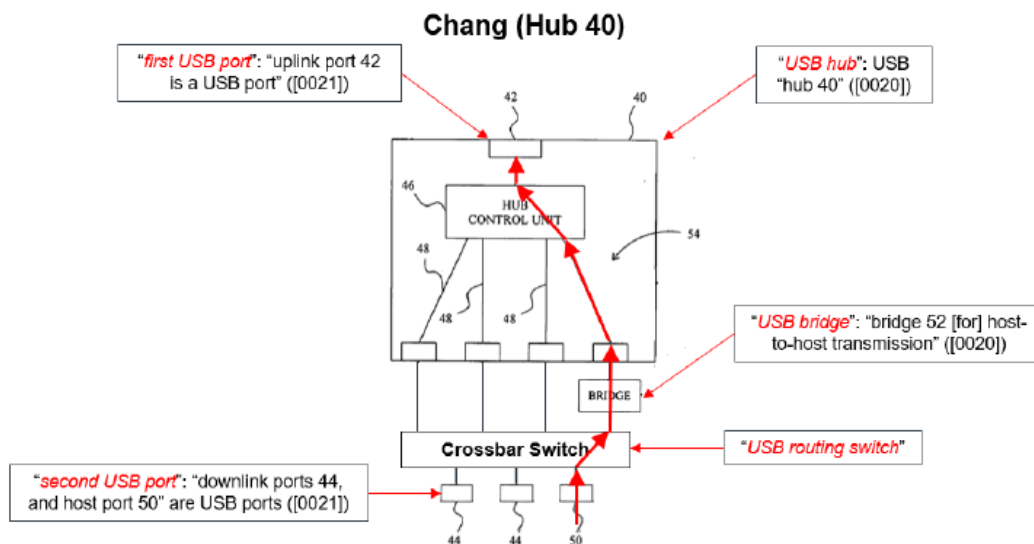
(Petition, 45-49, 58; EX2019, ¶71.)

This implementation again does not utilize Chang II's internal switching. (EX2019, ¶74.) Instead, according to the Petition, as above, the crossbar can switch a downstream USB port (44, 50) to the hub control unit 46 directly, bypassing bridge 52 (if a connected device is in device mode):



(Petition, 68; EX2019, ¶72.)

And as above, the crossbar can switch the downstream USB port to the hub control unit 46 through bridge 52 (if the connected device is in host mode):



(Petition, 62; EX2019, ¶73.)

In the proposed combination, the crossbar apparently performs the switching based on the signals generated by Chang II's bridge/detection unit. (Petition, 41-

42 n. 11, 58-61, 64-65; EX1013, ¶189; EX2019, ¶74.) The Petition speculates that this proposed modification “would have been routine and obvious.” (Petition, 41-42 n. 11; EX2019, ¶74.)

B. The Proposed Combination Is Incomplete and Technically Unsound

Petitioner’s proposed combination—including all three implementations—is incompletely described in the Petition; and is technically unsound and would not be operable in the manner set forth in the Petition. (EX2019, ¶75.) The proposed combination further is unsupported by the references, and relies on expert testimony that is contradictory and unreliable. (EX2019, ¶75.)

1. The Petition Fails to Show the Switching Limitations With Particularity For Any Challenged Claim

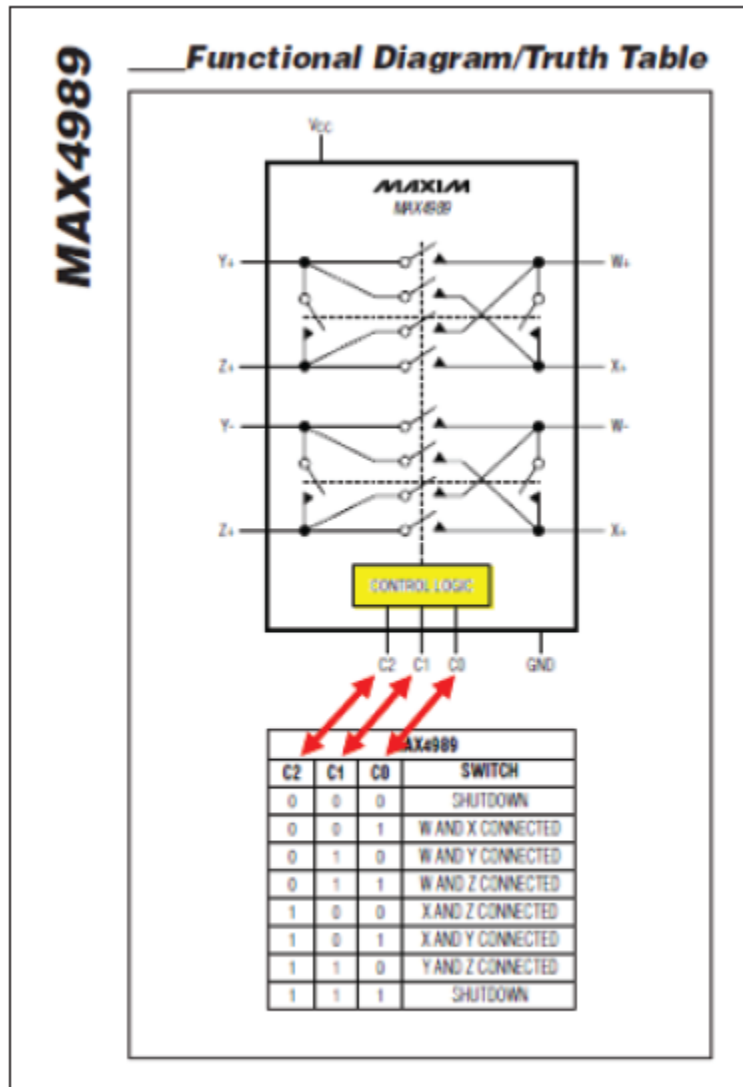
All challenged claims recite switching limitations (*e.g.*, a USB routing switch) having a particular configuration. As described above, the proposed combination relies on “off-the-shelf” switching elements—multiplexers or crossbar switches—to implement the claimed USB routing switch. (*See* Petition, 49-50; EX2019, ¶76.) These switching elements are absent from Chang and Chang II, and are instead supplied from the POSITA’s alleged knowledge. (*See* Petition, 36-48, 41-42 n. 11, 58-61, 64-65; EX2019, ¶76.)

The claimed switching elements cannot be met by off-the-shelf switching components alone. (EX2019, ¶77.) The claims instead have particular

requirements. *First*, as recited in independent claim 18 and its dependents, the claimed USB routing switch provides a first communication path between the second USB port and the USB host-to-host bridge, and a second communication path between the second USB port and the first USB port that bypasses the USB host-to-host bridge. (EX1003, claim 18.) *Second*, the USB routing switch connects the first communication path when the first consumer device is connected to the second USB port and is operating in a USB host mode, thereby providing bidirectional initiation of communication between the USB host and the consumer device. (EX1003, claim 18.) *Third*, the USB routing switch connects the second communication path, thereby only responding to communication initiated by the USB host when the first consumer device is connected to the second USB port and is operating in a USB device mode. (EX1003, claim 18.) Independent claim 13 and its dependent claim 14 recite analogous switching limitations. (EX1003, claim 13; EX2019, ¶77.)

The Petition fails to show how generic switching elements—muxes or crossbars—would be combined with Chang and Chang II to meet these specialized requirements. As the Petition recognizes, switching components such as multiplexers and crossbars rely on “control signals” or “select lines” to configure which input(s) are routed to which output(s) within the switching element. (Petition, 77, 79-80; EX2019, ¶78; EX1013, ¶¶89, 91, 253 (citing EX1055, 284-

288, EX1015, [0038]).) For example, as Mr. Welch provides, the switching paths of a crossbar are controlled by its control signals, as defined by a truth table:



(EX1013, ¶¶252 (citing EX1063, 8), 228; EX2019, ¶78.)

But the Petition is incomplete, inconsistent, and erroneous about how those control signals would be supplied or implemented in the proposed combination. Instead of explaining with particularity how the control signals of the multiplexer

or crossbar would implement the claimed switching configurations, the Petition relegates the required control signals to a footnote, speculating that “It would have been routine and obvious for the detection unit and/or bridge [of Chang II] to control the switching functionality.” (Petition, 41-42 n. 11; EX2019, ¶79.)

The Petition’s evidentiary support is limited and nonspecific. (EX2019, ¶80.) The Petition identifies that “Chang II’s bridge controls routing”; observes generically that the Chang II bridge includes a control chip and detection unit, and that Chang II discloses an “inquire signal” internal to the control chip; and cites to Mr. Welch’s description of garden-variety multiplexers and crossbars. (Petition, 41-42 n. 11, 59, 64-65; EX2019, ¶80.) From this, the Petition surmises that “any known host/device detection technique could be (and would have been) used in the Crossbar Implementations” to determine when the consumer device is in a USB host mode and in a USB device mode. (Petition, 58-59; EX2019, ¶80.) The Petition further concludes, without explanation, that “Upon detection, asserting the appropriate crossbar control signals connects the consumer product to the bridge (for host-to-host path 54) or directly to the hub (for host-device path 48).” (Petition, 61; EX2019, ¶80.)

The Petition fails to set forth how the inquire signal of Chang II (or any other signal) would be utilized by the crossbar in the Crossbar Implementations to perform the claimed determining or connecting the USB ports in the specific

configurations recited by the claims; or how any such modification to Chang and Chang II would be within the scope of the POSITA's general knowledge.

(EX2019, ¶81.) To the contrary, as Dr. Houh explains, while the POSITA's knowledge may include multiplexer and crossbar components, it does not include the specific knowledge of how to use such generic switching components to modify Chang and Chang II to meet the specific switching requirements of the claims. (EX2019, ¶81.) Moreover, while Mr. Welch's declaration explains that Chang II's detection unit "produces either a 'bridging detection signal' (after detecting a host) or 'slave detection signal' (after detecting a device)," Mr. Welch fails to explain (and the Petition does not allege) how these signals could satisfy the claim limitations. (EX1013, ¶159; EX2019, ¶81.)

The Petition's generic and evidence-starved description of switching cannot meet the Petitioner's duty to identify, "in writing and with particularity ... the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge". (35 U.S.C. § 312(a)(3); EX2019, ¶82.) The Petition is deficient with respect to all challenged claims for at least this reason.

2. The Proposed Combination Is Technically Unsound Because the USB Routing Switch Would Disconnect Its Control Signals

The Petition's proposed combination simply would not operate as described, and the Petition is further deficient with respect to all challenged claims for at least this additional reason. (EX2019, ¶83.)

Even though Chang II provides its own mechanism for switching transmission paths based on the mode of a connected device, the proposed combination does not rely on Chang II's switching elements to meet the claimed USB routing switch. (See EX2021, 147:10-24, 148:11-25; EX2019, ¶84.) Instead, the Petition relies on a *crossbar* as the USB routing switch. (Petition, 56-58; EX1013, ¶¶185, 189-190; EX2019, ¶84.) As described above in Section VII.A, the crossbar (whether in the internal or external implementation) is used to switch between (1) connecting a downstream USB port directly to the hub control module 46, if a device on the downstream port is in device mode; and (2) connecting the USB port to the hub control module 46 via the bridge, if the device on the downstream port is in host mode. (EX2019, ¶84.)

Notwithstanding the Petition's deficient description of the crossbar control signals, discussed above, the proposed combination relies on Chang II's control chip 13 and detection unit 134 in the bridge to provide the control signals that cause the crossbar to route the downstream ports through the appropriate

transmission path. For example, the Petition indicates that “*Chang II’s bridge* controls routing, *viz.*, ‘Bridge Device 1’ in Fig. 1 includes ‘control chip 13’ (shown in Fig. 5) with ‘detection unit’ (134) and CPU (135)”; and further that “it would have been obvious for Chang’s bridge and/or detection unit to control, *e.g.*, the switch’s select lines.” (Petition, 41-42 n. 11, 50; EX1013, ¶¶192-193, 227-228; EX2019, ¶85.) Similarly, Mr. Welch clarifies that “Chang II’s bridge includes [the] ‘*detection unit*’ (in the control chip) that detects the mode of the downstream product for selection of the appropriate transmission path.” (EX1013, ¶193 (citing EX1015, [0022]-[0023], [0034]); EX2019, ¶85; *see also* EX1015, [0016], [0022]-[0028], Fig. 2 (circuit diagram of bridge device and control chip).)

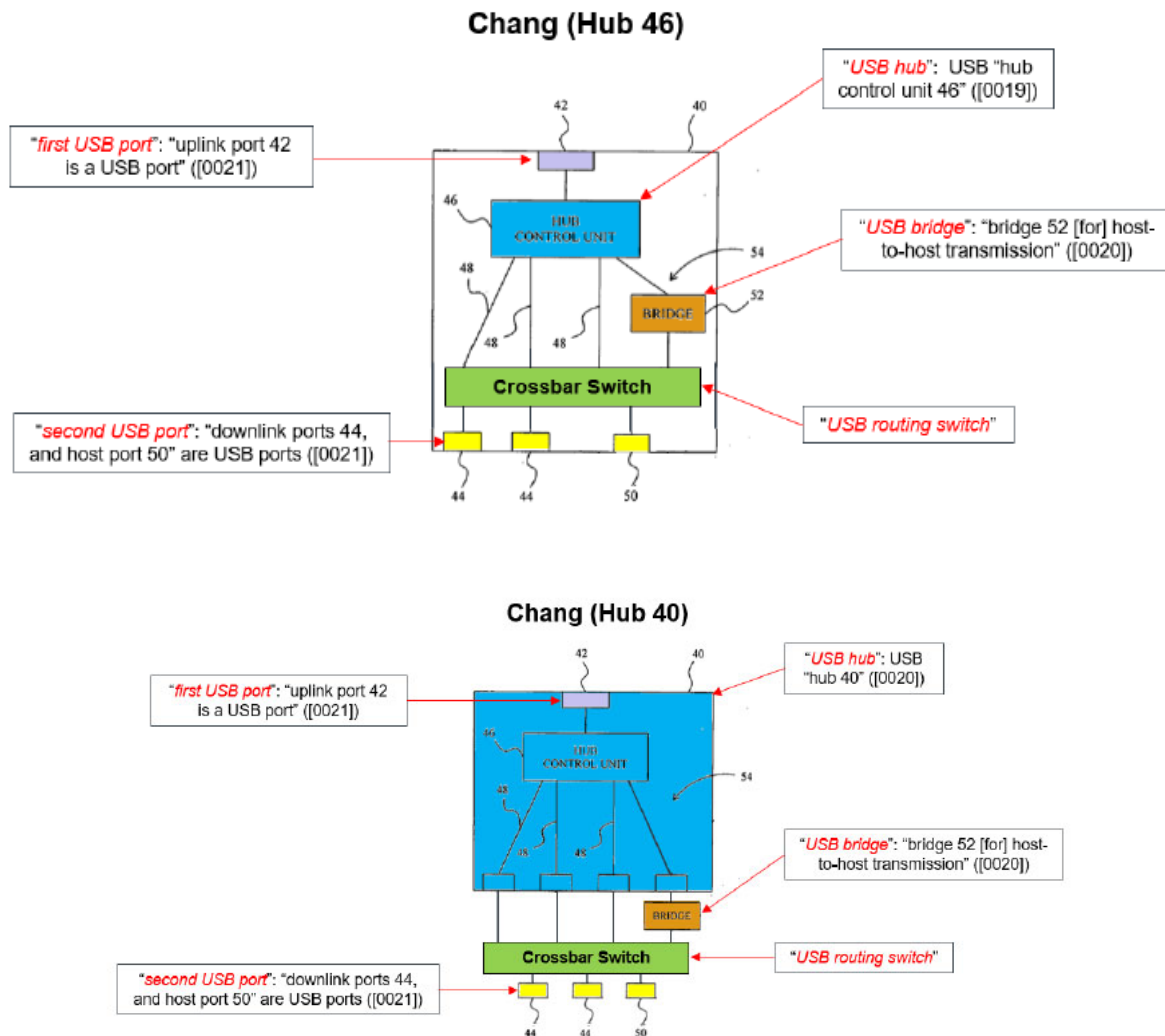
The Petition relies on the detection unit’s control signals to connect the appropriate transmission path: “Upon detection, *asserting the appropriate crossbar control signals* connects the consumer product to the bridge (for host-to-host path 54) or directly to the hub (for host-device path 48).” (Petition, 61; EX1013, ¶254; EX2019, ¶86.) For instance, the Petition describes that “Chang II’s control chip selects the bridge path upon detecting a downstream host and a bridge connection is made to ‘complete the bridging.’” (Petition, 64-65 (citing EX1015, [0026], [0021], [0038]; EX2019, ¶86.) The Petition further relies on Mr. Welch’s declaration, which explains the mechanism by which the detection unit of the bridge provides the control signals: “the detection unit detects the connection of 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). The detection unit then produces either a ‘bridging detection signal’ (after detecting a host) or ‘slave detection signal’ (after detecting a device). These signals cause the switching to the appropriate transmission ‘path’ (to use the bridge or bypass the bridge).” (EX1013, ¶¶159 (internal citations omitted), 80, 189-190, 259; EX2019, ¶86.) For instance, these detection signals “would be used to control the crossbar control signals and establish the appropriate routing connections” (*i.e.*, for a downstream port to use the bridge or to bypass the bridge). (EX1013, ¶¶252, 159, 190, 193, 265; EX2019, ¶86.)

In order to send or receive the inquire signal, and thus produce the bridging/slave detection signals, the detection unit 134 executes the process shown in FIG. 6 of Chang II, described above. (Petition, 32, 59; EX1015, FIG. 6, [0024]; EX2019, ¶87; EX1013, ¶¶159, 189 (citing EX1015).)

But the proposed combination includes a structural flaw. (EX2019, ¶88.) As Mr. Welch cautions: “the detection unit *must connect* to the downstream port to detect the mode, as shown in Chang II.” (EX1013, ¶193 (emphasis added).) But in the proposed combination, the control chip and detection unit (in the bridge) are *separated* from the downstream ports (*i.e.*, 44, 50) by the routing switch—*i.e.*,

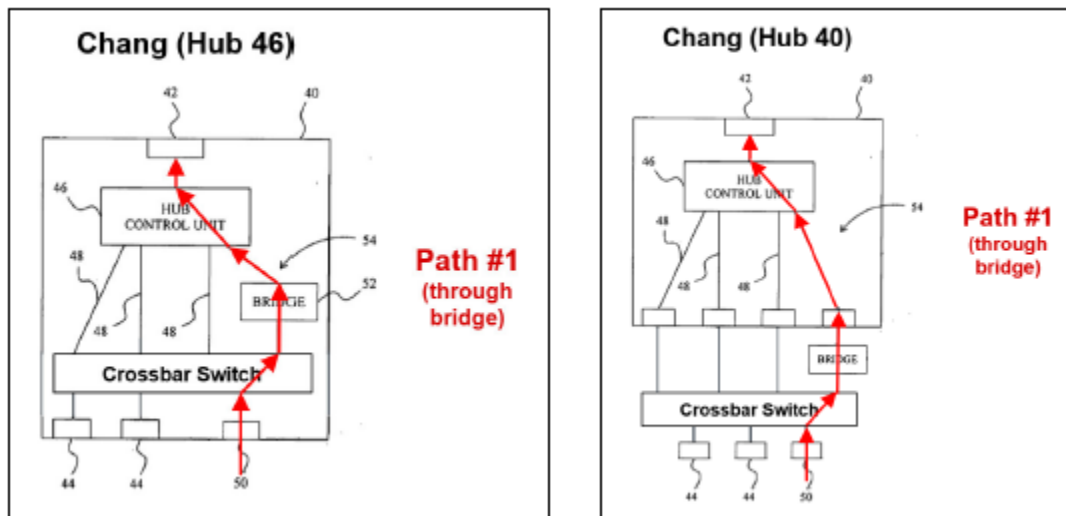
a crossbar². (EX2019, ¶88.) The Petition illustrates this separation, in both the Hub 46 and Hub 40 implementations:



² Because the Petition does not contend that its mux implementation meets any challenged claim, as noted above, the mux implementation is not specifically discussed here. However, the structural flaw described herein would apply equally well to the mux implementation. (EX2019, ¶88 n. 2.)

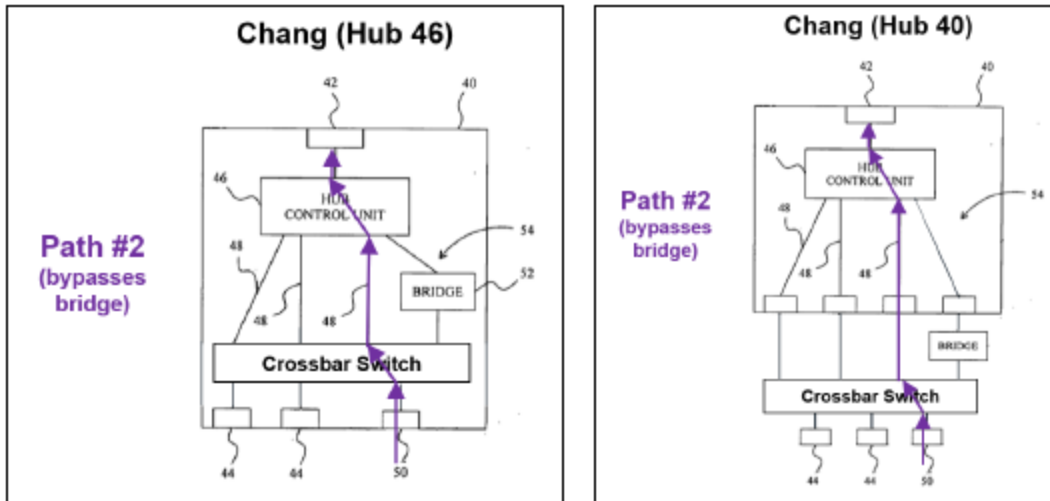
(Petition, 45-49; EX2019, ¶88.)

The behavior of the routing switch demonstrates the need for Mr. Welch’s admonition. When the crossbar connects the downstream port 50 to the hub via the bridge 52, the bridge 52 is connected to the downstream port 50 through the switching element:



(Petition, 80, 58; EX2019, ¶89.)

But when the crossbar connects the downstream port 50 via the direct-to-hub path—*i.e.*, when the device on the port is in device mode—it “bypasses [the] bridge” entirely:



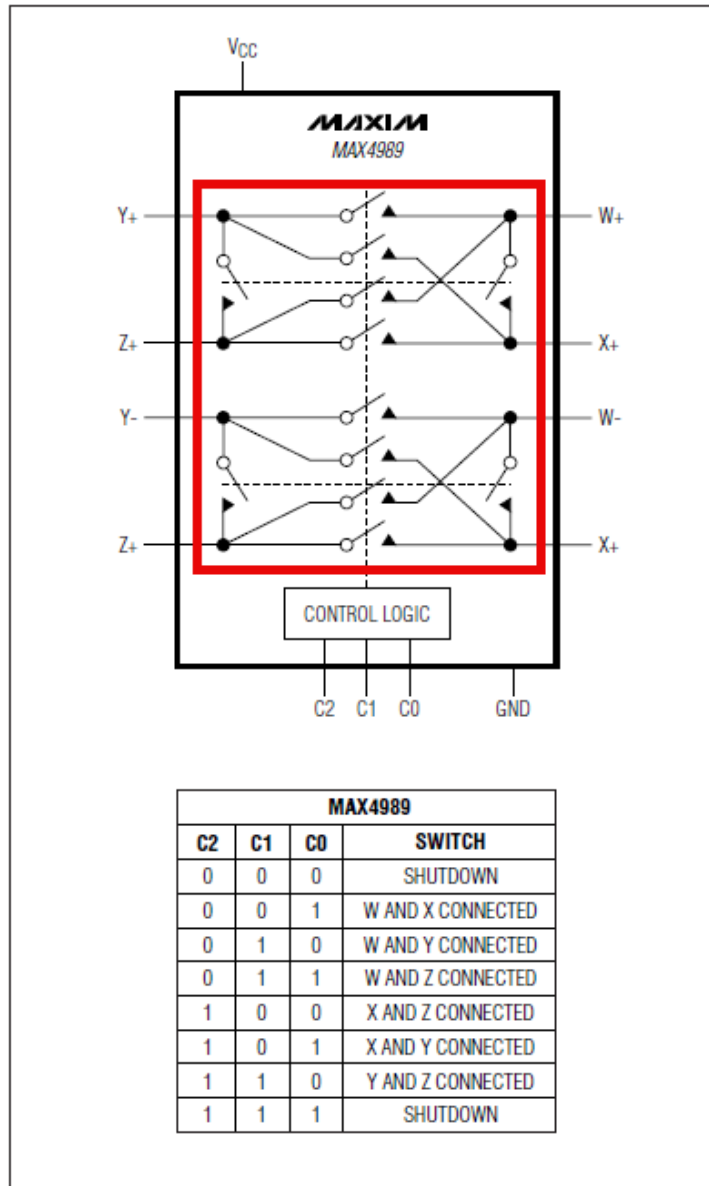
(Petition, 81, 63-64; EX2019, ¶¶90; *see* EX1013, ¶¶159 (“These signals cause the switching to the appropriate transmission ‘*path*’ (to use the bridge or bypass the bridge)”), 179, 190, 247.)

As Dr. Houh explains, consistent with Mr. Welch’s description of crossbars and supporting evidence, the crossbar selecting the direct-to-hub path electrically disconnects the bridge device from all downstream USB ports. (EX2019, ¶¶91; *see, e.g.,* EX1013, ¶¶93.) For example, Mr. Welch explains that in a switch, a disconnected path “will be left floating (*e.g.,* tri-stated).” (EX1013, ¶¶188; EX2019, ¶¶91.) Similarly, a reference cited by Mr. Welch explains that transmission gates, such as those that connect a crossbar’s inputs to its outputs, comprise transistors that switch between a closed circuit and an open circuit of “essentially infinite resistance.” (EX1069, 23; EX2019, ¶¶91.) And the MAX4989 switch, on which

Mr. Welch relies to illustrate a crossbar, indicates that the control logic operates to electrically connect and disconnect (via open circuits) its inputs and outputs:

MAX4989

Functional Diagram/Truth Table



(EX1063, 8 (annotated); EX2019, ¶91; *see also* EX1013, ¶58.)

When the bridge device is bypassed by the crossbar, it is thus electrically disconnected from the downstream USB ports coupled to the crossbar. (EX2019, ¶92.) Because the bridge device and its control chip and detection unit cannot send or receive signals (*e.g.*, “inquire signals”) from a downstream USB port in this state, the bridge device is rendered incapable of detecting whether a device is in host or device mode, such as described above for FIG. 6 of Chang II. (EX2019, ¶92.) This, accordingly, prevents the bridge device and the control chip and the detection unit from generating the bridging detection signal, or otherwise providing control signals to the crossbar. (EX2019, ¶92.) Consequently, once the USB hub module in the proposed combination switches to the device mode, it is *incapable* of directing the crossbar to perform any further switching operations—including connecting or reconnecting any downstream ports to the bridge 52 or to the hub control unit 46 (*e.g.*, in response to a connected device switching to a host or device mode). (*See* Petition, 33-36; EX1013, ¶¶80, 159, 251; EX2019, ¶92.)

FIG. 6 of Chang II further demonstrates the flaw in the proposed combination. As described above, FIG. 6 illustrates the process performed by Chang II’s bridge device (*i.e.*, control chip 13 and detection unit 134 of the bridge device) to detect whether a connected external device is in host mode or device (“slave”) mode. (EX2019, ¶93.)

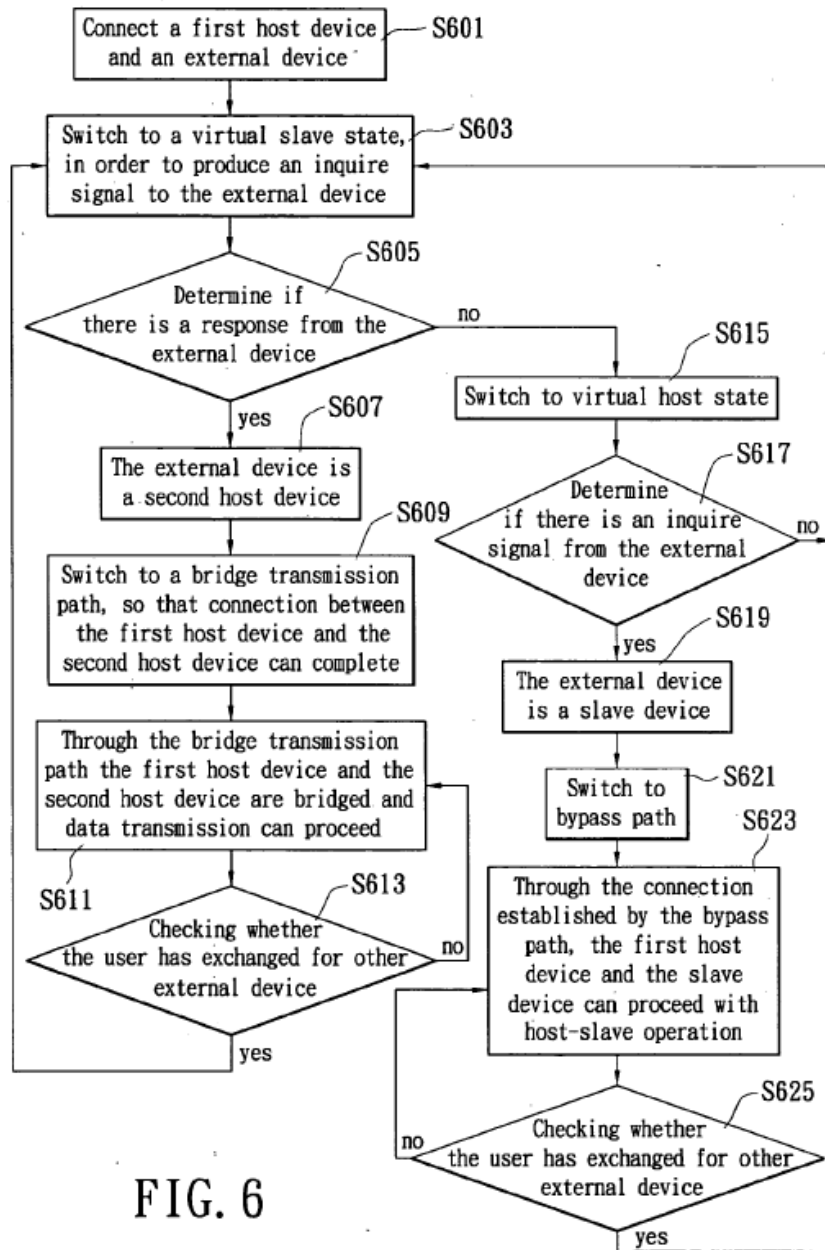


FIG. 6

(EX1015, FIG. 6; EX2019, ¶93.)

In the illustrated process, the control chip exchanges inquire signals with the external device at least at stages S603, S605, and S617; and checks for a newly inserted external device at stages S601, S613, and S625. (EX1015, FIG. 6;

EX2019, ¶94.) In the proposed combination, once a connected device is detected to be in device mode, the crossbar switches to a direct-to-hub path that bypasses the bridge device and disconnects it from downstream ports, as described above.

(EX2019, ¶94.) In this disconnected state, the bridge device is unable to exchange signals with an external device; thus, the bridge device will never reach stages S607 or S619 in the FIG. 6 process and cannot direct the crossbar to switch paths accordingly. Moreover, because the bridge device is unable to detect a newly inserted external device, the Petition's USB hub module will remain in the device mode even if a new device is connected. (EX2019, ¶94.) This prevents the proposed combination from performing "hot-swapping" of devices. (EX2019, ¶136.)

C. The Proposed Combination Does Not Meet the Claim Limitations

1. Claim 13

The Petition's proposed combination fails to meet the limitations of claim 13 and its dependent claim 14. (EX2019, ¶95.)

a. **The Proposed Combination Does Not Meet the Claimed *Determining When the Consumer Device Is Operating In A USB Host Mode And In A USB Device Mode***

Claim 13 recites *determining when the consumer device is operating in a USB host mode and in a USB device mode*. (EX1003, claims 13, 14.) To meet this claim limitation, the Petition relies on its proposed Crossbar Implementations, in which Chang II’s bridge and detection unit “automatically operate[s] ... to determine the type of device connected with the second connection interface, and a detection signal is produced accordingly.” (Petition, 58-59 (citing EX1015, [0013], [0027], [0046]); EX1013, ¶¶189, 193; EX2019, ¶96.)

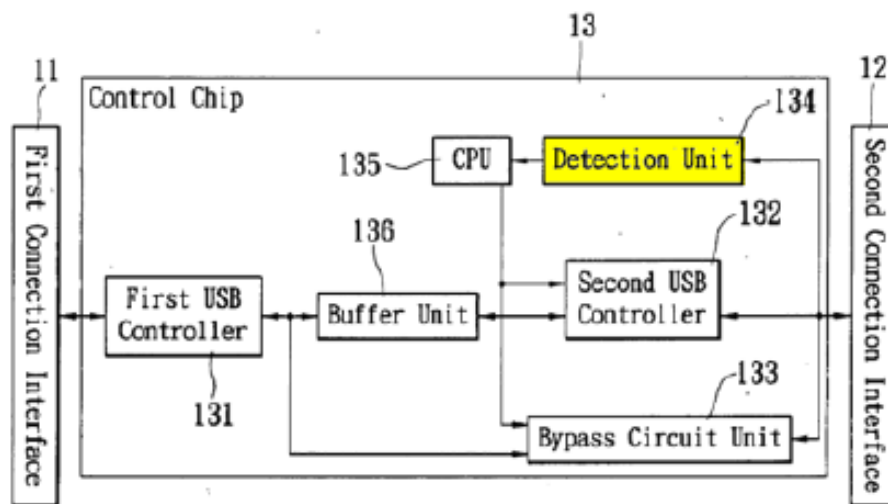


FIG. 5

(Petition, 58-59 (citing EX1015, Fig. 5).)

The Petition further relies on Chang II’s description of “operational details of detection unit 134,” such as by providing an inquire signal, with Fig. 6 of Chang

II providing the host/device detection algorithm. (Petition, 58-59 (citing EX1015, [0038]-[0040], [0042]-[0045], Fig. 6); EX2019, ¶97.)

But as explained above in Section VII.B, the Petition's characterization of the proposed combination is inaccurate, and the Petition thus relies on faulty premises to meet these limitations. (EX2019, ¶98.) For example, the proposed combination is incapable of providing the claimed determining when the consumer device is operating in a USB host mode and in a USB device mode. (EX2019, ¶98.) Instead, it reaches a state in which the crossbar routes the downstream consumer device directly to the USB hub, bypassing and disconnecting the bridge, control chip, and detection unit on which the Petition relies; and rendering it unable to detect the consumer device's operating mode. (EX2019, ¶98.) For example, once the consumer device has been routed directly to the USB hub, bypassing the bridge, the consumer device may operate in a USB host mode or in a USB device mode, but the detection unit will be unable to determine any such operation mode as described above in Section VII.B. (EX2019, ¶98.) Thus, the proposed combination cannot determine *when* the consumer device is operating in a USB host mode and in a USB device mode and thus cannot meet the claim limitation. (EX2019, ¶98.)

Further, the Petition relies for this element on the testimony of Mr. Welch, which is inaccurate and unreliable for the reasons described herein and should be

afforded no weight. (EX2019, ¶¶99.) The Petition thus fails to show this claim element is met. (EX2019, ¶¶99.)

b. The Proposed Combination Does Not Meet The Claimed *Connecting The Consumer Device Steps*

The crossbar implementations similarly cannot meet the required steps of connecting the consumer device via the second USB port to the USB host via the first USB port through the USB routing switch and the USB bridge, thereby providing bidirectional initiation of communication between the USB host and the consumer device when the consumer device is determined to be in the USB host mode; and connecting the consumer device via the second USB port to the USB host via the first USB port through the USB routing switch and the USB hub thereby bypassing the USB bridge to only respond to communication initiated by the USB host when the consumer device is determined to be in the USB device mode. (EX1003, claim 13; EX2019, ¶¶100.)

To meet these claimed steps, the Petition relies on its proposed Crossbar Implementations being able to “connect the appropriate transmission path upon detecting the downstream consumer product’s operating mode (i.e., device/host).” (Petition, 60-63; EX2019, ¶¶101.) The Petition explains the limitations are met because “Upon detection, asserting the appropriate crossbar control signals connects the consumer product to the bridge (for host-to-host path 54) or directly to the hub (for host-device path 48).” (*Id.*) Further, the Petition apparently relies

on the detection unit 134 of Chang II's bridge to meet these crossbar control signals. (Petition, 41-42 n. 11, 50; EX1013, ¶193; EX1015, [0022]-[0023], [0034]; EX2019, ¶101.)

But as with the “determining” step described above, the Petition's characterization of the proposed combination is inaccurate, and the Petition thus relies on faulty premises to meet these limitations. (EX2019, ¶102.) For example, the proposed combination does not “connect[] said first communication path when the first consumer device is connected to said second USB port and is operating in a USB host mode”; or “connect[] said second communication path ... when the first consumer device is connected to said second USB port and is operating in a USB device mode.” (EX2019, ¶102.)

Instead, as described above in Section VII.B, the proposed combination reaches a state in which the crossbar routes the downstream consumer device directly to the USB hub, disconnecting the bridge and detection unit that generates the crossbar control signals; and rendering it unable to detect the consumer device's operating mode, let alone “connect the appropriate transmission path” or assert “the appropriate crossbar control signals,” as described above. (EX2019, ¶103.) The proposed combination is thus unable to connect the first/second communication path when the consumer device is determined to be in the USB host/device mode, as required by claim 13. (EX2019, ¶103.) Further, the Petition

relies for this element on the testimony of Mr. Welch, which is inaccurate and unreliable for the reasons described herein and should be afforded no weight.

(EX2019, ¶103.) The Petition thus fails to show this claim element is met.

(EX2019, ¶103.)

2. Claim 14

Claim 14 depends from claim 13. In addition to the reasons described above for claim 13, claim 14 is not rendered obvious because the Petition’s proposed combination cannot meet claim 14’s limitation that *the step of determining if when the consumer device is operating in the USB host mode or in the USB device mode is performed by the USB routing switch*. (EX1003, claim 14.) This limitation is not taught by any reference, and further cannot be met while also satisfying the parent claim’s requirement of *bypassing the USB bridge*. (EX2019, ¶104.)

To show that the “determining” limitation is performed by the USB routing switch, Petitioner speculates that it would have been obvious for the proposed combination to feature a single integrated circuit (IC) including both the alleged USB routing switch (*i.e.*, the crossbar) and the detection unit 134 of Chang II, which is alleged to meet the “determining” limitation. (Petition, 69-71, 58-59; EX2019, ¶105.)

This fails to show that claim 14 is met. (EX2019, ¶106.) First, the Petition points to no evidence of a single IC that includes both detection unit 134 and the

crossbar relied upon by the Petition. (EX2019, ¶106.) Instead, the Petition apparently contends the POSITA would have known to design a custom IC, speculating that the POSITA “would have known how to easily do so,” and that it would have been “common sense.” (Petition, 69-71; EX2019, ¶106.)

But IC design is a complex field posing non-trivial technical challenges, and requiring specific electronic design expertise. (EX2019, ¶107.) These complexities are overlooked by the Petition, which fails to explain in any detail how the POSITA would have been able to combine the crossbar and detection unit 134 into a single IC, and to incorporate that IC into the proposed combination, with any reasonable expectation of success. This is particularly so given the level of skill in the art, which under either party’s formulation does not include any IC design experience. (*See supra* Section III; Petition, 22-23; EX2019, ¶107.) Moreover, as the Federal Circuit has explained, the Petition’s appeal to “common sense” to supply missing claim limitations is proper only if supported by evidence and a reasoned explanation—both absent here. *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363 (Fed. Cir. 2016).

Second, the Petition’s proposed IC would defeat another limitation of claim 14: that connecting the consumer device to the USB host through the USB routing switch when the device is in USB device mode must *bypass* the USB bridge. (EX1003, claim 13; EX2019, ¶108.) As proposed by Petitioner, claim 14 is met by

a single IC component that includes both the USB routing switch and Chang II's detection unit 134. (Petition, 69-70; EX2019, ¶108.) But as Petitioner and its expert recognize, the detection unit 134 is a component of the USB bridge. (EX2019, ¶108.) For example, the Petition observes that Chang II's "Bridge Device 1' in Fig. 1 includes 'control chip 13' [...] with 'detection unit' (134) and CPU (135)." (Petition, 41-42 n. 11; EX2019, ¶108.) And Mr. Welch explains that "Chang II's bridge includes [the] '*detection unit*' (in the control chip) that detects the mode of the downstream product for selection of the appropriate transmission path." (EX1013, ¶193 (citing EX1015, [0022]-[0023], [0034]); EX2019, ¶108; *see also* EX1015, [0016], [0022]-[0028], Fig. 2 (circuit diagram of bridge device and control chip).)

The Petition relies on this detection unit, and thus the bridge, to perform the determining step. (Petition, 58-59; EX2019, ¶109.) Thus, in the proposed combination, the same electronic component (the IC) comprises both the bridge and the USB routing switch. (EX2019, ¶109.) This IC makes it impossible for the proposed combination to connect the consumer device through the USB routing switch, and also to bypass the USB bridge, as required by claim 14. (EX2019, ¶109.) The proposed combination fails to satisfy claim 14 for at least this additional reason. (EX2019, ¶109.)

3. Claims 18-20

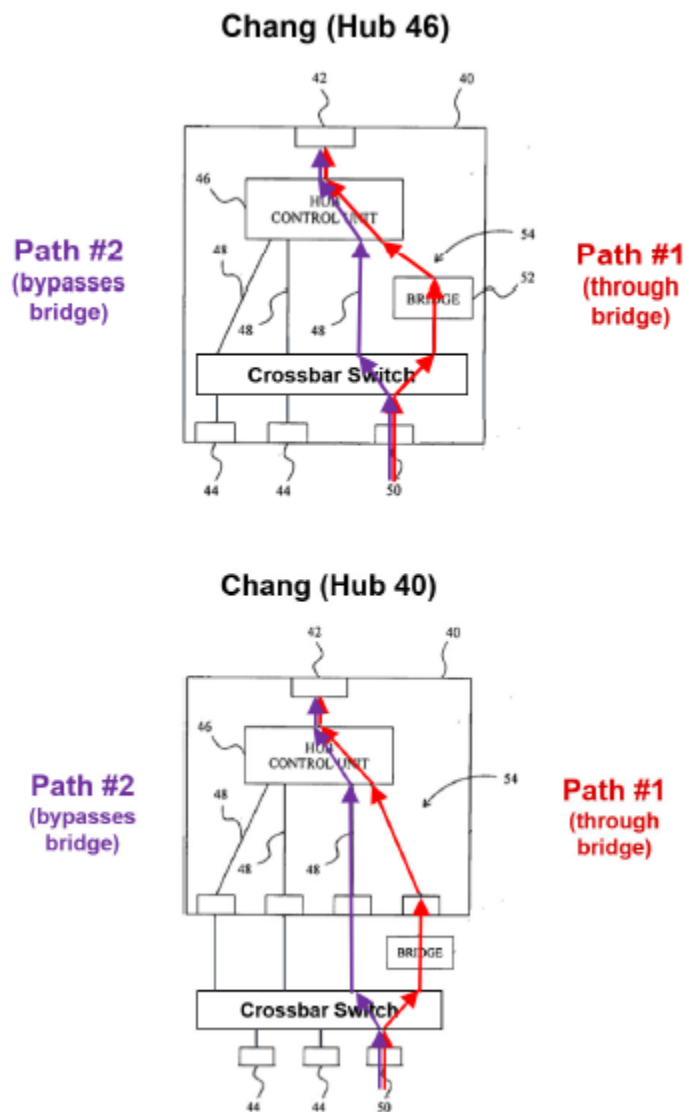
a. **The proposed combination does not meet the claimed *USB routing switch***

Claim 18 requires a USB routing switch configured according to specific requirements. For example, the claimed USB routing switch provides a first communication path between the second USB port and the USB host-to-host bridge, and a second communication path between the second USB port and the first USB port that bypasses the USB host-to-host bridge. Further, the claimed USB routing switch connects the first communication path when the first consumer device is connected to the second USB port and is operating in a USB host mode, thereby providing bidirectional initiation of communication between the USB host and the consumer device. The USB routing switch also connects the second communication path, thereby only responding to communication initiated by the USB host, when the first consumer device is connected to the second USB port and is operating in a USB device mode. (EX1003, claims 18-20; EX2019, ¶110.)

To meet this claim limitation, the Petition relies on its proposed Crossbar Implementations “automatically detecting the type of device connected (host or slave),” and thus “switch[ing] to the proper transmission path.” (Petition, 77-82; *see* EX1013, ¶¶189, 193; EX2019, ¶111.) The Petition explains the limitation is met by “asserting appropriate crossbar control signals based on the downstream product’s host/device mode.” (Petition, 77; *see* EX1013, ¶¶189, 193; EX2019,

¶111.) Further, the Petition apparently relies on Chang II's bridge, including the control chip 13 and detection unit 134, to meet these crossbar control signals.

(Petition, 41-42 n. 11; *see* EX1013, ¶¶189, 193; EX2019, ¶111.) But as the Petition illustrates, when the host-device path is selected, the bridge is bypassed entirely:



(Petition, 77-78; EX2019, ¶111.)

But as explained above in Section VII.B, and further with respect to claim 13, the Petition’s characterization of the proposed combination is inaccurate, and the Petition thus relies on faulty premises to meet these limitations. (EX2019, ¶112.) For example, the proposed combination does not “automatically detect[] the type of device connected (host or slave),” and thus “switch to the proper transmission path.” (Petition, 77; EX2019, ¶112.)

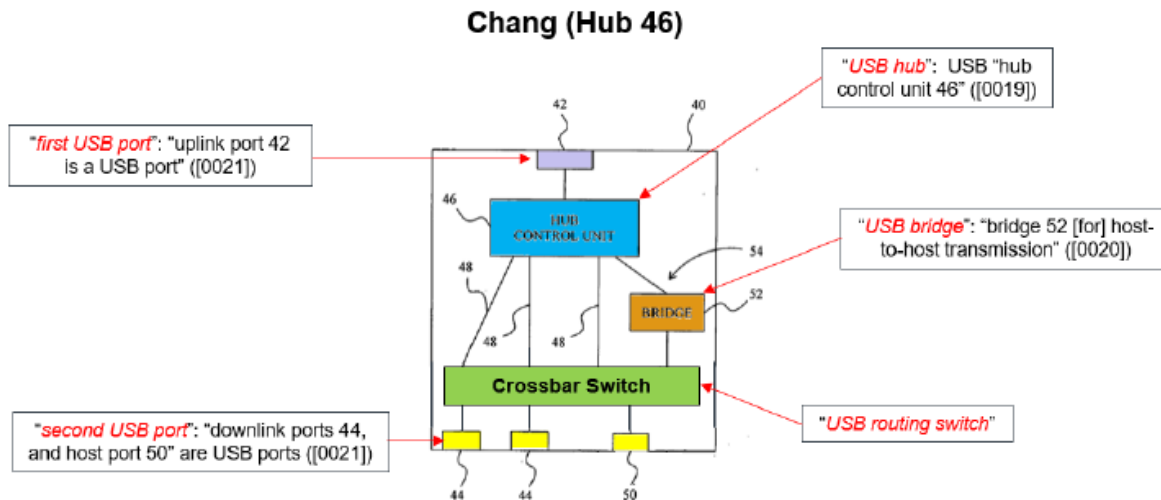
Instead, as described above, the proposed combination reaches a state in which the crossbar routes the downstream consumer device directly to the USB hub, disconnecting the bridge, control chip, and detection unit that generate the crossbar control signals; and rendering it unable to detect the consumer device’s operating mode. (EX2019, ¶113.) The USB routing switch of the proposed combination is thus unable to connect the first/second communication path when the consumer device is operating in a USB host/device mode, as required by claim 18. (EX2019, ¶113.) Further, the Petition relies for this element on the testimony of Mr. Welch, which is inaccurate and unreliable for the reasons described herein and should be afforded no weight. (EX2019, ¶113.) The Petition thus fails to show this claim element is met. (EX2019, ¶113.)

b. The proposed combination does not meet the claimed *USB hub including a first USB port and a second USB port*

As described above in Section IV, the Board declined to adopt the proposed construction of claim 18 as *a USB hub interconnected to a first USB port and a second USB port*. (DI, 15.) Similarly, the Board declined to adopt the proposed construction of claim 19 as *wherein the USB hub is interconnected to a third USB port*. (DI, 15.) Accordingly, for the purposes of this proceeding, claim 18 and its dependent claims 19 and 20 require a USB hub including a first USB port and a second USB port. Similarly, dependent claim 19 (and its dependent claim 20) further require that the USB hub includes a third USB port.

In addition to the reasons discussed above, claims 18-20 are additionally not rendered obvious because the Petition's proposed combination cannot meet these claim limitations. (EX2019, ¶115.) That is, neither of the two crossbar implementations relied on by the Petition can meet the claimed USB hub that includes the claimed USB ports. (EX2019, ¶115.)

First, with respect to the internal crossbar implementation, the Petition relies on the USB hub control unit 46 of Chang as the alleged USB hub:

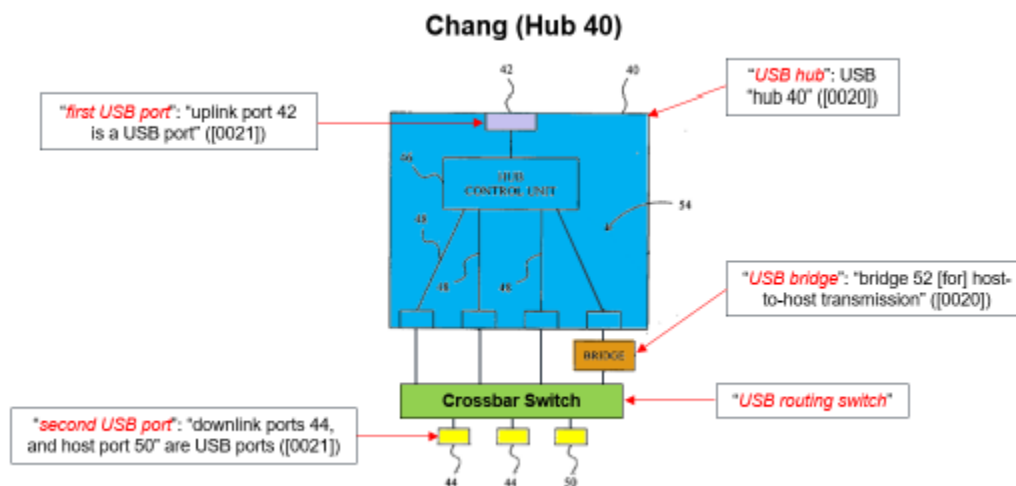


(Petition, 71-73 (citing EX1014, Fig. 3 (modified and annotated by Petitioner)), 51-53; EX2019, ¶116.)

The internal crossbar implementation cannot meet the claimed USB hub because the alleged USB hub does not include the first USB port and the second USB port. (EX2019, ¶117.) Instead, the first USB port (identified as uplink port 42) and second USB port (downlink ports 44 and host port 50) are located entirely outside of the alleged USB hub 46, and are further separated from the alleged USB hub by the crossbar switch, as evident from the above figure and the Petitioner's annotations. (EX2019, ¶117.) Similarly, Chang discloses that the hub control unit 46 is separated from the host port 50 by bridge 52; this configuration is inconsistent with the hub control unit 46 including the host port 50. (EX1014, [0020]; Petition, 29; EX2019, ¶117.)

The Petition does not dispute that the USB hub does not include the first and second USB ports; to the contrary, the Petition contends only that the USB hub is *interconnected* to the first and second USB ports. (Petition, 71-73, 51-53; EX2019, ¶118.)

Second, with respect to the external crossbar implementation, the Petition relies on the USB hub 40 of Chang as the alleged USB hub, as illustrated below:



(Petition, 71-73 (citing EX1014, Fig. 3 (modified and annotated by Petitioner)), 53-54; EX2019, ¶119.)

The external crossbar implementation cannot meet the claimed USB hub because the alleged USB hub does not include the claimed second USB port. (EX2019, ¶120.) Instead, the second USB port (identified as downlink ports 44 and host port 50) are located entirely outside of the alleged USB hub 40, and are further separated from the alleged USB hub by the crossbar switch, as evident from the above figure and the Petitioner's annotations. (EX2019, ¶120.)

The Petition does not dispute that the USB hub does not include the second USB port; to the contrary, the Petition contends only that USB hub is *interconnected to* the second USB port. (Petition, 71-73, 53-54; EX2019, ¶121.)

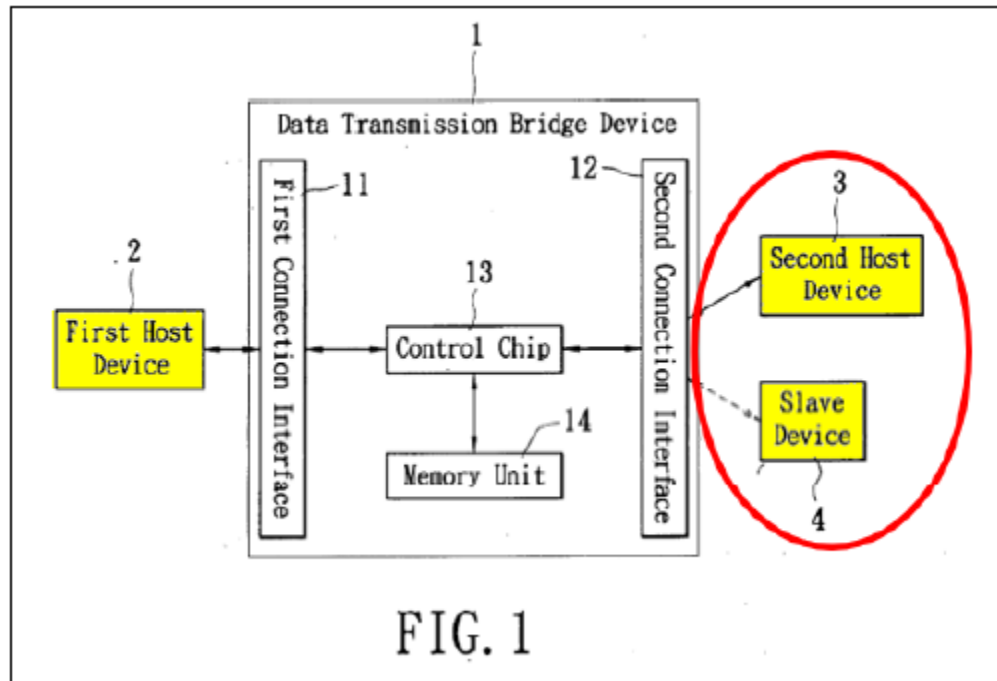
Likewise, with respect to claims 19 and 20, the proposed combination cannot meet the claimed USB hub that *includes* a third USB port. (EX2019, ¶122.) As the Petition explained, “In the Crossbar implementations, the ‘third USB port’ is any of ports 44 or 50 not mapped as the ‘second USB port.’” (Petition, 82; EX2019, ¶122.) Thus, in either the internal or external crossbar implementations, the alleged USB hub (*i.e.*, hub control unit 46 or USB hub 40, respectively) does not include the third USB port for at least the reasons described above with respect to the second USB port (downlink ports 44 and host port 50). (EX2019, ¶122.) Claims 19 and 20 are not met for this additional reason. (EX2019, ¶122.)

4. Claims 19, 20

Further, the Petition’s proposed USB routing switch cannot meet *connecting a third communication path between said third USB port and said first USB port when a second consumer device is connected to said third USB port and is operating in the USB device mode*, as recited in claim 19. (EX2019, ¶123.)

As described above, the Petition relies on Chang II’s control chip 13 and detection unit 134 of the bridge device to generate control signals that direct the crossbar to select a transmission path for a downstream USB port. (Petition, 82-

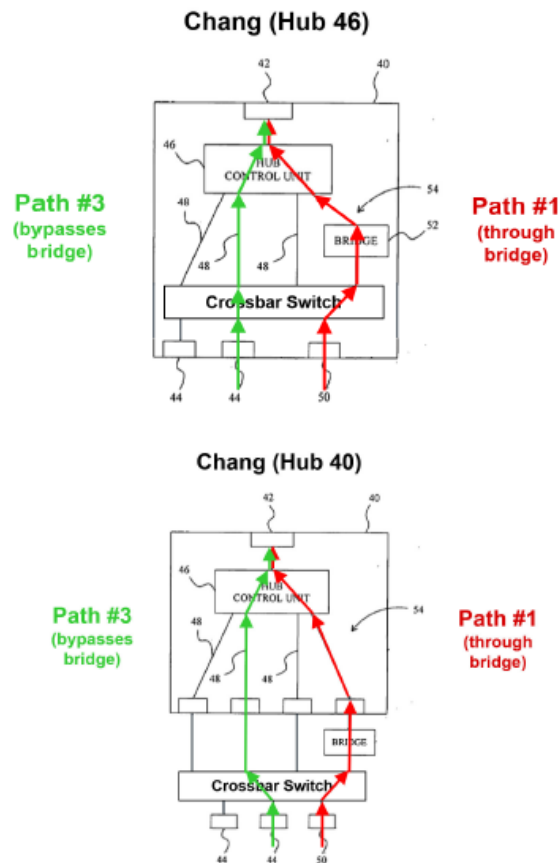
85; EX2019, ¶124.) However, as the Petition acknowledges, Chang II's bridge device includes only a "single port" that accepts either a host device or a slave device:



(Petition, 30-31; EX1015, [0030], [0012]; EX2019, ¶124.)

The proposed combination thus lacks the requisite control logic for configuring the crossbar to connect multiple devices (*i.e.*, the claimed first and second consumer devices on the second and third USB ports) to the first USB port in the manner required by claim 19. (EX2019, ¶125.) And the Petition does not offer any modification that would permit Chang II's bridge to accept multiple devices. (EX2019, ¶125.) The proposed combination thus cannot meet claims 19 and 20. (EX2019, ¶125.)

Even if Chang II were modified to detect multiple downstream device connections, the bridge device is disconnected from downstream USB ports once the crossbar selects the direct-to-hub path, bypassing the bridge, as described in Section VII.B and shown in the Petition:



(Petition, 83-85; EX2019, ¶126.)

This cannot satisfy claims 19 or 20, which require that the routing switch be configured to “connect[] a third communication path ... when the second consumer device is connected to said third USB port and is operating in the USB device mode.” (EX1003, claim 19; EX2019, ¶127.) This connection “bypasses” the

bridge and thus prevents the bridge's detection unit from determining "when the second consumer device ... is operating in the USB device mode" and providing the crossbar with the control signals needed to connect the second consumer device as recited by the claims. (EX2019, ¶127.)

With respect to claim 20, the proposed combination cannot meet "*simultaneously provid[ing] the [third] communication path³ ... without interrupting the first communication path between said first USB port and said second USB port.*" (EX1003, claim 20; EX2019, ¶128.) The Petition relies on "asserting the appropriate crossbar lines" to make this connection via the crossbar. (Petition, 86-87; EX2019, ¶128.) However, in addition to the deficiencies of the proposed combination described above, it cannot provide the third communication path without interrupting the first communication path.

As described above in Sections VI.B and VII.B, Chang II's detection unit provides control signals in response to determining whether a downstream device is in a host mode or a device mode, in a process described by Fig. 6 of Chang II. (EX2019, ¶129.) But as explained in Chang II, and further by Mr. Welch, that

³ The claimed second communication path in claim 20 is understood here by both parties to refer to the third communication path recited in claim 19. (See Petition, 28.)

process involves entering a “virtual slave state” and a “virtual host state” to determine the mode of the downstream device—interrupting any existing communication path by changing the operation mode while USB communications are ongoing. (EX1015, [0026]-[0027], [0038]-[0045]; EX1013, ¶¶159, 259; EX2019, ¶129.) Claim 20 is thus not met for this additional reason. (EX2019, ¶129.)

D. The Proposed Combination Is Improper For Relying On Conclusory Statements And Unspecific Expert Testimony To Establish A Missing Claim Limitation

Even if the Petition’s proposed combination of Chang and Chang II with POSITA knowledge (including the addition of otherwise undisclosed circuit elements) were viewed to meet the claim limitations, the proposed combination is improper because it relies on generically alleged common knowledge, rather than reasoned analysis and evidentiary support, to supply a claim limitation that is missing from the prior art references. In *Arendi S.A.R.L. v. Apple Inc.*, the Federal Circuit reversed the Board’s finding of obviousness in an IPR proceeding for relying on the POSITA’s knowledge to provide such a missing claim limitation, where the POSITA’s knowledge was alleged based on “conclusory statements” and “unspecific expert testimony” rather than “reasoned analysis and evidentiary support.” *Arendi*, 832 F.3d at 1362, 1366 (Fed. Cir. 2016).

The Federal Circuit revisited the issue in *Koninklijke Philips N.V. v. Google LLC*, to clarify that it may sometimes be permissible to rely on the POSITA's general knowledge to meet an otherwise missing claim limitation. *Koninklijke Philips*, 948 F.3d 1330, 1337-38 (Fed. Cir. 2020). However, the Federal Circuit distinguished the reliance on “conclusory statements and unspecific expert testimony” in *Arendi* from the facts in *Koninklijke Philips*, where un rebutted expert evidence, corroborated by the prior art itself, substantiated the POSITA's alleged general knowledge. *Id.* at 1338.

Here, as described above in Section VII.A, the Petition does not dispute that the switching elements (*e.g.*, the USB routing switch) of the challenged claims are not found in Chang or Chang II, and instead relies on the POSITA's general knowledge to supply those elements. But as in *Arendi*, the Petition relies on conclusory statements and unspecific expert testimony to establish that the specific switching elements required by the claims were part of the POSITA's general knowledge. For example, the Petition relies on conventional crossbar components, and generic descriptions of switching in Chang II, to conclude that “it would have been routine and obvious for the detection unit and/or bridge to control the switching functionality.” (Petition, 41-42 n. 11.)

The Petition cites to the testimony of Mr. Welch. But Mr. Welch—like Appellees' experts in *Arendi*—fails to support extrapolating the missing claim

element from the POSITA's general background knowledge of switching.

(Petition, 41-42 n. 11.) Further, at his deposition, Mr. Welch admitted he was “not certain” about how the references would produce the bridging detection signal on which the Petition relies for the claimed USB routing switch; and that his interpretation was “just plausible.” (EX2021, 283:4-23.) Additionally, Mr. Welch's testimony is contradictory: for example, Mr. Welch cautions that “the detection unit *must connect* to the downstream port to detect the mode,” EX1013 at ¶193, but then proposes a prior art combination that disconnects the detection unit from the downstream port, as described in Section VII.B.2. Mr. Welch's testimony is thus unreliable. Moreover, unlike in *Koninklijke Philips*, Mr. Welch's conclusory and speculative testimony is rebutted by Patent Owner's own expert, who explains that even if generic switching elements were part of the POSITA's knowledge, the specific configurations required by the claims were not. (EX2019, ¶81.)

The Board accordingly should give no weight to the Petition's conclusory and improper assertions that the claimed switching elements can be met by the POSITA's knowledge.

E. The POSITA Would Not Have Been Motivated to Modify Chang in View of Chang II and the POSITA’s Knowledge To Meet The Claim Limitations

The Petition’s proposed combination additionally fails to render the challenged claims obvious because it relies on hindsight reconstruction—a process employed by Petitioner’s expert, *see* EX2021 at 64:24-65:17, EX2021 at 9:15-10:10, but long rejected as impermissible. *Graham v. John Deere Co.*, 383 U.S. 1, 36 (1966); *In re Kotzab*, 217 F.3d 1365, 1369 (Fed. Cir. 2000). The Petition proposes a multiple-stage reconstruction: first modifying a prior art USB hub (Chang) with a control circuit from an unrelated reference (Chang II); and then modifying the combination again—transforming components and rewiring internal connections in the process—to insert new electronic switching components (multiplexers and crossbars) cherry-picked from the “POSITA’s knowledge.” (EX2019, ¶130.) At best, the Petition’s results-driven proposal describes how the POSITA *might have* combined the prior art, disregarding how the POSITA as of the priority date *would have been motivated* to combine the prior art with a reasonable expectation of success. (EX2019, ¶130.)

As Petitioner’s expert admitted, the proposed combination is a product of a claims-first analysis, in which Mr. Welch was provided with various patent claims, and with the Chang and Chang II references; and tasked with determining whether they taught the claims. (EX2021, 64:24-65:17.) Asked to explain why multiple

implementations were proposed but not relied on for claims, Mr. Welch testified: “It was about if a specific claim had language which could be interpreted in order to have one of these rather than the other.” (EX2021, 220:11-221:11.) This hindsight analysis improperly fails to consider evidence of how the POSITA would not have been motivated to make the proposed combination; the Petition fails to make a *prima facie* case of obviousness for at least these reasons. (EX2019, ¶131.)

1. The Proposed Combination Would Change the Principles Under Which The Prior Art Was Designed to Operate And Would Render The Prior Art Inoperable For Its Intended Purposes

If a proposed prior art combination would “change the ‘basic principles under which the [prior art] was designed to operate,’” or would “render the prior art ‘inoperable for its intended purpose,’” then the proposed combination is insufficient to render the claims *prima facie* obvious. *Plas-Pak Indus., Inc. v. Sulzer Mixpac AG*, 600 F. App'x 755, 758 (Fed. Cir. 2015)(internal citations omitted); *see also McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1354 (Fed. Cir. 2001) (inoperative combinations of references “teach away from the combination and thus cannot serve as predicates for a *prima facie* case of obviousness”).

The proposed combination improperly transforms the references, removing key functionality, and cannot support a *prima facie* case. (EX2019, ¶133.) As the Petition repeatedly emphasizes, Chang II repeats two “fundamental concepts”: “(1)

host/device detection and (2) selecting between two different transmission paths.” (Petition, 32 (citing EX1015, [0024], [0046]); EX2019, ¶133.) These concepts enable Chang II’s express “main feature”: a control chip that can automatically detect the type of device connected and internally switch to the appropriate transmission path (*i.e.*, the bridge transmission path or the bypass path). (Petition, 32-36, 41; EX1015, [0021]; EX2019, ¶133.) But as described above, the Petition’s proposed combination would be unable to “automatically detect” the type of device once the hub module has been placed into device mode, and to switch to the appropriate transmission path accordingly (*e.g.*, from a device mode back to a host mode). (EX2019, ¶133.)

Thus, the proposed combination would render Chang II inoperable for its admitted main feature and intended purpose. (EX2019, ¶134.) And with respect to Chang, limiting the user’s ability to connect a consumer device to a USB hub would defeat Chang’s intended purpose of providing “a device capable of easily establishing a connection between a computer and another computer.” (See EX1014, [0002]; EX1013, ¶178; EX2019, ¶134.) Moreover, by replacing the existing internal switching functionality of Chang II with an external switching element (a crossbar), the proposed combination physically bypasses Chang II’s bridge circuit, thus changing Chang II’s principle of operation: utilizing its switching circuitry to switch to the appropriate transmission path. (Petition, 32-36,

41-42, 45-49; EX1013, ¶¶160-165; EX2019, ¶134.) In addition to being non-functional, as described herein, this replacement circuitry disposes of one of Chang II's "fundamental concepts."

2. The Proposed Combination Would Impair Usability And Functionality And Undermine USB Goals

The proposed combination suffers from additional defects that no POSITA would be motivated to incur. (EX2019, ¶135.) As described above, the proposed combination enters a state from which it cannot return: Chang II's control chip 13 and detection unit 134 are physically disconnected from the downstream USB ports (and any devices connected to those ports), and can no longer perform the process of Chang II's FIG. 6 to determine whether the connected device is in a host mode. (EX2019, ¶135.) Further, Chang II's control chip 13 cannot re-execute this process unless and until the control chip is somehow reconnected to the downstream USB port—an operation wholly unaddressed by the Petition. (EX2019, ¶135.) Additionally, as described above, the proposed combination would be unable to properly detect new external devices connected to the bridge device. (EX2019, ¶135.) This would impair usability and result in confusion, because the proposed combination would respond to user input in a manner inconsistent according to users' expectations—such as by retaining an out-of-date, and perhaps inapplicable, USB mode when a new device is connected (*e.g.*, a direct-to-hub connection for a newly inserted device in host mode). (EX2019,

¶135.) This concern may be especially critical in the context of vehicle systems, *see, e.g.*, claim 18, in which safety and regulatory matters may be implicated by the failure or unexpected behavior of vehicle control and communication systems.

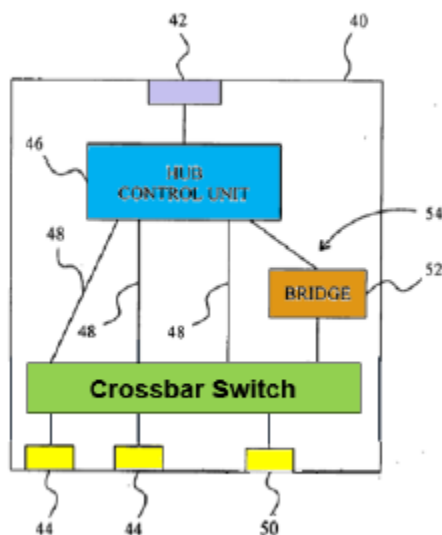
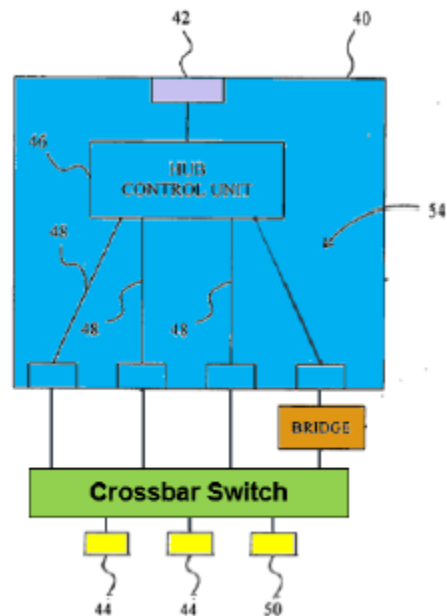
(EX2019, ¶135.) Moreover, the proposed combination would remove existing USB hub functionality, including the ability to connect and reconnect USB devices in host mode or device mode, present in Chang and Chang II. (EX2019, ¶135.) No POSITA would thus be motivated to modify Chang and Chang II in the manner proposed. (EX2019, ¶135.)

Furthermore, as described above, the proposed combination limits or disables “hot-swapping” functionality, by removing Chang II’s ability to detect newly inserted downstream devices. (EX2019, ¶136.) But as the USB 2.0 specification demonstrates, support for “dynamically attachable and reconfigurable peripherals” was a key design feature of USB. (EX1018, 41; EX2019, ¶136.) Similarly, Mr. Welch identified “Support [for] hot plug and unplug” as motivation for the development of USB. (EX1013, ¶51.) The proposed combination’s loss of functionality would thus undermine the goals of USB generally, and could defeat the ’420 patent’s ability to maintain compatibility with the USB standard and other USB devices. (EX1003, 4:3-11; EX2019, ¶136.) No POSITA would be motivated to implement this combination. (EX2019, ¶136.)

3. The Proposed Combination Would Introduce Unnecessary Complexity, Redundancy, and Additional Costs

The proposed combination is wasteful and inefficient. As described above, the Petition takes existing USB solutions in Chang and Chang II; adds duplicative switching components and new electronic hardware; and disregards existing components, for no reason other than to conjure a hindsight version for the challenged claims. (EX2019, ¶137.) For example, as described above, the Petition proposes modifying Chang’s USB hub by replacing its ports with new dual-role ports, and applying the bridge device of Chang II to the existing bridge device of Chang. (EX2019, ¶137.)

Even though Chang II already includes, as its “main feature,” circuitry for switching between two transmission paths, EX1015 at [0021], the Petition proposes *further* modifying the Chang/Chang II combination to insert additional switching hardware, inside and outside of Chang’s hub, *e.g.*:

Chang (Hub 46)**Chang (Hub 40)**

(Petition, 46; EX2019, ¶138.)

As described above, the proposed combination uses the new switching hardware as a replacement for Chang II’s existing switching circuitry. (EX2019, ¶139.) For example, the Petition explains that when the crossbar switches a USB port to a direct-to-hub path, the switch “bypasses the bridge.” (Petition, 77-78; EX2019, ¶139.) In this combination, the Chang II control chip circuit is left intact, but neither the bypass circuit unit 133, nor the existing switching circuitry connecting to the bypass circuit unit, are utilized:

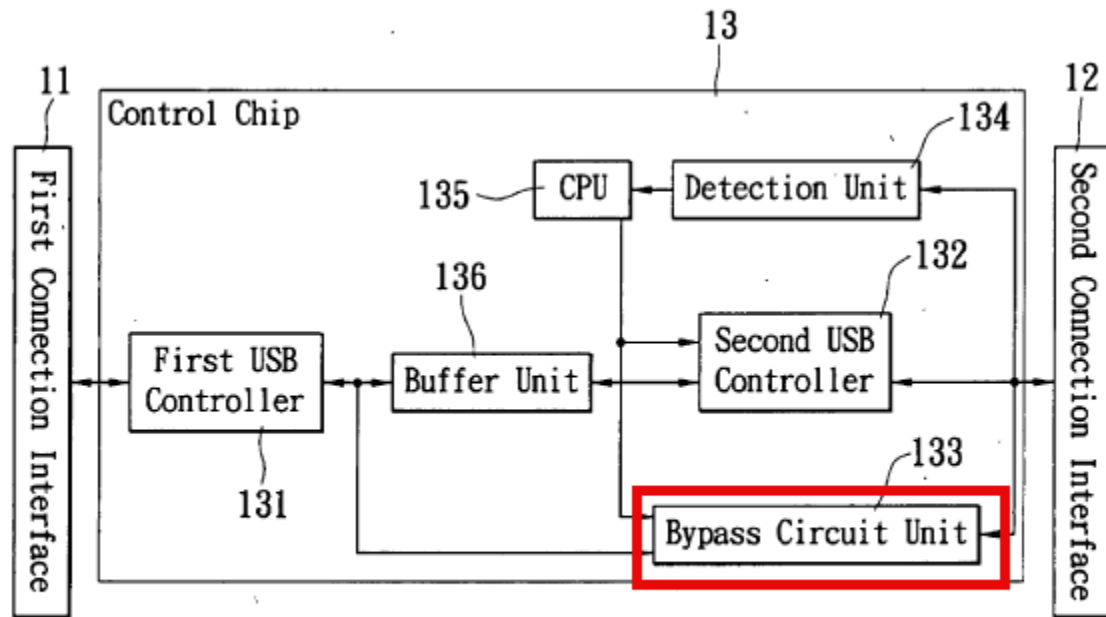
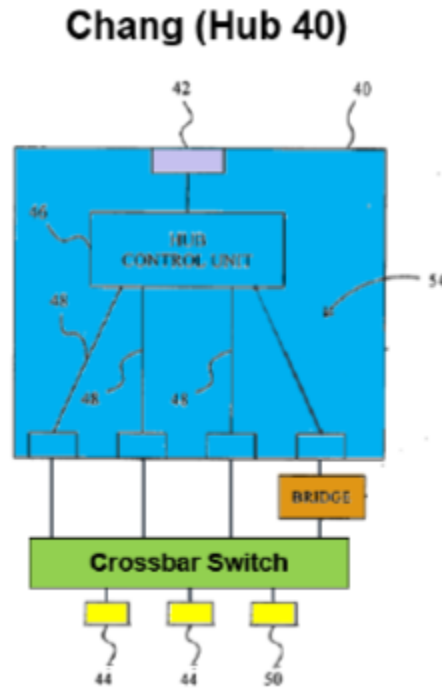


FIG. 5

(EX1015, FIG. 5 (annotated); EX2019, ¶139.)

Similarly, the proposed combination, at least in some implementations, introduces additional ports (44, 50) to Chang's USB hub, which already includes ports; and extends the circuitry outside Chang's existing hub enclosure 40:



(Petition, 46; EX2019, ¶140.)

In at least these instances, the proposed combination introduces redundant components with no clear benefit; adds unnecessary complexity; and wastefully leaves existing components unused or underutilized. (EX2019, ¶141.) This inefficiency brings with it real costs, as Petitioner's expert does not dispute (and did not consider in his analysis)—potentially including, for example, expenses associated with manufacturing, purchasing, integrating, and maintaining components; additional bulk and power consumption; unnecessary heat dissipation; and overall complexity. (See EX2021, 235:19-24, 236:5-22, 237:7-16, 240:24-241:18; EX2019, ¶141.) No POSITA would be motivated to combine the prior art in a manner that introduces such costs and complexity unnecessarily.

(EX2019, ¶141.) Moreover, the proposed combination would undercut key goals of Chang II: simplicity, efficiency, and convenience. (EX1015, [0010], [0021]; EX2019, ¶141.) Chang II thus discourages the Petition’s proposed combination. (EX2019, ¶141.)

4. The POSITA Would Not Have Any Reasonable Expectation Of Success In Combining The References

The Petition additionally fails to establish a *prima facie* case of obviousness because the POSITA would have no reasonable expectation of success in combining the references as proposed by the Petition to achieve the claimed invention. *In re Merck & Co., Inc.*, 800 F.2d 1091, (Fed. Cir. 1986); EX2019, ¶142. For the reasons described above, the proposed combination would be incapable of meeting the claim limitations, and would suffer from critical defects in usability, including as the loss of detection functionality once a device mode has been entered. (EX2019, ¶142.) The Petition fails to acknowledge these defects, let alone to offer any evidence of how a POSITA would be able to combine the prior art with any reasonable expectation of success. (EX2019, ¶142.)

VIII. SECONDARY CONSIDERATIONS FURTHER SUPPORT THAT THE CLAIMS ARE NON-OBVIOUS

Courts have provided a number of additional considerations when determining whether a particular combination of references was obvious at the time of the claimed invention. These “objective evidence of nonobviousness

includes copying, long felt but unsolved need, failure of others, commercial success, unexpected results created by the claimed invention, unexpected properties of the claimed invention, licenses showing industry respect for the invention, and skepticism of skilled artisans before the invention.” *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998) (internal citations omitted).

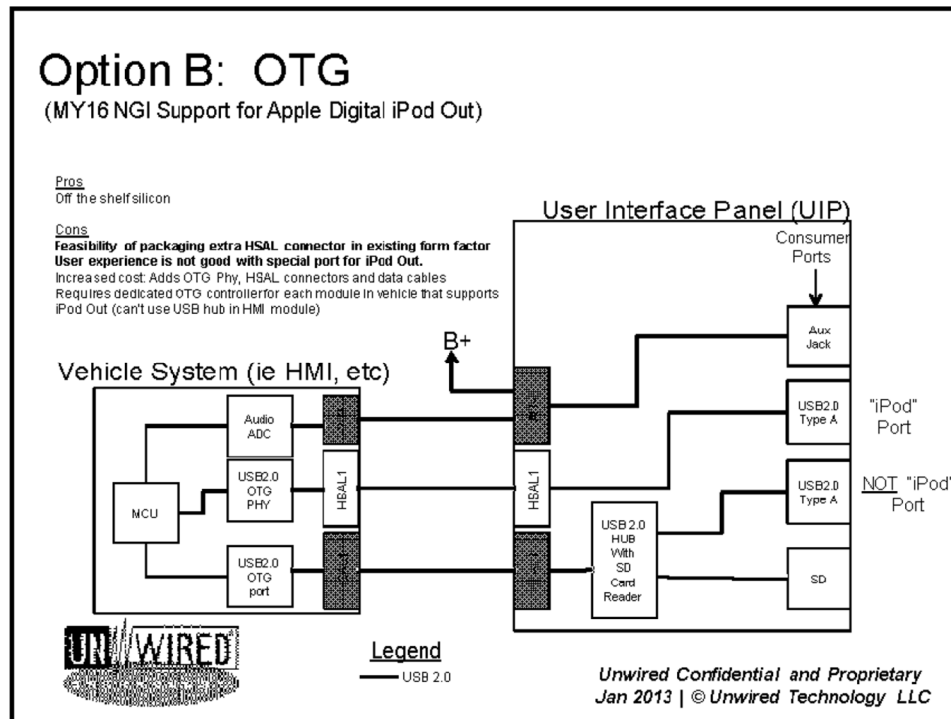
A. There Are Numerous Objective Indicia Of Non-Obviousness As To The Patented Approach To Providing Persistent Downstream Connectivity

1. Long-felt but unsolved needs

When Apple first introduced the ability to support a standardized iPod interface for in-car displays in 2010 with its “iPod Out” feature, automakers began looking for ways to support it. (EX2019, ¶145.) This interest only grew stronger once Apple announced its broad release of the feature (later known as CarPlay) in early 2013. (EX2019, ¶145; EX2040, Trial Tr. (Vol. 2) at 84:5-86:5.) This was a difficult proposition because the traditional arrangement automakers used for allowing interaction between a vehicle’s infotainment system and a mobile phone was a single USB network with the infotainment system acting as the host. (EX2019, ¶147; EX2040, 89:3-11; EX2041, 91:19-92:4.) Both iPod Out and CarPlay, however, required that the iPhone act as a USB host. (EX2019, ¶147; EX2041, 91:5-92:1.)

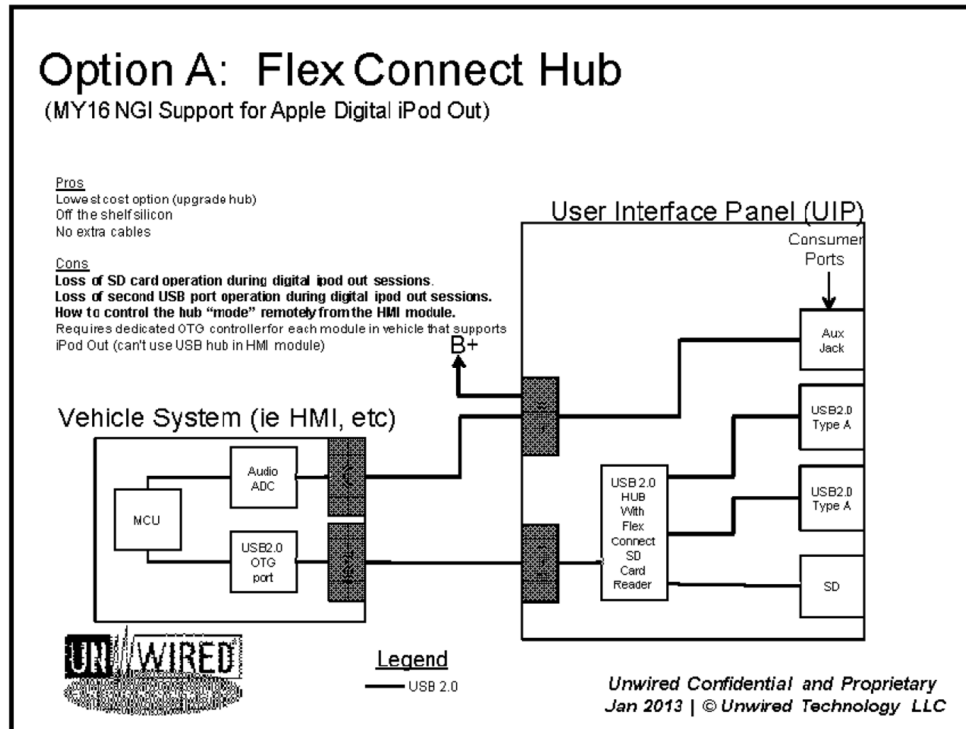
As Microchip’s own expert explained in his trial testimony, automakers laid out three requirements for any CarPlay solution: (1) a “single lane to the head unit,” (2) “CarPlay enabled on all downstream ports,” and (3) “persistent USB connections when CarPlay is activated.” (EX2003, 70:2-12; EX2032, 139:16-141:22; *see also* EX2033, 181:17-182:9; EX2019, ¶146.) Microchip’s contemporaneous internal emails likewise acknowledge this pressure from automakers. (See EX2008 (“the car makers want . . . connectivity with the smart phones throughout the car – and they are willing to pay for it. . . . There is no way to defeat the competitive threat without accomplishing this.”); EX2005, 2 (Chrysler did “not want to lose data capability on the other ports not tied to the Apple device.”); EX2006, 2 (“[OEMs] want CarPlay AND they want additional connectivity to [*sic.*] head unit to other devices”).) Despite this clear mandate, no company, including Microchip, was able to provide a solution that satisfied all three requirements.

Prior to Aptiv’s innovative solution, there were two generally acknowledged approaches to providing CarPlay support. The first was to have two separate USB networks—one in which the head unit acts as the USB host for downstream ports and a second with OTG capability that would allow a connected device to act as a host and the head unit to act as a device. (EX2019, ¶147; EX2037, 19; EX2029, 1.)



(EX2029, 1.) There were, however, two drawbacks to this solution. First, it would require a second USB port/cable in the head unit—a costly approach requiring a head unit redesign and additional components. (EX2019, ¶147; EX2037, 19; EX2029, 1; EX2037, 19; EX2041, 140:7-16.) Second, only ports on the OTG network would be capable of supporting CarPlay; all others would be USB Device-only ports. (EX2037, 19; EX2029, 1.)

The second recognized solution did not require a second upstream data connection, instead using port-reversal technology that would effectively convert the head unit to a USB device. (EX2019, ¶147; EX2037, 20; EX2029, 1.)



(EX2029, 1.) This was unpalatable to the automakers because, while it allowed CarPlay on multiple ports, it would disrupt data connectivity on all non-CarPlay ports because the head unit was no longer acting as a USB host. (EX2037, 20; EX2029, 1.)

Summary

- Neither option A or B complies fully with existing functional requirements.
 - Option A does not allow access to the SD card or the second USB port if a iOS device is plugged in. Eg can't run vehicle nav app when iphone is connected (which is likely all the time).
 - Option B forces the user to 'find the right port' to make the phone work. Eg K2 vehicles have 5 ports in reach of the driver but only one will work. 80% chance to get it wrong.
- Option B may not package.
- Option B is expensive.

Conclusion: Neither option looks good. Need another option.



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(EX2029, 2.)

Aptiv's⁴ dual role hub provided a third solution which satisfied all three of the automakers' requirements, as Microchip's expert acknowledged during his trial testimony. (EX2041, 139:16-141:22, 327:17-328:8; *see also* EX2025 (presentation to Apple outlining the "unique benefits of Delphi/Unwired Hub"); EX2029, 2.)

⁴ This solution was originally conceived of by Unwired Technology LLC ("Unwired"), which was acquired by Delphi Automotive Systems ("Delphi") in 2014. Delphi later changed its name to Aptiv. Here, "Unwired," "Delphi," and "Aptiv" generally refer to Patent Owner.

Key System Considerations	Two USB Paths	Port Reversal Hub	Delphi Dual Role Hub
Head Unit used "Host" port (OTG not required)	No	No	Yes
CarPlay™ available on any USB port	No	Yes	Yes
Other hub ports work during CarPlay™	Yes	No	Yes
Impact to USB signal integrity	Severe	Some	None
Vehicle System Cost	Highest	Moderate	Lowest
Head Unit Software Drivers Required	No	Yes	Yes

(EX2037, 22.)

2. Failure of others/skepticism of skilled artisans

When CarPlay was announced, Microchip was the undisputed market leader in the field of automotive USB hub chips, controlling 100% of the market share for the Big 3 automakers. (EX2040, 211:23-212:6.) As of 2022, Microchip sold about eight billion chips per year and had at least 2,000 engineers working on product development. (*Id.* at 195:17-21, 199:5-9, 200:12-20, 203:22-204:3.)

Despite these substantial advantages, Microchip was unable to provide the functionality automakers demanded. In particular, Microchip was not able to provide persistent downstream data connectivity for non-CarPlay ports. (EX2040, 237:22-238:8 (“what we couldn’t do was ... allow these other items to stay connected to the [head] unit”).) Microchip repeatedly acknowledged this limitation, both internally and externally to its customers:

- On June 18, 2014, Microchip declared that the problem was not solvable and “physically outside the capabilities of ANY USB system” (EX2005, 1-2 (emphasis in original).)⁵
- During an April 2022 trial,⁶ Microchip admitted that it told customers that the problem was not solvable. (EX2002, 312:4-9.)
- On July 20, 2014, Microchip acknowledged that Aptiv had invented a solution to the problem that Microchip could not solve. (EX2008, 1 (July 20, 2014) (persistent USB is “highly desirable by the car makers” and must be provided “to defeat the competitive threat”).)
- On August 11, 2014, even after Aptiv demonstrated a solution, Microchip continued to maintain that no viable solution was possible:

This is completely NON-STANDARD USB. . . . ***This goes against the primary requirement of USB***; one bus /

⁵ The author of this email, Brigham Steele, was an electrical engineer with over a decade of post-degree experience at the time he made these statements. See <https://www.linkedin.com/in/brigham-steele-2244a79/>, EX2040 at 308:1-4.

⁶ Microchip sued Aptiv for patent infringement in Delaware district court; a jury returned a verdict of complete noninfringement. (EX2018.)

one Host. . . . Could be demo'd but *no way it can be guaranteed.*

(EX2009, 1 (emphases added).)

- In October 2014, Microchip was still telling its customers that there was no feasible way to have persistent downstream connectivity. (EX2006, 2 (advising that USB charging ports were possible, but they “saw no way” for downstream data connectivity).)
- Even at the end of 2014, Microchip still had not been able to offer a system with persistent USB:

When persistent USB is a requirement *we definitely have run into a wall.*

(EX2007, 1 (Dec. 1. 2014) (emphasis added).)

“We looked at developing a solution for 1 upstream lane, persistent USB data and we don’t have a solution. We wish we could provide a solution, but we don’t have it.

(EX2010, 1 (Dec. 2 2014); *See also* EX2041, 12:8-15.)

Only in January 2015, after studying Aptiv’s solution in detail (*see infra* Section VIII.A.5, “Copying”) did Microchip acknowledge that it was “technically feasible to develop a solution that competes with Unwired’s.” (EX2034, 1 (Jan.

26, 2015).) And even then, Microchip cautioned that “[t]he concept of supporting USB transactions between two hosts via bridged peripheral endpoints is unique, and as such poses risk.” (EX2026, 11.)

Automakers, too, had struggled with this same problem and were surprised by Aptiv’s success. (EX2042, 202:14-203:14 (Hyundai engineers skeptical even after demo).)

3. Commercial success

When automakers learned of Aptiv’s ability to satisfy all three requirements for a viable CarPlay solution, they were interested in using that solution in their upcoming vehicles. (*See* EX2008 (“Unwired has gained traction at GM, Chrysler, and Ford.”).)

Despite initial concerns about Aptiv’s ability to ramp up manufacturing to meet demand, the Big 3 quickly switched from Microchip to Aptiv to source for upcoming model year products. (EX2040, at 229:14-19; EX2037, 13.) Altogether, Aptiv captured 40% of the global Big 3 offerings for model year 2016, representing 10 million units. *Id.* Ultimately, Aptiv sold approximately 45 million units between 2015 and November 2021. (EX2041, 281:12-22.) This was an unquestionable commercial success for a new product launch in the automotive industry. (EX2036, ¶10.)

This sudden shift to an inexperienced chip manufacturer with a product not yet tested in the market was extraordinary. As Microchip's VP of Networking explained at trial: "[W]e were certainly surprised. Historically, the automotive industry is extremely conservative. They didn't want to put anything out there to start a problem in the field. So the fact that they would do something out of standard certainly is surprising." (EX2040, 241:4-15.)

Aptiv won this business because its innovative solution permitted it to satisfy the three automaker requirements: (1) single upstream connection, (2) CarPlay on all ports, and (3) persistent downstream connectivity on non-CarPlay ports. (EX2033, EX2042, 201:19-202:22.) Aptiv's pitch to automakers for the dual role hub focused on this functionality. (*See e.g.*, EX2027, 11; EX2028, 3.) Microchip repeatedly acknowledged the absence of any other solution capable of providing this capability as the reason for Microchip's failure to secure sales. (*See e.g.*, EX2007, 1 ("[w]hen persistent USB is a requirement we definitely have run into a wall."); EX2007 ("[FCA] need[s] USB data on all ports even during CarPlay with one USB lane from the Head Unit to the Media Hub.").)

4. Industry praise

Aptiv also received significant acclaim within the automotive industry for its dual role hub. Most notably, it was the winner of the 2016 PACE Award, an industry honor awarded by Automotive News in conjunction with Ernst & Young

for an innovation (1) developed primarily by a supplier, (2) that is new to the automotive industry, (3) that is in use in a production vehicle, and (4) that “changes the rules of the game.” (EX2036, ¶4; EX2042, 184:23-185:6.) The PACE award is regarded in the automotive industry as the most prestigious award available to automotive suppliers. (EX2036, ¶3.) Its recipients are selected by a cross-disciplinary panel of independent judges after conducting site visits to evaluate the importance of the innovation to the industry. (*Id.*, ¶5.) Previous innovations that earned the award include adaptive cruise control and keyless push-to-start functionality. (*Id.* ¶3; EX2042, 185:7-24.)

Aptiv’s dual-role hub received the PACE award because of its ability to allow persistent downstream USB connectivity to non-CarPlay devices while CarPlay was active without requiring an alteration to the head unit hardware to permit a second upstream connection. (EX2036, ¶9.) The award citation for Aptiv’s 2016 PACE award states that the Dual Role Hub “solved [the] vexing problem” of permitting an iPhone to operate as a host while also allowing a driver “to access music on another device, play video on a passenger’s tablet or listen to music on a passenger’s Android phone.” (EX2038; EX2036, ¶7.) The video shown at the award ceremony, a screenshot of which is provided below, explained the innovation as allowing “a driver [to] connect their Apple iPhone to the radio

head unit to host navigation, music and messaging, and also connect a second or third device, say an Android phone or a tablet.”⁷ (EX2039; EX2036, ¶8.)



5. Copying

When others in the industry learned of Aptiv’s success, they began to develop products that copied the core operation of Aptiv’s solution, including its host-to-host bridge and multiplexing switches.

At the time, Microchip offered two solutions for CarPlay that mirrored the generally acknowledged approaches to CarPlay at the time—a dual-upstream solution with designated CarPlay ports and a “FlexConnect” solution with role

⁷ A copy of this video is publicly available at

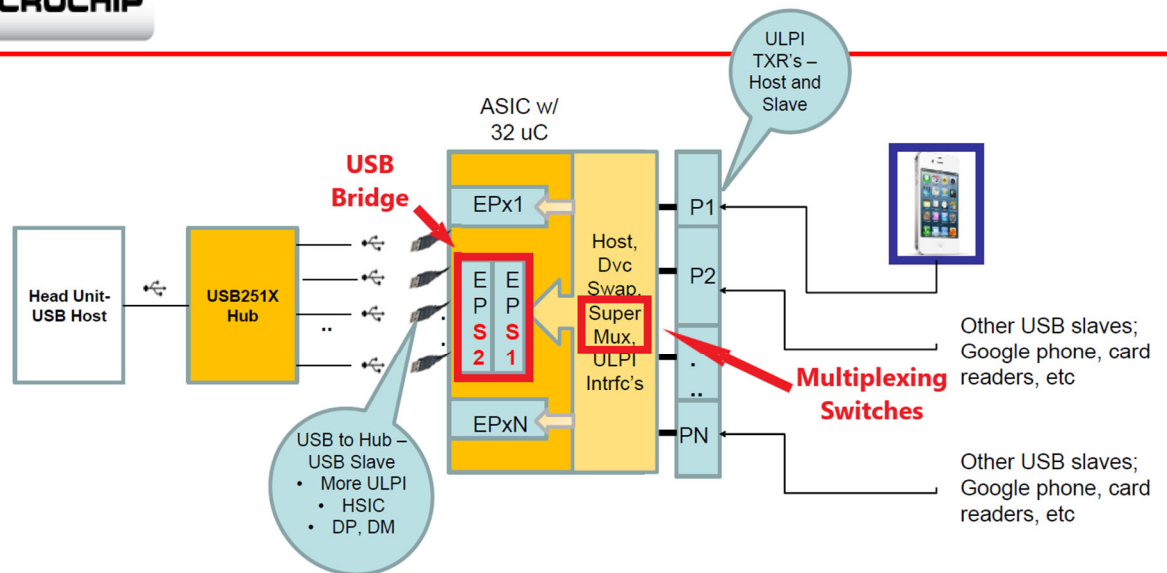
<https://www.autonews.com/article/20160411/VIDEO/304119865/2016-pace-award-winners>.

reversal, but no persistent downstream USB connectivity. (EX2040, 230:4-10, 294:18-295:11.) Before Aptiv entered the marketplace, “pretty much every car manufacturer” had planned to use one of these solutions. (*Id.* at 230:4-10.) Once Aptiv’s dual role hub entered the market, automakers began pressing Microchip for a competing solution that provided the same benefits. (*Id.* at 233:22-9; EX2033, 1 (“Chrysler came to us very aggressively to look at doing a spoofed device.”).)

Microchip responded by investigating the Unwired solution. (EX2040, 234:10-235:6.) Its engineers spoke to automakers and head unit manufacturers that had seen demonstrations of the Unwired solution and pieced together enough information to prepare a presentation for automakers disparaging the solution. (*See* EX2031.) This presentation contained diagrams showing that Microchip understood the basic structure of Unwired’s product, including the host-to-host USB bridge and multiplexing switches that helped enable persistent downstream USB connectivity:



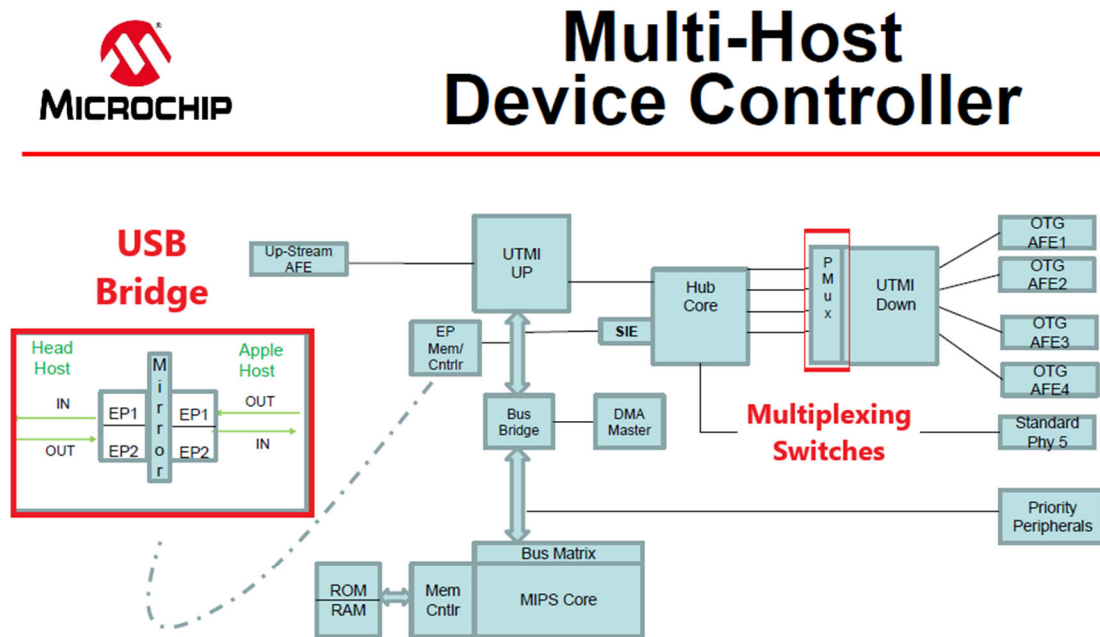
BoB Alternative Approach



(EX2031, 6 (annotated).)

As Microchip began investigating how it could provide a CarPlay solution capable of competing with Aptiv's, it realized that it would need to copy Aptiv. Microchip's Vice President in charge of its networking group testified during trial: "[A]s we thought about it, we said well, okay, we can't do it a different way, then what is Unwired doing?" (EX2040, 240:1-241:3.) In late 2014, Microchip launched a program codenamed "Sandia" aimed at developing its own version of the Aptiv solution. From the very beginning, the lead architect of that project, Santosh Shetty, relied on the diagram above depicting Aptiv's product. (See e.g., EX2032 (Dec. 22, 2014 email with "a few questions regarding the unwired solution PPT you send [sic]" and including a functional block diagram of the Aptiv

product).) Unsurprisingly, the initial internal block diagrams of Microchip's own product were quite similar, including both a host-to-host USB bridge and multiplexing switches:



- Single upstream port
- 5 downstream ports; 4 CarPlay capable, 1 standard (CR or hub expansion)
- Priority peripherals – I2C, SPI, UART, I2S

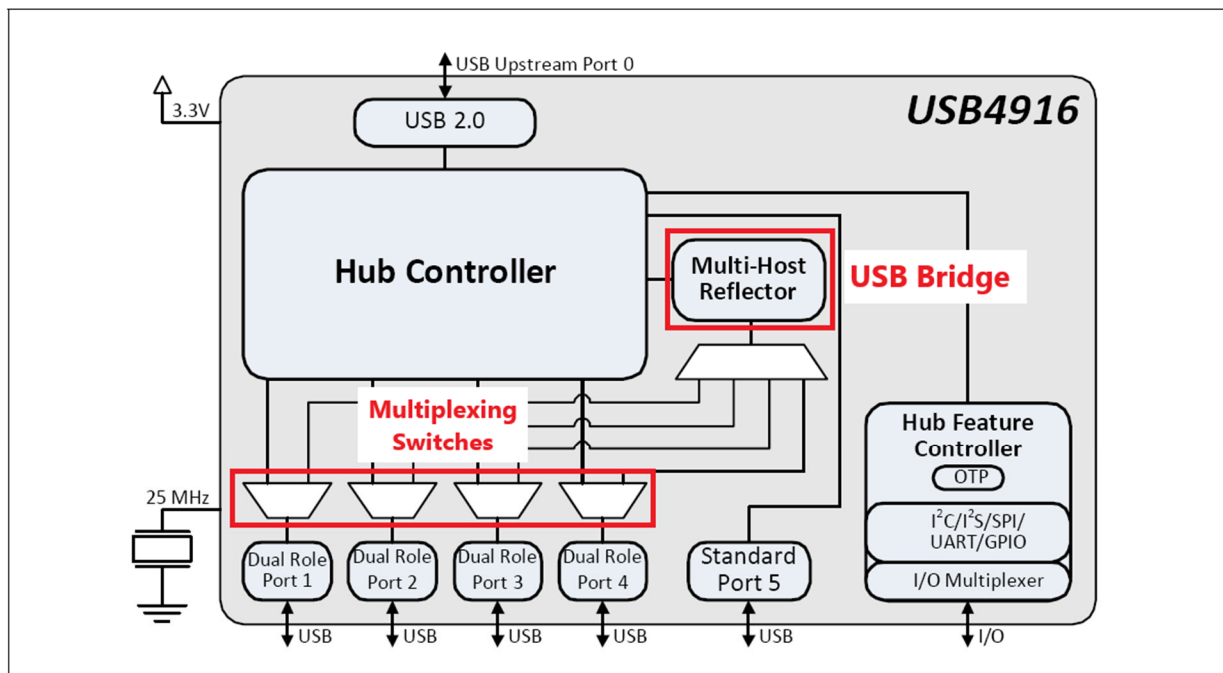
(EX2034, 5 (annotated).)

In addition to attempting to understand the Aptiv solution by speaking with automakers and head unit manufacturers that had seen demonstrations, Microchip also obtained one of Aptiv's chips from a competitor and analyzed it to understand its capabilities. (EX2040, Trial Tr. (Vol. 2) at 186:22-188:12.) Microchip's engineer explained at trial that Microchip had "decapped" Aptiv's Boston 2 chip, which is the process of etching away the cover from the integrated circuit, allowing

the inner workings of the chip to be studied. (*Id.*; EX2019, ¶157.) As Petitioner’s expert explained, this type of reverse engineering is generally only necessary if the way that a product works is not obvious. (EX2021, 191:8-192:17; *accord* EX2019, ¶157.)

Several years later, Microchip introduced what it referred to as a “multi-host endpoint reflector,” which—like Aptiv’s product—used a host-to-host USB bridge and multiplexing switches to provide CarPlay support using a single upstream connection while still providing persistent downstream data connectivity on the non-CarPlay ports:

FIGURE 2-1: INTERNAL BLOCK DIAGRAM



(EX2030, 1, 6 (Annotated).) As one of Microchip’s engineers testified at trial, this structure enables persistent downstream USB connectivity, enables CarPlay on all

ports, and enables the two separate hosts, head unit and the iPhone, to both be active at the same time. (EX2040, 105:3-13.)

B. There Is A Clear Nexus Between The Persistent Downstream Connectivity Claims And Objective Indicia

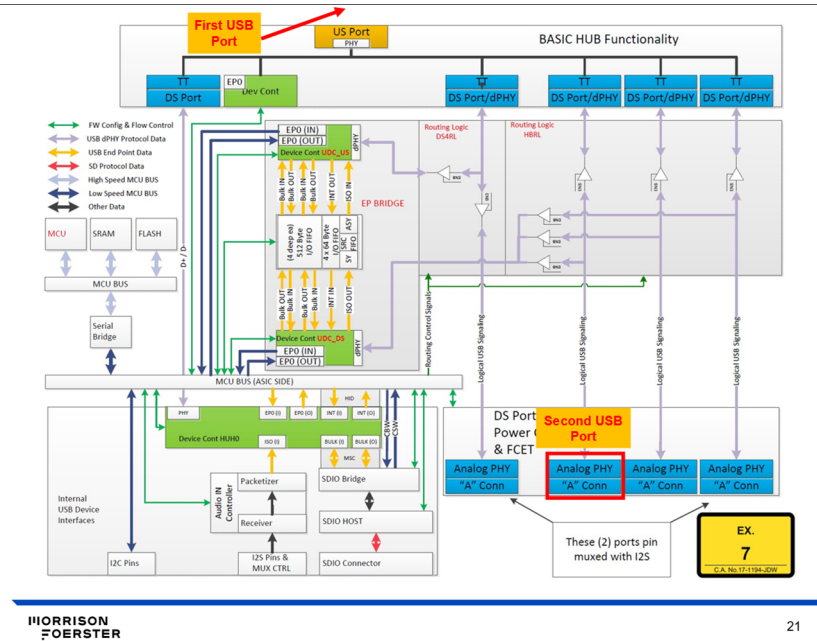
The law requires that “the evidence of secondary considerations must have a ‘nexus’ to the claims, *i.e.*, there must be ‘a legally and factually sufficient connection’ between the evidence and the patented invention.” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). There exists “a rebuttable presumption of nexus between the asserted evidence of secondary considerations and a patent claim if the patentee shows that the asserted evidence is tied to a specific product and that the product ‘*is* the invention disclosed and claimed.’” *Id.* (quoting *Demaco Corp. v. F. Von Langsdorff Licensing, Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988)). If the patentee cannot establish facts supporting a presumption of nexus, it may nevertheless show “that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Id.* (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)).

In the present case, the challenged claims are tied to Aptiv’s commercial “dual-role hub” containing its Boston-2 chip. The combination of a host-to-host USB bridge with USB routing switches allowed the dual role hub to provide CarPlay support on each downstream port without the need for a second upstream connection with the head unit and without interrupting USB connectivity on the

non-CarPlay downstream ports. (EX2042, 201:19-202:10-13.) It was therefore the specific arrangement claimed in the patent that provided a solution to the “vexing problem” facing automakers and their suppliers and which ultimately drove demand for Aptiv’s product. (*Id.*, 202:14-22.) As a result, Aptiv is both entitled to a presumption of nexus between the claims and the dual-role hub and has independently established that the secondary considerations are the “direct result of the unique characteristics of the claimed invention”—particularly as to claims 19 and 20 of the ’420 Patent, which are directly tied to the persistent downstream USB connectivity desired by automakers.

The requisite nexus between the claimed invention and Aptiv’s product is supported by the chart below, which demonstrates on a per-limitation basis how Aptiv’s Dual Role Hub meets all limitations of exemplary claims 19 & 20. It is further supported by the Supplemental Declaration of Dr. Houh. (EX2019, ¶¶158-160.)

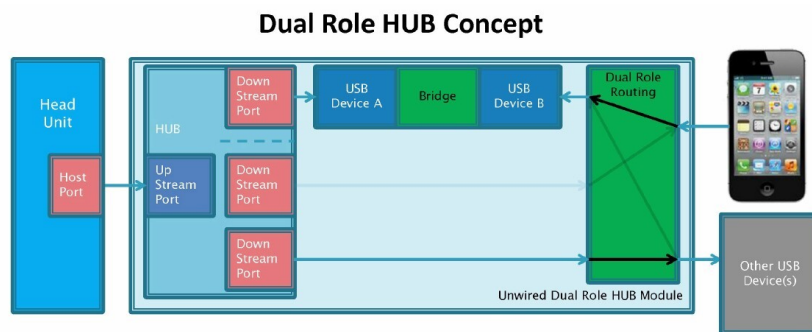
Challenged Claim	Aptiv Dual Role Hub
18[P]	To the extent the preamble is limiting, the Boston 2 chip in Aptiv's Dual Role Hub is configured to act as part of a communication system.
18[A]	The Boston 2 chip includes a first USB port and a second USB port: EX2023, Fig. 7-35(a) (Annotated).



EX2024 (Annotated).

18[B]

The Boston 2 chip is designed to connect a first, upstream USB port with a central vehicle microcontroller contained in an automotive head unit:

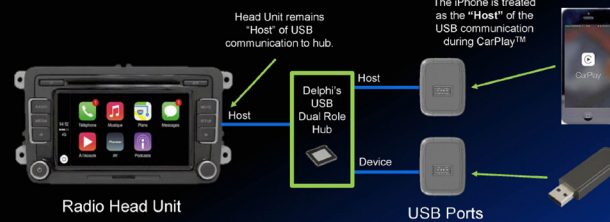
**Description :**

- Upon connection to Apple device the head unit will authenticate and then command the Bridge driver to role reverse resulting in the Apple device to be routed to the Bridge
 - Module contains a single Bridge
 - Either user accessible port may be role reversed and connected to the bridge
- When the iOS device is in host mode it will transfer data to Device B and Device B will transfer it to Device A.
- The Bridge driver in the head unit will read the data from endpoints in device A and pass it to a gadget driver

EX2022, 12.

USB Connectivity Option 3 – Multiple USB Connections with Apple CarPlay™

Delphi's Dual Role Hub



Multiple USB Connections

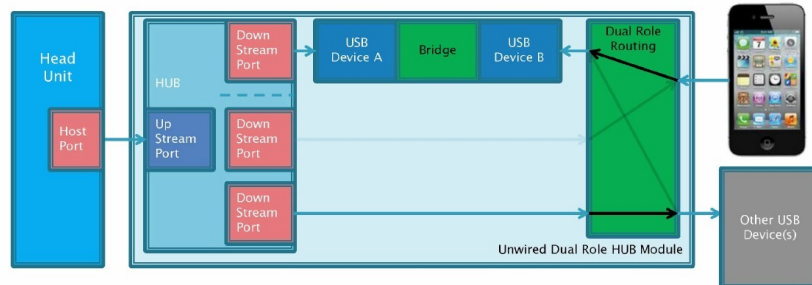
- Does not require OTG port on Head Unit → no hardware change to Head Unit
- When one of the ports is used for CarPlay™, the other ports ARE ABLE to transfer data to the Head Unit!
- Robust USB signal integrity

EX2037, 21.

18[C]

The Boston 2 chip is configured to connect a first consumer device to a second, downstream USB port:

Dual Role HUB Concept



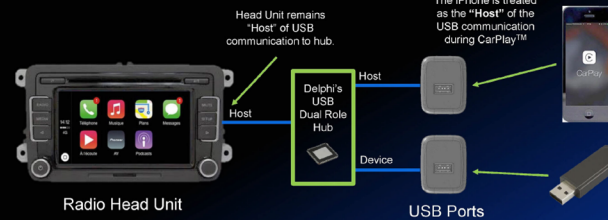
Description :

- Upon connection to Apple device the head unit will authenticate and then command the Bridge driver to role reverse resulting in the Apple device to be routed to the Bridge
 - Module contains a single Bridge
 - Either user accessible port may be role reversed and connected to the bridge
- When the iOS device is in host mode it will transfer data to Device B and Device B will transfer it to Device A.
- The Bridge driver in the head unit will read the data from endpoints in device A and pass it to a gadget driver

EX2022, 12.

USB Connectivity Option 3 – Multiple USB Connections with Apple CarPlay™

Delphi's Dual Role Hub



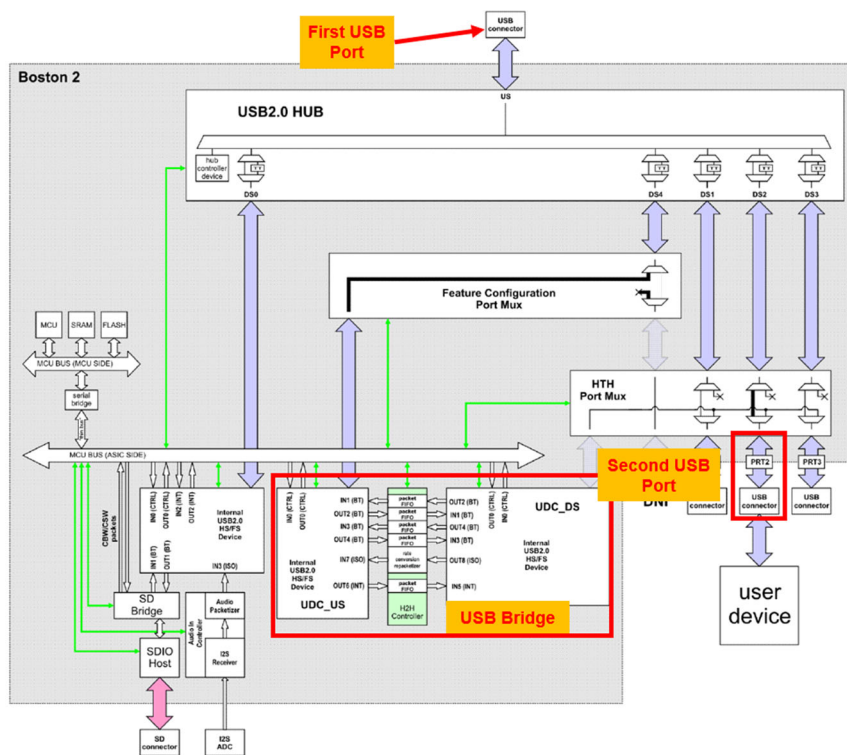
Multiple USB Connections

- Does not require OTG port on Head Unit → no hardware change to Head Unit
- When one of the ports is used for CarPlay™, the other ports ARE ABLE to transfer data to the Head Unit!
- Robust USB signal integrity

EX2037, 21.

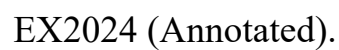
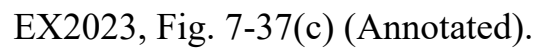
18[D]

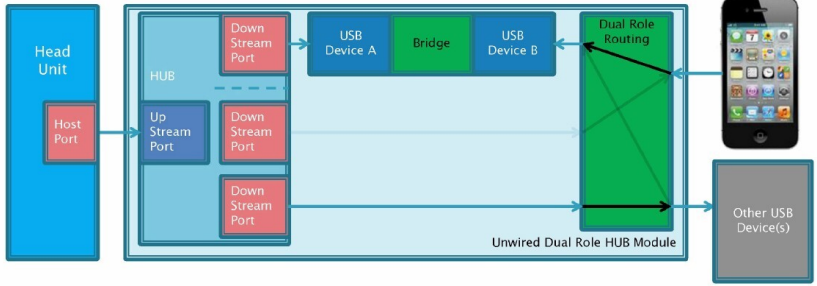
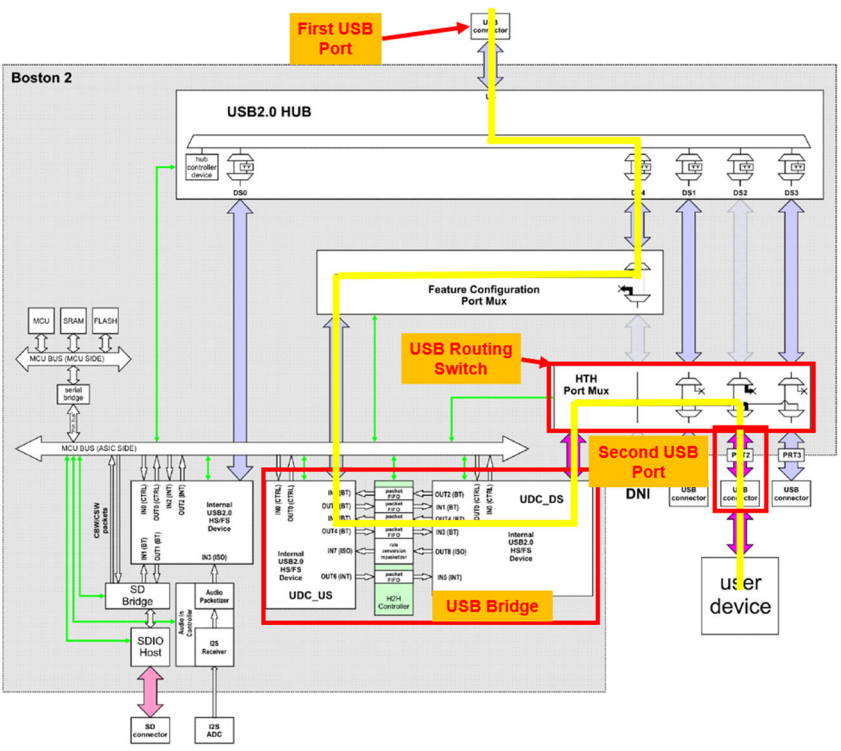
The Boston 2 chip contains a USB host-to-host bridge connected to said first USB port:



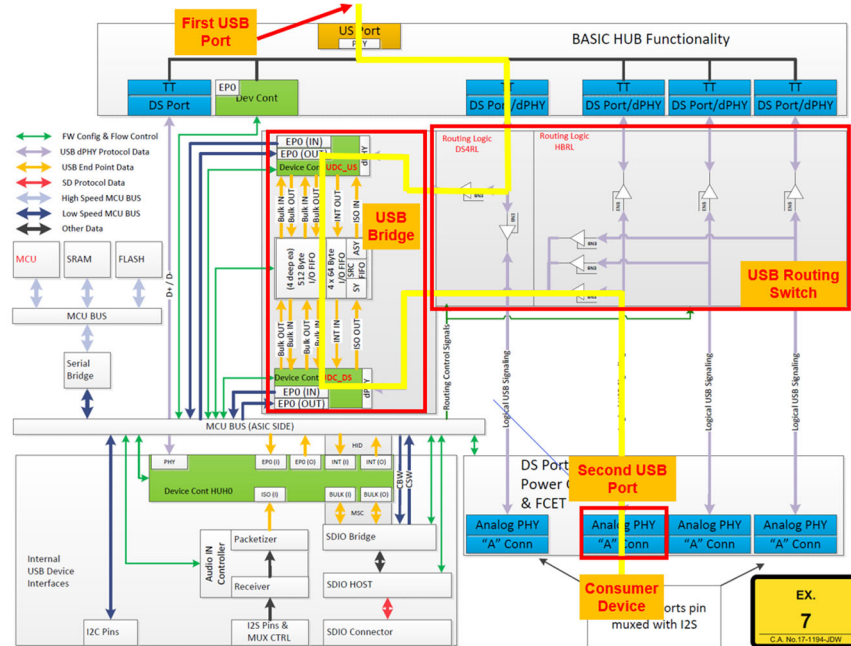
EX2023, Fig. 7-35(a) (Annotated).

	EX. 7 C.A. No. 17-1194-20W EX2024 (Annotated).
18[E]	The Boston 2 chip in Aptiv’s dual role hub contains a USB routing switch providing a first communication path between said second USB port and said USB host-to-host bridge and a second communication path between said second USB port and said first USB port that bypasses said USB host-to-host bridge:

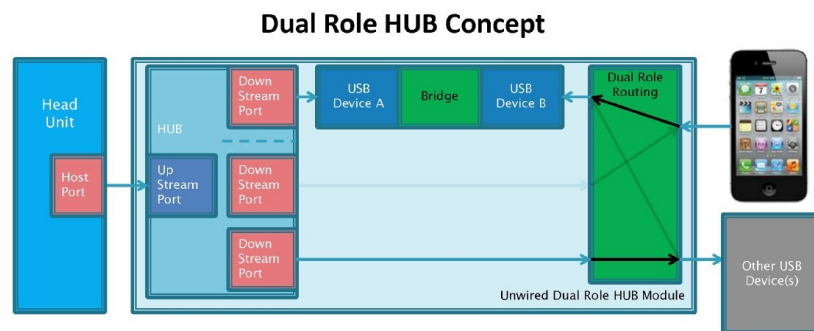


	Dual Role HUB Concept  Description : - Upon connection to Apple device the head unit will authenticate and then command the Bridge driver to role reverse resulting in the Apple device to be routed to the Bridge - Module contains a single Bridge - Either user accessible port may be role reversed and connected to the bridge - When the iOS device is in host mode it will transfer data to Device B and Device B will transfer it to Device A. - The Bridge driver in the head unit will read the data from endpoints in device A and pass it to a gadget driver EX2022,12.
18[F]	The USB routing switch in Aptiv's Boston 2 chip is configured to connect said first communication path when the first consumer device is connected to said second USB port and is operating in a USB host mode, thereby providing bidirectional initiation of communication between the USB host and the consumer device: 

EX2023, Fig. 7-37(c) (Annotated).



EX2024 (Annotated).



Description :

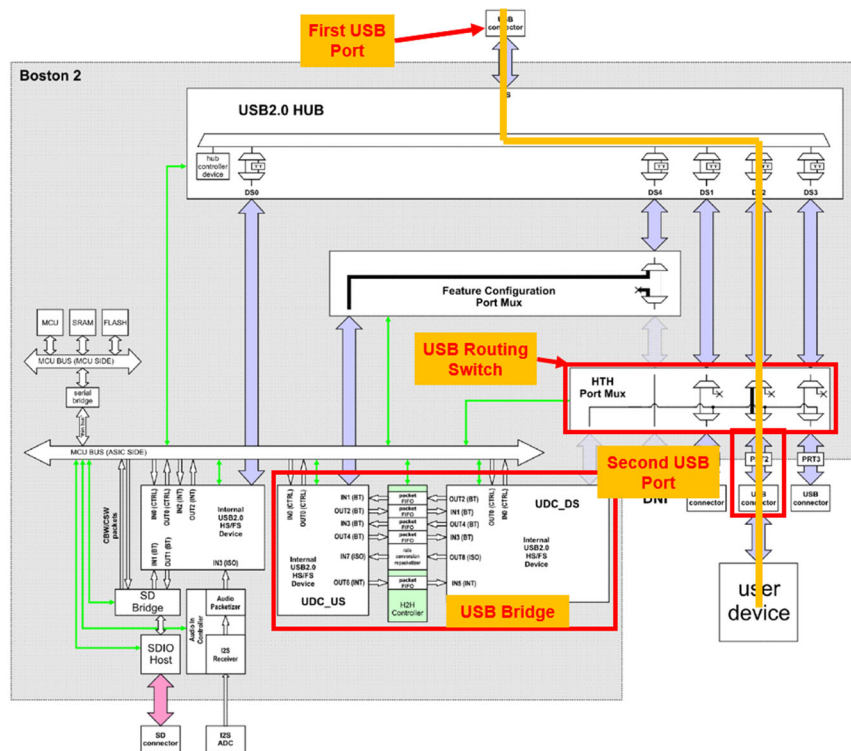
- Upon connection to Apple device the head unit will authenticate and then command the Bridge driver to role reverse resulting in the Apple device to be routed to the Bridge
 - Module contains a single Bridge
 - Either user accessible port may be role reversed and connected to the bridge
- When the iOS device is in host mode it will transfer data to Device B and Device B will transfer it to Device A.
- The Bridge driver in the head unit will read the data from endpoints in device A and pass it to a gadget driver

EX2022, 12.

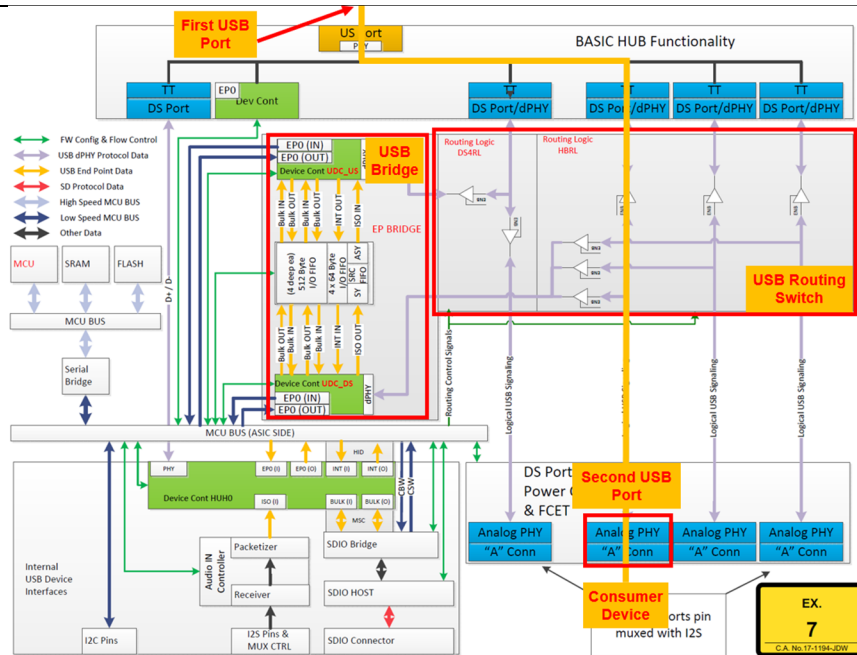
EX2023, 90-93 (describing the port switch sequence, whereby a consumer device operating in USB host mode is connected via the USB bridge).

18[G]

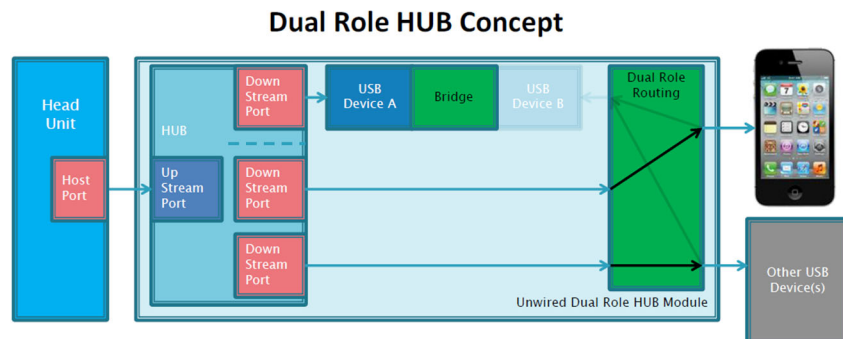
The USB routing switch in Aptiv's Boston 2 chip is configured to connect said second communication path, thereby only responding to communication initiated by the USB host when the first consumer device is connected to said second USB port and is operating in a USB device mode:



EX2023, Fig. 7-35(a) (Annotated).



EX2024 (Annotated).



EX2022, 11.

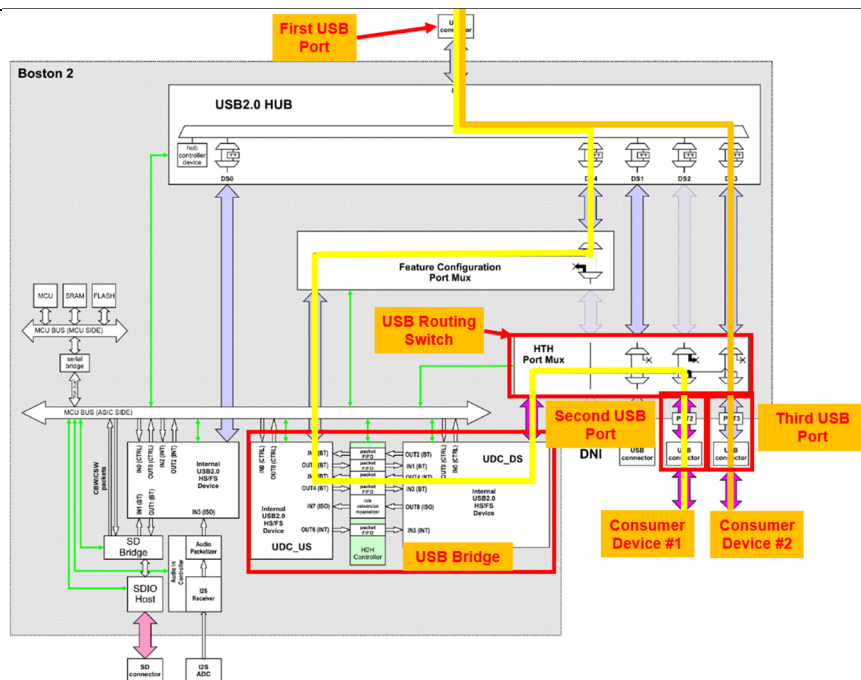
EX2023, 90-93 (describing the port switch sequence, whereby a consumer device operating in USB device mode is routed around the USB bridge).

19[P]	As addressed previously, the Boston 2 chip is designed for use in a communication system that embodies all limitations of claim 18.
19[A]	The Boston 2 chip is configured to allow the connection of a second consumer device to a third USB port:

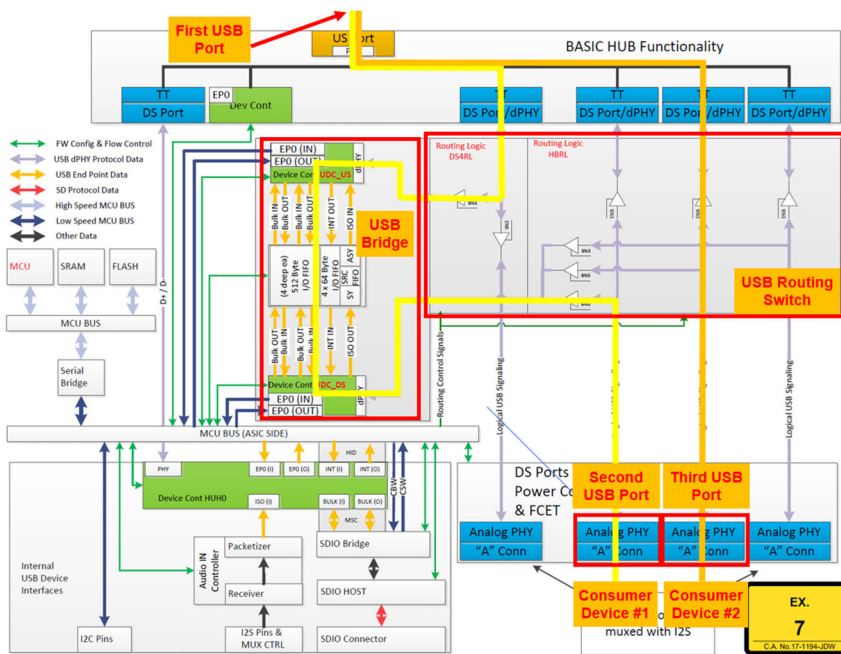


The USB routing switch in Aptiv's Boston 2 chip is configured to further connect a third communication path between said third USB port and said first USB port that bypasses said USB host-to-host bridge, thereby only responding to communication initiated by the USB Host when the second consumer device is connected to said third USB port and is operating in the USB device mode:

19[B]



EX2023, Fig. 7-37(c) (Annotated).



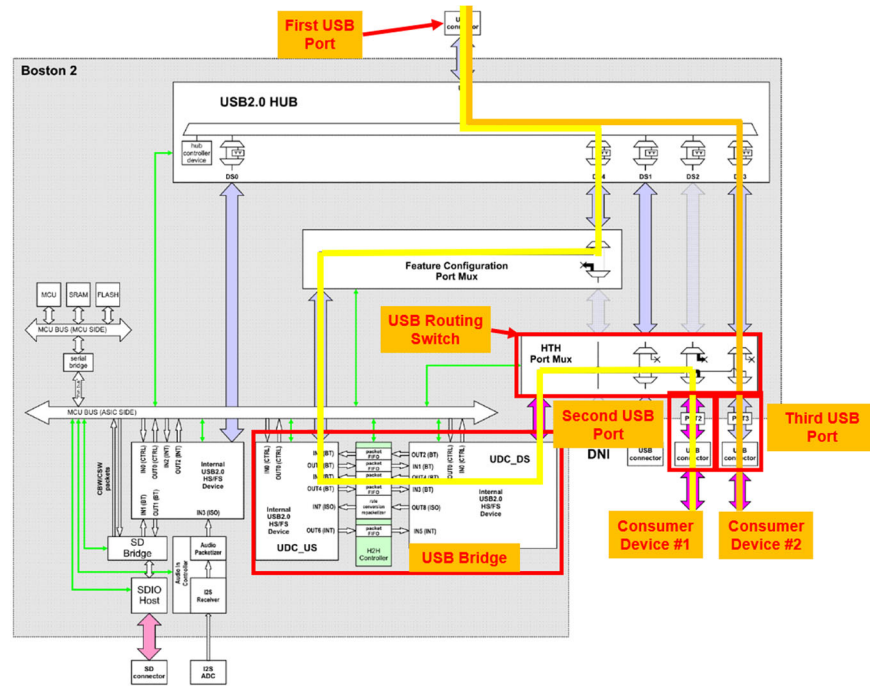
EX2024 (Annotated).

20[P]

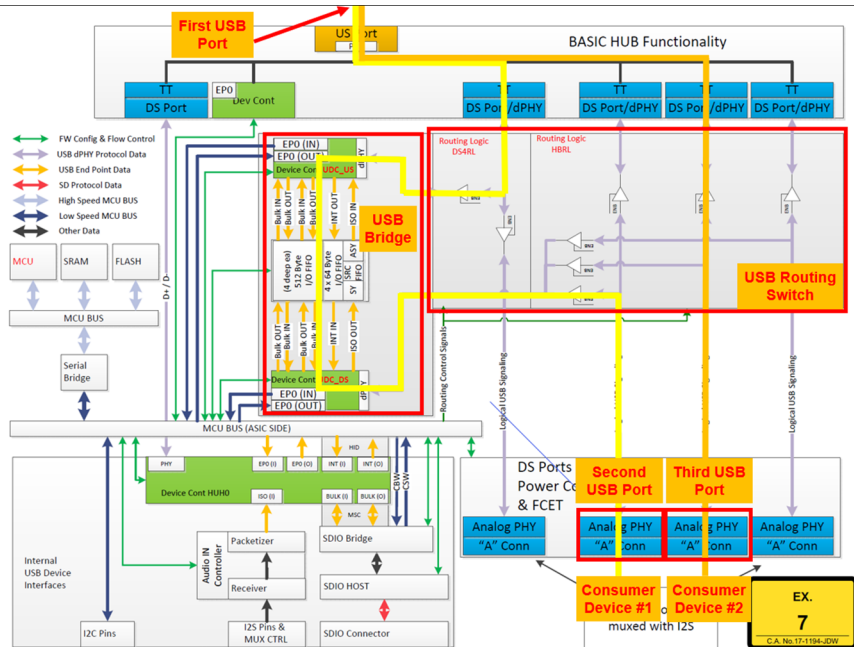
As addressed previously, the Boston 2 chip is designed for use in a communication system that embodies all limitations of claims 18 and 19.

20[A]

The USB routing switch in Aptiv's Boston 2 chip is configured to simultaneously provide the second communication path between said first USB port and said third USB port without interrupting the first communication path between said first USB port and said second USB port:



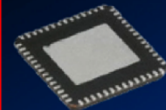
Ex2023, Fig. 7-37(c) (Annotated).



EX2024 (Annotated).

How do we support CarPlay™ in Hubs and Media Modules?

- What differentiates us is our own ASIC to support Apple CarPlay™ – which recently won the PACE award!
- This chip is designed for multi-port architecture with CarPlay™ support through unique Host-to-Host bridging technology.
- A fully functional system of downstream ports is enabled with a single USB connection to head unit
- Any of downstream ports may host CarPlay™.
- While one of the ports is occupied with Apple CarPlay™ session, the rest of ports in the system stay active and may exchange data.
- No need for USB MUX switches that can cause USB eye diagram degradation.
- Our ASIC is in production with 3 OEMs currently, with 1 more OEMs planned for later this year.



DELPHI

EX2027, 11 (Annotated).

Multiple USB Connections

- Does not requires OTG port on Head Unit → no hardware change to Head Unit
- When one of the ports is used for CarPlay™, the other ports ARE ABLE to transfer data to the Head Unit!
- Robust USB signal integrity

EX2037, 21.

Key System Considerations	Two USB Paths	Port Reversal Hub	Delphi Dual Role Hub
Head Unit used "Host" port (OTG not required)	No	No	Yes
CarPlay™ available on any USB port	No	Yes	Yes
Other hub ports work during CarPlay™	Yes	No	Yes

EX2037, 22.

IX. CONCLUSION

For the foregoing reasons, claims 13-14 and 18-20 of the '420 patent are not unpatentable.

Dated: November 20, 2024

Respectfully submitted,

By: /Alex S. Yap/

Alex S. Yap

Reg. No. 60,609

MORRISON & FOERSTER LLP

707 Wilshire Blvd., Suite 6000

Los Angeles, CA 90017

Email: AYap@mofo.com

Tel: 213-892-5200

Counsel for Patent Owner

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Dated: November 20, 2024

By: /Bryan Blumenkopf/
Bryan Blumenkopf

CERTIFICATE OF SERVICE

I hereby certify that the attached PATENT OWNER'S RESPONSE was served as of the below date via email (by agreement) to the following counsel of record for the Petitioner:

Travis Jensen (Registration No. 60,087)
tjensen@orrick.com
T61PTABDocket@orrick.com
Jeremy Jason Lang (Registration No. 73,604)
jlang@orrick.com
PTABDocketJJL2@orrick.com
Orrick, Herrington & Sutcliffe LLP
1000 Marsh Road
Menlo Park, CA 94025-1015

Dated: November 20, 2024

By: /Bryan Blumenkopf/
Bryan Blumenkopf