

A. Chang

52. Chang is an abandoned 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, ¶52~~.) Chang’s hub addresses the express goal of “easily establishing a connection between a computer and another computer.” (EX1014, [0003]; ~~EX2019, ¶52~~.) 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, ¶52~~.) FIG. 3 illustrates: (EX1014, FIG. 3.)

~~(EX1014, FIG. 3; EX2019, ¶52.)~~

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, ¶53~~.) 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, ¶53~~.)

B. Chang II

54. Chang ~~II~~¹ is an abandoned 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, ¶54.~~) 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, ¶54.~~) FIG. 1 illustrates: (EX1015, FIG. 1.

~~(EX1015, FIG. 1.)~~

55. 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, ¶55.~~) Chang II's control chip implements this feature via a process shown in FIG. 6: (EX1015, [0023], [0042], FIG. ~~6; EX2019, ¶556.~~)

~~VII, IX.~~ GROUND I: CLAIMS 1-~~12 AND 15~~-17 ARE NOT RENDERED OBVIOUS BY CHANG IN VIEW OF CHANG II AND POSITA KNOWLEDGE

56. The Petition proposes in Ground I that claims 1-12 and 15-17 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 which Petitioner claims were within the knowledge of the POSITA. (*See, e.g.*, Petition, 32-46; ~~EX2019, ¶56.~~)

57. In my view, the challenged claims are not rendered obvious by the Petition's proposed combination at least because, as explained below, the proposed combination fails to meet all limitations of the challenged claims. ~~(EX2019, ¶57.)~~ I understand 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, ¶57.)~~ Furthermore, as explained below, 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, ¶57.)~~

A. The Petition's Proposed Combination

58. The Petition proposes three separate implementations of combining Chang, Chang II, and the POSITA's knowledge. (Petition, 32-46; ~~EX2019, ¶58.~~) 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, 32-46; ~~EX2019, ¶58.~~)

59. 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, ¶59.~~) 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 as described herein.~~-(EX2019, ¶59.)~~

1. **The Mux Implementation**

60. The Petition discloses a proposed implementation (the “mux implementation”), that inserts a multiplexer within Chang’s USB hub 40. (Petition, 38-39.) Notably, the Petition does not identify the mux implementation as a basis for challenging any claim. (*See* Petition, 32-83; 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).) I understand the mux implementation is thus outside the scope of Ground I. (*See* 35 U.S.C. § 312(a)(3).)

61. 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, 34-43;~~EX2019, ¶61.~~) 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, 10, 38-39;~~EX2019, ¶61.~~)

62. The Petition then modifies the combination further to incorporate Chang II's bridge device 1; the Petition supposes that Chang II's detection unit and/or bridge would generate signals that control the multiplexer's switching, surmising that doing so "would have been routine and obvious." (Petition, 37-38 n.11;~~EX2019, ¶62.~~)

2. The Internal Crossbar Implementation

63. In two other proposed implementations (the "crossbar implementations"), Chang and Chang II are modified by inserting a crossbar switch. (Petition, 43-47;~~EX2019, ¶63.~~) In the "internal crossbar implementation," or "Hub 46 implementation," the crossbar is inserted within Chang's USB hub 40. (Petition, 45-46;~~EX2019, ¶63.~~) 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, 38-39, 45;
~~EX2019, ¶63.~~)

64. 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, 63;
~~EX2019, ¶64.~~)

65. 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, 58;
~~EX2019, ¶65.~~)

66. As with the mux implementation, the Petition does not rely on Chang II's internal switching between the bridge path or the bypass path; instead, as discussed below, the crossbar apparently performs the switching based on the same bridging detection signal generated by Chang II's control chip 13.

(Petition, 38 n.11, 57 n.15;
~~EX2019, ¶66.~~) The Petition speculates that this proposed modification “would have been routine and obvious.” (Petition, 38 n.11;
~~EX2019, ¶66.~~)

3. The External Crossbar Implementation

67. In the “external crossbar implementation,” or “Hub 40 implementation,” the crossbar is inserted external to Chang's USB hub 40. (Petition, 42-43;
~~EX2019, ¶67.~~) 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, 38-39, 46;~~EX2019, ¶67.~~)

68. 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, 63;~~EX2019, ¶68.~~)

69. 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, 58;~~EX2019, ¶69.~~.)

70. As above, the Petition does not rely on Chang II's internal switching between the bridge path or the bypass path; instead, the crossbar apparently performs the switching based on the same bridging detection signal generated by Chang II's control chip 13. (Petition, 38 n.11, 57 n.15;~~EX2019, ¶70.~~) The Petition speculates that this proposed modification “would have been routine and obvious.” (Petition, 38 n.11;~~EX2019, ¶70.~~)

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, ¶71.)~~ The proposed combination further is unsupported by the references, and relies solely on expert testimony that is contradictory and unreliable. ~~(EX2019, ¶71.)~~

1. ~~1.~~ The Petition Fails to Show the USB Routing Switch With Particularity For Any Challenged Claim

72. All challenged claims recite 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, 54-55; ~~EX2019, ¶72.~~) These switching elements are absent from Chang and Chang II, and are instead supplied from the POSITA’s alleged knowledge. (See Petition, 33-46, 38 n.11, 57 n.15; ~~EX2019, ¶72.~~)

73. The claimed USB routing switch cannot be met by off-the-shelf switching components alone. ~~(EX2019, ¶73.)~~ The claims instead require the USB routing switch to be configured in a particular manner. *First*, the claimed USB routing switch must be configured to connect a second USB port to the first USB port through the USB bridge when a consumer device connected to the second USB port is in a USB host mode, thereby providing bidirectional initiation of communication with the upstream USB port. (See *e.g.*, EX1003, claim 1.) *Second*, the claimed USB routing switch must be configured to connect the second USB port directly to the first USB port through the USB hub

when the consumer device connected to the second USB port is in a USB device mode. (EX1003, claim 1.)

74. The Petition fails to show how generic switching elements—muxes or crossbars—would be combined with Chang and Chang II to meet these specialized configuration 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. (~~EX2019, ¶74;~~ (EX1013, ¶¶89, 91, 223, 237, 259 (citing EX1055, 284-299, 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, ¶¶148, 163, 258 (citing EX1063, 8), 223;~~EX2019, ¶74.~~)

75. 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 footnotes, 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, 38 n.11, 57 n.15;~~EX2019, ¶75.~~)

76. The Petition’s evidentiary support is limited and nonspecific. ~~(EX2019, ¶76.)~~ The Petition identifies that “Chang II’s bridge controls routing”; and observes generically that the Chang II bridge includes a control chip and detection unit, and that Chang II discloses a “bridging detection signal” internal to the control chip; ~~and cites to Mr. Welch’s description of garden-variety multiplexers and crossbars.~~ (Petition, 38 n.11, 57 n.15; ~~EX2019, ¶76.~~) From this, the Petition concludes that in its proposed Crossbar Implementations, “the crossbar ~~would connect~~connects the downstream port to the bridge upon detecting a downstream host.” (Petition, 57 n. 15; ~~EX2019, ¶76.~~) But the Petition fails to set forth how the bridging detection signal of Chang II would be utilized by the crossbar in the Crossbar Implementations to connect the USB ports in the specific configurations recited by claim 1; or how any such modification to Chang and Chang II would be within the scope of the POSITA’s general knowledge. ~~(EX2019, ¶76.)~~ 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 routing switch configuration of the claims. ~~(EX2019, ¶76.)~~

77. 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, ¶77.)~~) 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

78. 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, ¶78.)~~

79. In the proposed combination, as described above in Section ~~VHIX~~.A, a multiplexer or a 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 connecting the USB port to the hub control module 46 via Chang’s bridge 52, if the device on the downstream port is in host mode. ~~(EX2019, ¶79.)~~ The Petition proposes modifying Chang with Chang II’s bridge device 1, which includes a control chip 13 for detecting (via detection unit 134) the mode of a connected downstream device, and switching between two transmission paths accordingly. (See Petition, 28 (citing EX1015, [0024], [0046]); ~~EX2019, ¶79.)~~)

80. 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, ¶80.~~) Instead, the Petition relies on the *crossbar* as the USB routing switch. (Petition, 45-46, 54-56; EX1013, ¶¶185, 190; ~~EX2019, ¶80.~~) This switching process is described in Section ~~VHIX~~.A.

81. Notwithstanding the Petition's deficient description of the crossbar control signals, discussed above, the proposed combination relies on installing Chang II's detection unit 134 in Chang's bridge 52 to provide the control signals that cause the crossbar to route the downstream ports through the appropriate transmission path. (See EX1013, ¶¶222-223 (explaining that Chang II's detection unit is part of control chip 13 and "built into the same component where the bridge is located"), 239; ~~EX2019, ¶81.~~) For example, the Petition indicates that Chang II's "bridging detection signal," which is provided by detection unit 134, is applied to the crossbar to direct it to connect the downstream port to the bridge upon detecting a downstream host. (Petition, 57 n.15; ~~EX2019, ¶81.~~) Similarly, the Petition states (with respect to claim 6, which depends from claim 1): "The detection unit and CPU control switching; namely, the detection unit 'determine[s] the type of device currently connected'

(host/device) and sends the CPU a ‘detection signal’ ~~which switches~~
~~(connects)~~ used to switch (connect) the appropriate path ... Applying this teaching
to Chang, *Chang’s bridge* would be configured to control the ~~crossbar via~~
~~its crossbar’s~~ control inputs.” (Petition, 72 (~~emphasis added~~) (~~citing~~ EX1013,
¶¶270-271; ~~EX1068, 2~~; EX1063, 7; EX1060, 1; EX1055, 284-288); ~~EX2019,~~
~~¶81.))~~.) Similarly, Mr. Welch explains that “the bridge could send a signal to the
switch directing it to connect what was plugged in directly to one of the Hub
ports,” thus providing the Petition’s Crossbar Implementations. (EX1013, ¶239;
~~EX2019, ¶81.~~)

82. In order to generate the detection signal, the detection unit 134
executes the process shown in FIG. 6 of Chang II, described above. (Petition,
28; EX1015, FIG. 6, [0024]; ~~EX2019, ¶82~~; EX1013, ¶¶159, 270 (citing
EX1015).) Generating the detection signal requires that the detection unit 134
(and thus the bridge) communicate with the downstream port. (~~EX2019, ¶82.~~)
For example, as described by Mr. Welch, the detection unit determines the
connection of either a host or device on the port by “sending an ‘inquire signal’
and receiving a response” when a host connects (as shown in S603 and S605 of
FIG. 6), or “receiving an ‘inquire signal’” when a device connects (S617); and
producing a detection signal (*e.g.*, a bridging detection signal or slave detection
signal) accordingly. (EX1013, ¶¶80, 159, 189, 244; ~~EX2019, ¶82.~~) Mr. Welch

further explains that these detection signals “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, ¶¶159, 190, 193, 258; ~~EX2019, ¶82.)~~

83. Furthermore, as Mr. Welch recognizes, Chang II’s switching detection circuit is “built into the same component where the bridge is located,” and is advantageously located on the same physical control chip 13 as other bridge elements, such as Chang II’s CPU, buffer unit, and first and second USB controllers, as shown in Fig. 2 of Chang II. ~~(EX1013, ¶¶275-276 (citing EX1015, Figs. 1, 2, 5, [0034], [0037]-[0038], [0040]); EX2019, ¶83.)~~ The ~~detection circuit is thus located in Chang’s bridge 52. (EX2019, ¶83.)~~ controllers, as shown in Fig. 2 of Chang II. (EX1013, ¶¶275-276 (citing EX1015, Figs. 1, 2, 5, [0034], [0037]-[0038], [0040]).) The detection circuit is thus located in Chang’s bridge 52.

84. But the proposed combination includes a structural flaw. ~~(EX2019, ¶84.)~~ 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 detection unit (in Chang’s bridge 52) is *separated* from the downstream ports (*i.e.*, 44, 50) by the

routing switch—*i.e.*, a ~~crossbar². (EX2019, ¶84.)~~crossbar. The Petition illustrates this separation: ~~(Petition, 38-39, 45.) (Petition, 38-39, 46.)~~

85. 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, 58; EX2019, ¶85.) (Petition, 58; EX2019, ¶85.)~~

86. 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, 63; EX2019, ¶86.)~~ (Petition, 64; ~~EX2019, ¶86; 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,~~87. 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, ¶87; (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, ¶87.)~~ 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, ¶87.~~) 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: (EX1063, 8; ~~EX2019, ¶87;~~ *see also* EX1013, ¶58.)

88. When the bridge device is bypassed by the crossbar, it is thus electrically disconnected from the downstream USB ports coupled to the crossbar. ~~(EX2019, ¶88.)~~ Because the bridge device 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; and, accordingly, prevents the bridge device generating the bridging detection signal, or otherwise providing control signals to the crossbar. ~~(EX2019, ¶88.)~~ 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, 29; EX1013, ¶¶80, 159, 239; ~~EX2019, ¶88.~~)

89. FIG. 6 of Chang II further demonstrates the flaw in the proposed combination. As described above, FIG. 6 illustrates a process performed by Chang II's bridge device (*i.e.*, control chip 13 of the bridge device) to detect whether a connected external device is in host mode or device ("slave") mode ~~(EX2019, ¶89.) (EX1015, FIG. 6; EX2019, ¶89.)~~

(EX1015, FIG. 6.)

90. In the illustrated process, the control chip exchanges signals with the external device at least at stages S603, S605, S617; and checks for a newly inserted external device at stages S601, S613, and S625. ~~(EX1015, FIG. 6; EX2019, ¶90.)~~

6.) 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, ¶90.)~~ 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, ¶90.)~~

This dead-end state—which the Petition wholly fails to address—renders the

proposed combination incapable of meeting the claimed dynamic switching as described above. ~~(EX2019, ¶90.)~~

C. The Proposed Combination Does Not Meet the Claim Limitations

i. Claims 1, 7, and 15

91. The Petition's proposed combination fails to meet the limitations of claim 1 or analogous claims 7 and 15. ~~(EX2019, ¶91.)~~ Because all challenged claims depend from claim 1, 7, or 15, this defect is fatal to the Petition.

a. The Proposed Combination Does Not Meet the Claimed USB Routing Switch

92. Claims 1, 7, and 15 require a USB routing switch configured according to specific requirements. For example, the claimed USB routing switch is configured to connect the second USB port to the first USB port through the USB bridge, thereby providing bidirectional initiation of communication between the USB host and the consumer device when the consumer device connected to the second USB port is in a USB host mode. Further, the claimed USB routing switch is configured to connect the second USB port directly to the first USB port through the USB hub, thereby only responding to communication initiated by the USB Host when the consumer device connected to the second USB port is in a USB device mode. (*See e.g.*, EX1003, claim 1.)

93. To meet this claim limitation, 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, 57.) The Petition explains the limitation is met because “Upon detection, the appropriate crossbar control signals are asserted to connect the consumer product to the bridge (for host-to-host transmission path 54) or directly to the hub (for host to-device transmission path 48).” (*Id.*) Further, the Petition apparently relies on Chang II’s “bridging detection signal” to meet these crossbar control signals. (Petition, 57 n. 15.)

94. But as explained above in Section ~~VHIX~~.B, the Petition’s characterization of the proposed combination is inaccurate, and the Petition thus relies on faulty premises to meet these limitations. ~~(EX2019, ¶94.)~~ For example, the proposed combination does not “detect[] the downstream consumer product’s operating mode (i.e., device/host)” at all. ~~(EX2019, ¶94.)~~ Instead, it reaches a state in which the crossbar routes the downstream consumer device directly to the USB hub, disconnecting the detection unit that generates the bridging detection signal; 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, ¶94.)~~ 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, ¶94.)~~ The Petition thus fails to show this claim element is met. ~~(EX2019, ¶94.)~~

b. The Crossbar Implementations Cannot Meet The USB Routing Switch

95. The crossbar implementations cannot meet the claims for the additional reason that they do not meet the required relationship between the components of the USB hub module. ~~(EX2019, ¶95.)~~ The claims require “a USB Bridge *interconnected to* the USB Hub” and “a USB routing switch *interconnected to* the USB Bridge, the USB Hub, and the second USB Port.”

96. To the extent the Petition argues that Hub Control Unit 46 (a subcomponent of USB Hub 40) meets the claimed USB Hub, that mapping is unsustainable. ~~(EX2019, ¶96.)~~ First, it contradicts the references: Chang expressly identifies USB Hub 40—not its subcomponent, Hub Control Unit 46—as its USB hub. ~~(EX1014, [0019]; EX2019, ¶96.)~~ Second, it contradicts the Petition itself: in describing the crossbar implementations, Petitioner simultaneously identifies both USB Hub 46 and USB Hub 40 as the claimed USB Hub. (Petition, 42-43, 45-52; *see* EX2021, 137:10-20; ~~EX2019, ¶96.~~) Third, it contradicts Petitioner’s expert, who testified that Chang’s control unit

46 does not satisfy the definition of a hub in the challenged claims. (EX2021, 215:6-23;~~EX2019, ¶96.~~)

97. Neither can USB hub 40 meet the claim limitations. In the corresponding litigation between the parties, Petitioner took the position (with respect to the related '037 patent) that “A POSITA would have understood that components that are part of the USB hub ... cannot also be connected to it.” (EX2020, 22.) Similarly, Petitioner endorsed the position that “it [is] not logical that [Component A] and [Component B] can be *components of* the USB switching hub 119 that are contained within USB switching hub 119 and at the very same time be *interconnected to* the same USB switching hub 119.” (EX2020, 22 (emphases in original).) And Petitioner’s expert admitted in his deposition that Chang’s bridge 52, which is internal to Chang’s USB Hub 40, is not interconnected with USB Hub 40. (EX2021, 208:1-6.) Yet in the Petition, the purported USB routing switch (*i.e.*, the crossbar) is both within USB Hub 40 and interconnected to that same USB Hub 40. (Petition, 45-46;~~EX2019, ¶97.~~) Similarly, the Petition’s purported USB bridge is both within USB Hub 40 and also interconnected to USB Hub 40. (Petition, 45-46;~~EX2019, ¶97.~~) This mapping is inconsistent with the scope of “interconnected to” that Petitioner and its expert have endorsed.~~(EX2019, ¶97.)~~

ii. Claims 2, 8, 16, and 17~~2.~~

98. Claims 2, 8, 16, and 17~~Claims 2, 8, 16, and 17~~ depend from claims 1, 7, and 15, respectively. In addition to the reasons described above for the parent claims 1, 7, and 15, claims 2, 8, 16, and 17 are not rendered obvious because the Petition's proposed combination cannot meet limitations of claims 2, 8, 16, and 17 requiring that the USB routing switch be configured to connect *multiple simultaneous* downstream USB devices to the USB hub.~~(EX2019, ¶98.)~~

99. As described above, the Petition relies on Chang II's control chip 13 to generate control signals that direct the crossbar to select a transmission path for a downstream USB port. ~~(EX2019, ¶99.)~~ 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, 27; EX1015, [0030], [0012]; ~~EX2019, ¶99.)~~.)

100. The proposed combination thus lacks the requisite control logic for configuring the crossbar to connect multiple devices (*i.e.*, on both a first downstream USB Port and a second downstream USB Port) to the USB Hub in the manner required by the claim. ~~(EX2019, ¶100.)~~ And the Petition does not offer any modification that would permit Chang II's bridge to accept multiple devices. ~~(EX2019, ¶100.)~~ The proposed combination cannot meet claims 2, 8, 16, or 17 for at least this reason. ~~(EX2019, ¶100.)~~

101. Moreover, 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 ~~VHIX~~.B. Even this hypothetical modification still could not meet claims 2, 8, 16, or 17: parent claims 1, 7, and 15 require that the routing switch be configured to “connect the second USB port directly to the first USB port through the USB hub.” (~~EX2019, ¶101.~~) As described above, this connection bypasses the bridge and prevents the detection unit from providing the crossbar with the control signals that would be needed to simultaneously connect a second downstream device according to claims 2, 8, 16, and 17. (~~EX2019, ¶101.~~)

a. The Multiplexer Implementation Cannot Meet The USB Routing Switch

102. The Petition’s element-by-element analysis of the claims is silent with respect to the proposed mux implementation; the Petition does not even attempt to show that this implementation would meet the claimed USB routing switch. (Petition, 45-64; ~~EX2019, ¶102.~~) In his deposition, Mr. Welch explained why: in the mux implementation, the purported USB routing switch—the 2:1 multiplexer—has “only ... one dual-role port,” and thus cannot meet a routing switch configured to “simultaneously connect another second USB port” as recited in claim 2. (~~EX1021, 218:6-21; EX2019, ¶102.~~) For at least this reason,

in addition to those described above, the mux implementation would fail to read on claim 2, claims 8, 16, and 17 (which similarly recite the routing switch configured to connect multiple downstream ports), or their respective dependent claims, even if it were asserted in the Petition. (EX1021, 218:6-21;~~EX2019, ¶102.~~)

~~3.~~ iii. Claim 3

103. Claim 3 depends from claim 1 and recites that the USB hub module is configured to recognize whether the consumer device connected to the first downstream USB port is configured to act as the USB host or as a USB device and control the USB routing switch accordingly. (EX1003, claim 3.) For this claim, the Petition relies on Chang II’s detection unit “automatically operat[ing] to ... determine the type of device currently connected” to the port; and hypothesizes that “the detection results would control the crossbar control signals.” (Petition, 68-69.) But as explained above in Section ~~VHIX~~.B, in the proposed combination, the detection unit would be inoperable to perform any such detection if the downstream USB port is configured to act as a USB device and has been connected to the USB hub; the USB hub module is thus unable to control the USB routing switch “accordingly” as required by claim 3.~~(EX2019, ¶103.)~~

104. Additionally, the Petition speculates that the POSITA would “naturally integrate detection functionality into the hub, bridge, or switch”; but fails to set forth how the POSITA would have integrated Chang II’s detection unit (on which the Petition relies) into the combination of Chang and the POSITA’s knowledge, with any reasonable expectation of success. (Petition, 69; ~~EX2019, ¶104.~~) The Petition fails to meet claim 3 for at least these reasons, in addition to the reasons described for parent claim 1. ~~(EX2019, ¶104.)~~

iv. Claim 4

105. The Petition’s proposed combination suffers from glaring and fatal defects that render it incapable of meeting claim 4, as described herein.

~~(EX2019, ¶105.)~~ Claim 4 is patentable in view of the Petition for this reason, in addition to the reasons discussed above for parent claim 1 from which it depends.

a. The proposed combination disconnects the bridge device from the downstream ports, rendering it incapable of dynamically switching

106. Claim 4 depends from claim 1 and requires that the claimed USB hub module be configured to *dynamically switch* operation of the second USB port between supporting the consumer device in the USB device mode or the USB host mode. (EX1003, claim 4; ~~EX2019, ¶106.~~) Under any reasonable interpretation, dynamically switching *between* the USB device mode and the

USB host mode must at minimum mean that the USB hub module permits switching from host mode to device mode; and from device mode to host mode.

~~(EX2019, ¶106.)~~ To find otherwise would read out the claim term “between,” which limits the claimed dynamic switching. ~~(EX2019, ¶106.)~~

b. The proposed combination only detects device modes when an external device is newly connected

107. Even if the proposed combination did not result in disconnecting the bridge device from the downstream ports, as described above, the proposed combination still cannot meet claim 4 because Chang II’s bridge device cannot detect a device’s mode changes, making dynamic switching impossible.

~~(EX2019, ¶107.)~~ The Petition asserts it would have been obvious for the POSITA to “periodically check the device/host mode and ‘dynamically switch’ paths based on the current mode.” (Petition, 70; ~~EX2019, ¶107.~~) The Petition claims that a POSITA would be motivated to make this combination to “avoid unplugging/replugging products to change modes.” (Petition, 70; ~~EX2019, ¶107.~~)

108. However, the proposed combination relies on Chang II’s control chip to detect the mode change. As discussed above, in order to detect a mode of an external device, the control chip performs the process illustrated in FIG. 6: (EX1015, FIG. 6; ~~EX2019, ¶1086.~~)

109. Contrary to the Petition’s assumptions, Chang II’s detection process does not include any ability to detect a mode change of an external device. (Petition, 70;~~EX2019, ¶109.~~) Instead, as apparent from FIG. 6, the control chip only detects whether a device is in a host mode (S607) or a slave mode (S619) *after* the control chip has determined that an external device has been connected (*i.e.*, at S601, S613, or S625). (EX1015, FIG. 6;~~EX2019, ¶109.~~) Once a device’s mode has been determined at S607 or S619, the control chip will loop at stage S613 or S625 until it has determined that the user has connected another external device. (EX1015, FIG. 6;~~EX2019, ¶109.~~) This is contrary to the Petition’s speculation that the proposed combination can detect a single device’s mode change “during an active session,” or without “unplugging/replugging products to change modes.” (Petition, 70;~~EX2019, ¶109.~~) Mr. Welch agreed emphatically at his deposition, characterizing it as “absolutely correct” that FIG. 6 is silent about “checking to see if a connected device has switched modes while remaining plugged in.” (EX2021, 252:23-253:7;~~EX2019, ¶109.~~)

110. While Mr. Welch claims that Chang II is “‘automatically and periodically’ and ‘constantly’ checking the host/device status of a connected product,” EX1013 at 265, this is misleading: Chang II only describes “‘automatically and periodically” switching between a virtual host state and a

virtual slave state at stages S603 and S615 of the process in FIG. 6. (EX1015, [0024]; ~~EX2019, ¶110.~~.) As FIG. 6 makes clear, the process will repeat stages S603 and S615 only until it determines that the external device is a host device (S607) or a slave device (S619), as illustrated by the red arrows in the below figure: (EX1015, FIG. 6 (annotated); ~~EX2019, ¶110.~~.)

111. As described above, the behavior of the control chip is governed by FIG. 6, which indicates that the detection process is not repeated until it determines that a new external device has been connected (S613, S625). (EX1015, FIG. ~~6~~; ~~EX2019, ¶111~~.)

112. The Petition proposes making “minimal changes” to the FIG. 6 algorithm, such that steps S613 and S625 would “check for a mode change regardless of whether the user plugged in another USB product.” (Petition, 70-71; EX1013, ¶¶264-265; ~~EX1013, ¶112.~~) For example, Mr. Welch suggests that S613 and S625 could be modified as follows: (Petition, 70-71; EX1013, ¶264 (annotated by Patent Owner); ~~EX2019, ¶112.~~.)

113. However, this proposed modification would not cure the defects described above. (~~EX2019, ¶113.~~) For example, the proposed modified combination would be unable to “check for a mode change” on a device connected to a downstream USB port, once the routing switch has connected that

downstream USB port directly to the USB Hub (*e.g.*, upon detecting that the connected device is in device (slave) mode at S619). ~~(EX2019, ¶113.)~~ This is for the reasons described above: when the downstream port is connected directly to the USB Hub, the bridge is bypassed, and the control chip that executes the FIG. 6 process is unable to connect to, or communicate with, a device on that downstream port. ~~(EX2019, ¶113.)~~ The proposed combination would thus be unable to detect any mode change of any such device; and would be unable to meet the claimed “dynamically switching” at least because once the operation of the second USB port has been switched to USB device mode, it cannot be switched back to the USB host mode (*i.e.*, “between” the device mode and the host mode). ~~(EX2019, ¶113.)~~

114. Accordingly, the proposed combination cannot meet claim 4 for at least these reasons. ~~(EX2019, ¶114.)~~

5.—v. Claims 5 and 11

115. Claims 5 and 11 depend from claims 1 and 7, respectively, and further limit the configuration of the claimed USB routing switch. In claims 5 and 11, the USB routing switch must be configured to connect the consumer device to either the USB bridge or the USB hub based on whether the consumer device attached to the second USB port is configured to act as the USB host or a USB device. ~~(EX2019,~~

~~¶115.)~~

116. In addition to the reasons discussed above for the parent claims, Claims 5 and 11 are not rendered obvious because the Petition’s proposed combination does not meet this additional limitation of the USB routing switch.

~~(EX2019, ¶116.)~~ The Petition disregards this limitation, and relies on its analysis of claims 1 and 2 to purportedly meet claims 5 and 11. (Petition, 71-72, 73-74;
~~EX2019, ¶116.)~~ As the POSITA would recognize, the language “the consumer device attached to each downstream USB port in the plurality of downstream USB ports” requires a plurality of at least two consumer devices, in order for there to be a consumer device attached to each of a plurality of downstream USB ports. ~~(EX2019, ¶116.)~~ The Petition’s proposed combinations cannot meet this requirement that the USB routing switch be configured to connect to multiple downstream USB devices for the reasons discussed above with respect to claims 2 and 11. ~~(EX2019, ¶116.)~~

**ED. 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**

117. 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 that I understand has long been 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—to 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, ¶117.)~~ 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, ¶117.)~~

118. 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, at 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, ¶118.)~~

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

119. I understand that 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”).

120. The proposed combination improperly transforms the references, removing key functionality, and cannot support a *prima facie* case. ~~(EX2019, ¶120.)~~ As the Petition repeatedly emphasizes, Chang II repeats two “fundamental concepts”: “(1) host/device detection and (2) selecting between two different transmission paths.” (Petition, 28-29 (citing EX1015, [0024], [0046]); ~~EX2019, ¶120.)~~). 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, 28-29, 33, 38, 58; EX1015, [0021]; ~~EX2019, ¶120.~~) 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, ¶120.)~~

121. Thus, the proposed combination would render Chang II inoperable for its admitted main feature and intended purpose. ~~(EX2019, ¶121.)~~ 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, ¶121.~~) 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, 29-32; EX1013, ¶¶160-165; ~~EX2019, ¶121.~~)

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

122. The proposed combination suffers from additional defects that no POSITA would be motivated to incur. ~~(EX2019, ¶122.)~~ As described above, the proposed combination enters a state from which it cannot return: Chang II's control chip 13 is 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, ¶122.)~~ 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, ¶122.)~~ Additionally, as described above, the proposed combination would be unable to properly detect new external devices connected to the bridge device. ~~(EX2019, ¶122.)~~ 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, ¶122.)~~ 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, ¶122.)~~ No

POSITA would thus be motivated to modify Chang and Chang II in the manner proposed. ~~(EX2019, ¶122.)~~

123. 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, ¶123.)~~ 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, ¶123.~~) 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, ¶123..)~~ No POSITA would be motivated to implement this combination. ~~(EX2019, ¶123..)~~

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

124. 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, ¶124.)~~ 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, ¶124.)~~

125. 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.*:

(Petition, 43; ~~EX2019, ¶125.~~)

126. As described above, the proposed combination uses the new switching hardware as a replacement for Chang II’s existing switching circuitry.

~~(EX2019, ¶126.)~~ 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, 78; ~~EX2019, ¶126.~~) 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: (EX1015, FIG. 5 (annotated); ~~EX2019, ¶126.)~~.)

127. 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, ¶127.~~)

128. 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, ¶128.)~~ 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, ¶128.~~) No POSITA would be motivated to combine the prior art in a manner that introduces such costs and complexity unnecessarily. ~~(EX2019, ¶128.)~~ Moreover, the proposed combination would undercut key goals of Chang II: simplicity, efficiency, and convenience. (EX1015, [0010], [0021]; ~~EX2019, ¶128.~~.) Chang II thus discourages the Petition’s proposed combination. ~~(EX2019, ¶128.)~~

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

129. 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, ¶129.~~ 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, ¶129.)~~ 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, ¶129.)~~

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

130. I understand that 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).