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I hereby appoint:

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OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

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Assignee Name and Address: Aptiv Technologies Limited
Erin Court, Bishop's Court Hill
St. Michael, Barbados 14004

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	/Craig A. Baldwin/	Date	22 October 2019
Name	Craig A. Baldwin	Telephone	248-813-1214
Title	Assistant Secretary, Aptiv Technologies Limited		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Aptiv Technologies Limited

Application No./Patent No.: _____ Filed/Issue Date: Herewith

Titled: FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

Aptiv Technologies Limited, a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

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STATEMENT UNDER 37 CFR 3.73(c)

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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Craig A. Baldwin/	22 October 2019
Signature	Date
Craig A. Baldwin	Assistant Secretary 37772
Printed or Typed Name	Title or Registration Number

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
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Abstract

A method to enable a vehicle's embedded USB Host system to connect to multiple mobile devices through a USB Hub, regardless of whether the mobile devices are configured to act as USB Hosts or USB Devices, without USB On the Go (OTG) controllers or additional vehicle wiring, or inhibiting the functionality of any consumer devices connected to the same USB Hub. Preferably, the method is configured to provide that no additional cabling is required, and no hardware changes are required to be made to the HU. The method can be employed between a vehicle's embedded USB Host, USB Hub and at least one consumer accessible USB port. When the consumer device is acting as a USB Host, signals between the consumer device and the vehicle's embedded USB Host are processed through a USB bridge, thereby rendering the consumer device compatible with the vehicle's embedded USB Host.

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What is claimed is:

1. A method for providing efficient communications among USB components of a data communication system that includes multiple USB hosts and multiple USB devices, said method comprising the steps of:

providing a first input port for receiving a first USB signal from a first USB host;

providing a second input port for receiving a second USB signal;

routing the second USB signal from a second USB host via a USB bridge to said first USB host, and

routing the second USB signal from a USB device via a USB hub to said first USB host.

2. The method according to claim 1, wherein said second USB signal from the second USB host is not routed to the first USB host via the USB hub.

3. The method according to claim 1, wherein the second USB signal is routed via only one of the USB bridge or the USB hub.

4. The method according to claim 1, wherein the second USB signal from the second USB host is transmitted to the first USB host via the USB bridge and the USB hub.

5. A method, comprising the steps of:

providing a first USB port for communication with a USB host;

providing a second USB port for communicating with a consumer device;

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providing a signal detection circuit for receiving USB signals from the consumer device via said second USB port;

determining, via the signal detection circuit, whether the USB signals emanating from the consumer device indicate that the consumer device is operating in a USB host mode and if so, routing said USB signals via a USB bridge to said first USB port;

determining, via the signal detection circuit, whether the USB signals emanating from the consumer device indicate that the consumer device is operating in a USB device mode and if so, routing said USB signals via a USB hub to said first USB port.

6. A USB communication management method for interconnecting sources of USB signals, said method comprising the steps of:

receiving first USB host signals from a first USB host;

receiving second USB signals from a second USB signal source;

determining whether the second USB signals emanate from a second USB host;

routing the second USB signals emanating from the second USB host via a USB bridge to said first USB host; and

routing the second USB signals not determined to emanate from a USB host via a USB hub to said first USB host.

7. The method according to claim 8, further comprising the steps of:

determining whether the second USB signals emanate from a USB device; and

routing the second USB signals determined to emanate from the USB device via a USB hub to said first USB host.

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8. (Currently amended) A USB communication management method for interconnecting sources of USB signals, said method comprising the steps of:

receiving a first USB host signal from a first USB host;

receiving a second USB signal from a second USB signal source;

determining whether the second USB signal emanates from a second USB host;

establishing a first communication path via a USB bridge between said first USB host and said second USB signal source if said second signal emanates from the second USB host; and

establishing a second communication path via a USB hub between said first USB host and said second USB signal source if said second USB signal is determined not to emanate from the second USB host.

9. The method according to claim 8, further comprising the steps of:

determining whether the second USB signal emanates from a USB device; and

establishing the second communication path via a USB hub between said first USB host and said second USB signal source if said second USB signal is determined to emanate from the USB device.

10. The method according to claim 8, wherein the first communication path does not include a USB hub and wherein the second communication path does not include a USB bridge.

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11. A method for providing efficient communications among USB components of a data communication system that includes multiple USB hosts and multiple USB devices, said method comprising the steps of:

providing a first port connected to a first USB host;

providing a second port connected to a second USB host;

providing a third port connected to a USB device;

providing a USB hub configured to simultaneously broadcast data from the first USB host to the second and third ports and to transmit data from the second USB Host to the first USB host.

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FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

Related Applications

This application is a continuation application and claims benefit under 35 U.S.C. § 120 of U.S. Patent Application No. 15/441,775, filed February 24, 2017, which claimed benefit of U.S. Patent Application No. 15/268,728, now U.S. Patent No. 9,619,420, filed September 19, 2016, which claimed benefit under 35 U.S.C. § 120 of U.S. Patent Application No. 14/487,947, now U.S. Patent No. 9,460,037, filed on September 16, 2014, which claimed benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 61/882,915, filed on September 26, 2013, the entire disclosure of each of which are hereby incorporated herein by reference.

Background

The present invention generally relates to Universal Serial Bus ("USB") connectivity between, for example, mobile consumer devices and vehicle electronic systems. More specifically, the present invention relates to a system which is configured to provide that consumer devices that act as either USB host or USB device can connect to a vehicle's embedded USB host that does not have On the Go ("OTG") capability through an embedded USB hub in the vehicle.

Historically, mobile consumer devices such as media players, smart phones, tablets and the like have relied on connections to other devices, such as laptop or desktop personal computers ("PC's") to acquire content, exchange data, and charge the device's internal battery. For many years now, that has been accomplished through USB ports on each device. The use of

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USB technology is suitable for such needs since it is commonly available, familiar to the end user, cost effective and ubiquitous. USB protocols require a point-to-point connection in which one end is the USB Host or master, and the other end is a USB Device or slave. In this way, the flow of messages between the two devices is managed and controlled, whereby the USB Device responds to messages initiated by the USB Host. Historically, PC's have provided USB Host ports for connection to simpler USB Devices such as printers, memory sticks, mobile phones, etc. The USB Host has a greater burden of software and hardware requirements than a USB Device, so it has made sense to designate the PC as the USB Host in such systems.

In vehicle systems that employ USB connections, the same concepts apply. In such systems, the vehicle is typically the USB Host. The USB Host function is often embedded into a component of the vehicle infotainment system, such as into the radio or other control module. Typically, multiple USB ports are strategically designed into the vehicle in locations convenient for the driver and passengers to connect their consumer devices. Once a consumer device is connected to one of the ports, the device begins charging and the vehicle infotainment system can access content on the consumer device. This is useful to enable features such as streaming music, video and other services the device may provide.

Such a system requires that each of the USB ports be physically connected to the vehicle's USB Host in a manner suitable for USB data flow. This is accomplished through electrical cabling which is embedded in the vehicle, and which connects each of the ports to the USB Host. Since there can be many USB ports in a vehicle, and each port requires a cable to connect the port to the USB Host, it is desirable to share cabling when possible to minimize cost and mass of the vehicle. This is accomplished through the use of USB Hubs. USB Hubs allow a

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single USB Host to connect to multiple USB Devices over a single cable between the USB Host and the USB Hub. As shown in Figures 1 and 2, a single USB Hub can connect one USB Host to several USB Devices. Specifically, Figure 1 illustrates a system wherein a self-powered USB Hub having a plurality of USB ports connects to a plurality of USB Devices (via a plurality of consumer-facing USB ports), while Figure 2 illustrates a system wherein a self-powered USB Hub provides not only a plurality of USB ports which are in communication with a plurality of consumer-facing USB ports, but also a Secure Digital ("SD") card reader which is connected to a consumer-facing SD card connector. Other portions of Figures 1 and 2, such as Power Management, are standard in the industry and self-explanatory upon viewing Figures 1 and 2.

Furthermore, as shown in Figure 3, multiple USB Hubs can be tiered, such that USB Hubs connect to other USB Hubs. Specifically, Figure 3 illustrates a vehicle system architecture that includes a central vehicle microcontroller (also referred to as the Head Unit or "HU"). Connected to the Head Unit are components or systems such as displays, the audio system, entertainment system and the driver controls. The Head Unit may be architected as a single module encompassing all functions or distributed such that various functions are managed by individual modules. The Head Unit includes a Root USB Hub which is typically connected to one or more downstream USB Hubs distributed throughout the vehicle. Each USB Hub has a plurality of downstream ports (at least one of which may be an SD reader or USB audio device), thereby effectively providing that each USB port in the vehicle has a connection to the USB Host or Head Unit. In Figure 3, for example, the Root Hub is embedded in the radio, and is connected to four (4) self-powered USB Hubs, wherein one is in the vehicle's center console, one is in the vehicle's center stack, and two are in the vehicle's rear seats.

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Recently, mobile devices such as smart phones have gained in popularity. This is, in part, due to their usefulness as standalone computing devices. With advances in consumer electronic technology and increases in the speed of mobile networks, these devices are no longer reliant on being connected to PCs to access content. These smart mobile devices now have many of the same hardware resources, connectivity and software operating systems that only PCs had in past years. As has been the case with desktop PCs, accessories for these mobile devices have become available to aid in their ease of use. These accessories have included devices such as keyboards, mice, displays, touchscreen, audio systems, and other interface devices. These accessories commonly connect via a USB connection. By way of established convention in the consumer electronics market, these accessories are typically low cost and limited in USB capability to act only as a USB Device. To connect them to a smart phone, the smart phone must be the USB Host. Therefore, leading mobile device manufacturers and system designers have begun designing their mobile device products (i.e. smart phones, tablets, etc.) to support both USB Host and USB Device roles. In other words, the phone may configure itself such that it can function as a USB Device when it needs to be, or as a USB Host when it needs to be. Recently, the system level design thinking has shifted towards viewing smart phones as the USB Host, and any device connecting thereto as the USB Device. Again, this is not surprising since this is exactly how laptops and PCs work today. Extending this trend into the future, it can be predicted that the smart phone will act primarily as the USB Host, and will rarely or never act as a USB device. This presents some problems for automotive systems.

As explained previously, automotive systems have a USB Host and require USB Devices to connect to it. If a phone acts as a USB Host, then the system will not function since by USB

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convention, two USB Hosts cannot directly connect with each other. Automotive manufacturers desire compatibility with smart phones and are therefore motivated to adapt to this changing technology. A redesign of the USB architecture in the vehicle is thus necessary such that the vehicle can act either as the USB Host (when necessary to connect to USB Devices such as memory sticks, thumb drives, etc.) or USB Device (when necessary to connect to USB Hosts, such as a smart phone which demands to be USB Host rather than USB Device.

The USB organization has added a standard that addresses the need for devices to act as either USB Host or USB Device and as such can be considered a "dual role" USB controller. It is referred to in USB nomenclature as "On the Go" or "OTG" for short. Any device that meets the OTG standard can act as either USB Host or USB Device and can change roles dynamically. Therefore, one possible approach to modifying the vehicle USB architecture to support all use cases is to upgrade the vehicle's USB Host to USB OTG. This solution addresses the issue but has some disadvantages. First, USB Hubs do not support OTG and can no longer be used in the system. Each consumer accessible USB port that supports OTG must have a dedicated wire link to a dedicated OTG controller in the Head Unit thus negating the wiring savings associated with use of USB Hubs. As a result several costly cables may need to be added to the vehicle's electrical system. Second, there may not be enough OTG controllers available in the Head Unit to connect to each of the vehicle's user accessible USB ports. This then forces the vehicle designer to choose a limited number of the many USB ports in the vehicle to support the OTG function and run dedicated USB cables to them. This can lead to user confusion and dissatisfaction since only certain consumer ports support the required functionality. Also, ports that support OTG may be co-located with other physically identical ports that do not. If the user

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chooses the wrong one, the applications they desire to run from the consumer device that requires USB Host mode won't work.

Another possible solution is to implement custom USB hubs wherein the USB Hub is able to dynamically swap its upstream port with one it's downstream ports when commanded to do so. System solutions built with this concept still require OTG controllers in the head unit but benefit from the fact that no additional wires need to be installed in the car. The existing USB cable between the USB OTG Host and the USB Hub can facilitate the necessary USB communications between the USB OTG controller in the Head Unit (HU) and a consumer device in USB Host (such as a smart phone). This solution also has some disadvantages however. For example, when the USB Hub is commanded to swap its upstream port with a downstream port, all other downstream ports of the USB Hubs lose their data connection with the Head Unit. While in this mode the Head Unit access to the other downstream ports of the hub cease. This may prevent use of certain vehicle system functions such as navigation or audio playback that may need consistent access to the other downstream ports of the hub to function. Furthermore, it requires the HU to have an available USB OTG port and a signaling path to control the hub upstream/downstream port configuration.

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Summary

An object of an embodiment of the present invention is to provide a system which is configured to enable a vehicle's embedded USB Host system to connect to mobile devices through a USB Hub, regardless of whether the mobile devices are configured to act as USB Hosts or USB Devices, without the need to provide OTG or dual role controllers in the head unit and without the need to provide additional cabling in the vehicle. Preferably, no hardware changes are required to be made to the USB Host circuits in the HU.

An embodiment of the present invention provides a system which can be employed between a vehicle's embedded USB Host and at least one, but preferably multiple, consumer facing USB ports provided in the vehicle for connection to consumer devices. The system is configured to recognize and control whether the consumer device is required to be connected to each USB port as a USB Host or as a USB Device. Further, the system is able to dynamically switch the device connection between USB Device mode and USB Host mode when desired. In the case where the consumer device is acting as a USB Device, signals are routed normally through a USB Hub to the Head Unit. In the case where the consumer device is acting as a USB Host, signals between the consumer device and the vehicle's embedded USB Host are routed and processed through a USB Host to Host Bridge which is connected to the USB Hub, thereby rendering the consumer device compatible with the vehicle's embedded USB Host.

The present invention is capable of being implemented in several different embodiments. For example, an embodiment of the present invention comprises a USB Hub Module having a USB Hub, USB Bridge, and USB routing switches implemented as discrete devices. The USB

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Hub upstream port is configured to be connected to a vehicle's embedded USB Host (such as a USB Host in a Head Unit). The USB Hub Module also includes a switching device (such as USB analog multiplexing switches for example) that is configured to route each consumer port to either the Bridge or the Hub. The USB Bridge is configured to effectively control the switching device. The USB Bridge is configured, based on signals from the Head Unit, whether the consumer device which is connected to the USB port is acting as USB Host or USB Device. In the case where the consumer device is acting as USB Host, the USB Bridge controls the switching device to route the USB port to the Bridge. The Bridge processes the signals from the consumer device and provides them to the USB Hub, thereby rendering the consumer device compatible with the vehicle's embedded USB Host. In the case where the consumer device is acting as USB Device, the USB Bridge controls the switching device such that the switching device provides the signals to the USB Hub, effectively bypassing the Bridge.

Still another embodiment of the present invention provides that the USB routing logic, USB Bridge, and USB Hub are integrated in a single combination USB Hub/USB Bridge Integrated Circuit (IC).

Still other embodiments are entirely possible, some of which are described and illustrated herein. For example, the concept can be extended to include additional embedded USB Device functions such as USB HID and USB Audio. Further it is also envisioned that all consumer facing USB ports of the Hub Module can emulate or otherwise support dual role USB capability provided that each downstream port has a Bridge to support USB Host mode for the connected device and a direct connection to the USB Hub to support USB Device mode. In all cases, compliance to USB protocols and architectures is preferably maintained.

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Brief Description of the Drawings

The organization and manner of the structure and operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings wherein like reference numerals identify like elements in which:

Figure 1 illustrates a system wherein a multiple port self-powered USB Hub functions to connect a single USB Host to a plurality of USB ports;

Figure 2 illustrates a system wherein a self-powered USB Hub provides not only a plurality of USB ports, but also a Secure Digital ("SD") card reader;

Figure 3 illustrates a vehicle infotainment system structure wherein multiple USB Hubs are connected together or tiered, such that USB Hubs feed other USB Hubs;

Figure 4 illustrates a system which is in accordance with an embodiment of the present invention, wherein a USB Hub, USB Bridge and a switching device are provided as discrete components;

Figure 5 illustrates a system which is in accordance with an alternative embodiment of the present invention, wherein USB routing/switching logic and a USB Bridge are integrated with a USB Hub in a combination USB Hub/USB Bridge Integrated Circuit (IC);

Figure 6 illustrates the different components of the combination USB Hub/Bridge IC shown in Figure 5;

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Figure 7 illustrates one possible endpoint configuration of the USB Bridge shown in Figures 5 and 6; and

Figure 8 illustrates an example implementation of a Head Unit Software Architecture.

Description of Illustrated Embodiments

While this invention may be susceptible to embodiment in different forms, there are specific embodiments shown in the drawings and will be described herein in detail, with the understanding that the present disclosure is to be considered an exemplification of the principles of the invention, and is not intended to limit the invention to that as illustrated.

Figure 4 illustrates a system which is in accordance with an embodiment of the present invention. The system is configured to effectively render a vehicle's embedded USB Host compatible with consumer devices which are configured to also act as USB Host or USB Device. The system is in the form of a self-powered USB Hub Module having a USB, a USB Bridge, and a switching device implemented as discrete devices. The USB Hub is preferably provided in the form of an integrated circuit (IC), and is configured (via an upstream USB port) connected to a vehicle's embedded USB Host (such as a USB Host in a Head Unit) via vehicle internal wiring, such as, in one embodiment, via a single USB data cable between the Head Unit and USB Hub. The USB Hub also includes a plurality of downstream USB ports, at least one of which is connected to a USB Bridge (which also is preferably provided in the form of an integrated circuit (IC)). At least one downstream USB port of the USB Hub is connected to a switching device (such as USB analog multiplexing switches, for example). The switching device is configured to be connected to at least one USB port in the vehicle for connection to a consumer device. The

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USB Bridge is configured to effectively control the switching device although other control mechanisms are envisioned. The USB Hub Module is configured such that signals received from at least one USB port are received by the switching device, and the switching device routes the signals to the USB Bridge or the USB Hub. In the case where the consumer device is acting as USB Host, the USB Bridge processes the USB packets from the consumer port and provides them to the USB Hub, thereby rendering the consumer device compatible with the vehicle's embedded USB Host. In the case where the consumer device is acting as USB Device, the USB Bridge controls the switching device such that the switching device provides the USB signaling directly to the USB Hub, bypassing the Bridge.

As shown in Figure 4, the system also includes Power Management structure, as well as some other conventional structure not specifically shown in Figure 4, but which would be readily assumed to be present by one having ordinary skill in the art.

In use, the Head Unit controls the switching device via the USB Bridge hardware or any other convenient means of control. The HU software application may choose to enable, for example, a phone on any one of the consumer USB ports, by requesting, commanding or otherwise knowing the phone is required to be in USB Host mode and commanding the routing of the specific USB port the phone is attached to the USB Bridge. Once routed to the USB Bridge, the phone will detect a USB Device is connected and the phone will begin the standard USB enumeration sequence. The detection and enumeration processes are defined by USB standards and not explained here in detail. However, for purposes of describing the operation of the invention, a general understanding is provided herein. The enumeration process follows a strict sequence of USB descriptor requests from the USB Host and USB descriptor responses

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from the USB Device that allow the Host to determine the capabilities and functions of the Device and configure the USB Device for operation. Once the complete set of device descriptors are known the USB Host will then load the appropriate USB driver(s) and applications to support in the functionality that the USB Device provides. In the scope of this invention it is envisioned that the responses to the descriptor requests made by the phone (USB Host) are either answered locally by the Bridge or preferably, the requests are forwarded through the Bridge to the Head Unit where its device drivers process the request and return the response. The descriptor responses from the device driver are conveyed to the USB Bridge, which then, in turn, passes them to the phone. By passing descriptor request to the Head Unit drivers and returning the responses from the Head Unit drivers back to the consumer device, the Bridge appears as a transparent component in the USB system architecture. The system capabilities are controlled by the Head Unit and the system remains flexible without need for changes to the Bridge firmware or hardware when the system designer requires changes to the descriptor responses. Once the consumer device completes the enumeration process, the Head Unit's USB functional capabilities are known to the consumer device and the consumer device may enable use of those functions over USB communication. At this point, the consumer device or the Head Unit may begin activating any number of supported services such as data connections, streaming audio and streaming video to and from the vehicle via the USB Bridge.

Another embodiment of the present invention can be provided, wherein the bridge is configured to act as an OTG port thus negating the need for switches and/or routing logic. In this case there would exist one Bridge functional block for each downstream port. This embodiment would effectively be a more generalized case of the example illustrated in Figure 4.

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Figure 4 shows just one Bridge that any one of the consumer USB ports can be routed to. With just one bridge, only one consumer USB port can be connected to a USB host at a time. However, if each downstream port of the Hub has a dedicated Bridge, then multiple consumer ports can support connection to USB Host devices at the same time. Thus, any consumer port can be in either USB Host or USB Device mode at any time independently of the others.

Figure 5 illustrates an alternative embodiment wherein the switching device comprises USB routing logic, and both the USB routing logic and the USB Bridge are integrated with the USB Hub in a combination USB Hub/USB Bridge Integrated Circuit (IC). This configuration has cost and size advantages over building it with discrete components connected together on a printed circuit board.

Figure 6 illustrates the internal components of the USB Hub/USB Bridge Integrated Circuit (IC) shown in Figure 5. As shown, preferably the components of the USB Bridge include a bridge controller as well as endpoint buffers. While the exact configuration of endpoints is effectively up to the system designer to choose for a particular need, a specific example of one possible endpoint configuration is shown in Figure 7; however, many others are possible.

As shown in Figure 7, the endpoints of the Bridge may be designed to support multiple pipes of Bulk USB data connections between the Host A (Head Unit) and Host B (consumer device). In the Bridge, the IN endpoints of Device A are connected to the OUT endpoints of Device B and the OUT endpoints of Device A are connected to the IN endpoints of Device B. The design of the Bridge may be such that the data flow between the endpoints may be direct or buffered. For example, in the case of direct connection, once a USB packet is received from

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Host A on a Device A OUT endpoint, the internal logic of the Bridge moves to packet to the Device B IN endpoint if it is available. If Device B IN endpoint is full or otherwise not available then subsequent attempts of Host A to send more packets to Device A in the Bridge will be rejected until such time that the Device B IN endpoint is clear and the contents of the Device A OUT buffer is moved to it. Alternatively, there may exist a local buffer in the Bridge between the endpoints of Device A and B. For example, packets received on an OUT endpoint of Device A are placed in a local memory device for temporary storage until Device B IN endpoint is ready for them. The OUT endpoints are thus capable of receiving multiple packets from the Host until the buffer is full. Likewise the IN endpoints may, at times, transmit multiple packets until the buffer is empty. Such buffers are not required, but are envisioned, to improve system throughput performance in certain circumstances where one of the USB Hosts is occasionally busy and not keeping up with USB transactions at the same rate as the other USB Host. Regardless of the buffer configuration, the Bridge hardware has IN and OUT endpoints on Device A mapped to OUT and IN endpoints respectively on Device B, thus forming a bidirectional bridge that passes USB traffic between two USB Hosts with bandwidth sufficient to support the application requirements of the system.

Also shown in Figure 7, Device A and Device B provide a bidirectional Control endpoint connected to their respective USB Hosts. Control endpoints are required per USB standard to support USB defined control messages between the Host and Device both during and after the enumeration sequence. Optionally, USB endpoints may also be utilized per USB standard to employ messages intended to control user defined custom device specific behavior, referred to as Vendor Specific messages. As can be seen in Figure 7, the Control endpoints are mapped to the

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Bridge Controller (BC). The BC logic may be implemented in hardware or preferably software. The BC provides the capability to send, receive and process USB standard Control endpoint messages as well as vendor specific messages essential to the control and operation of the Bridge. At system startup, the A Host requests and receives descriptors from the BC via the Control endpoint. Once complete, Host A then loads the Bridge Driver in its software stack and configures the custom Bridge hardware for operation. Host A can then control the functions of the Bridge, such as USB switch routing control. The system is now ready to accept connection with USB Host mode consumer devices on the B Device of the Bridge. When such a connection is made, the BC will notify the Bridge Driver in Host A by sending a message on the control endpoint to Host A. Further, Host B will begin sending descriptor requests on the control endpoint to Device B in Bridge. The BC receives theses requests, encapsulates them with information that identifies them as descriptor requests from Host B and passes them to the Bridge Driver on Host using the control endpoint. Host A Bridge Driver receives these requests, identifies them as descriptor requests and passes the requests on to other software components in Host A system and waits for the descriptor responses. The descriptor responses are encapsulated by the Bridge driver to indicate they are descriptor responses that are to be forwarded to Host B. The response is then sent to the BC via the control endpoint. The BC receives them, identifies them as descriptor responses that should be forwarded to Device B and places them on the control endpoint for Device B. This process of receiving and forwarding messages back and forth between the two hosts continues until the enumeration process is complete with Host B. From that point on the two hosts may begin to use the IN and OUT endpoints to transfer application data and services over the bulk endpoints.

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Figure 8 illustrates one possible configuration of the system architecture including software components in the Head Unit interfacing with the Bridge/Hub. There are multiple ways that the operating system and software architecture can be constructed to support the functions of the USB Bridge/Hub. In Figure 8, a typical Linux implementation is shown including the Bridge/Hub Module and the Head Unit. The system design utilizes standard Linux Kernel components and configurations and should be familiar to those skilled in the art. The Head Unit USB Host Controller hardware is driven by the Host Controller Driver. The Host Controller Driver is connected to the USB Core. The USB Core connects the HCD with the standard USB Linux Device Drivers and the custom Bridge Driver. The Bridge Driver is configured to optionally connect directly to the User Space Application software or to the USB Gadget Driver depending on system architecture. The custom Bridge Driver plays a dual role of both controlling the functions of the Bridge hardware as well as providing a data path between the gadget device drivers and applications running on the Head Unit. The architecture illustrated is capable of handling both the operation and data paths associated with the Bridge and the Hub at the same time, thus allowing concurrent operation of consumer devices operating in USB Device mode with consumer devices operating in USB Host mode. In one embodiment, the Hub/Bridge supports simultaneous active USB data connections between the Head Unit and multiple consumer devices, at least one of which being in host mode while the others are in device mode. In another embodiment, the Hub/Bridge supports simultaneous active USB data connections between the Head Unit and some combination of embedded and consumer USB devices along with at least one device being in host mode. While it is understood that the software functions of the head unit are essential to building a complete system, the designs of which can vary

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significantly and this example is provided only as a means of demonstrating one way to utilize the functionality of the present invention.

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Figure 1

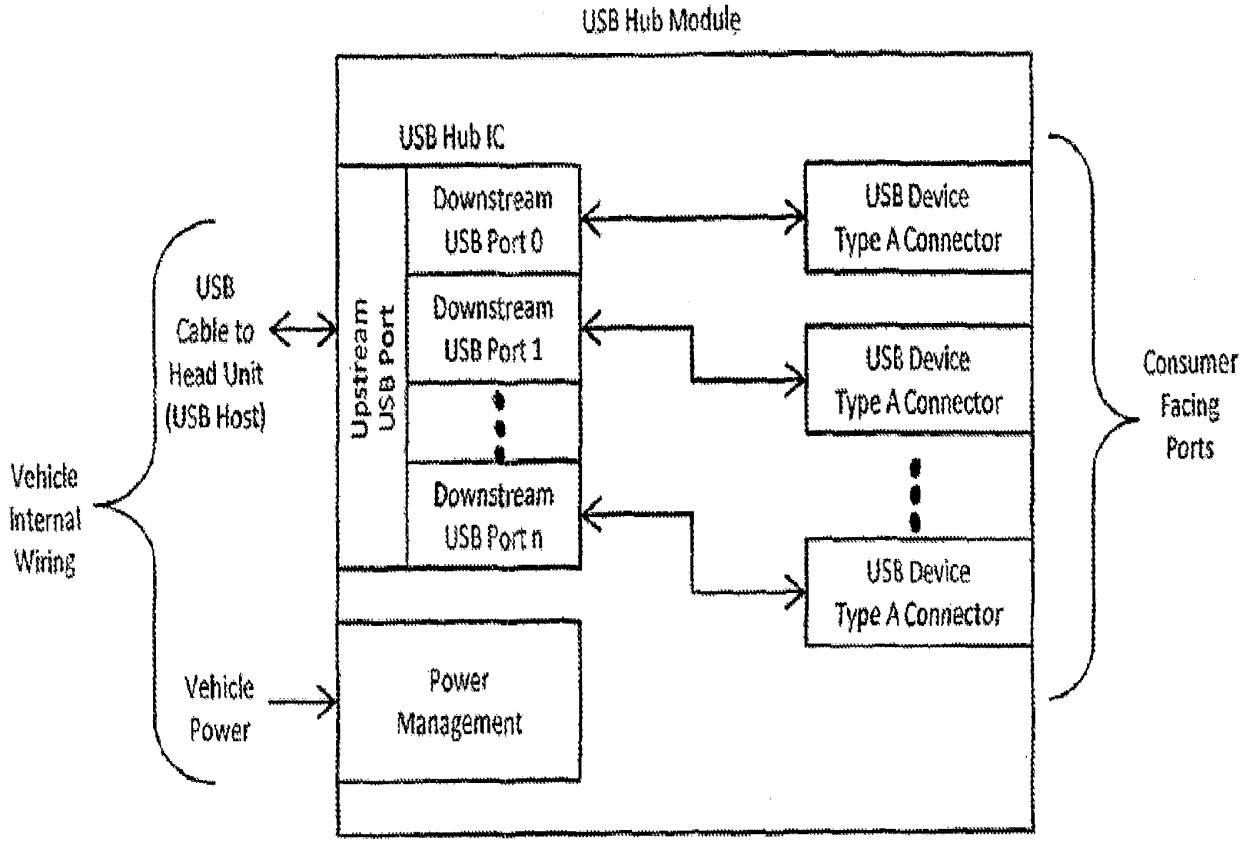
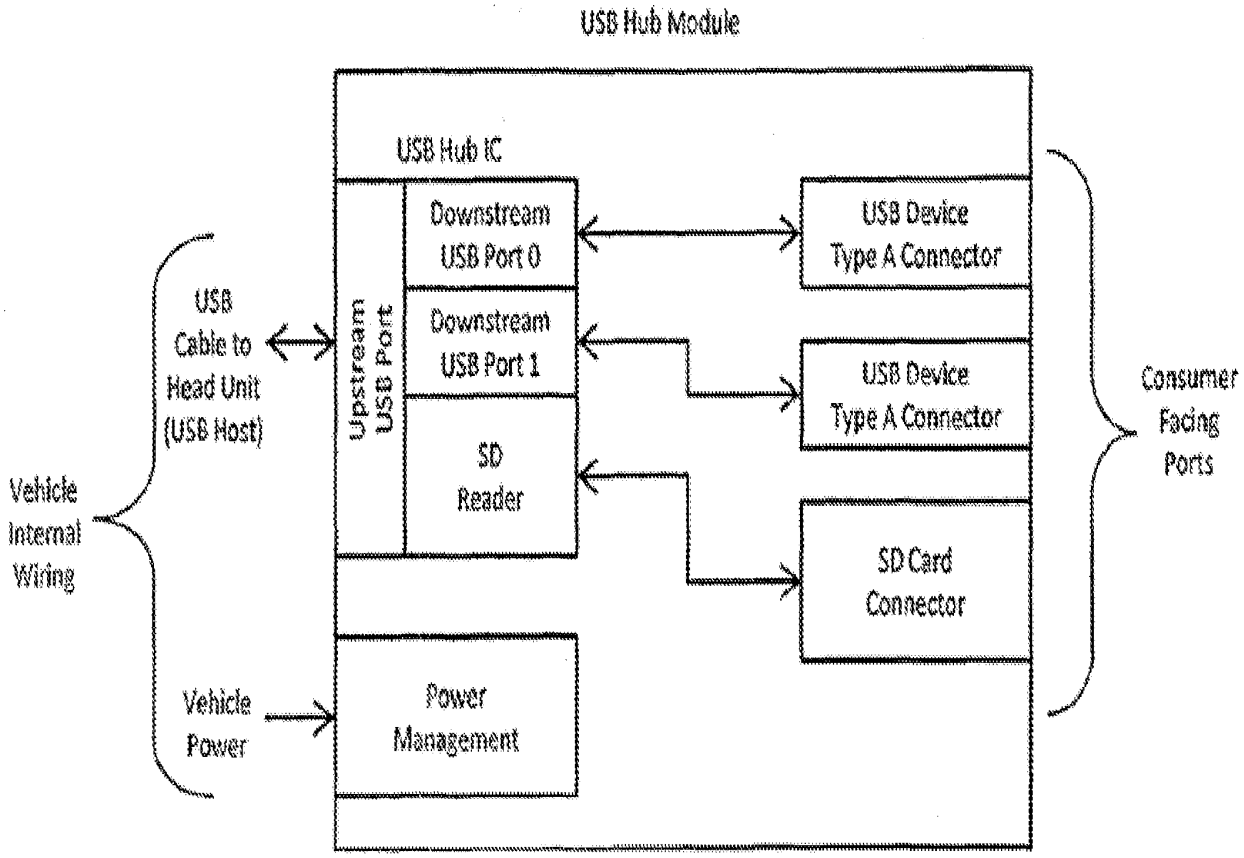

USB Hub Module
USB Hub IC
Upstream USB Port
Downstream USB Port 0
Downstream USB Port 1
Downstream USB Port n
USB Device Type A Connector
USB Device Type A Connector
USB Device Type A Connector
Consumer Facing Ports
USB Cable to Head Unit (USB Host)
Vehicle Internal Wiring
Vehicle Power
Power Management

Figure 2


USB Hub Module
USB Hub IC
Upstream USB Port
Downstream USB Port 0
Downstream USB Port 1
SD Reader
USB Device Type A Connector
USB Device Type A Connector
SD Card Connector
Consumer Facing Ports
USB Cable to Head Unit (USB Host)
Vehicle Internal Wiring
Vehicle Power
Power Management

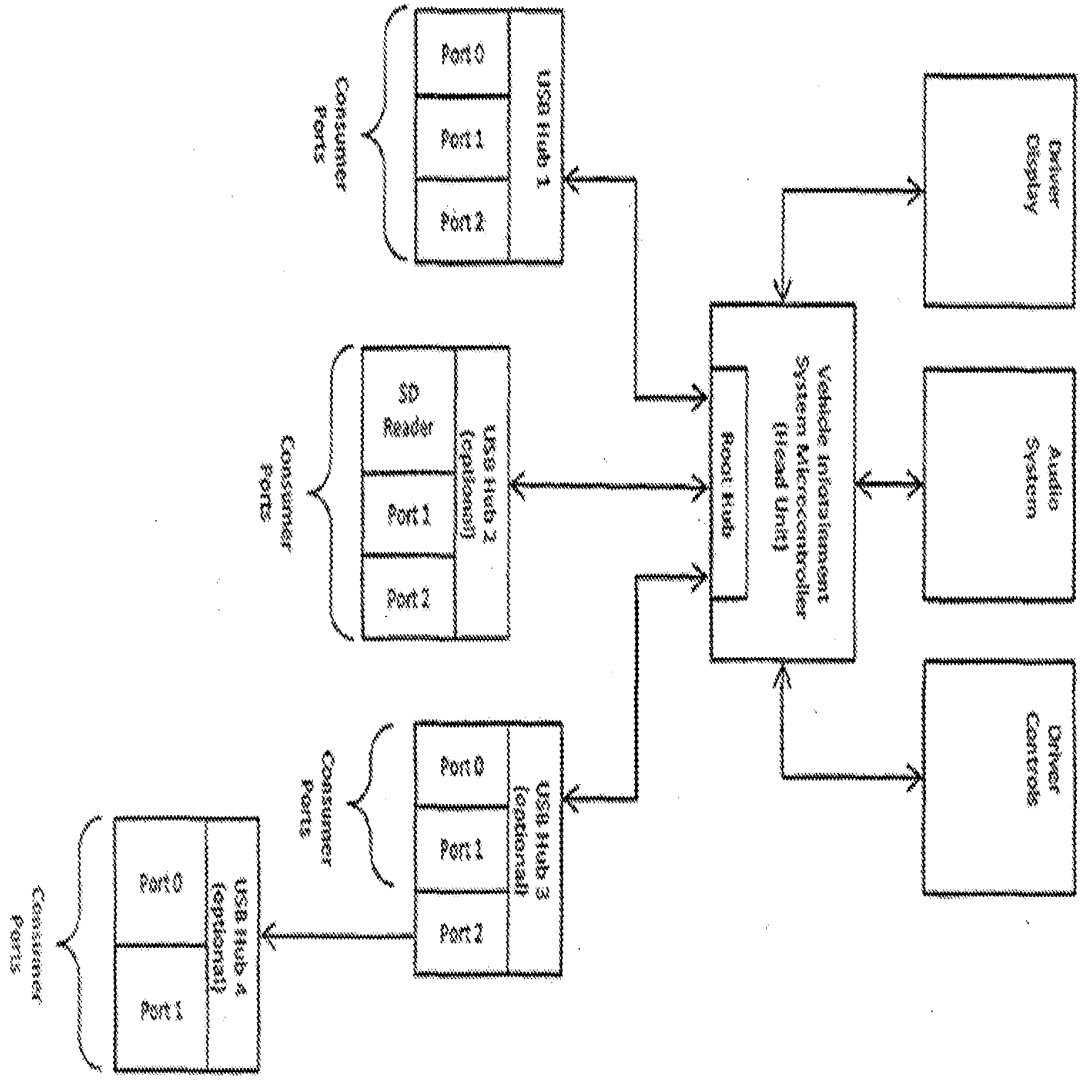

Driver Display
Audio System
Driver Controls
Vehicle Infotainment System Microcontroller (Head Unit)
Root Hub
USB Hub 1
Port 0
Port 1
Port 2
Consumer Ports
USB Hub 2 (optional)
SD Reader
Port 1
Port 2
Consumer Ports
USB Hub 3 (optional)
Port 0
Port 1
Port 2
Consumer Ports
USB Hub 4 (optional)
Port 0
Port 1
Consumer Ports

Figure 3

Figure 4

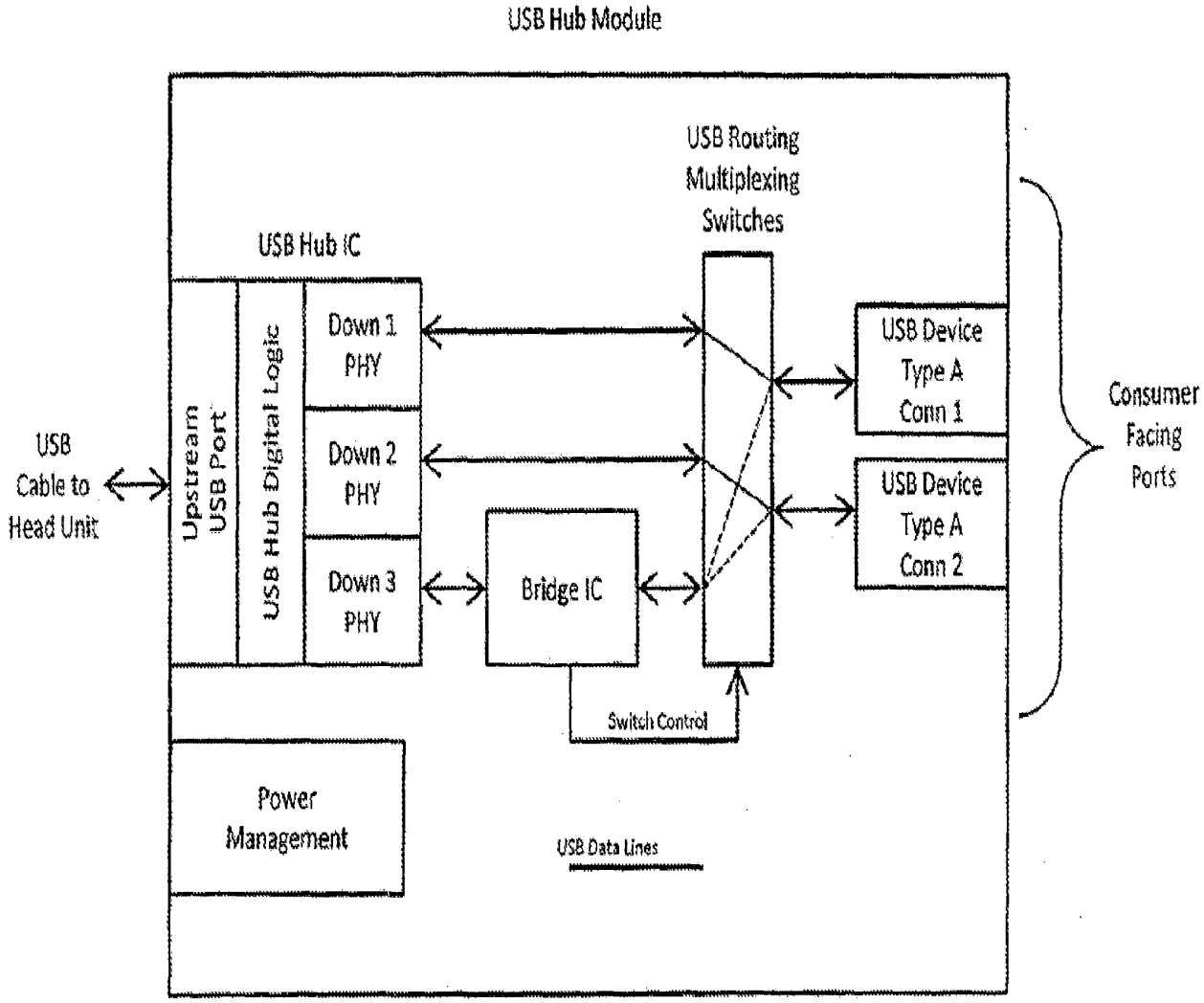

USB Hub Module
USB Routing Multiplexing Switches
USB Hub IC
USB Cable to Head Unit
Upstream USB Port
USB Hub Digital Logic
Down 1 PHY
Down 2 PHY
Down 3 PHY
Bridge IC
USB Device Type A Conn 1
USB Device Type A Conn 2
Consumer Facing Ports
Switch Control
Power Management
USB Data Lines

Figure 5

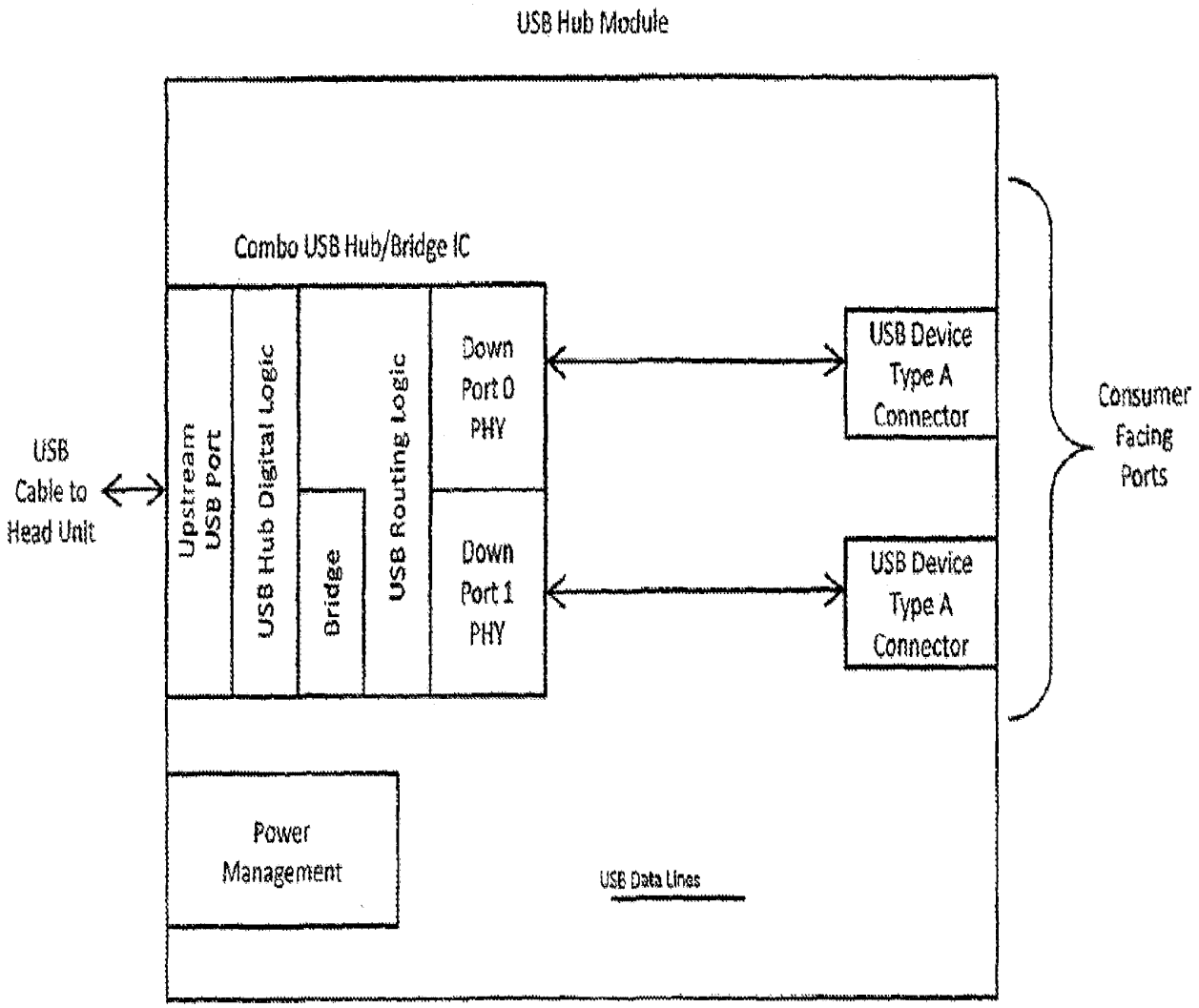

USB Hub Module
Combo USB Hub/Bridge IC
USB Cable to Head Unit
Upstream USB Port
USB Hub Digital Logic
Bridge
USB Routing Logic
Down Port 0 PHY
Down Port 1 PHY
USB Device Type A Connector
USB Device Type A Connector
Consumer Facing Ports
Power Management
USB Data Lines

Figure 6

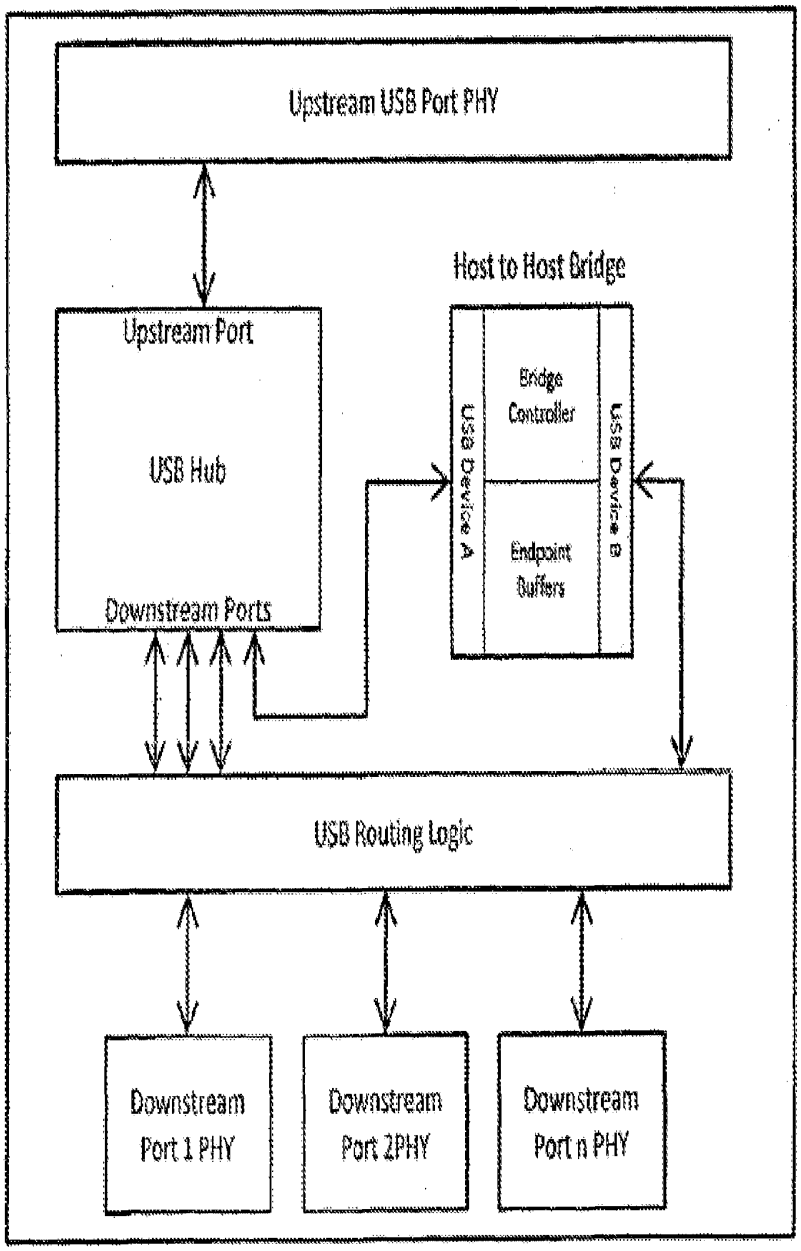
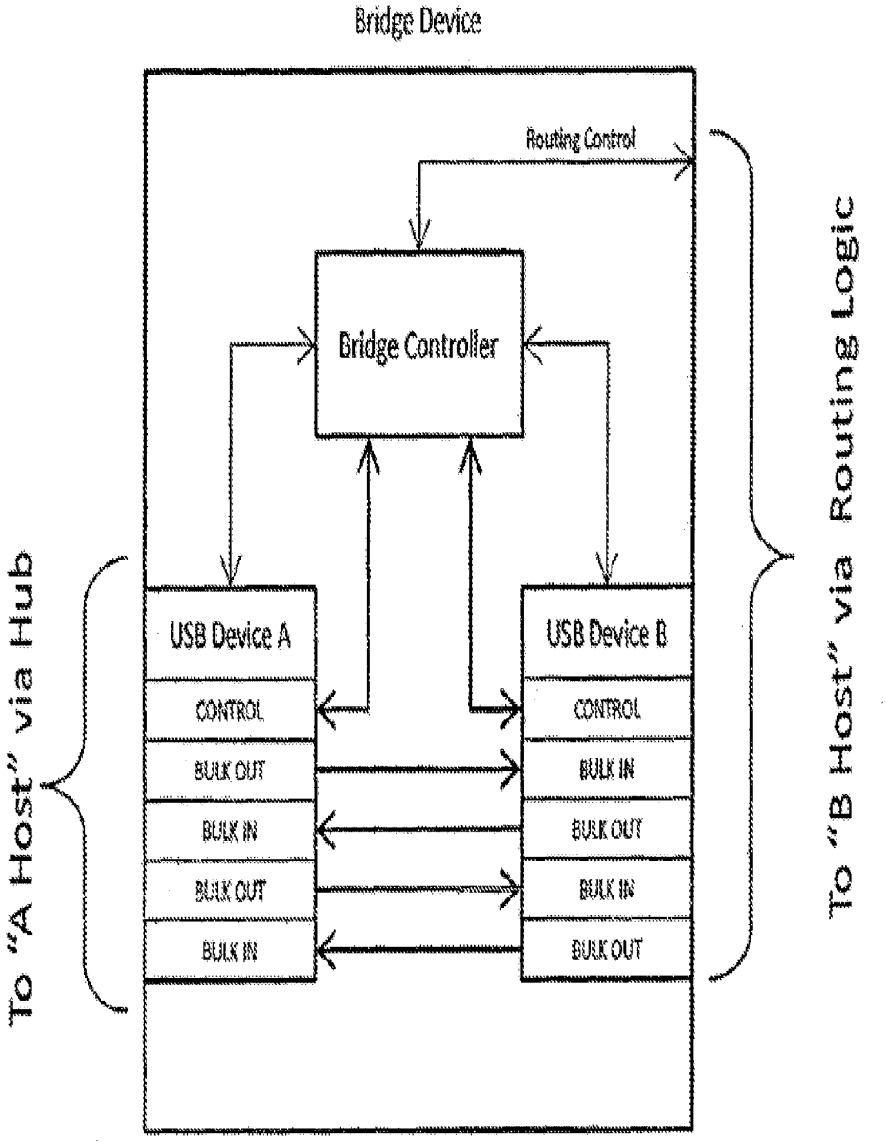

Upstream USB Port PHY
Host to Host Bridge
Upstream Port
USB Hub
Downstream Ports
Bridge Controller
Endpoint Buffers
USB Device A
USB Device B
USB Routing Logic
Downstream Port 1 PHY
Downstream Port 2PHY
Downstream Port n PHY

Figure 7


Bridge Device
Routing Control
Bridge Controller
USB Device A
CONTROL
BULK OUT
BULK IN
BULK OUT
BULK IN
USB Device B
CONTROL
BULK IN
BULK OUT
BULK IN
BULK OUT
To "A Host" via Hub
To "B Host" via Routing Logic

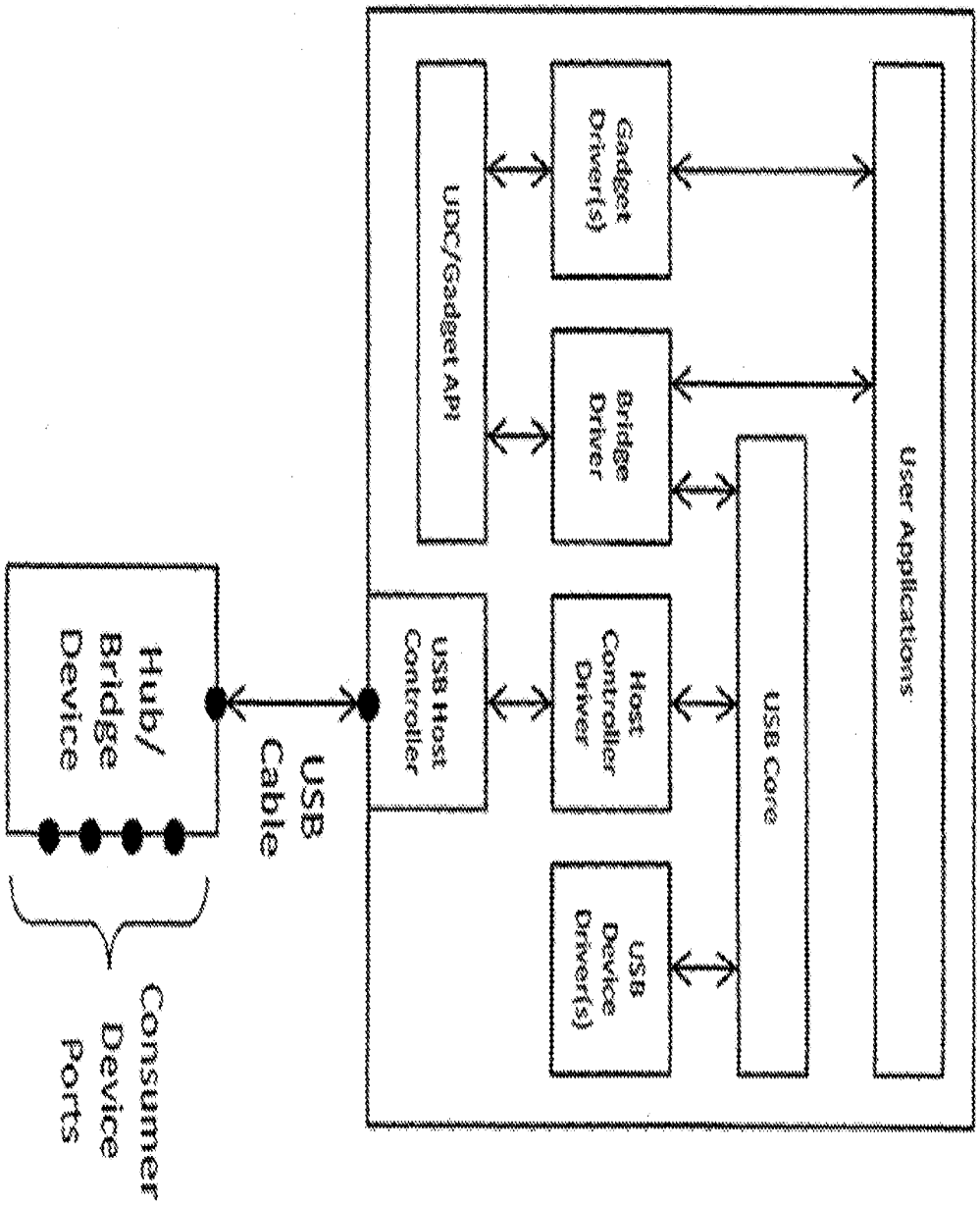

Head Unit
User Applications
Gadget Driver(s)
UDC/Gadget API
Bridge Driver
USB Core
USB Host Controller
Host Controller Driver
USB Device Driver(s)
USB Cable
Hub/ Bridge Device
Consumer Device Ports

Figure 8

PTO/SB/08a (01-10)
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First Named Inventor	Robert M. Voto, et al.
Art Unit	
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Attorney Docket Number	DP-322037 CON3

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	2	8447598	B2	2013-05-21	Chutorash et al.	
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	Attorney Docket Number	DP-322037 CON3

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	4	470887	TW	B	2002-01-01	JANG LIANG-SHI		

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	Examiner Name	
	Attorney Docket Number	DP-322037 CON3

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	Examiner Name	
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OR

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert J. Myers/	Date (YYYY-MM-DD)	2019-10-22
Name/Print	Robert J. Myers	Registration Number	69,783

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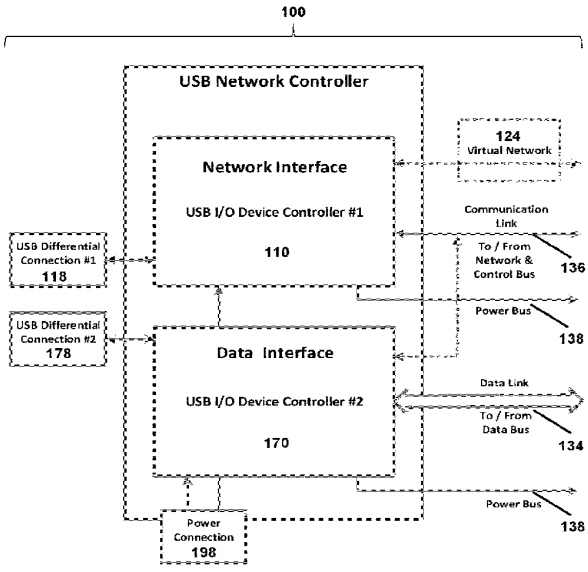


Fig. 1 a

(57) Abstract: A High Speed Link System providing network and data transfer capabilities, implemented via standard input/output (I/O) device controllers, protocols, cables and components, to connect one or more Host computing systems, comprising a System, Apparatus and Method is claimed; and described in one or more embodiments. An illustrative embodiment of the invention connects two or more Host systems via USB 3.0 ports and cables, establishing Network, Control, Data Exchange, and Power management required to route and transfer data at high speeds, as well as resource sharing. A Link System established using USB 3.0 operates at the full 4.8Gbps, eliminating losses inherent when translating to, or encapsulating within, a network protocol, such as the Internet Protocol. Method claimed herein describes how two or more connected Host systems, detect one another, and establish separate communication and data exchange bridges, wherein control sequences from the Hosts' application direct the operation of the Apparatus.

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LINK SYSTEM FOR ESTABLISHING HIGH SPEED NETWORK COMMUNICATIONS AND FILE TRANSFER BETWEEN HOSTS USING I/O DEVICE LINKS

FIELD OF THE INVENTION

[0001] The present application relates generally to the establishment of a network for communications and high speed file transfers between one or more Host systems using bridged connections of standard high speed peripheral devices and cables; and having a preferred implementation that leverages Universal Serial Bus (USB) peripheral cables and device components, to establish USB Host to Host and Host to multi-Host networking and high speed file transfers.

BACKGROUND OF THE INVENTION

[0002] Peripheral communications protocols provide the ability to connect additional electronic devices directly to the CPU of a Host system. Most modern peripheral communications protocols provide ultra-high speed connections to ensure the transfer of data to meet the requirements of modern CPUs. Popular peripheral protocols include the Universal Serial Bus (USB) and the Peripheral Component Interconnect (PCI) among others. USB is a globally accepted and widely used plug-and-play interface for peripheral devices such as digital cameras, scanners, printers, Compact Disc (CD) players, Digital Versatile Disc (DVD) players, as well as modern game consoles, etc. USB connections continue to evolve, providing improvements in high speed data transfer with power delivery. Two recently released versions of the USB Specification introduced multiple advantages over previous versions and other protocols, including full duplex communications. USB version 3.0 (hereinafter "USB 3") delivers high speed data rates of 5Gbps (Gigabits per second) and USB version 3.1 (hereinafter "USB 3.1") delivers 10Gbps.

[0003] Peer to peer connections between Hosts using USB version 2.0 (hereinafter "USB 2.0" or "USB 2") employ a fixed Host to Host cable with embedded specialized electronic components and dependent on various protocol conversions. The USB 2.0 Host to Host cable is, in reality, a virtual Ethernet cross-over cable or bridge device deployed using the USB interface solely as the medium for interconnection to the Host computers. As such, these cables require proprietary drivers and paired application software running at both ends of the connection; thus creating substantial throughput limitations as Internet Protocol (IP) packet processing and conversions are required at each Host to support the connection. As a result, despite an available 40MBps throughput provided by the USB 2.0 port interface, actual data transfer speeds drop to

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only 12MBps. Linking additional Hosts via Ethernet connections, while possible, is not viable – each additional host significantly increases overhead requirements and overall performance suffers significantly.

[0004] A direct USB 3.0 Host to Host connection has similarly been released into the market, employing the familiar method of using Ethernet cross-over cable to carry encapsulated USB 3.0 packets. Effective speed of the USB 3.0-to-Ethernet Host to Host cable using this method is reported to be approximately 40 MBps; a significant reduction from the available 480MBps provided by the USB 3 specification. New USB 3 specifications define the use of a direct link USB 3 Male-A to Male-A Crossover cable, which does not include the Vbus or Bus Power contingent, designed primarily for connecting two Hosts for the purposes of diagnosis and other restricted uses.

BRIEF SUMMARY OF THE INVENTION

[0005] The present application discloses a method and apparatus for establishing a Link System providing network communications and high speed data transfer capabilities between two or more coupled Host computers (hereinafter "Host" or "Host system" or USB Host system") employing at least two standard peripheral connections, in bridged configuration, creating a dedicated communication link and a dedicated data link which, in combination, form a private network to independently exchange control and high speed data between the coupled Host systems. Implementations employing the USB 3.0 SuperSpeed protocol, provide for network and file transfer speeds of 5Gbps; similarly the use of USB 3.1 Enhanced SuperSpeed protocol and components can achieve speeds of 10Gbps.

[0006] In using the apparatus, methods and system proposed herein, the Host systems, upon connection, may detect one another and establish a network link consisting of several bridged paths for network, control, high speed data transfer, and power may be established. The Host systems may employ one or more protocols providing detection, negotiation, link, service, flow direction, high speed data transfer management, and power management.

[0007] In a preferred embodiment, a proposed system comprises a centrally located Link System with a standard USB 3 Type-A Male connector at each end of a link cable extending from the Link System. The Link System may be seen to serve as to couple the USB 3 Host ports by interconnecting or bridging the various opposing communications and high speed data exchange paths in a network environment in which control sequences from the Host application interact with both the Link System and opposite Host system. The Hosts, coupled through the

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intermediary Link System, negotiate and facilitate the selection of data paths and data directional flow; interface elements and provisions to accommodate Data and File transportation are provided by native Host Operating System functionality.

[0008] According to an aspect of the present disclosure, there is provided a method for transferring data over links established between a first universal serial bus Host and a second universal serial bus Host, wherein the link includes a first path on a physical layer of an interconnection architecture and a second path on the physical layer of the interconnection architecture. The method includes the first universal serial bus Host transferring, across the first path, link controls to the second universal serial bus Host and the first universal serial bus host transferring, across the second path, high speed data to the second universal serial bus Host.

[0009] According to another aspect of the present disclosure, there is provided an apparatus for connecting a first Host and a second Host. The apparatus includes a high speed data link over a data bridge, a switching manager adapted to create temporary interconnections between the first universal serial bus Host and the second universal serial bus Host, a Network and Control Manager adapted to establish addressing and network switching, a Data Control Manager to direct the Data Exchange mechanism to transact Data and File Transfers between the first universal serial bus Host and the second universal serial bus Host and a detector to detect that a device has been coupled to the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A more complete understanding of aspects of the present application is to be derived from the detailed description provided herein and from the accompanying drawings relating to some embodiments of the present application, which, however, are not to be understood as limiting to the specific embodiments as detailed, but are for the purposes of illustration to help better explain and for clarity in understanding the present application. Reference will now be made, by way of example, to the accompanying drawings which show example implementations; and in which:

[0011] FIG. 1a illustrates, in a schematic diagram, a USB Network Controller in accordance with aspects of the present application;

[0012] FIG. 1b illustrates, in a schematic diagram, a USB I/O Device Controller for Network and Control Management in accordance with aspects of the present application;

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[0013] FIG. 1c illustrates, in a schematic diagram, a USB I/O Device Controller for Data Management in accordance with aspects of the present application;

[0014] FIG. 2 illustrates a Link System in which an example USB Host system is illustrated along with the USB Network Interface comprising a USB Network Controller of FIG. 1a in accordance with aspects of the present application;

[0015] FIG. 3 illustrates a Link System as an alternative to the Link System of FIG. 2 in accordance with aspects of the present application;

[0016] FIG. 4 illustrates a Link System as an alternative to the Link System of FIG. 2 and the Link System of FIG. 3 in accordance with aspects of the present application;

[0017] FIG. 5 illustrates a Link System featuring two coupled USB Host systems each with the USB Network Interface comprising a USB Network Controller of FIG. 1a similar to that illustrated in FIG. 2, in accordance with aspects of the present application;

[0018] FIG. 6a illustrates a schematic of a further USB Link System, wherein there is a mirrored network interface implementation having multiple components common to each side in accordance with aspects of the present application;

[0019] FIG. 6b illustrates a schematic of the operational flow of a further USB Link System, wherein two USB Host systems couple and engage in a High Speed File Transfer process in accordance with aspects of the present application;

[0020] FIG. 7 illustrates a Link System featuring a plurality of Host Systems in accordance with aspects of the present application;

[0021] FIG. 8 illustrates, in schematic form, a Link System featuring a number of support elements that form a pair of USB Network Interfaces for coupling a first USB Host system to a second USB Host system in accordance with aspects of the present application;

[0022] FIG. 9 illustrates, in schematic form, a Link System featuring two or more separate pathways for Data Transfer to and from a USB Network in accordance with aspects of the present application; and

[0023] FIG. 10 illustrates, in schematic form, the elements and operation of an Application used in conjunction with a Link System featuring coupling between a first USB Host and a second USB Host in accordance with aspects of the present application.

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DETAILED DESCRIPTION OF THE EMBODIMENTS

[0024] Aspects of the present application, in some embodiments, wherein the peripheral communications protocol, and supporting connectors, device controllers, linking mechanism and components, are described in reference to an implementation of the USB protocol, may equally refer to another peripheral communications protocol such as PCI, and its derivatives, SCSI or other communications protocols designed for Host to Device communications.

[0025] Aspects of the present application, in some embodiments, wherein Host is synonymous with Host system and USB Host, relate to USB Host to Host and Host to multi-Host communications and networking;

[0026] Aspects of the present application, in some embodiments, wherein USB Network Interface relates to USB Link System comprising of two or more coupled USB Network interfaces for USB Host to Host and to USB Host to multi-Host Link communications and networking.

[0027] Aspects of the present application, in some embodiments, wherein USB Network Interface relate to the latest version USB (USB 3) USB Link System comprising of two or more coupled USB Network interfaces for USB Host to Host and to USB Host to multi-Host communications and networking.

[0028] Aspects of the present application, in some embodiments, relate to USB Host-to-Host Link System and/or Bridge and/or Switch and Host-to-multi-Host Link System, and/or multi-Host Bridge and/or multi-Host Switch.

[0029] Aspects of the present application, in some embodiments, relate to a system wherein two or more USB Network Interfaces are coupled and form a Link System wherein links are formed and/or established.

[0030] Aspects of the present application, in some embodiments, relate to a system wherein two or more Host systems are coupled by and/or through a Link System and links and or bridges are formed and/or established.

[0031] Aspects of the present application, in some embodiments, relate to a system wherein two or more USB Network Interfaces are coupled and form a Link System wherein a Link System includes several individual links to the first Host, and several other individual links to a

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second Host to form links or bridges between the Hosts and/or USB Network Interfaces when coupled.

[0032] Aspects of the present application, in some embodiments, relate to a system wherein two or more Host systems (computers) are coupled by and/or through a Link System wherein a Link System includes several individual links to the first Host, and several other individual links to a second Host and/or other Hosts to form links or bridges between the Hosts systems when coupled.

[0033] Aspects of the present application, in some embodiments, relate to a system wherein two or more Host systems are coupled by and/or through a Link System wherein a Link System includes several individual links to each of several hosts in which various links or bridges are formed between any two or more coupled hosts, in a multi-bridge or data switch configuration.

[0034] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration provides for communications between any two coupled hosts, and separately and simultaneously between any two other coupled hosts, in that multiple individual bridges or linked data paths can be established ad hoc.

[0035] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration provides for communications and networking between any two or more coupled hosts, and separately and simultaneously between any two or more other coupled hosts, in that multiple individual multi-host bridges or linked data paths can be established ad hoc.

[0036] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration provides for communications and networking between any host to be bridged with any number of other coupled Hosts at the same time in a one-to-many Host configuration or a broadcast type configuration.

[0037] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration provides for communications and networking between any number of coupled hosts to be simultaneously bridged with any one coupled Host at the same time in a many-to-one Host configuration or convergence-type configuration.

[0038] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration includes and supports port-to-port and port-to-multiport and or Host to Host and Host to multi-Host configurations providing direct, any-to-any, one-to-many,

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many-to-one, one-to-cascaded-many, one-to-any in hunt group, third-party coupling, and expansion to additional parallel or daisy-chained Link Systems.

[0039] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration in router mode provides a means to link coupled Hosts belonging to one separate and distinct network with coupled Hosts belonging to another separate and distinct network.

[0040] Aspects of the present application, in some embodiments, relate to a system wherein a bridge or data switch configuration in router mode provides a means to link coupled Hosts belonging to one separate and distinct network or virtual network with coupled Hosts belonging to another separate and distinct network or virtual network.

[0041] Aspects of the present application, in some embodiments, relate to a system wherein a system includes a first Host and a second Host. The first host, upon being connected, detects the Link System and a connection is established. The second host, upon being connected, detects the Link System and a second connection with the Link System is established, after which a bridge connection through the Link System is established, and thereby coupling or connecting the first Host with the second Host. Indeed, many more than just the first Host and the second Host may be connected in this manner.

[0042] Aspects of the present application, in some embodiments, relate to a system wherein a system includes a first Host system, a second Host system, and a Link System. The Link System includes a detector to detect the established connection to the first and second Host systems and the Link System logic establishes two or more bridge connections from the first Host system to the second Host system through the Link System. Indeed, many more than just the first Host system and the second Host system may be connected in this manner, with potential for multiple Host systems, multiple Link Systems and multiple bridges.

[0043] Aspects of the present application, in some embodiments, relate to a system wherein a system includes a first Host system, a second Host system, a Link System, a coupling condition, and a virtual network. The Host systems include a detector to detect the coupling condition through the Link System, and the Host logic establishes a virtual network connection or bridge to the second Host system as a response to the detection condition. Indeed, many more than just the first Host system and the second Host system may be connected in this manner, with potential for multiple Host systems, multiple Link Systems, multiple coupling conditions and multiple virtual network, network connections or bridges.

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[0044] Aspects of the present application establish a method for transferring data between two or more coupled Host systems; wherein a Link System employed comprises two or more separate and distinct paths on the physical layer of an interconnection architecture; wherein the established paths are wired, wireless, virtual, or a combination of same; wherein high speed data is transferred between Host systems across enumerated Universal Serial Bus channels, and wherein network and link controls are provided via one or more secondary or other, alternate communications path or paths on the same bridged link, separate from the path or paths establishing other bridged links for high speed data communications.

[0045] In some embodiments, wherein a Host system coupled via a Link System is detected, two or more ports or Host controllers of the detected Host system are negotiated with, and it is determined whether to operate with the detected Host system in response to the negotiating. Notably, the two or more ports or Host controllers may comprise one or more endpoints.

[0046] In some embodiments, Host logic allows operation as a Host system and with a coupled Host system, and a detector detects a coupled Host system via Link logic and determines whether to operate with the detected Host system and the Host logic on the detected host responds to the Link logic; and wherein Host logic resides on the Host systems and Link logic resides on the Link System. Notably, there may be multiple Hosts systems and potentially multiple Link Systems.

[0047] In some embodiments, a cable device assembly or Link System couples a first Host system and a second Host system. The second Host system includes Host logic to allow operation as a Host system, and a detector to detect a coupled cable device assembly or Link System, and to indicate whether the Host logic is to be coupled to the cable device assembly or Link System. Indeed, many more than just the first Host system and the second Host system may be connected in this manner.

[0048] In some embodiments, a coupling condition of a cable device assembly or Link System is detected, and an indication as to whether to couple with the attached Host system or Host systems is made in response to the detecting.

[0049] In an aspect of the present application, wherein more than two USB Host systems require coupling, the Link System takes on the role of a USB Data Bridge or USB Data Switch in terms of configuration, whereby coupled USB Host systems are interconnected through a series of Links on a main USB Network Bus or Buses; through the interconnection of a series of Links and or Buses, a basic configuration of the Link System may be expanded in many aspects.

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[0050] In some embodiments, multiple USB Host systems are coupled by implementing multiple Link Systems between USB Host systems in a daisy-chain configuration wherein all USB Host systems, except those located at the ends of the chain, employ an additional USB Host Controller and additional USB ports. The additional USB Host Controllers may serve as an extension or bridge to the other separate Link Systems in coupling adjacent USB Host systems to both the network and the data links and facilities.

[0051] In some embodiments, multiple USB Host systems are coupled by deploying a number of separate Link Systems to a centrally located USB Host system, wherein a number of USB Host Controllers and USB ports are deployed, to establish a star configuration wherein all coupled USB Host systems are interconnected in a Server-Client environment in which the centrally located Host system emulates the aforementioned bridge/data switch configuration.

[0052] In some cases, according to aspects of the present application, multiple USB Host systems are connected via a mix of daisy-chain, star, mesh and bridge/data switch interconnect configurations; in this manner, elaborate network structures can be created and implemented in either fixed or ad hoc installations.

[0053] In some embodiments, a dedicated hardware-based implementation may be made, for example, in file sync applications. For example, in some embodiments, a personal computer or a Home Entertainment System can connect to a notebook computer or tablet system using a USB Type-A to USB Type-A cable with an embedded Link System for fast connection speeds and transfer of data and/or information.

[0054] Some aspects of the present application may allow a device with a connection to a USB Host system to "push" data in controlled situations, particularly when the data is stored as a large file, as is common to media applications, wherein a user connects to a Host to rent or purchase movies, video, music, documents, and/or other media, etc. For example, in some embodiments, distribution of music and/or video downloads (for example, interactive DVD, HD-DVD, Blu Ray, etc.) at high speeds (for example, USB 3 speeds) via kiosk type implementations, for media retailing in locations such as airports, convenience stores, etc.

[0055] In some embodiments, a USB 3 Host system may appear to be and may operate as a USB 3 device and may enable what would appear to be a Host to Host connection to be made, such that the coupled USB 3 Host system becomes transparent to a user. In some embodiments, standard features (systems included as part of the Host system OS), such as a USB mass storage device driver, a device letter, and/or a file drag and drop feature, may be used in either

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Command Line Interface or in Graphical User Interface to provide a means by which content can be moved or copied between two USB Host systems. Additional user intervention in such applications would not be required in conjunction with the use of these standard features, thereby allowing seamless operation for features such as Sync-and-Go, or scheduled backups.

[0056] In some embodiments, a file transfer may be initialized and controlled by a storage facility that acts as a USB Host system, that supports two or more coupled USB Hosts systems, and that may serve as a means to augment a current local area network and/or a file storage facility and/or a file sharing facility. For example, a file transfer may be initialized and controlled by a network storage device in a user's home to bridge fixed-place devices and portable devices, and/or as a file sync facility for daily document management in commercial applications.

[0057] Aspects of the present application may cause two or more servers to connect; wherein each connected Host system (server) remains fully operational and able to control operations on other Host systems, including, but not limited to, file transfer, virus invigilation, other file processing or operations.

[0058] In some aspects of the present application, a Host to Host connection supports the provisioning of a shared environment such as a virtual host or other sharing of system resources including but not limited to other attached USB Devices and other network attached devices (for example a USB thumb drive, or a Network Attached Storage unit (NAS).

[0059] In a particular embodiment, a USB Host system, usually a smaller system such as a mobile phone, tablet or similar, may be provided with a dock, or similar resting point, may employ aspects of the present application to cause the establishment of a network connection to other USB Host systems, and/or devices. Connecting using aspects of the present application may be considered to support sync-n-go, system resource sharing, sharing of hardware features such as touch interfaces, and other components, whether implemented automatically at connection, or via user control.

[0060] Some aspects of the present application may employ USB 3.0 or USB 3.1 Host systems. In other aspects, other USB versions, such as USB 2.0, can be used to provide same or similar performance. Future versions and/or implementations are contemplated, using USB and/or other high speed or fast bus implementations and protocols.

[0061] While some embodiments have been described with regards to particular implementations, in accordance with some or other embodiments, other implementations are possible. In addition, the order, composition and/or format of components, circuit elements or

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other features represented in the drawings and/or described herein are not necessarily required to be arranged in the particular way as represented or described herein. According to some embodiments, other arrangements are possible.

[0062] Terms such as "coupled" and "connected" used herein, may be replaced by any derivative such as "bridged." Although seemingly having a similar contextual definition, these terms are not intended as interchangeable replacements for one another. More specifically, in particular embodiments, "connected" may be used to indicate that two or more entities and/or elements and/or units are in direct physical or electrical contact with each other, wherein "Coupled" and/or "Bridged" may mean that two or more entities are in direct physical or electrical contact; and where "Coupled" and/or "Bridged" may also mean that two or more entities and/or elements and/or units are not in direct contact with each other, but exist and/or interact in a co-operative bind with each other.

[0063] Terms such as "block" and "unit" are used herein, may be replaced by any derivative such as "element." Although seemingly having a similar contextual definition, these terms are not intended as interchangeable replacements for one another. More specifically, in particular embodiments, "block" may be used to indicate that two or more entities and/or elements and/or units are in relation to one another, wherein "unit" may mean two or more entities and/or elements and/or units are in relation to one another and that two or more entities and/or elements and/or units are not in relation to one another other, but exist and/or interact in a co-operative bind with each other.

[0064] Some aspects of the present application may be implemented in one or any combination of hardware, firmware, and software. Some embodiments may employ a computing platform to perform the operations described herein whereby instructions may be read and executed after having being stored on a machine-readable medium. Machine-readable media may include any mechanism that can store and/or transmit information in a form readable by a machine (for example, a computer). For example, a machine-readable medium may include one or more of the following: read-only memory (ROM); random-access memory (RAM); magnetic disk storage media; optical storage media; flash memory devices; electrical, optical, acoustical or other form of propagated signals (for example carrier waves, infrared signals, digital signals, the interfaces that transmit and/or receive signals, etc.), and others.

[0065] Accordingly, while some diagrams may have been used herein to describe particular embodiments and/or implementations thereof, the present application is not intended to be limited to those diagrams and/or to corresponding descriptions herein. That is to say, the

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indicated movement or direction of any process or connection need to be or need not to be with or through each illustrated box or connection point or entity, or to be or not to be in exactly the same order as illustrated and described herein.

[0066] In some embodiments, a USB Host may be used to operate as a USB device, wherein the connection from one USB Host system to another USB Host system coupled either directly through a Link System or by means of an alternate Network system so as to allow what would appear to be a Host-to-Host connection established in a manner which may be transparent to a user. In some embodiments, standard features normally associated with those being provided by the Host system Operating System, including interaction with USB Devices using a USB mass storage device driver, device letter, and/or file drag and drop features, may be used to move or copy content between two Host systems. Integration with these standard mechanisms allows existing applications such as Sync and Go to work seamlessly and without the requirement of any additional user intervention. This aspect of the present application can be considered advantageous in that system and peripheral resource sharing for applications in consumer, commercial and industrial scopes are considered high value for all facets of connectivity and storage solutions and for virtualization solutions.

[0067] Accordingly, while some embodiments are described herein as USB 3 embodiments, other aspects of the present application may not require these particular implementations. For example, some implementations require other USB embodiments such as USB 2.0 and, likewise, it is also contemplated that future or alternate versions and/or implementations of USB and/or other fast bus implementations such as PCI, and its derivations, SCSI or others thereof, may be performed according to some aspects of the present application.

[0068] Accordingly, with regards to each system shown in a figure herein, the elements within the figure, in some cases, may each have a same or a different reference number, so as to suggest that the elements represented could be similar, same and/or different. Notwithstanding, an element may be flexible enough to have different implementations and remain working with some or all of the systems shown or described herein. The various elements shown in the figures, may be the same or different. Which one is referred to as a first element and which is called a second element is in some cases arbitrary.

[0069] Accordingly, to some embodiments, USB 3 provides additional features including a bus training sequence used to establish the communications between USB ports, as part of the response to detecting a connection. Upon initial connection of the aspects of the present application, there is an exchange of information between the Host system controllers and Link

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System controllers as is the case whenever a USB device is connected to a USB Host port (for example, a USB Scanner to a USB Host or a USB Device to a USB Hub). Host system controllers will declare themselves as downstream ports (as in the normal manner) and Link System controllers will declare themselves as upstream ports (in a manner similar to a USB Device). This allows the Host system at either end of the Link System to act as a Host while both are connected, seemingly, to each other, although, physically through the Link System which appears as USB Devices to each of the respective connected Host systems. In this manner a USB 3 peer-to-peer connection is possible, and a full scale peer-to-peer network is also possible.

[0070] In some aspects of the present application, USB implementations use differentially driven receive block logic as well as differentially driven transmit block logic at either end of a coupled Link System, whereby the Network Manager appoints opposite ends as either the sender or the receiver as per the user interface Application's request. Additionally, in some embodiments, a USB interconnect may include two more differential pairs or multiple differential pairs which can be used and in some embodiments are used, for link management (for example Network and Control Management) and/or other lower speed and bandwidth data communications.

[0071] Accordingly, in some embodiments, since USB 3 is a dual simplex connection that supports concurrent IN and OUT transactions, a transmitter and a receiver block logic may be included in a Host system, and therefore beneficial to have the same in the Link System as block logic such that communications for each individual host is performed separately and simultaneously with the Link System whether or not a data transfer is executing at the time.

[0072] Accordingly, in some aspects of the present application, two USB Host systems (for example, two USB 3 Host systems) can be connected and/or coupled together via the Link System, wherein for example, in some embodiments, a personal computer (PC) configured as HTPC (Home Theater PC) can be connected and/or coupled with a tablet computer (for example, an iPad™ from Apple Inc. of Cupertino, CA) via a USB connection. In some embodiments, a high bandwidth connection is made between systems wherein it is ideal for transferring large media files in extremely short times. For example, such a high bandwidth connection is used for rapid transfers of large media files containing standard definition (SD) content and/or high definition (HD) content (for example, from a personal computer to a notebook computer for later playback). In some embodiments, the high bandwidth connection does not require any specific or additional support from a specification (for example, from a USB specification such as a USB 2.0 or a USB 3.0 specification). In some embodiments, the high bandwidth connection uses

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unmodified USB type-A receptacles (for example, unmodified USB 3.0 type-A receptacles). In some embodiments, the operation of the high bandwidth connection is transparent to the user. In some embodiments, existing USB device class drivers may be used (for example, existing USB 3 device class drivers). In some embodiments, Host systems having ports with capability for such a high bandwidth connection may connect to a Link System for such an implementation.

[0073] In some aspects the present application, aspects can be delivered in a product form that would match the benefits of a passive crossover cable (for example, passive USB crossover cable such as a passive USB 3.0 crossover cable) and may be used for the purpose of connecting two Host systems with the desired intention to transfer data back and forth between the coupled Host systems. The user's perspective, would be one of a seamless nature, in that the connection between two Host systems (for example coupled together by means of aspects of the present application configured as a Link System) would simply work whenever the cable is plugged in to each Host system. Sync and Go applications based on drive letter addressing, simply work. In the manner as described, the throughput efficiency is very high in that the Link System is serving and communicating directly with only two Host systems; saving valuable bandwidth and Network Management resources as would occur if deploying over an IP based protocol.

[0074] In some embodiments, performing may be considered synonymous with appearing to act, such that one Host system may perform as a host and the second Host system may perform as a device, and on command, one Host system may alternate to performing as a device, while the second Host system, in synchronized manner, may alternately perform as a host. In some embodiments, two Hosts each act simultaneously as both a host and a device. For example, a Host system can in some embodiments perform simultaneously as both a host and a device.

[0075] In some embodiments, performing may be considered synonymous with appearing to act, such that a device configured as a bridge cable, comprised of a Link System situated in between the USB Male-A to USB Male-A connectorized cables, coupling the Host systems, perform as would an entirely passive cable (for example, a crossover cable). In some embodiments, the control hierarchy (which is to say, which Host system will perform as the conventional host and which shall perform as the conventional device) may be established using, for example, hardware and/or hardware controlled by software, at one or both of the coupled Host systems. In some embodiments, the host performing as the host and the host performing as the device, can be dynamically swapped using hardware and/or software and/or both, at one or both of the Host systems.

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[0076] In some embodiments, performing may be considered synonymous with appearing to act, such that a device configured as the Host system may be presented to the coupled Host system as a Mass Storage Device, and/or performing as having a connection with a directly attached storage subsystem, wherein storage capability is provided.

[0077] In some embodiments, performing may be considered synonymous with appearing to act, such that a device configured as the Host system may be presented to the coupled Host system as an Ethernet emulation mode communication device and/or interface, and/or performing as facilitating the establishment of network addressable access, and/or network addressable access to other network addressable devices such as a network attached storage (NAS) subsystem, wherein storage capability is provided.

[0078] In some embodiments, performing may be considered synonymous with appearing to act, such that a device configured as the Host system may be presented to the coupled Host system as a device. For example, in some embodiments, the coupled Host system performs as a storage hard disk drive (HDD) having an OS generated and/or recognizable and/or compatible drive letter, just as it would see any other USB storage device such as a USB thumb drive, wherein the coupled Host system requires no additional hardware or software to participate in a peer to peer connection. Logic may be resident at the coupled Host systems and within the Link System therein.

[0079] In some embodiments, performing may be considered synonymous with appearing to act, such that a device configured as the Host system may be presented to the coupled Host system like any other network addressable host or file server (for example, a computer), and from the perspective of the Host system the coupled Host system may be presented like any other network addressable host or file server (for example, a computer). In some embodiments, the network interface may be generated by software (for example, a device driver) on the Host system, and presents the file system in the same manner as any direct attached network host or file server, or network attached storage (NAS) system. The driver may optionally present only a subset of the file system (for example, the user's "My Documents" directory).

[0080] In some embodiments, performing may be considered synonymous with appearing to act, the Link System may perform as if employing the USB over IP protocol, although not employing the USB over IP protocol, which is known to have inherent large overhead issues affecting operational factors and transfer speeds. The present application is not intended to be limited to or preclude implementations from including and/or using such protocol either exclusively or inclusively as a supplemental protocol for any desired or required design criteria.

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[0081] Notably, much the same could be said about the Link System performing as if employing the "IP over USB" protocol, in that aspects of the present application may involve performing as if employing the IP over USB protocol and, although it is not being employed, it is understood that implementations are not limited to or precluded from being employed by aspects of the present application or from being included and/or using such protocol either exclusively or inclusively as a supplemental protocol for any desired or required design criteria.

[0082] Aspects of the present application may be considered to relate to a dual interface, such that some aspects may be implemented physically as a device, these aspect may then appear as a Host at the Application level, thereby provisioning a Virtualized Host system with the ability to connect to devices and other Hosts, both physical and virtual.

[0083] Aspects of the present application provide an ability for any coupled Host system to connect to multiple separate and distinct Link Systems. As such, the number of separate and independent data links to one or many other Host systems may be seen to increase, such that the aggregate high speed data transfer throughput is equal to the sum of all of the transfer speed capability of each of the attached Link Systems. For example, if any one Host system is attached to any one other Host system, using four separate and independent bridged peripheral connection pairs supporting the data transfer, using a separate and distinct Host controller for each of the attached bridged peripheral connection pairs by both Host systems, whereby the average transfer speed on any one data link through a Link System is 400MB/s, the total potential throughput in this implementation would approximate 1600MB/s. Aspects of the present application may be seen to include facilities to transfer one file using all available data links, or multiple files simultaneously using all available data links. Other facilities could be included to use any number of the available data links in this type of embodiment, as "Send Only" data links, with all other data links set as "Receive Only" data links. Other functionality can be included to switch any data link function (i.e., "Send Only") to any other data link function in an ad hoc manner. Embodiments of a similar nature could be used whereby relaying or routing of data to more than one Host system would provide higher throughput for applications requiring real time duplication or redundancy. This aspect of the application can be considered as advantageous in that high speed data transfers may be provided for applications in consumer, commercial and industrial scopes at lower cost points than current competitive solutions.

[0084] Aspects of the present application provide for establishment of a Link System deployed as a virtual Host system, such as that commonly deployed as a Zero Client, in which a virtual host is implemented via a Multi-Seat Host OS, System/application, in which the user interfaces,

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namely video, keyboard, mouse and audio functionality and facility are delivered to the Link System by means of the existing USB interface, and the required USB controllers are implemented within the Link System for such an embodiment. Interconnection to other Desktop or Smart Device Host systems via the USB interface to the Link System may provide a private and high speed personal network for file sync, backup, etc. Additionally, an embodiment having specific interfaces and deployed in such a manner can be construed as a Docking Station for Smart Devices such as laptops, notepads, tablets, phablets, Smart Phones, etc., whereby the user is provided a means to implement an additional and typically larger display or screen, a more accommodating keyboard, mouse and audio devices. Provisioning to the home or corporate network can also be established through the Link System, with options for local and faster storage, and common or shared file storage, or for access to cloud based storage.

[0085] Aspects of the present application, in some embodiments, relate to a system wherein a device bridge provides for direct logical access to system resources, including CPU, Memory and hard drive, as well as peripheral resources such as printers, scanners and other devices; and wherein direct access to system resources eliminates protocol conversions required by other network methods and protocols, such as Ethernet. Connections established via a bridged hub connection may further establish default pools of privately shared resources available to any connected Host without user or system intervention. This aspect of the present application can be considered advantageous in that system and peripheral resource sharing for applications in consumer, commercial and industrial scopes are valuable for virtualization and other connectivity solutions.

[0086] The described implementations herein of the present application are intended to be examples only, and when employing USB 3.1 version of the protocol, any and or each of the USB connectors referenced herein may be implemented as a USB 3.1 Type-C connectors.

[0087] The described implementations herein of the present application are intended to be examples only. Alterations, modifications and variations may be effected to the particular implementations by those skilled in the art without departing from the scope of the application, which is defined by the claims appended hereto.

[0088] FIG. 1a illustrates, in a schematic diagram, a USB Network Controller 100 in accordance with aspects of the present application. As illustrated, the USB Network Controller 100 may include at least two USB differential pair connections or ports 118 and 178 respectfully (for example a USB 2 differential pair connection or port 118, or a USB3 multi-differential pair connection or port 178) each of which is communicatively connected to USB I/O Device

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Controller #1 110 and USB I/O Device Controller #2 170 respectively, which provide a Communication Link 136 and a Data Link 134 respectively along with combined Power Links 138 with an optional separate external Power supply port 198; to establish interconnection with one or more USB Host systems, and where upon a Virtual Network 124 may be established upon coupling with one or more USB Host systems. Each USB I/O Device Controller #1 110, and USB I/O Device Controller #2 170 is illustrated in Figs 1b and 1c respectively.

[0089] FIG. 1b illustrates, in a schematic diagram, a USB I/O Device Controller #1 110 in accordance with aspects of the present application. As illustrated the USB I/O Device Controller #1 110 may include Network and Control Management 112, a USB Network Interface 114, and a Power Interface 116. The Network and Control Management block 112 may be comprised of various elements; a Code Logic block 156, a Memory Block 152, a Clock 154, each of which is communicatively connected to each other and additionally to a Central Processing Unit 150 (hereinafter "CPU") and also interfaces directly with the Serial I/O Bridge 158 in the USB Network Interface block 114 and additionally with the Power Manager 162 of the Power Interface block 116. In accordance with aspects of the present application the USB I/O Device Controller #1 110 may establish a Communication Link across the Network and Control Bus 136 for coupling with the USB I/O Device Controller #1 110 of one or more other USB Network Controllers 100. Additionally, a Power Bridge 160 may provide Vbus Power and or an optionally provided external power source to the shared Power Bus 138 via the Power Manager 162 as may be directed by the USB Host system application, should the need be presented. The various elements of the USB I/O Device Controller #1 110 may further include the establishment of a connection to the Virtual Network 124 which may be seen as a virtual connection and used as a real IP Network formed between any or all of the coupled USB Host system(s) to any other coupled USB Host system(s).

[0090] FIG. 1c illustrates, in a schematic diagram, a USB I/O Device Controller #2 170 in accordance with aspects of the present application. As illustrated the USB I/O Device Controller #2 170 may include Data Control Management 172, a USB Network Interface 174, and a Power Interface 176. The Data Control Management Block 172 may be comprised of various elements; a Memory Block 182, a Clock 184, each of which is communicatively connected to each other and additionally to a Central Processing Unit 180 (hereinafter "CPU") and interfacing with a Code Logic Block 186 and an Optional Control Logic block 196, both of which may be located externally of the Data Control Management Block 172; and may also interface directly with the Serial I/O Bridge 188 in the USB Network Interface block 174 and additionally with the Power Manager 192 of the Power Interface block 176. In accordance with aspects of the present

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application the USB I/O Device Controller #2 170 may establish a Data Link across the Data Bus 134 for coupling with the USB I/O Device Controller #2 170 of one or more USB Network Controllers 100. Additionally, a Power Bridge 190 may provide Vbus Power and or optionally provided external power to the shared Power Bus 138 via the Power Manager 192 as directed by the USB Host system application, should the need be presented. The various elements of the USB I/O Device Controller #2 170 may further include the establishment of an optional connection from the Optional Control Logic block 196, to establish a Communication Link across the Network and Control Bus 136. One of the main features of the USB I/O Device Controller #2 170 is the ability to adapt or convert incoming USB 3 formatted data through the Serial I/O Bridge 188, which may then be altered to suit Bit-Wide delivery options ranging from 4 to 64 as directed by means of the Bit-Wide Data Exchange 194. This conversion process may also be deployed in the opposite direction such that Bit-Wide Data may be adapted or converted to USB 3 format for compliance with the USB 3 protocol.

[0091] In operation, the USB Network Controller 100 may allow for a link between a USB Host system and a USB Network Bus to be provisioned. Furthermore, the USB Network Controller 100 may be useful when establishing a non-standard USB communications architecture, permitting one Host system to be directly connected to another Host system in typical computer network topologies and interconnections. The USB Differential Pair(s) Connections or ports #1 118, and #2 178 may facilitate interconnection with a standard USB Host system (for example, a computer system) via a standard USB or USB 3 cable. The Power connection 198 may facilitate an interconnection with a standard external power source as a means for more or supplemental power. The Link System interface buses including Network and Control Bus 136, the Data Bus 134, the Power Bus 138 may facilitate interconnections with the USB Network Bus, other buses, routers, switches and other similar or dissimilar networks.

[0092] As is illustrated in FIG. 1b, the Network and Control Management block 112 may facilitate a means by which a connection management system may be deployed to bridge USB Host system communications with the USB Network Interface, for the purpose of interconnecting with and to other coupled USB Hosts systems through a Link System comprised of two or more coupled USB Network Controllers 100. The Network and Control Management block 112, may function as a traffic manager, wherein various communication paths physical and virtual are established when USB Host systems are coupled through the Link System with each communication path having specific and distinct operating functions and processes.

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[0093] The Network and Control Management block 112 may receive and issue commands. Additionally, the Network and Control Management block 112 may detect and negotiate with the various systems within the USB Network Controller system 100 and, externally, with a coupled USB Host system, the Link System and the optionally provisioned internal Console port within the Code Logic 156, and other coupled USB Hosts and/or devices.

[0094] The Data Control Management block 172 as shown in FIG. 1c may interact with the Bit-Wide Data Exchange unit 194 may enable fast bus communications for high speed data and file transfers with the Link System, performing data direction selection and path routing and switching; and executing data flow and data speed alterations as instructed by the Data Control Management block 172, and in collaboration with the direction of the Network and Control Management block 112. The Data Interface unit 174 may accommodate transfers of command and control instructions and data, but does so as a secondary and/or simultaneous parallel service, thereby supplementing its main service which is specifically to provision USB and USB 3 high speed data and file transfers. Aspects of the present application include separate and distinct paths within the USB Link System. The Link System Data Bus may be connected to the USB I/O Device Controller #2 170 to enable fast, efficient and directed data delivery to and from the USB Network Interfaces 100, since control and addressing functions may mainly be provisioned by the USB I/O Device Controller #1 110 connected to the Control bus of the USB Network.

[0095] The Code Logic blocks 156 and 186 may be configured to store machine code data for use by the Network and Control Management block 112 and the Data Control Management block 172 relating to configuration, process execution, and data path and handling instructions.

[0096] The Virtual Network block 124 may be established as a pseudo-Control Manager within the coupled USB Host systems wherein functional network commands are carried out in sync with those issued at the Link System level. Functional network commands relate to control sequencing and operational functions provisioned by and through the Network and Control Management block 112, and the Data Management block 172, between coupled USB Hosts systems, and transacted on the Link System, as directed by the Network and Control Management block 112, from user interaction at the USB Host system(s) Application level.

[0097] Other aspects of the present application may include a pre-processor unit and/or a postprocessor unit and/or both, placed or located anywhere prior to the Bit-Wide Data Exchange unit 194 in the case of a pre-processor and/or placed anywhere after the Bit-Wide Data Exchange unit 194 in the case of a post-processor and/or a mix of both as per design criteria. For example a

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buffer, a multiplexer/demultiplexer (mux/demux), a serializer/deserializer (SERDES), a data converter, a bit converter, a bit checker, etc. Notably, Fiber Optic Cable may be employed as the USB Transmission Line, with a benefit of reducing distance limitations as well as noise interference and signal degradation typically associated with high speed bus transmissions over copper-based cable.

[0098] FIG. 2 illustrates a Link System 200 in which two or more USB Host systems 210 may be coupled in a fully addressable and managed Network architecture by deploying a USB Network Interface 212 over a shared USB Network Bus 218. An example USB Host system 210 is illustrated. The USB Network Interface 212, as a portion of the Link System, may provide a manner for the USB Host system 210 to connect to a USB Network Bus 218.

[0099] Aspects of the present application may include two or more network paths from the USB Host system 210 through the USB Network Interface 212 to the USB Network Bus 218. At least one of those connections may be a physical connection and all others may be either physical or virtual, or a combination of both.

[00100] In the embodiment illustrated in FIG. 2, a primary physical connection may employ a USB Transmission line 216 (for example, a USB 3 Cable including several differential pairs) connecting a USB 3 Port 232 of the USB Host system 210 (for example, a Computer) to a USB 3 Hub 244 (for example a USB3 Hub Controller) through USB Connector 242 to each of the USB and USB 3 I/O Device Controllers built into the USB Network Controller 100. The USB Host system 210 may include the necessary physical and logical components for data storage, retrieval, access, and transfer duties. The components may include: an Operating System 234; a File System 236; one or more Data Stores 238; an Application 240; a USB 3 Host Controller 228, and a Virtual Network Interface Controller (NIC) 230.

[00101] A USB Network Transmission line 214, which may be connected to the Link System interface via USB Network Controller 100, and may include a first Link to bridge a Network Bus and or a Control Bus for addressing, signaling, switching and routing signals and controls, and a second Link to bridge a high speed Data Bus, and a third Link to bridge a Virtual Network Bus 124 for application interfacing at the Host system, and a fourth Link to bridge a Power Bus for delivery to coupled Host systems or bridged device controllers for low-power or battery powered Host systems, may connect the USB Network Interface 212 to the USB Network Bus 218.

[00102] In aspects of the present application, reductions may be found in distance limitations of the physical interconnects between the USB Host system 210 and the USB Network Bus 218. As

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can be seen in FIG. 2, the USB Transmission line 216 may be connected to the USB Network Interface 212. In some embodiments, Copper USB cables serving as the USB Transmission line 216 may be limited to specific length dimensions, so that only minimal external and internal signal degradation may occur due to interference and differential pair signal loss on the USB Transmission line 216.

[00103] As Power and Ground signals are inclusive in USB connections, some power levels may be affected over distances and may not be sufficient as a power source for the attached Link System 200. As such, an External Power connection may be provided by way of the Power port 254.

[00104] In operation, the Application 240 may provide a user with means to perform data and file transfers by means of a network facility. In some embodiments, the network facility may be serviced by the Virtual NIC 230 which provides typical Internet Protocol type network functionality with address and port interaction in accordance with the OS 234 and Application 240 requirements.

[00105] In some aspects of the present application, the Virtual NIC 230 may be established when coupling the USB Host system 210 to the USB Network Bus 218. The coupling may be accomplished via the USB 3 port of a USB 3 Hub 244 (for example a USB3 Hub Controller) through to each of the USB and USB 3 I/O Device Controllers of the USB Network Controller 100 and via the USB Network Transmission line 214, which may be connected to the Link System interface or USB Network Bus 218. Upon coupling, the OS 234 enumerates a Virtual NIC 230, and may configure and or establish an IP address and Port on the Virtual NIC 230 which may allow for the Application 240 to interact with other coupled USB Host systems 210 presenting IP addresses on the same family and subnet. The Application may render command instructions and associated system queries of the File System 236 with respect to the data in the Data Store 238, on both the USB Host system 210 and of that of any other coupled USB Host system 210. The Application 240 also renders typical file handling and file transfer commands typically associated with modern day computing systems such as file storage listings, file directory listings, file copy, move, delete, rename, compare, sync, backup, restore, etc., within the USB Host system 210 and with or to any other coupled USB Host system 210.

[00106] The Application 240 may interact with the OS 234 of the USB Host system 210 and any other coupled USB Host system 210 seemingly via the Virtual NIC 230, but all communications concerning network and control instructions and information are conducted on the communications bridge linking coupled USB Network Interfaces 100 on the Network and

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Control Bus 136. All exchanges of Data from one USB Host system 210 to any other coupled USB Host system 210 may transact via the data bridge linking coupled USB Network Interfaces 212 on the Data Bus 134, thus may allow for high speed data transfers in either direction.

[00107] USB cable lengths are relatively and prohibitively short in comparison to alternate network wiring solutions (for example CAT5, CAT6, etc.); as such, the USB Host system 210 may be caused, by cable length, to be in close proximity to the USB Network Interface 212. Other inherent restrictions can impede the working distance by which the USB Network Transmission Line 214 can be accommodated, ranging from number of conductors, shielding requirements, and gauge and connector structure as the primary sources.

[00108] Provisioning of Power, as in all implementations of USB interconnects, may be derived from the USB Host system through the USB Transmission line 216 and, ultimately, via the USB port 242. In situations in which additional Power is required, optional internal or external power sources may be connected or applied through the Power port 254, connecting to the USB Network Controller 100 Power Connection 198 and then managed by either Power Manager 162 and or 192 as directed by the Network and Control Management 112, such that all systems are functioning optimally and such that any USB Host systems' data interactions are not subject to communication speed reductions.

[00109] FIG. 3 illustrates a Link System 300 as an alternative to the Link System 200 of FIG. 2. In the Link System 300 of FIG. 3, a USB Network Interface add-in card 350 is illustrated as internally mounted inside a USB Host system 310.

[00110] The USB Host system 310 has many of the same components as the USB Host system 210 of FIG. 2, including an Operating System 334; a File System 336; one or more Data Stores 338; an Application 340; a Virtual NIC 330; a USB 3 Host Controller 332, and a USB port 366.

[00111] The USB Network Interface add-in card 350 may have many of the same components as the USB Network Interface 212 of FIG. 2. That is, the USB Network Interface add-in card 350 may include a USB port 362 (like the USB port 242 of FIG. 2), a USB Hub Controller 352 and a USB Network Controller 100 (like the USB Network Interface 212 of FIG. 2) and a Power port 356 (like the Power port 254 of FIG. 2). The USB Network Interface add-in card 350 may be implemented as a typical add-in peripheral card. Example typical add-in peripheral cards include: an adapter card; an expansion card; an add-in Ethernet Network Interface Card; and an externally attached dongle or device.

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[00112] The USB Host Controller 332 may allow the connection to the USB Network Interface add-in card 350 to connect to the USB Hub Controller 352 using the USB port 366 of the USB Host system 310, and the USB Port 362 of the USB Network Interface Addin Card 350, via a USB transmission line 316.

[00113] A USB Network Transmission line 314, which may be connected to the USB Network Controller 100, may connect the USB Network Interface add-in card 350 to the USB Network 218 in a similar fashion as outlined in Link System 200 in FIG. 2.

[00114] In operation, USB port detection, connection and enumeration by an eXtensible Host Controller Interface (xHCI) root host and/or an Enhanced Host Controller Interface (EHCI) root host within the USB Host Controller 332 may be handled by established USB specifications. Once connected and enumerated, the combination of the USB Host system 310 and the USB Network add-in card 350 form the Link System 300. Power for the USB Network add-in card 350 may be provisioned, by way of the Power port 356, directly from an Expansion Bus of the USB Host system 310 and may be managed internally by a Power Manager similar to the Power Manager 162 and or the Power Manager 192, which was described earlier, in conjunction with a review of the components of the USB Network Controller 100 of FIG. 1a, 1b, and 1c. The physical interface from the USB Host system 310 to the USB Network 218 may be implemented through a USB Network Transmission Line 314 which, as described earlier, can be made of various buses and also interfaces virtually with the USB Host 310 by an established Virtual Network as described previously.

[00115] In some aspects of the present application, the Virtual NIC 330 may be established when coupling the USB Host system 310 to the USB Network 218. Once coupled, the USB Network Interface 114 of FIG. 1b ma be detected within the Application 340, and the OS 334, may enumerate the I/O port and thereafter may enable the Virtual Network driver within the USB Host system 310 which may auto configure with an IP address and may provide access to various ports and resources for network activities. Upon activation, the OS may bind the Virtual Network Interface Controller 330, and the Application 340 may assume IP based network connections with other coupled USB Host systems, specifically using the Data Interface 174 in FIG. 1c for all Bulk Data exchanges with other coupled USB System hosts 310 including File Transfers to leverage the USB 3 5Gps bandwidth enabling high speed data transfer in the range of 400-450 MBps.

[00116] In some embodiments, as illustrated by FIG. 3, USB Network interfacing may provide significant advantages for Host-to-Host implementations wherein Host systems may be in close

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proximity to one another, such as in office environments, library pods, and in Server rack installations. The increased speed and bandwidth that may be realized by implementing a 5Gbps USB Network, may be seen to improve the overall usage and capability over other commonly used and inexpensive networking solutions. In some aspects of the present application, concurrent use of existing network connections and the proposed USB Network is a means by which data transfers, data syncs, and daily backups can be provisioned more quickly, securely and efficiently.

[00117] FIG. 4 illustrates a Link System 400 as an alternative to the Link System 200 of FIG. 2 and the Link System 300 of FIG. 3. In the Link System 400 of FIG. 4, a USB Network Interface add-in card 450 is illustrated as internally mounted in a USB Host system 410.

[00118] The USB Host system 410 has many of the same components as the USB Host system 210 of FIG. 2, including an Operating System 434; a File System 436; one or more Data Stores 438; an Application 440; a Virtual NIC 430 and a USB Host Controller 432.

[00119] The USB Network Interface add-in card 450 has many of the same components as the USB Network Interface 212 of FIG. 2. That is, the USB Network Interface add-in card 450 may include a USB Hub Controller 452 and a USB Network Controller 100 (like the USB Network Interface 212 of FIG. 2) and a Power port 456 (like the Power port 254 of FIG. 2). The USB Network Interface add-in card 450 may be implemented as a typical add-in peripheral card. Example typical add-in peripheral cards include: an adapter card; an expansion card; an add-in Ethernet Network Interface Card; and an externally attached dongle or device.

[00120] The USB Network Interface add-in card 350 has many of the same components as the USB Network Interface 212 of FIG. 2. That is, the USB Network Interface add-in card 350 may include a USB Hub Controller 452 and a USB Network Controller 100 (like the USB Network Interface 212 of FIG. 2) and a Power port 356 (like the Power port 254 of FIG. 2). The USB Network Interface add-in card 350 may be implemented as a typical add-in peripheral card. Example typical add-in peripheral cards include: an adapter card; an expansion card; an add-in Ethernet Network Interface Card; and an externally attached dongle or device.

[00121] The USB Network Interface add-in card 450 may have some components distinct from the USB Network Interface 212 of FIG. 2 and from the USB Network Interface Add-in Card 350 of FIG. 3, including a USB 3 Host Controller 462.

[00122] The USB Network Controller add-in card 450 may have a direct connection from the USB Host Controller 462 to the USB Network interface 454 by way of an internal connection of

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an onboard USB Transmission line, thereby eliminating an external USB Transmission Line to couple the USB Host 410 to the USB Network Interface 100 of the USB Network Controller add-in card 450.

[00123] The interface between the USB Network Interface add-in card 450 and the USB Host system 410 may be generically, for example, a Host Expansion or Peripheral bus. The Peripheral bus may, for example, be a local bus compliant with the Peripheral Component Interconnect (PCI) Local Bus standard or the PCI Express (PCIe) standard. To facilitate such an interface, the USB Host may include a PCI slot 464 and the USB Network Interface add-in card 450 may include a set 466 of PCI conductors.

[00124] Notably, the USB bus may be considered to be an extension of the known PCI bus and/or the known PCIe bus within a given Host system. It is common place for modern-day processors to expose the PCI/PCIe bus to the outside world by means of a protocol exchange, namely, a USB controller. The USB controller provides interconnection functionality with devices and other Hosts which are equipped with ubiquitous USB interfacing derived from their own exposed PCI/PCIe buses by means of compatible USB controllers. Such interfaces allow for high speed data transfer and or exchange over greater distances than that specified by the PCI/PCIe specification and at much lower cost than PCI/PCIe controller implementations. Also, new processor designs include USB buses direct to the CPU, thereby eliminating the need for an additional protocol exchange via an externally mounted controller. Embodiments of the invention claimed may include any "high-speed bus-related protocol" establishing Host to Device communications, and typically, but not necessarily, having a physical implementation employing differential pairs to deliver signals (data) at the hardware level; and are applicable protocols for use by aspects of the present application.

[00125] A USB Network Transmission line 414, which may be connected to the USB Network Controller 100, may connect the USB Network Interface add-in card 450 to the USB Network Bus 218.

[00126] As established, and in similar fashion as explained with regards to FIG. 3, connection and enumeration within the USB Host Controller 462 are handled according to USB specifications; and once connected and enumerated, the combination of the USB Host 410 and the embedded USB Network Controller add-in card 450 form the Link System 400.

[00127] Power for the Network Controller add-in card 450 may be provisioned, by way of the Power port 456, directly from an Expansion Bus of the USB Host 410 and may be managed

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internally by a Power Manager similar to the Power Manager 162 and or the Power Manager 192, which was described earlier, in conjunction with a review of the components of the USB Network Controller 100 of FIG. 1a, 1b, and 1c. The physical interface from the USB Host system 410 to the USB Network 218 may be implemented through a USB Network Transmission Line 414 which, as described earlier, can be made of various buses and also interfaces virtually with the USB Host 410 by an established Virtual Network as described previously.

[00128] In some aspects of the present application, the Virtual NIC 430 may be established when coupling the USB Host system 410 to the USB Network 218. Once coupled, the USB Network Interface 114 of FIG. 1b is detected within the Application 440, and the OS 434, enumerates the I/O port and thereafter may enable the Virtual Network driver within the USB Host system 410 which may auto configure with an IP address and may provide access to various ports and resources for network activities. Upon activation, the OS may bind the Virtual Network Interface Controller 430, and the Application 440 may assume IP based network connections with other coupled USB Host systems, specifically using the Data Interface 174 in FIG. 1c for all Bulk Data exchanges with other coupled USB System hosts 410 including File Transfers to leverage the USB 3 5Gps bandwidth enabling high speed data transfer in the range of 400-450 MBps.

[00129] FIG. 5 illustrates a Link System 500 featuring two Host systems, a first USB Host 210A and a second USB Host 210B, connected to each other by means of a Host-to-Host Cable implemented by deploying two USB Network Interfaces, a first USB Network Interface 212A and a second USB Network Interface 212B.

[00130] As previously outlined in FIG. 2, the first USB Host 210A includes various components for data and file transfer. The components may include: an Operating System 240A (not shown); a File System 236A (not shown); one or more Data Stores 238A (not shown); an Application 240A (not shown); a USB Host Controller 228A; a USB 3 Port 232A; and a Virtual NIC 230A. Similarly, the second USB Host 510B includes various components for data and file transfer. The components may include: an Operating System 240B (not shown); a File System 236B (not shown); one or more Data Stores 238B (not shown); an Application 240B (not shown); a USB Host Controller 228B; a USB 3 Port 232B; and a Virtual NIC 230B.

[00131] The first USB Network Interface 212A may, much like the components referenced earlier with respect to FIGS. 1 and 2, include a first USB Network Interface port 242A (not shown), a USB Hub Controller 244A (not shown), a USB Network Controller 100A (not shown),

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and a Power port 254A (not shown). Similarly, the second USB Network Interface 212B may include a second USB Network Interface port 242B (not shown), a USB Hub Controller 244B (not shown), a USB Network Controller 100B (not shown), and a Power port 254B (not shown).

[00132] In FIG. 5, a first USB Transmission line 216A connects a first host USB Port 232A of the first USB Host system 210A to the first USB Network Interface Port 242A (not shown) of the first USB Network Interface 212A. Similarly, a second USB Transmission line 216B connects a second host USB Port 232B of the second USB Host system 210B to the second USB Network Interface Port 210B (not shown) of the second USB Network Interface 212B.

[00133] A first USB Network Transmission line 214A, which may be connected to a first USB Network Controller 100A (not shown), may connect the first USB Network Interface 212A to a USB Network 218. Similarly, a USB Network Transmission line 214B, which may be connected to a first USB Network Controller 100B (not shown), and may connect the second USB Network Interface 212B to the USB Network 218.

[00134] In the first USB Network Interface 212A, an External Power connection may be provided by way of the first Power port 254A (not shown). Similarly, in the second USB Network Interface 212B, an External Power connection may be provided by way of the second Power port 254B (not shown).

[00135] As illustrated in FIG. 5, some embodiments relate to Host-to-Host connections for the purpose of deploying a Personal Area Network between Host systems of commercial, consumer and personal use such as Tablets, Laptops, Desktop Computers, and other smart devices including Smart phones and personal media players. In such an embodiment, the "bridge cable" use and operation resembles that of a ubiquitous USB2 Data Sync cable or an Easy Transfer Cable in which two host systems are coupled via a USB2-to-Ethernet converter bridged to the opposite side via another USB2-to-Ethernet converter, with relevance to an Ethernet cross-over cable; but enjoying the full transmission capacity available on the USB cable, unencumbered by Ethernet conversions, nor constrained by encapsulating USB transmissions within an Ethernet connection. This embodiment may be configured to allow remote control of the Host opposite, such that all resources, connections, interconnections, peripherals, devices, applications, and OS features and controls, are made available and usable with or without a security feature.

[00136] In some embodiments, the first USB Host 210A may be coupled to the second USB Host 210B via the Link System 500 by means of physical USB Network Bus 218, and a Virtual Network 124 being deployed upon enumeration of the first USB Network Interface 212A to the

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first USB Host 210A and the second USB Network Interface 212B to the second USB Host 210B. A closed loop deployment, the two USB Network Interfaces 212A, 212B are situated centrally and in opposition to one another, creating a USB Network architecture wherein USB connectivity may be provided to the USB Hosts 210A, 210B via the USB Transmission Lines 216A, 216B at either end of the Link System 500. Application software 240A, 240B (not shown) loaded and executed within respective USB Hosts 210A, 210B, using typical file management and utility software applications, and using common OS features, either located on or previously added to, respective USB Hosts 210A, 210B, may provide a means by which a user of either of the USB Hosts 210A, 210B, may move, copy, create, delete, and list the files (among other tasks and utilities) located on local and remote data stores 238A, 238B (not shown). In some embodiments, any system resource or capability residing in, or connected to, one USB Host system (for example USB Host system 210A) is also made available to the other USB Host system (for example USB Host system 210B.

[00137] In operation, links may be established through the Link System 500. These paths may be internal or external and may be physical or virtual. Conveniently, aspects of the present application may allow the Application 240A (not shown) and 240B (not shown), executed on the first USB Host system 210A, to connect and/or interface directly with or to any of the established links, be they internal or external, physical or virtual for which one or more coupled USB Host system (for example USB Host system 210B).

[00138] FIG. 5 also illustrates I/O encoders 510A, 520A, 510B and 520B may optionally be added as indicated, and may optionally be used in the operation of the apparatus. The I/O Encoders may be located within a device controller or without, and may encode raw data received by the device controller for transmission across the data bus, and may decode received data from across the bus for transmission to the device controller as raw data. As an example, the I/O encoder 520A may be located in between the USB I/O Device Controller #2A 170A and the USB Network Bus 218 for transmitting and receiving on the Data Bus 134A over the USB Network Bus 218 to the coupled Data Bus 134B; wherein the I/O encoder 520B located between USB Network Bus 218 and the USB I/O Device Controller #2B 170B having received the encoded data, may decode and send as raw data to USB I/O Device Controller #2B 170B. I/O encoders 510A and 510B may be located between USB I/O Controller #1A 110A and #1B 110B respectively.

[00139] FIG. 6a illustrates a schematic of a further USB Link System 600, wherein there is a mirrored network interface implementation having multiple components common to each side,

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some of which have been described previously herein. As illustrated in FIG. 6a, a first USB Host system 210A may have a first USB 3 Host Controller 228A, and a first USB connector 232A, for example a USB 3 Type A Female connector physically coupled to a first USB mating connector 242A, for example a USB 3 Type A Male connector which may be connected to an embedded first USB 3 Hub Controller 244A; which may have two or more sets of differential pair transmission lines and may also have Power transmission lines, in which all transmission lines may be forming a connection from the first USB 3 Hub Controller 244A to the first USB 3 Network Controller 100A. A second USB Host system 210B may have a second USB 3 Host Controller 228B, and a second USB connector 232B, for example a USB 3 Type A Female connector physically coupled to a second USB mating connector 242B for example a USB 3 Type A Male connector which may be connected to an embedded second USB Hub Controller 244B; which may have two or more sets of differential pair transmission lines and may also have Power transmission lines, in which all transmission lines may be forming a connection from the second USB 3 Hub Controller 244B to the second USB 3 Network Controller 100B.

[00140] The first USB 3 Network Controller 100A may be connected to a second USB 3 Network Controller 100B via several USB Network Transmission Lines 214A (not shown) coupled to other several USB Network Transmission Lines 214B (not shown) forming a USB Network Bus 218 (not shown) illustrated as several independent segments coupling several independent process blocks and interfaces, 134, 136, 138, 124.

[00141] The first USB connector, for example a USB 3 Type A Male connector 626A may connect to a first USB 3 Hub Controller 606A via two or more sets of differential pair transmission lines and may also include Power transmission lines (not shown).

[00142] Similarly, the second USB connector, for example a USB 3 Type A Male connector 242B may connect to a second USB 3 Hub Controller 244B via two or more sets of differential pair transmission lines and may also include Power transmission lines (not shown).

[00143] The first USB 3 Hub Controller 244A may connect to a first Network and Control Management block 110A for example a USB I/O Device Controller #1, of the first USB 3 Network Controller 100A via two or more sets of differential pair transmission lines and may also include Power transmission lines 604A.

[00144] Similarly, the second USB 3 Hub Controller 244B may connect to a second Network and Control Management block 110B for example a USB I/O Device Controller #1, of the

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second USB 3 Network Controller 100B via two or more sets of differential pair transmission lines and may also include Power transmission lines 604B.

[00145] The first USB 3 Hub Controller 244A may also connect to a first Data Control Management block 170A for example a USB I/O Device Controller #2, of the first USB 3 Network Controller 100A via two or more sets of differential pair transmission lines and may also include Power transmission lines 612A.

[00146] Similarly, the second USB 3 Hub Controller 244B may also connect to a second Data Control Management block 170B for example a USB I/O Device Controller #2, of the second USB 3 Network Controller 100B via two or more sets of differential pair transmission lines and may also include Power transmission lines 612B.

[00147] The first USB 3 Hub Controller 244A may also connect to both the first USB I/O Device Controller #1 Power Manager 162A and to the first USB I/O Device Controller #2 Power Manager 192A via two or more sets Power transmission lines 608A.

[00148] Similarly, the second USB 3 Hub Controller 244B may also connect to both the second USB I/O Device Controller #1 Power Manager 162B and to the second USB I/O Device Controller #2 Power Manager 192B via two or more sets Power transmission lines 608B.

[00149] The first Network and Control Management block 110A may be coupled to the second Network and Control Management block 110B by a Network and Control Bus 136.

[00150] The first Power Management block 162A and 192A may be coupled to the second Power Management block 162B and 192B respectively, by a Power bus 138.

[00151] The first Data Control Management block 170A may be coupled to the second Data Control Management block 170B by a Data Bus 134.

[00152] In some aspects of the present application, as illustrated in FIG. 6a, I/O encoders 510A, 520A, 510B and 520B may optionally be added as indicated, and may optionally be used in the operation of the apparatus. The I/O Encoders, as previously described herein, may be located within a device controller or without, and may encode raw data received by the device controller for transmission across the data bus, and may decode received data from across the bus for transmission to the device controller as raw data.

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[00153] Each of the first transmission lines 604A, 608A and 612A and each of the second transmission lines 604B, 608B and 612B may be implemented as, for example, copper traces on a circuit board or other embedded means within the Link System.

[00154] In operation, the various blocks 110A and 110B, 162A, 192A and 162B, 192B, and 170A and 170B in combination with the corresponding buses 136, 138 and 134 may be seen to form a USB Network which includes an established virtual network 124 having IP based addressing and using virtual Ports commonly associated with IP based networking. Physical network communications takes place over the Network and Control Buses 136 in which USB I/O Device Controllers on either Network Controller 100A and100B communicate using a serial protocol. The protocol may be any of the industry standard and accepted serial communications protocol as interconnection of Transmit and Receive signaling may be a requirement. These commonly used protocol may include RS-232, RS-422, RS-485, SPI, I2C, CAN, etc. Physical Data exchange takes place over the Data Buses 134 in which USB 3 I/O Device Controllers #2 on either Network Controller 100A and 100B transact Bulk Data Transfer over selected SuperSpeed Endpoints. Transfer methods such as Bulk Data transfer, Asynchronous data transfer and Isochronous First-In-First-Out (FIFO) data transfer may be used for alternate forms of transfer such as continuous feed or Streaming Data. Different functions within an Application may be directed to different endpoints. Each endpoint may be selected on the basis of the suitability of the endpoint to perform a desired function. Similarly, data traffic may be directed to an endpoint that is suited to an identified data speed when coupling different versions of USB Hosts.

[00155] FIG. 6b illustrates a schematic of the operational flow of a further USB Link System, wherein two USB Host systems couple and engage in a High Speed File Transfer process in accordance with aspects of the present application.

[00156] The Data Transfer process requires that Host 1, may connect to the apparatus, and may have all supporting devices and components enumerated and may have established an IP address on the Virtual Network, may couple with Host 2, which also may require being connected to the apparatus, and may have all supporting devices and components enumerated and may have established an IP address on the Virtual Network. Host 1 and Host 2 may now be connected via the Virtual Network and exchange Network and Control Commands on the Physical Network and Control Bus. The primary interaction in the Data Transfer process is that Host 1 may query Host 2 for data listing such that the User receives information regarding the Files and their locations on Host 2. Once decided by the User, Host 1 may transmit via the Network and Control

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Bus endpoint a Send request to Host 2 such that a specific file, on Host 2, may be transferred. Host 2 may acknowledge and may create payload information and may send to Host 1. Payload details may include file name, byte count, and various security and checksum details. Host 2 may ready the Bulk Transfer Endpoint on the Data Bus and endpoint may enter standby mode in anticipation of the Request to Send condition set by Host 1. Host 1 may select a Bulk Transfer Endpoint and may establish the space needed for the incoming File. Host 1 may send to Host 2 a Request to Send on the Network and Control Bus. Host 2 may acknowledge the Request to Send command, and may engage the Bulk Transfer process to send the selected File to the expectant endpoint on Host 1 via the high speed Data Bus. Upon completion, Host 2 may close the Data Bus endpoints and may reset back to normal operation. Host 1 may upon completion of the Data Transfer, close the Data Bus endpoint and may assess the payload against the payload information previously acquired, for payload completeness, integrity and security. This process may continue to repeat itself should the User select numerous files or entire folders or entire Drive contents.

[00157] FIG. 7 illustrates a Link System 700 featuring a plurality of USB Host Systems 210. Each USB Host system 210 of the plurality of USB Host Systems 210 may be connected, via a respective USB Transmission Line 216, to a USB Network Switch 706. The USB Network Switch 706 may also be called a USB Network Router or a USB Network Bridge. At the USB Network Switch 706, each of the USB Transmission Lines 216 may be received at a respective plurality of USB ports (not shown). Within the USB Network Switch 706, a shared USB Network Bus 218 may be found. A plurality of USB Network Interfaces 212 may connect to the shared USB Network Bus 218 via bi-directional USB Network Transmission Lines 214. Furthermore, each of the plurality of USB Network Interfaces 212 may connect to a respective one of the USB ports 242 (not shown).

[00158] Conveniently, the USB Network Transmission Lines 718 are located internal to the USB Network Switch 706.

[00159] The USB Network Switch 706 may include a Network Manager Interface 714 connected to the shared USB Network Bus 218.

[00160] The USB Network Bus 218 may be seen to establish a central data and file transfer distribution center for the plurality of USB Host systems 210, as is the case for most modern-day computer-based network systems such as, for example, Ethernet Switches, Bridges and Routers. Since, the USB Network Bus 218 is internal to the USB Network Switch 706, it follows that the Network and Control Bus and the Power Bus are internal to the USB Network Switch 706.

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Accordingly, only the USB ports 242 (not shown) are exposed for coupling with the USB Host systems 210.

[00161] In operation according to some aspects of the present application, the Network Manager Interface 714 may provide enhanced and additional control at the Console level for internal system configuration, security, diagnostics, and administrative control. The Network Manager Interface 714 may, additionally, be used to offset, or to supplement, the Network and Control Management of any or all of the USB Network Interfaces 212. Interaction with the internally located USB Network Interfaces 212 may be carried out through physical network pathways or virtual network pathways. Furthermore, a given one of the USB Host systems 210 may facilitate communications with the Network Manager Interface 714 based on administration, configuration and security settings and parameters, using a Network Manager Console application (not shown) on the given one of the USB Host systems 210.

[00162] In some aspects of the present application, as illustrated in FIG. 7, the number of USB Network Interfaces 212 is not limited by USB specification or conventions, nor by other network architecture restrictions or limitations. Indeed, theoretically, an unlimited number of USB Network Interfaces 212 may be coupled or interconnected, either directly or through interconnections of differing topologies, wherein concatenation of two or more USB Network Switches 706 is possible. As mentioned hereinbefore, the USB Network Switches 706 may also be known as Bridges and/or Routers.

[00163] In operation, through the coupling of the physical network components, including the USB Host systems 210, the USB Transmission Lines 216, the USB ports 242 (not shown), the USB Network Transmission Lines 214 and the USB Network Bus 218, a Virtual Network 124 may be seen to have been established. Notably, the specified Network Switches, Bridges, and/or Routers can be provisioned and/or located internally or externally and in either, or both a physical or virtual presence. Also, the actual location of any Network Switch, Bridge or Router is not to be understood as being only positioned as depicted in FIG 7., but can be located anywhere it is deemed to be necessary.

[00164] It can be said that in accordance with the description of the elements and components described earlier herein with respect to FIG. 2, similar elements having similar functionality in FIG. 7 may be established as being interchangeable. .

[00165] In some aspects of the present application, as illustrated in FIG. 7, a USB Host system 210 having interconnection with the Virtual Network 124 through interconnection of Virtual

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Router or Bridge, may optionally be used as a Network Manager and have Remote access capabilities with the Network Manager 714 or with any coupled USB Host system 210 should the system be configured in such a manner to provide this type of access and usage.

[00166] FIG. 8 illustrates, in schematic form, a Link System 800 featuring a number of support elements included in each of a pair of USB Network Interfaces 212A and 212B for coupling a first USB Host system 210A to a second USB Host system 210B. The FIG. 8, in the configuration shown is not inclusive of some of the components that are either being referred to and states as not shown, or are not indicated as their functionality although pertinent to the overall function of the Link System is not included in the scope of this particular description of this or other similar embodiments, including USB 3 Hub Controllers, USB Connectors, and optional I/O encoders, etc.

[00167] The first USB Host System 210A may be coupled, via a first USB Network Interface 212A, to the second USB Host system 210B via a second USB Network Interface 212B. The USB Network interface 212A and 212B has been described previously herein as it pertains to FIG 2. The first USB Host system 210A and the second USB Host system 210B, have also been described previously herein pertaining to FIG. 2, and are not shown in FIG. 8 but are understood to be connected via the first USB Interconnect 804A and a second USB Interconnect 804B, respectfully. The USB Host systems 210A and 210B (not shown) may each comprise a USB Host Controller; a USB Connector and a USB Transmission Line, described earlier herein, inclusive of several differential pairs and or multi-pairs and related Power conductors.

[00168] The first USB Network Interface 212A may include a first Power Management unit 842A. The second USB Network Interface 212B may include a second Power Management unit 842B. Both Power Management units 842A and 842B may be comprised of the Power Interfaces 116 and 176 of each of the USB I/O Device Controller #1 and #2 within the USB Network Controller 100 as previously referenced herein. The first Power Management unit 842A may be connected to the second Power Management unit 842B via a Power Bus Link 138A and 138B within the USB Network Bus 218, in accordance with the controls and commands issued from and through the Application 240 (not shown) on any of the coupled USB Host systems.

[00169] The first USB Network Interface 212A may include a first USB Differential Connection in which a first USB2 endpoint 834A and a first USB 3 endpoint 832A may be established. The second USB Network Interface 212B may include a second USB Differential Connection in which a second USB2 endpoint 834B and a first USB 3 endpoint 832B may be established. The first endpoints 832A, 834A may be made to communicate with the second

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endpoints 832B, 834B respectively via a Data Bus Link 134A and 134B within the USB Network Bus 218.

[00170] The first USB Network Interface 212A may further include a first Port Detector 822A which may connect to a first Link Negotiator 824A, which may be connected to a first Link Manager 826A. Similarly, the second USB Network Interface 212B may further include a second Port Detector 822B which may connect to a second Link Negotiator 824B, which may connect to a second Link Manager 826B. Port Detector 822A and 822B and Link Negotiator 824A and 824B may be directed by the user Application 240 (not shown) and USB Host System OS 234 (not shown) as required.

[00171] Furthermore, a first USB Network Interface 212A may include a first Service Management Block 812A and the second USB Network Interface 212B may include a second Service Management Block 812B. The first Service Management Block 812A and the second Service Management Block 812B may communicate via Service Bus Links 810A and 810B respectively as each are segments of the Network and Control Bus 136A and 136B respectively , and may be directed by the user Application 240 (not shown) and USB Host System OS 234 (not shown) as required.

[00172] The coupled Service Bus Links 136A and 136B may also be used when the first Service Management Block 812A and the second Service Management Block 812B communicate directly. Furthermore, the first Service Management Block 812A and the second Service Management Block 812B may employ an Addressing facility and may be directed by the user Application 240 (not shown) and USB Host System OS 234 (not shown) as required.

[00173] FIG. 8 illustrates an embodiment of the present application wherein the function of the Power Management units 842A, 842B may provision and monitor power requirements of the apparatus for optimal operation with respect to use of the fastest bus; and according to various factors, including, but not limited to, the distance from a connecting USB Host System, and the capacity relating to the USB Host System Bus power capacity when executing data transfer operations. Power may be derived, primarily, from a USB Host system through the appropriate USB Interconnect 804A, 804B. Within one or more embodiments, additional power may be provided via internal or external power courses, applied or connected via additional Power interconnects such as, as an example, and external Power adapter. Alternatively, external power sources may be applied or connected via any other coupled USB Host system on the Power Bus 138A and 138B, providing the other coupled USB Host system has sufficient regulated power

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and capacity. Furthermore, Power Management units 842A, 842B may be directed by the user Application 240 (not shown) and USB Host System OS 234 (not shown) as required.

[00174] In operation of the Link System 800 of FIG. 8, data may be passed between USB Host systems 210A and 210Busing one of either the USB 2 endpoints 834A, 834B or the USB 3 endpoints 832A, 832B. In either case, the data may be directed by a Data Control Manager to a Data Exchange unit, such as found as the Data Control Manager 172 (not shown) and the Data Exchange unit 194 in the USB Network Controller 100 of FIG. 1a and of the USB I/O Device Controller #2 in FIG. 1c. Additionally, the data may be reformatted and prepared for transfer to the Data Bus 134A and 134B. A Data Control Manager, such as the Data Control Manager (not shown) in the USB Network Controller 100 of FIG. 1a and of the USB I/O Device Controller #2 in FIG. 1c, may provide an open path and directives to each USB Host system to engage the transfer process. In some aspects of the present application, the Data Exchange unit 194 (not shown) may accommodate same and mixed transfers of any combination of USB 2 and USB 3 originating data and speeds. Optionally, Data I/O encoders (/decoders) 510A, 510B, and 520A and 520B as described previously herein with respect to FIG. 5, may be provisioned within this embodiment as well.

[00175] FIG. 8 does not show a Network and Control Manager 112 (not shown). However, in consideration of the Network and Control Manager 112 of the USB Network Controller 100 of FIG. 1a and 1b, one may consider that, in operation of the Link System 800 of FIG. 8, a Network and Control Manager 112 (not shown) synchronize, coordinate physical interconnections, and Virtual interconnections, between the coupled USB Host systems.

[00176] The Network and Control Manager 112 (not shown) may defer control to the Application 240 (not shown) and OS 234 (not shown). Indeed, the Network and Control Manager 112 (not shown) may attend, primarily, to lower level functions concerning detection and negotiation of the connected USB endpoints and implementing address determination and selection protocols along with data direction and flow control for the coupled USB Host systems 210A and 210B.

[00177] In operation, the first Port Detector 822A may sense the USB connection type. Accordingly, the first Port Detector 822A may permit or decline the connection as per Driver and Operating System 240A (not shown) instructions from one or more connected USB Host systems. If a connection is permitted, the first Link Negotiator 824A may establish a suitable physical and/or virtual reference for the connected USB Host system prior to being coupled with another USB Host system. The first Link Manager 826A, in turn, may establish an address on the

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first Address Bus Link 136A. The first Link Manager 826A may also inform the first Network and Control Manager 112 (not shown) of the pairing of physical and/or virtual addresses for the USB Host System 210A and 210B and the USB Network Interfaces 212A and 212B.

[00178] The first Service Management Blocks 812A and 812B may provide additional console-type connections for loading and upgrading code logic of the USB Network Interfaces 212A and 212B respectfully. The first Service Management Block 812A may also provide non-essential services, including control and switching of external reporting mechanisms for Process confirmations and/or acknowledgements of services. Exchange of such service to either side of the USB Network Bus 218 is provided for on the Service Bus Links 136A and 136B, and may be managed by the Network and Control Manager 112A (not shown) using logic executed by the first Link Manager 826A.

[00179] Process confirmations may include error, power, security and/or mode level indication and reporting. One example of a means to provide confirmation in a preferred embodiment comprises Light Emitting Diode signaling indicators using distinct colors to provide distinct indications or by on-off or dimming states.

[00180] FIG. 9 illustrates, in schematic form, a Link System 900 featuring two or more separate links for a Data Link for Data and File Transfer and a Communication Link for Network and Control communications to and from a USB Network Bus 218. The Link System 900 of FIG. 9 includes a USB 3 SuperSpeed configuration 902 and an alternative USB 2 Hi-Speed configuration 904.

[00181] The USB 3 SuperSpeed configuration 902 includes a first USB I/O Device Controller #2 910A connected to the USB Network Bus 218 via a first plurality of USB Network Transmission Lines 912A. Additionally, the first USB I/O Device Controller #2 910A may be connected to a first USB 3 Hub Controller 916A terminating to a USB 3 Male Type A connector 914A via a first USB 3 Transmission Line 906A. The USB 3 SuperSpeed configuration 902 also includes a first USB I/O Device Controller #1 920A connected to the USB Network Bus 218 via the first plurality of USB Network Transmission Lines 912A and may be connected to a first USB 3 Hub Controller 916A also terminating to a USB 3 Male Type A connector 914A via the USB 3 Transmission Line 906A. The target USB Host system may have a USB 3 Host Controller and USB 3 external Ports available for which to connect this configuration of the described embodiment in a USB 3 SuperSpeed configuration.

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[00182] The USB 3 SuperSpeed configuration 902 further includes a second USB I/O Device Controller #2 910B connected to the USB Network Bus 908 via a second plurality of USB Network Transmission Lines 912B. Additionally, the second USB I/O Device Controller #2 910B may be connected to a second USB 3 Hub Controller 916B and terminating to a USB 3 Male Type A connector 914B via a second USB 3 Transmission Line 906B. The USB 3 SuperSpeed configuration 902 also includes a second USB I/O Device Controller #1 920B connected to the USB Network Bus 908 via the second plurality USB Network Transmission Lines 912B and may be connected to second USB 3 Hub Controller 916B and terminating to a USB 3 Male Type A connector 914B via a second USB 3 Transmission Line 906B. The target USB Host system, may have a USB 3 Host Controller and USB 3 external Ports available to connect, completes this configuration of the described embodiment in a USB 3 SuperSpeed configuration.

[00183] The USB 2 Hi-Speed configuration 904 includes a first USB I/O Device Controller #2 910A in an alternative configuration connected to the USB Network Bus 218 via the first plurality of USB Network Transmission Lines 912A. Additionally, the first USB I/O Device Controller #2 910A in an alternative configuration may be connected to a first USB 3 Hub Controller 916A and terminating to a USB 3 Male Type A connector 914A via a first USB 3 Transmission Line 906A. The USB 2 Hi-Speed configuration 904 may also include a first USB I/O Device Controller #1 920A connected to a first USB 3 Hub Controller 916A also terminating to a USB 3 Male Type A connector 914A via the USB 3 Transmission Line 906A. The target USB Host system may have only USB 2 Host Controller and USB 2 external Ports available for which to connect this configuration of the described embodiment in a USB 2 Hi-Speed configuration.

[00184] The USB 2 Hi-Speed configuration 904 further includes a second USB I/O Device Controller #2 910B in an alternative configuration connected to the USB Network Bus 218 via the first plurality of USB Network Transmission Lines 912B. Additionally, the second USB I/O Device Controller #2 910B in an alternative configuration may be connected to a second USB 3 Hub Controller 916B and terminating to a USB 3 Male Type A connector 914B via a second USB 3 Transmission Line 906B. The USB 2 Hi-Speed configuration 904 may also include a second USB I/O Device Controller #1 920B connected to a second USB 3 Hub Controller 916B also terminating to a USB 3 Male Type A connector 914B via the USB 3 Transmission Line 906B. The target USB Host system may have only USB 2 Host Controller and USB 2 external Ports available for which to connect this configuration of the described embodiment in a USB 2 Hi-Speed configuration.

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[00185] In the Link System 900, as illustrated in FIG. 9, when a USB 3 SuperSpeed interconnection is made to a USB Host system via the first USB 3 Transmission Line 906A and the first USB 3 Male Type A connector 914A, the first USB I/O Device Controller #2 910A may be configured to fulfill data and file transfers between, both to and from, the USB Network Bus 218 via the first USB Network Transmission Lines 912A.

[00186] In some aspects of the present application, when connected to a USB 3 SuperSpeed Host system, the Link System may assign all Host-side and intra-Link or network, system command and management data including node addressing, directional flow, flow control, security, configuration, sync and traffic management, messaging and critical assist and override functions and others, to the first USB I/O Device Controller #1 920A in a separate Communication Link parallel to the Data Link already established via the first USB I/O Device Controller #2 910A.

[00187] Conveniently, when separate dual and parallel Links are employed, it may be shown that relatively high data transfer rates may be achieved when connecting to USB 3 SuperSpeed Host systems. These relatively high data transfer rates may be attributed to an exchange of control data and network management data on paths that are separate and distinct from the path on which the data is exchanged.

[00188] In some aspects of the present application, both the first USB I/O Device Controller #2 910A and the first USB I/O Device Controller #1 920A may be deployed as Data Transfer pathways. In this manner, the bandwidth of the first USB I/O Device Controller #2 910A may be supplemented by channeling relatively smaller size transfers to a slower secondary pathway such as that formed by the first USB I/O Device Controller #1 920A. Additionally or alternatively, deploying this method, using both first USB I/O Device Controller #2 910A and USB I/O Device Controller #1 920A for Data and File Transfers may allow for simultaneous file transfers in opposite directions.

[00189] In the Link System 900, as illustrated in FIG. 9, when a USB 2 Hi-Speed interconnection is made to a USB Host system via the first USB 3 Transmission Line 906A and the first USB 3 Male Type A connector 914A, the first USB I/O Device Controller #2 910A may be configured to fulfill data and file transfers between, both to and from, the USB Network Bus 218 via the first USB Network Transmission Lines 912A.

[00190] In some aspects of the present application, when connected to a USB 2 Hi-Speed Host system, the Link System may assign all Host-side and intra-Link communications, for example

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network, system command and management data including node addressing, directional flow, flow control, security, configuration, sync and traffic management, messaging and critical assist and override functions and others, to the first USB I/O Device Controller #1 920A in a separate Communication Link parallel to the Data Link already established via the first USB I/O Device Controller #2 910A.

[00191] Conveniently, when separate dual and parallel Links are employed, it may be shown that relatively high data transfer rates may be achieved when connecting to USB 2 Hi-Speed Host systems. These relatively high data transfer rates may be attributed to an exchange of control data and network management data on paths that are separate and distinct from the path on which the data is exchanged.

[00192] In an example of the embodiment of the invention as a USB Link System, mode selection between USB 3 SuperSpeed and USB 2 Hi-Speed may pertain to the version of the USB Protocol that is being used by the connected USB Host system at any given Endpoint, and may be controlled by a higher level Application on the USB Host system and by a Link System. The Code Logic within the Link System may provision capability for the Link System to select modes based on interconnect signal integrity and degradation level.

[00193] Some aspects of the present application may include a method, apparatus and system wherein two or more USB data paths may be established and used simultaneously, in any direction, and that the network and control path established between any and all coupled Host systems may be implemented as a shared resource and may accommodate shared control management.

[00194] FIG. 10 illustrates, in schematic form, the main components and or routine blocks and or Logic blocks of an Application program 1000 used to interact with the Link Systems outlined and described previously herein, featuring coupling between a first USB Host System 210A (not shown) and a second USB Host 210B (not shown) as per FIG. 2 and FIG. 5.

[00195] The Application may host navigation and execution commands provided by interaction with both the USB Host system and or the User input in operation of the Link System and coupled USB Host systems. Application software involving user interaction at the local level and or at a network level, may include a User Interface to provide a means to navigate and execute pre-programmed processes or routines, involving simplistic processes or gestures, such that Data may be transferred from one coupled USB Host system to another, amongst other desirable transactions. The Local User Interface 1002, refers to that User Interface (hereinafter "UI")

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pertaining to the USB Host system on which the Application may be running and for which there may be a User interacting with the Application in real time and in real session. The UI may include a Data In/Out 1004A data transfer facility or process unit as that which may be exposed to the User as both a reporting facility and an input facility. The UI may also include Flow Control facility and a Data Storage Manager 1008A. The Flow Control facility may provide access to viewing and selecting USB Host system Hardware Panels for monitoring and selecting Protocol based Endpoints, Ports, Addresses, and Data Handling features. The Data Storage Manager facility may provide File and Folder monitoring and maintenance functions, more commonly known as File Explorer functions whereby Data Storage devices are listed, and may be selected for retrieving storage capacity and for listing stored contents in folder and file formats as defined by the OS.

[00196] The Application program pertaining to the Link System 1000 of FIG. 10 may include a Traffic Manager 1010. The Traffic Manager 1010 is central to the Application in that all data traversing the USB Network Bus 218 (not shown) to and from the coupled USB Host systems, may be required that such traversals induce data traffic on all buses as previously described herein. For data transversal to be successfully accomplished, an ability to manage timing and path selection, and deselection, may be required.

[00197] In similar functional positioning as that of the Traffic Manager 1010, the Data Exchange 1040 process and the Negotiate Path and Device Selection 1020 routines may be the only processes or routines that directly transact across, or traverse, the USB Network Bus 218 (not shown) as Local and Remote references may be considered directional indicators and may not have logical demarcations. That is to say that logic in any of the three routine blocks may be considered as both a logical endpoints of the opposing data and command structures, and as a logical start point to any function or routine in reaction to the opposing endpoints.

[00198] The Data Exchange 1040 process may interact directly with the Link System's USB I/O Device Controllers #1 and #2 as previously described herein. Data within those Memory Blocks 152 and 182 may traverse the USB Network Bus under the instruction and direction of the Data Exchange process.

[00199] The Negotiate Path and Device Selection 1020 routines may also interact directly with the Link System's USB I/O Device Controllers #1 and #2 as previously described herein. Selections made by the user and or the Application may translate into openings or closings of specific ports on the USB Host systems and may include direct communications with the USB Network Controller 100 as described earlier herein.

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[00200] An Endpoint Manager 1044A routine may be used to determine the necessary endpoint to target for incoming and outgoing data exchanges as per the desired user action or in logical reaction to queries from the opposite coupled USB Host system Application. Logical control sequences are established by the Traffic Manager 1010 based on endpoint selection determined by the Local Endpoint Manager 1044A and in synchronization with the Remote Endpoint Manager 1044B.

[00201] The Data Manager/Converter 1042 routine may establish the format and exchange information of the sending or receiving payloads such that payload bits are both counted, aligned, and packaged for transport in either direction based on the engagement and determination by the Traffic Manager 1010 and respective Endpoint Managers 1044A and 1044B. The Local Data Manger/Converter 1042A may interact with the Remote Data Manager/Converter 1042B through interaction with the Traffic Manager 1010 Process Logic.

[00202] Both the Local Direction Select 1022A and its counterpart the Remote Direction Select routines may report and react to logic selections processed by the User input from the Local UI 1002A or the Remote UI 1002B, utility if engaged by the user, that may cause or require change to the Flow Control and Data Storage Manager 1008A and 1008B processes respectively, and confirmation of Data direction flow and Network Control sequences or routines may be synchronized by the Traffic Manager 1010, and subsequently may be reported or confirmed by the Application to both the engaged logic processes and the Local UI 1002A and or the Remote UI 1002B, if engaged.

[00203] In operation of the Link System 1000 of FIG. 10, an application executing on the first USB Host system 210A (not shown) may detect, sense, negotiate and direct data transfers, Network commands, Control command, and Link System commands to facilitate and synchronize device addressing and data flow through appropriate links. Data flow through the first USB Host system 210A (not shown) may involve a device driver exposing available endpoints for data transmission and available endpoints for network interconnects.

[00204] The available endpoints identified may vary depending on the type of data transfer via USB protocol to coincide with the desired service mode of the USB Network Interface 212A and 212B (not shown). Example types of data transfer include Bulk data transfer, Asynchronous data transfer and Isochronous First-In-First-Out (FIFO) data transfer. Different functions within the Application may be directed to different endpoints. Each endpoint may be selected on the basis of the suitability of the endpoint to perform a desired function. Similarly, data traffic may be

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directed to an endpoint that is suited to an identified data speed when coupling different versions of USB Hosts.

[00205] The Local Endpoint Manager 1044A may enable selection of, and switching to, various endpoints to meet requirements specified by an Application. The Local Endpoint Manager 1044A may also enable, engage or require the Local Data In/Out Transfer process 1004A of the Local USB Host system 210A (not shown).

[00206] The Local Data Manager 1042A may be engaged by an Application via requisite declaration of required space, file name(s), directory, file type(s) and supplemental processes, such as byte count, checksum, and others. Direct communication between the Local Data Manager 1042A and the Traffic Manager 1010 may assist to allow for relatively accurate data transfers and relatively higher levels of security. In this way, data transfers may be seen as highly efficient and a reduction may be realized in collisions and transfer resends.

[00207] In operation, activities at the Data Exchange 1040 may align to the needs of the Traffic Manager 1010 to support various modes of operation to allow for relatively high data transfer speed, relatively high bandwidth, relatively high security and relatively high data integrity for the attached or coupled USB Host systems 210A and 210B (not shown) respectively.

[00208] In operation, the Traffic Manager 1010 may seek information for link or pathway determination for efficient data transfer. Devices, device endpoints and data paths may be taken into account with respect to Data Flow direction, network and control messaging, and process reporting to an Application and to a USB Network Interface.

[00209] Also in operation, the Negotiate Path and Device Selection Unit 1020 may execute logic when such information for link or pathway determination is sought by the Traffic Manager 1010 or when triggered by the Local and or Remote Direction Select 1022A and 1022B processes respectfully, and or by the Local and or Remote Flow Control and Data Storage Manager 1008A and 1008B processes respectively.

[00210] The Local Direction Select 1022A and the Local Flow Control and Data Storage Manager 1008A may execute processes within a Local USB Network Interface 212A in conjunction with an Application's requirements and events that may be triggered by the Local USB Host system 210A (not shown) and Link System 1000 logic. The Local Operating System 234A (not shown) and a Local Application 240A (not shown) may execute at the Local USB Host system 210A (not shown) and may interact to indicate requirements to the Local Flow Control and Data Storage Manager 1008A accessed via the Application 240A and Local device

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drivers, such that each communicates directly with the Local USB Network Interface 212A (not shown) logic in collaboration with the Remote USB Network Interface 212B (not shown) logic across the Network and Control Management Bus 136A and 136B (not shown) respectfully. The same could be said with respect to processes triggered or executed on both the Local and or the Remote sides or counterparts of those referenced above.

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CLAIMS

1. A system for transferring data between a first host computer and a second host computer comprising:

a first host computer capable of sending and receiving data and control information;

a second host computer capable of sending and receiving data and control information;

a first network interface controller comprising at least two input/output (I/O) device controllers and a means for receiving power to the first network interface controller, wherein each I/O device controller of the first network interface controller is communicatively coupled to the first host computer, and wherein a first of the at least two I/O device controllers is communicatively coupled to a shared control bus and a second of the at least two I/O device controllers is communicatively coupled to a shared data bus; and

a second network interface controller comprising at least two I/O device controllers and a means for receiving power to the second network interface controller, wherein each I/O device controller is communicatively coupled to the second host computer, and wherein a first of the at least two I/O device controllers is communicatively coupled to the shared control bus and a second of the at least two I/O device controllers is communicatively coupled to the shared data bus;

wherein the first network interface controller and the second network interface controller interconnect the first host computer and the second host computer across the shared control bus and the shared data bus to thereby establish a network between the first host computer and the second host computer.

2. The system of claim 1, wherein the first host computer and the second host computer each comprise installed software which when executed establishes the network between the first host computer and the second host computer and provides for the transfer of data and control information over the network.

3. The system of claim 2, wherein the installed software when executed establishes a control link over a control path and a data link over a data path.

4. The system of claim 3, wherein the installed software when executed establishes one or more further control links for security, software updates or other administrative capabilities.

5. The system of claim 3, wherein the installed software further comprises a network and control manager adapted to create a temporary interconnection between the first host computer

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and the second host computer and to establish addressing and a data manager adapted to transact data and file transfers between the first host computer and the second host computer.

6. The system of claim 1, further comprising an I/O encoder in at least one of the first and second network interface controllers for encoding raw data received by the I/O device controller communicatively coupled to the shared data bus for transmission across the shared data bus.

7. The system of claim 1, wherein the communicative coupling between the first network interface controller and the first host computer is adapted for the communication of differential signals.

8. The system of claim 1, wherein the communicative coupling between the first network interface controller and the first host computer includes a hub.

9. The system of claim 1, wherein the communicative coupling between the first network interface controller and the first host computer includes, over a single connection to the first host computer, a first electronic path from the first of the at least two I/O device controllers and a second electronic path from the second of the at least two I/O device controllers.

10. The system of claim 1, further comprising:

one or more further host computers each capable of sending and receiving data and control information;

one or more further network interface controllers each comprising at least two I/O device controllers and a means for receiving power to the third network interface controller, wherein each I/O device controller of the one or more further network interface controllers is communicatively coupled to one of the one or more further host computers, and wherein a first of the at least two I/O device controllers is communicatively coupled to the shared control bus and a second of the at least two I/O device controllers is communicatively coupled to the shared data bus;

wherein the first network interface controller, the second network interface controller and the one or more further network interface controllers interconnect the first host computer, the second host computer and the one or more further host computers across the shared control bus and the shared data bus to thereby establish a network between the first host computer, the second host computer and the one or more further host computers.

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11. The system of claim 10, wherein the network is in a mesh, star, ring or bus network configuration.

12. A link system apparatus for transferring data between a first host computer and a second host computer comprising:

a first network interface controller comprising at least two input/output (I/O) device controllers and a means for receiving power to the first network interface controller, wherein each I/O device controller of the first network interface controller is communicatively coupled to a differential pair connection or an optical connection, and wherein a first of the at least two I/O device controllers is communicatively coupled to a shared control bus and a second of the at least two I/O device controllers is communicatively coupled to a shared data bus; and

a second network interface controller comprising at least two I/O device controllers a means for receiving power to the second network interface controller, wherein each I/O device controller is communicatively coupled to a differential pair connection or an optical connection, and wherein a first of the at least two I/O device controllers is communicatively coupled to the shared control bus and a second of the at least two I/O device controllers is communicatively coupled to the shared data bus;

wherein the first network interface controller communicatively couples to the first host computer and the second network interface controller communicatively couples to the second host computer and the link system apparatus interconnects the first host computer and the second host computer across the shared control bus and the shared data bus to thereby establish a network between the first host computer and the second host computer.

13. The link system apparatus of claim 12, further comprising an I/O encoder in at least one of the first and second network interface controllers for encoding raw data received by the I/O device controller communicatively coupled to the shared data bus for transmission across the shared data bus.

14. The link system apparatus of claim 12, wherein the communicative coupling between the first network interface controller and the first host computer includes a hub.

15. The link system apparatus of claim 12, wherein each of the first and second network interface controllers further comprises a wireless transceiver and a wireless device controller.

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16. A method for transferring data between a first host computer and a second host computer comprising:

communicatively coupling a first input/output (I/O) device controller and a second I/O device controller to a first host computer;

communicatively coupling a third I/O device controller and a fourth I/O device controller to a second host computer;

establishing a control link between the first I/O device controller and the third I/O device controller;

establishing a data link between the second I/O device controller and the fourth I/O device controller; and

transferring data from the first host computer to the second host computer by communicating the data to the second I/O device controller and then over the data link to the fourth I/O device controller and then to the second host computer.

17. The method of claim 16, wherein the data is communicated over the data link using USB protocol.

18. The method of claim 16, further comprising the first host computer using a resource of the second host computer over the network by logical direct access.

19. The system of claim 18, wherein the resource comprises a peripheral device.

20. The system of claim 19, wherein the resource comprises a host resource.

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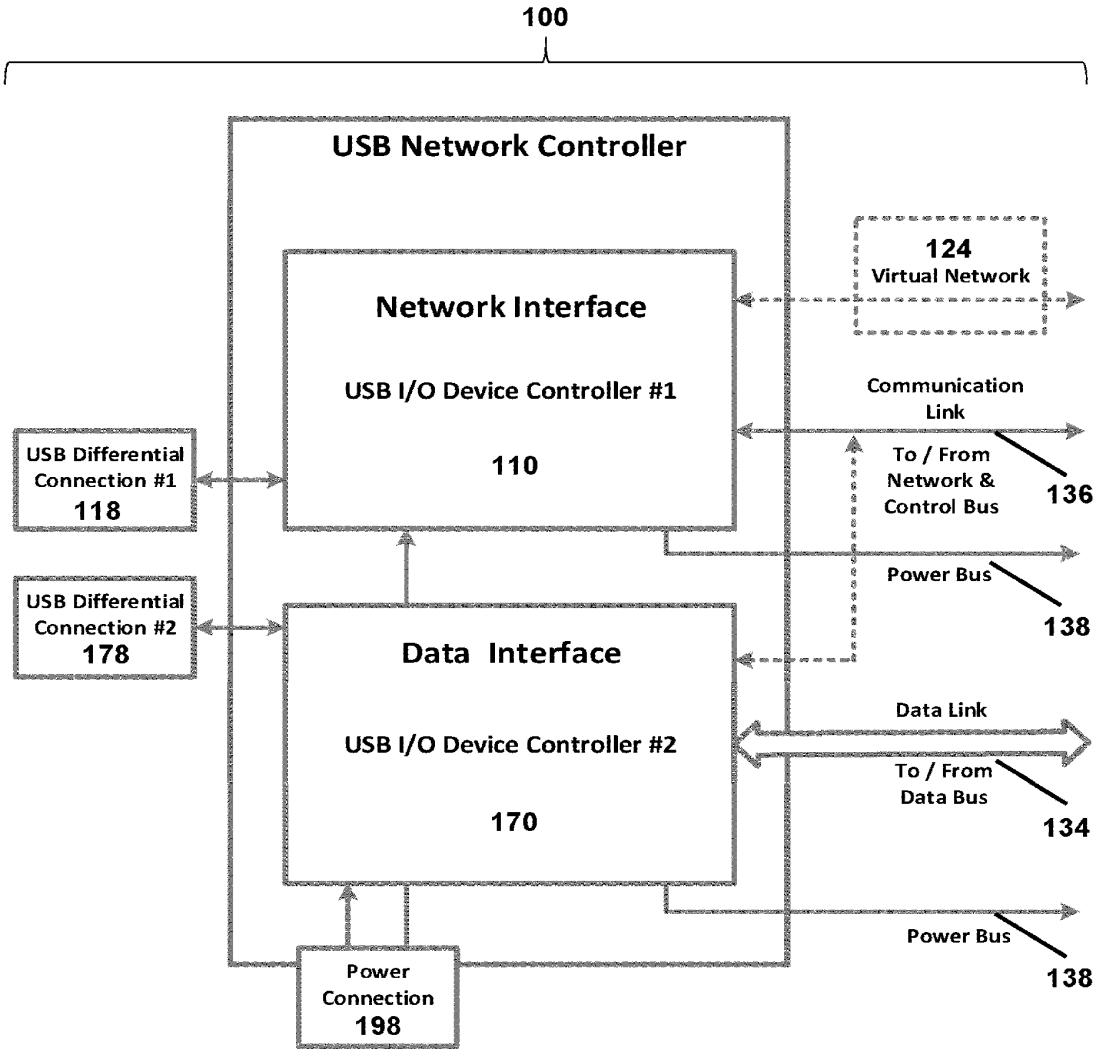

100
USB Network Controller
Network Interface
USB I/O Device Controller #1
110
124
Virtual Network
Communication
Link
To / From
Network &
Control Bus
136
Power Bus
138
USB Differential
Connection #1
118
USB Differential
Connection #2
178
Data Interface
USB I/O Device Controller #2
170
Data Link
To / From
Data Bus
134
Power Bus
138
Power
Connection
198

Fig. 1 a

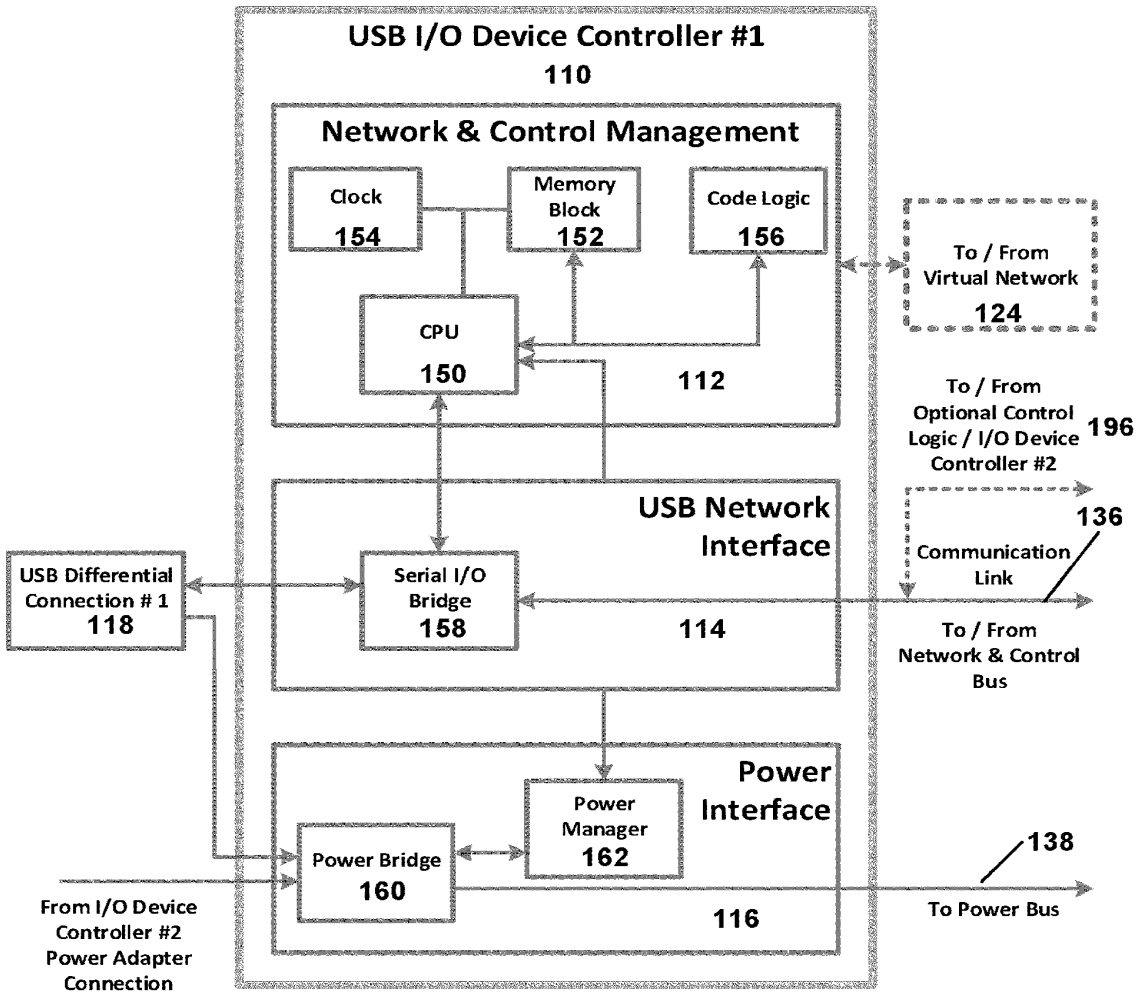

USB I/O Device Controller #1
110
Network & Control Management
Clock
154
Memory Block
152
Code Logic
156
CPU
150
112
To / From Virtual Network
124
To / From Optional Control Logic / I/O Device Controller #2
196
USB Network Interface
136
Communication Link
USB Differential Connection # 1
118
Serial I/O Bridge
158
114
To / From Network & Control Bus
Power Interface
Power Manager
162
Power Bridge
160
138
116
From I/O Device Controller #2 Power Adapter Connection
To Power Bus

Fig. 1 b

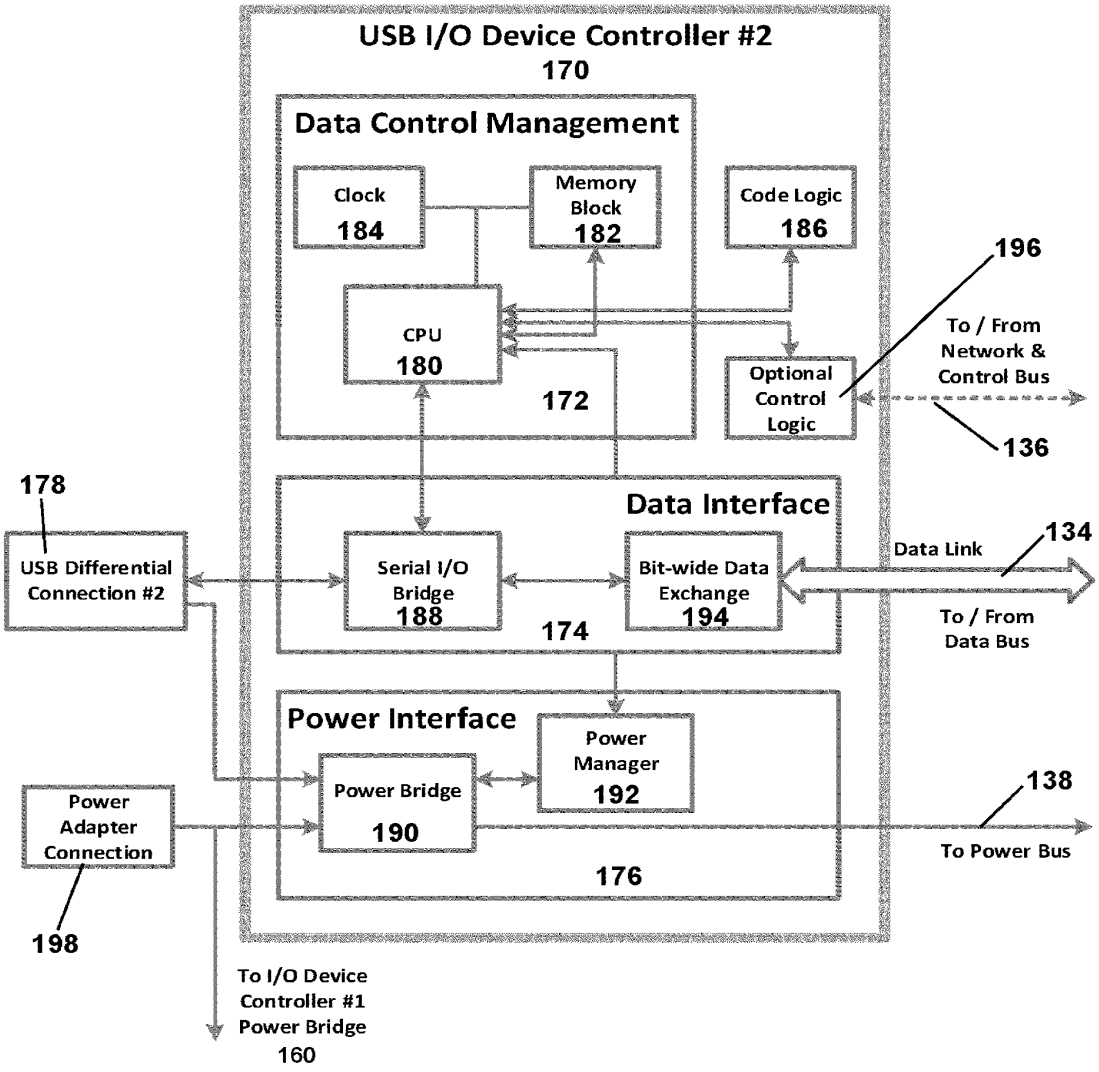

USB I/O Device Controller #2
170
Data Control Management
Clock
184
Memory Block
182
Code Logic
186
CPU
180
172
196
To / From Network & Control Bus
Optional Control Logic
136
178
USB Differential Connection #2
Data Interface
Serial I/O Bridge
188
Bit-wide Data Exchange
194
174
Data Link
134
To / From Data Bus
Power Interface
Power Manager
192
Power Bridge
190
Power Adapter Connection
138
To Power Bus
176
198
To I/O Device Controller #1 Power Bridge
160

Fig. 1 c

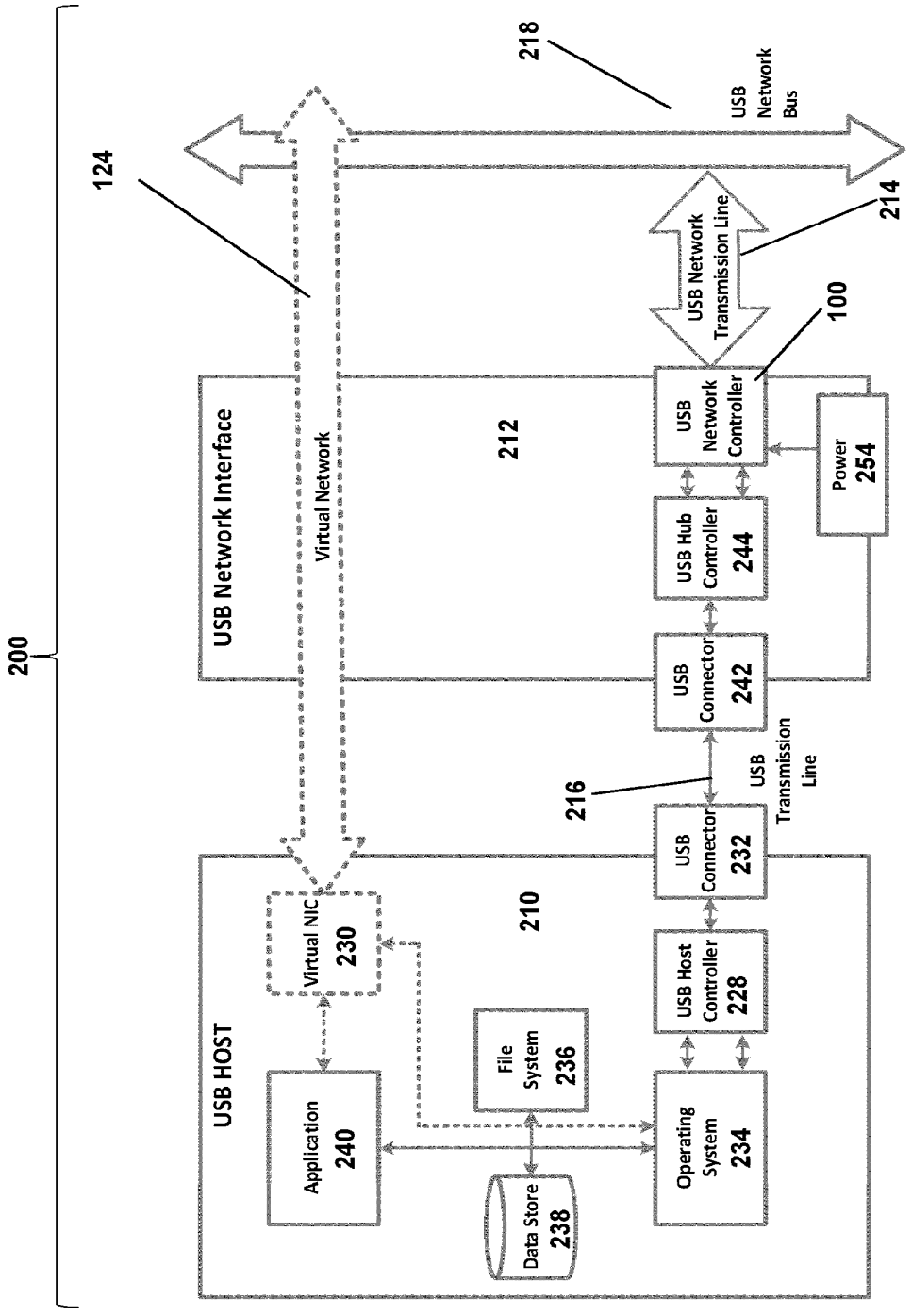

200
124
218
USB Network Bus
214
USB Network Transmission Line
100
USB Network Interface
Virtual Network
212
USB Network Controller
Power 254
USB Hub Controller 244
USB Connector 242
216
USB Transmission Line
USB Connector 232
USB HOST
Virtual NIC 230
210
USB Host Controller 228
File System 236
Application 240
Operating System 234
Data Store 238

Fig. 2

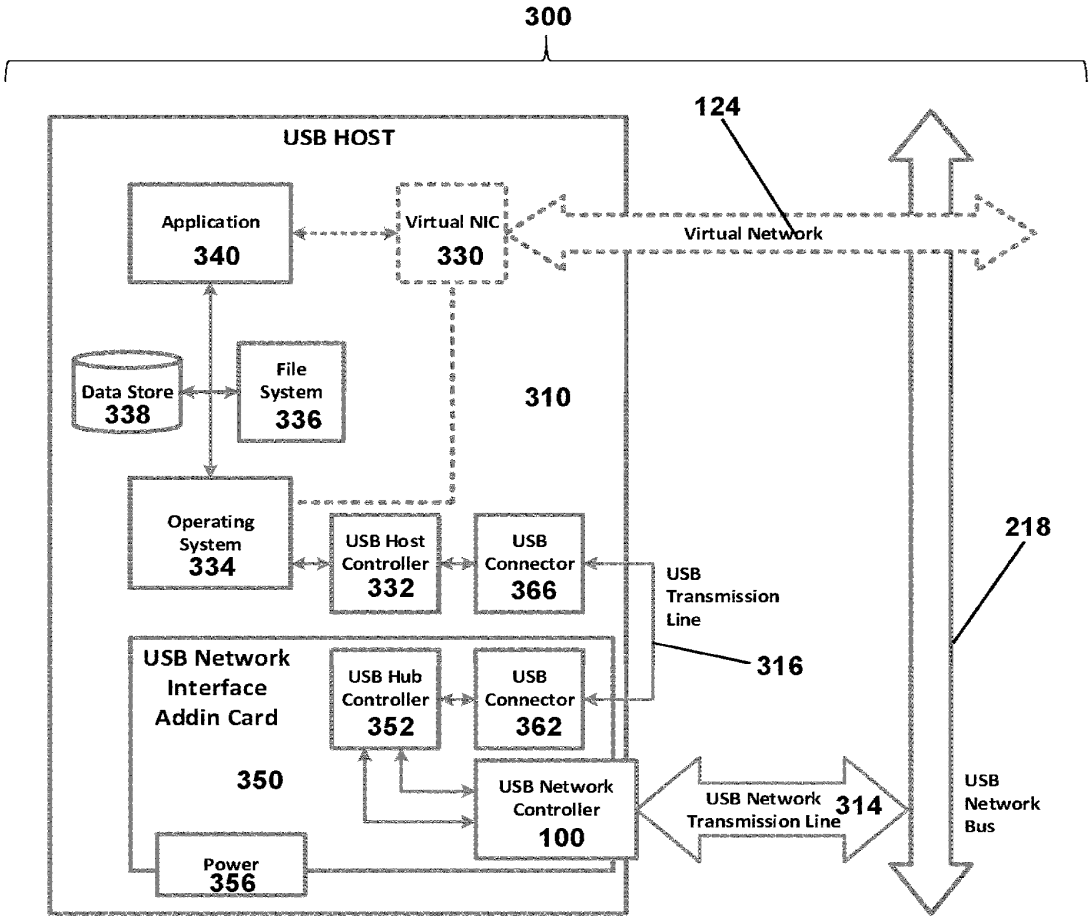

300
124
USB HOST
Application
340
Virtual NIC
330
Virtual Network
Data Store
338
File
System
336
310
Operating
System
334
USB Host
Controller
332
USB
Connector
366
USB
Transmission
Line
316
218
USB Network
Interface
Addin Card
350
USB Hub
Controller
352
USB
Connector
362
USB Network
Controller
100
USB Network
Transmission Line
314
USB
Network
Bus
Power
356

Fig. 3

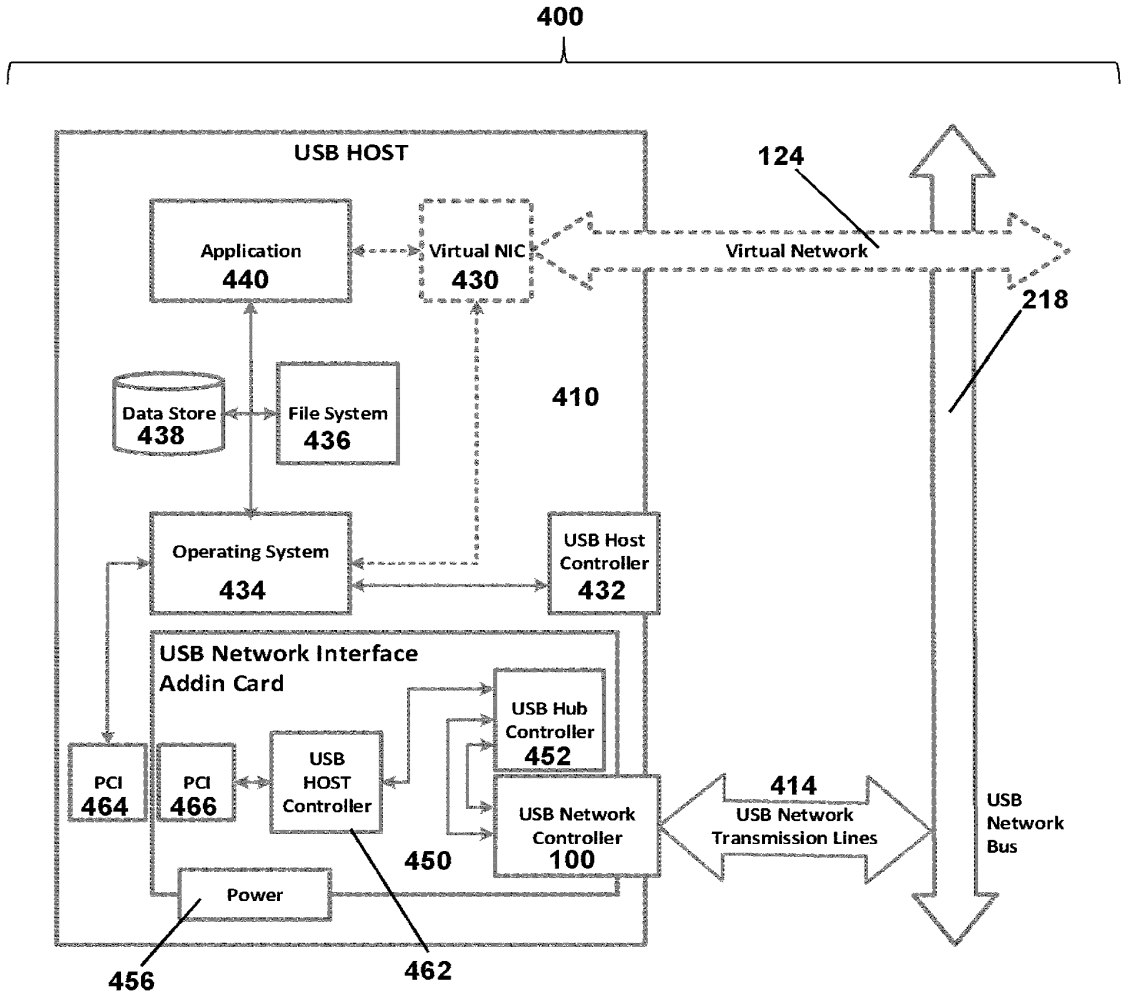

400
USB HOST
124
Application
440
Virtual NIC
430
Virtual Network
218
Data Store
438
File System
436
410
Operating System
434
USB Host
Controller
432
USB Network Interface
Addin Card
USB Hub
Controller
452
PCI
464
PCI
466
USB
HOST
Controller
USB Network
Controller
100
414
USB Network
Transmission Lines
USB
Network
Bus
450
Power
456
462

Fig. 4

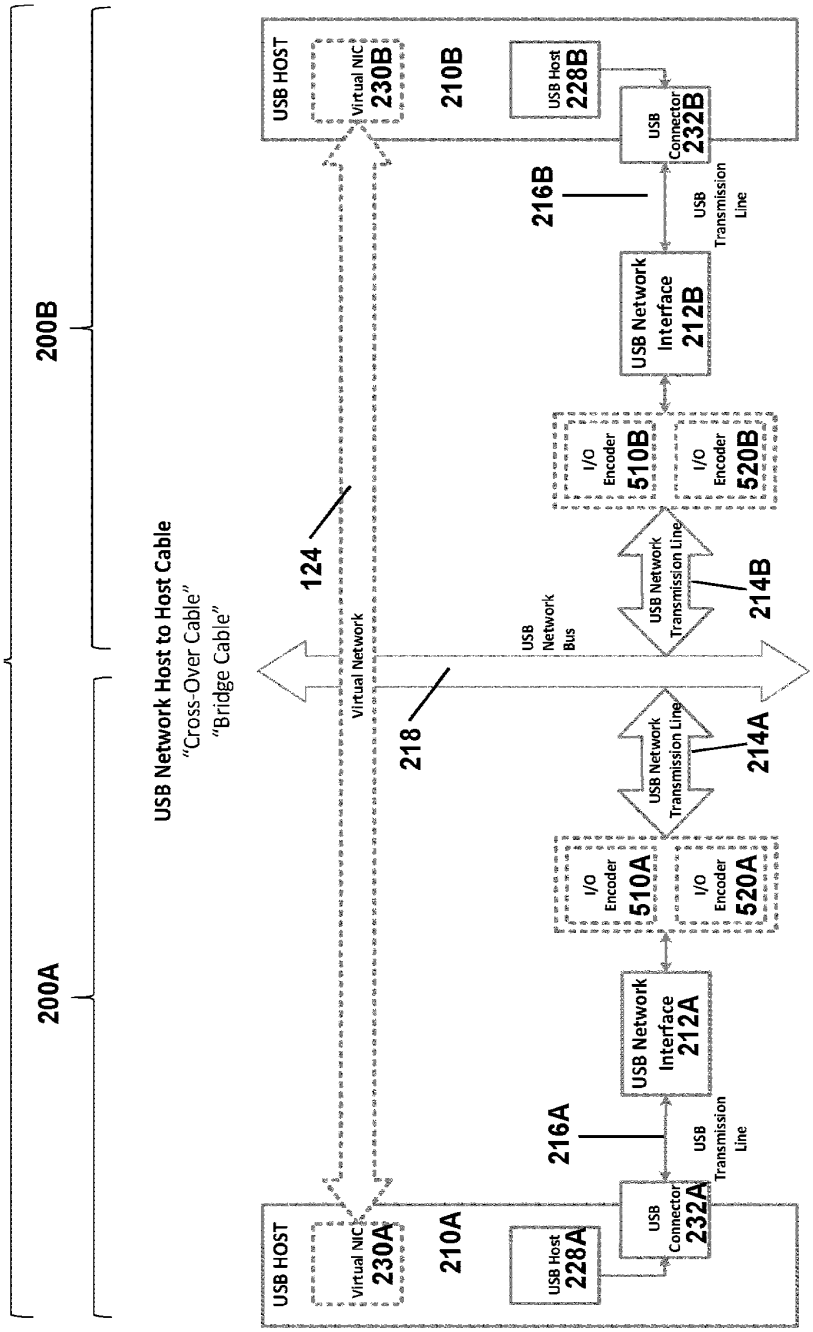

500
200B
200A
USB Network Host to Host Cable
"Cross-Over Cable"
"Bridge Cable"
USB HOST
Virtual NIC
230B
210B
USB Host
228B
USB
Connector
232B
216B
USB
Transmission
Line
USB Network
Interface
212B
I/O
Encoder
510B
I/O
Encoder
520B
USB Network
Transmission Line
214B
124
Virtual Network
USB
Network
Bus
218
USB Network
Transmission Line
214A
I/O
Encoder
510A
I/O
Encoder
520A
USB Network
Interface
212A
216A
USB
Transmission
Line
USB HOST
Virtual NIC
230A
210A
USB Host
228A
USB
Connector
232A

Fig. 5

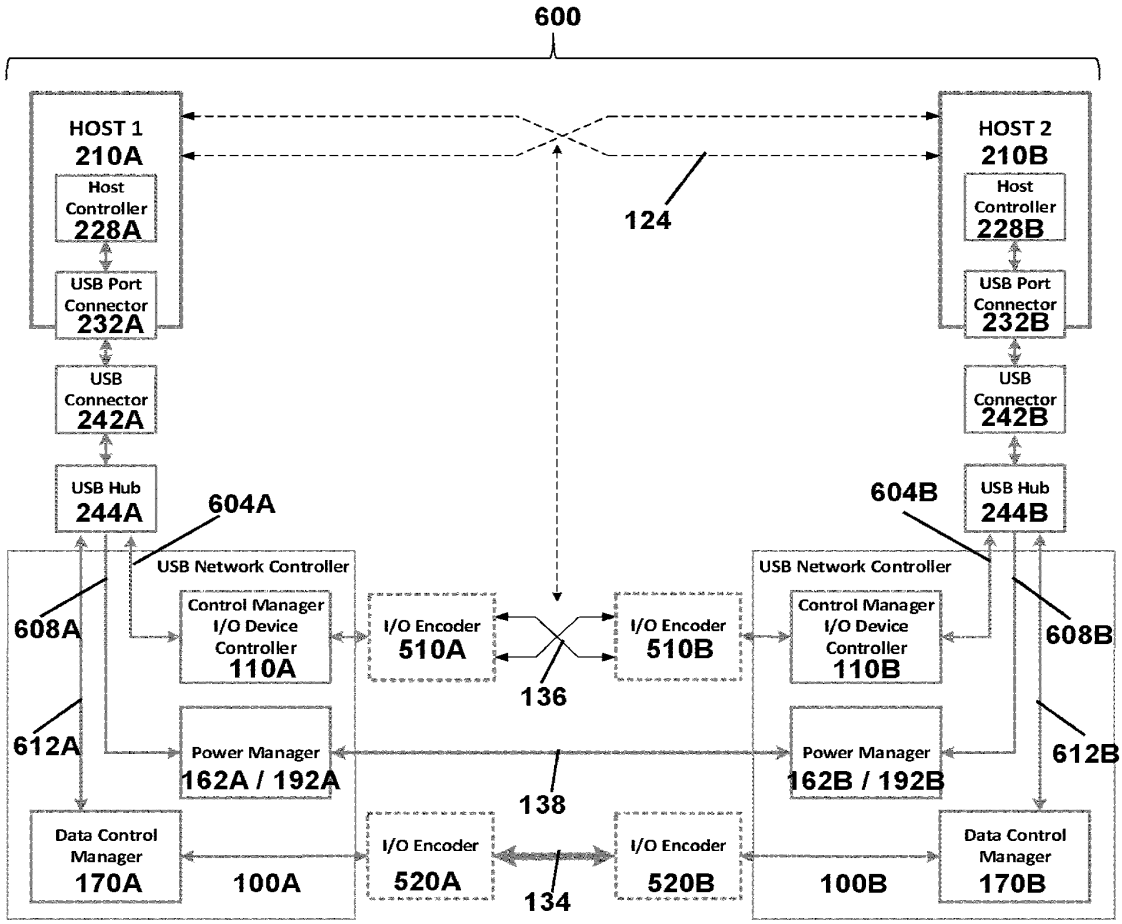

600
HOST 1
210A
Host Controller
228A
USB Port Connector
232A
USB Connector
242A
USB Hub
244A
604A
USB Network Controller
608A
Control Manager I/O Device Controller
110A
612A
Power Manager
162A / 192A
Data Control Manager
170A
100A
124
I/O Encoder
510A
I/O Encoder
510B
136
I/O Encoder
520A
I/O Encoder
520B
134
138
HOST 2
210B
Host Controller
228B
USB Port Connector
232B
USB Connector
242B
USB Hub
244B
604B
USB Network Controller
608B
Control Manager I/O Device Controller
110B
612B
Power Manager
162B / 192B
Data Control Manager
170B
100B

Fig. 6 a

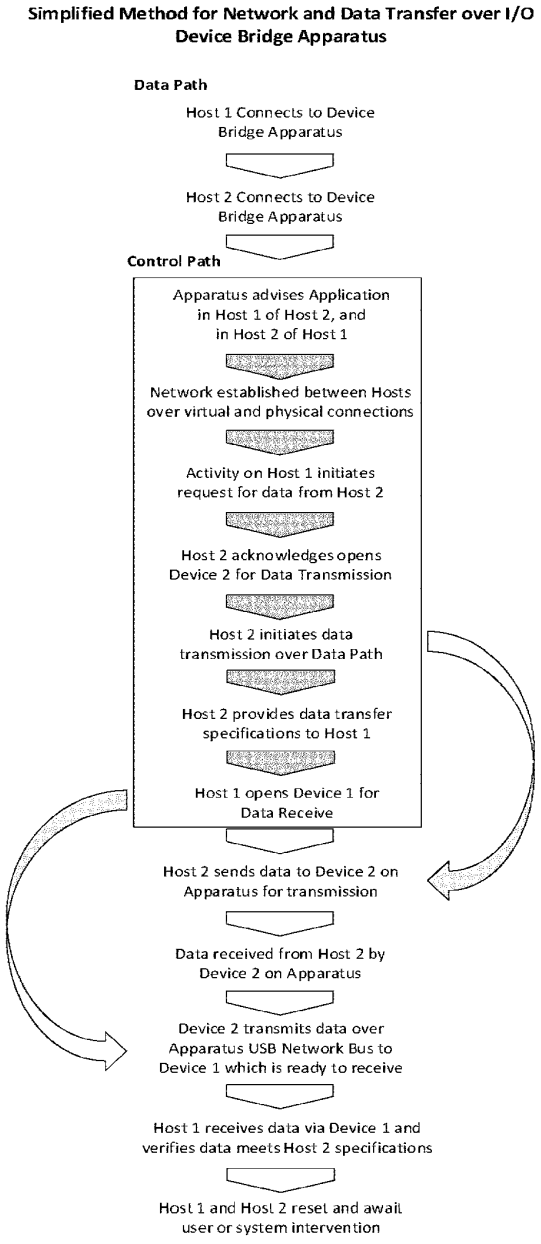

Simplified Method for Network and Data Transfer over I/O Device Bridge Apparatus
Data Path
Host 1 Connects to Device Bridge Apparatus
Host 2 Connects to Device Bridge Apparatus
Control Path
Apparatus advises Application in Host 1 of Host 2, and in Host 2 of Host 1
Network established between Hosts over virtual and physical connections
Activity on Host 1 initiates request for data from Host 2
Host 2 acknowledges opens Device 2 for Data Transmission
Host 2 initiates data transmission over Data Path
Host 2 provides data transfer specifications to Host 1
Host 1 opens Device 1 for Data Receive
Host 2 sends data to Device 2 on Apparatus for transmission
Data received from Host 2 by Device 2 on Apparatus
Device 2 transmits data over Apparatus USB Network Bus to Device 1 which is ready to receive
Host 1 receives data via Device 1 and verifies data meets Host 2 specifications
Host 1 and Host 2 reset and await user or system intervention

Fig. 6 b

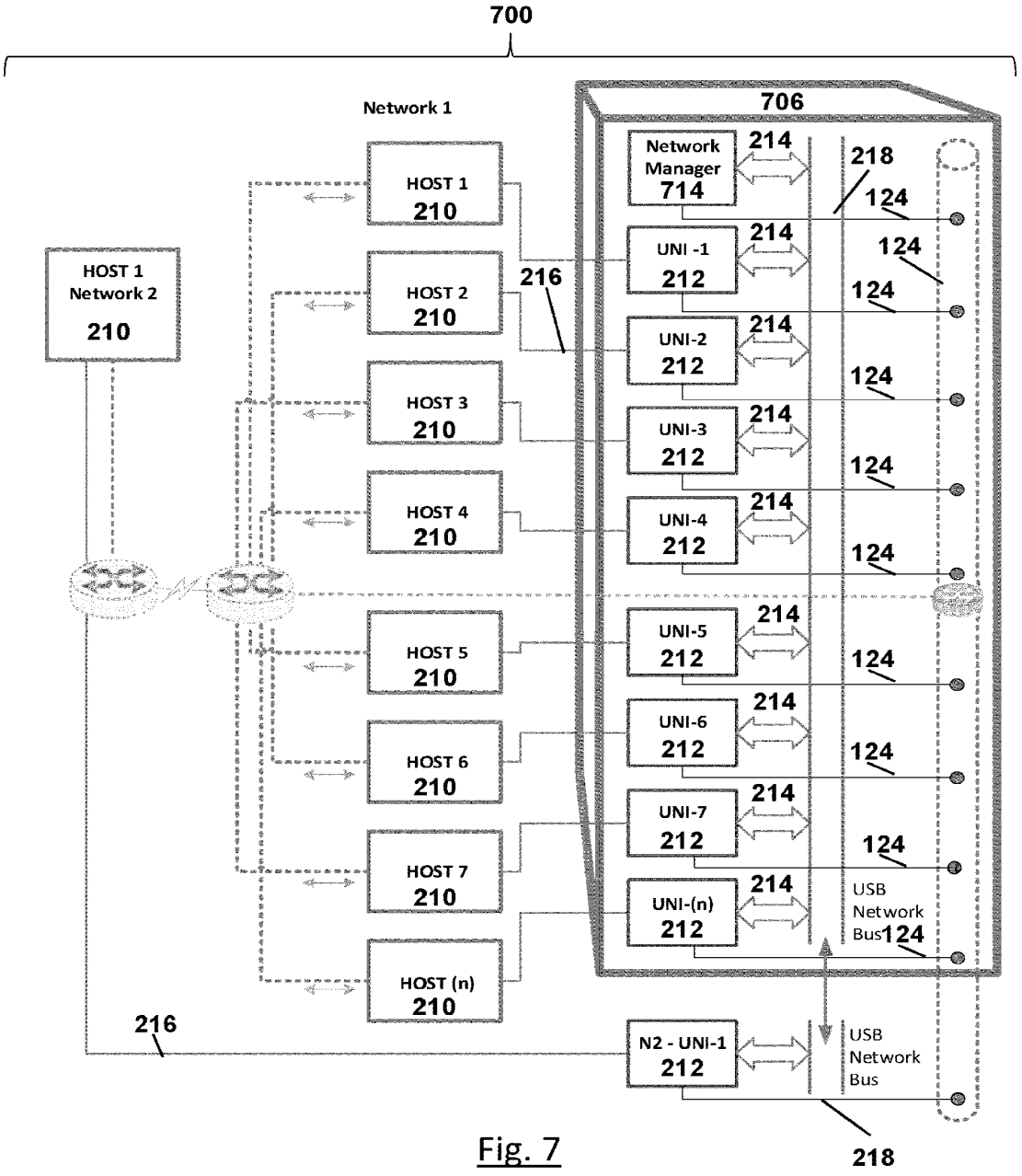

700
Network 1
706
HOST 1
210
HOST 1
Network 2
210
HOST 2
210
HOST 3
210
HOST 4
210
HOST 5
210
HOST 6
210
HOST 7
210
HOST (n)
210
216
216
Network
Manager
714
UNI -1
212
UNI-2
212
UNI-3
212
UNI-4
212
UNI-5
212
UNI-6
212
UNI-7
212
UNI-(n)
212
N2 - UNI-1
212
214
218
124
USB
Network
Bus
USB
Network
Bus
218

Fig. 7

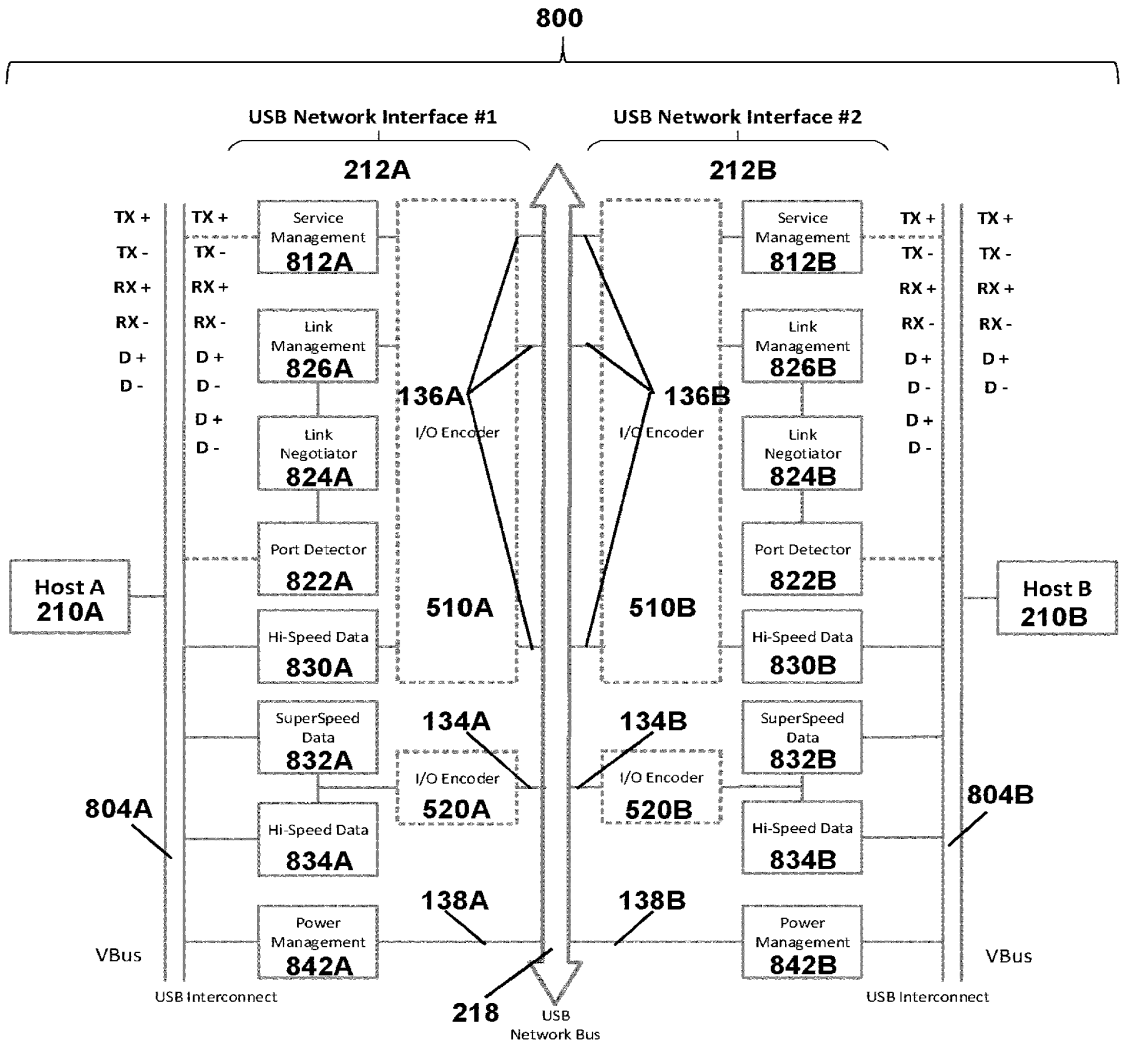

800
USB Network Interface #1
USB Network Interface #2
212A
212B
TX +
TX -
RX +
RX -
D +
D -
Service Management 812A
Link Management 826A
Link Negotiator 824A
Port Detector 822A
Hi-Speed Data 830A
SuperSpeed Data 832A
Hi-Speed Data 834A
Power Management 842A
136A
I/O Encoder
510A
134A
I/O Encoder 520A
138A
Host A 210A
804A
VBus
USB Interconnect
218
USB Network Bus
136B
I/O Encoder
510B
134B
I/O Encoder 520B
138B
Service Management 812B
Link Management 826B
Link Negotiator 824B
Port Detector 822B
Hi-Speed Data 830B
SuperSpeed Data 832B
Hi-Speed Data 834B
Power Management 842B
Host B 210B
804B
VBus
USB Interconnect

Fig. 8

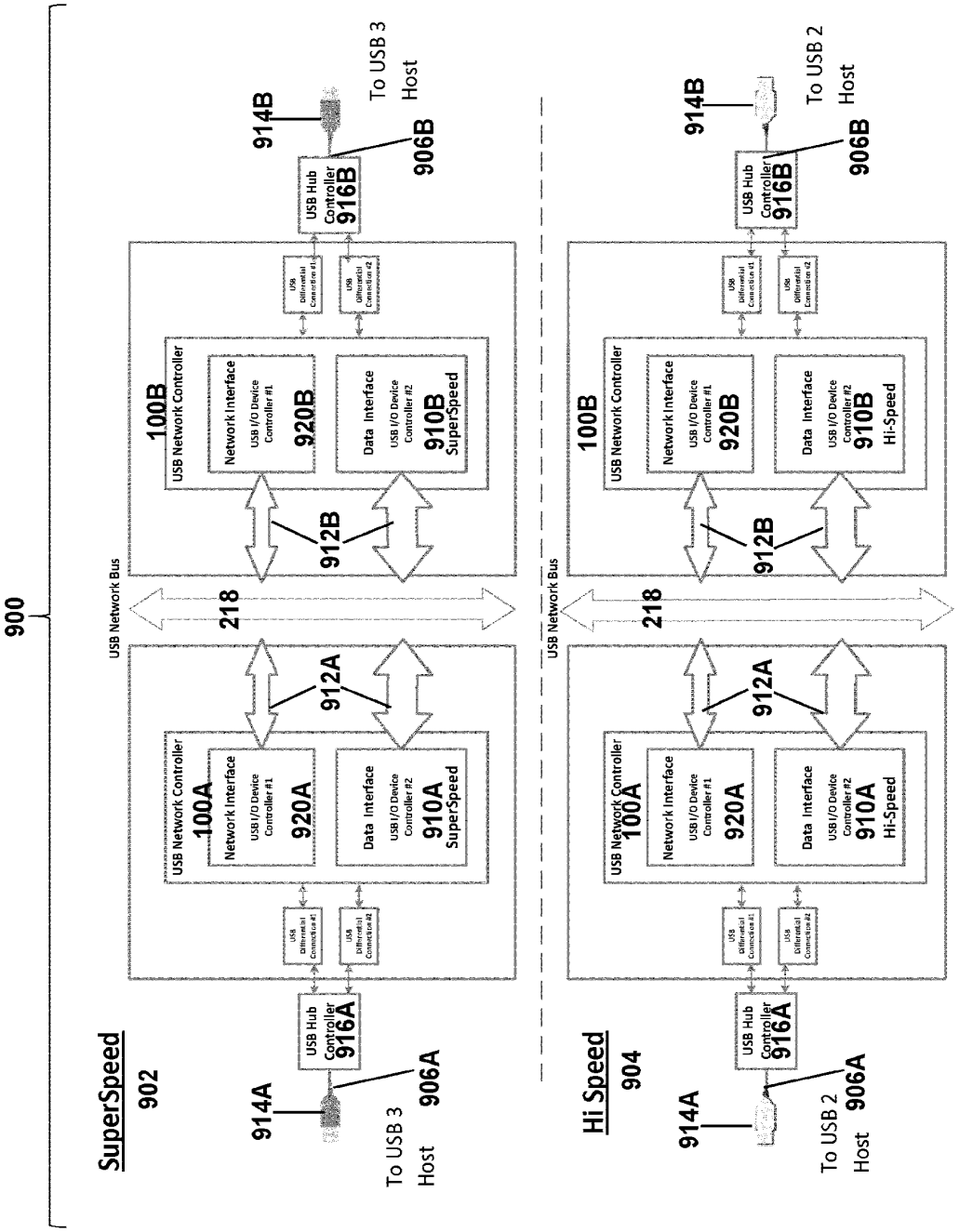

900
SuperSpeed
902
Hi Speed
904
USB Network Bus
218
USB Network Controller
100A
100B
Network Interface
USB I/O Device Controller #1
920A
920B
Data Interface
USB I/O Device Controller #2
910A SuperSpeed
910B SuperSpeed
910A Hi-Speed
910B Hi-Speed
912A
912B
USB Differential Connection #1
USB Differential Connection #2
USB Hub Controller
916A
916B
906A
906B
914A
914B
To USB 3 Host
To USB 2 Host

Fig. 9

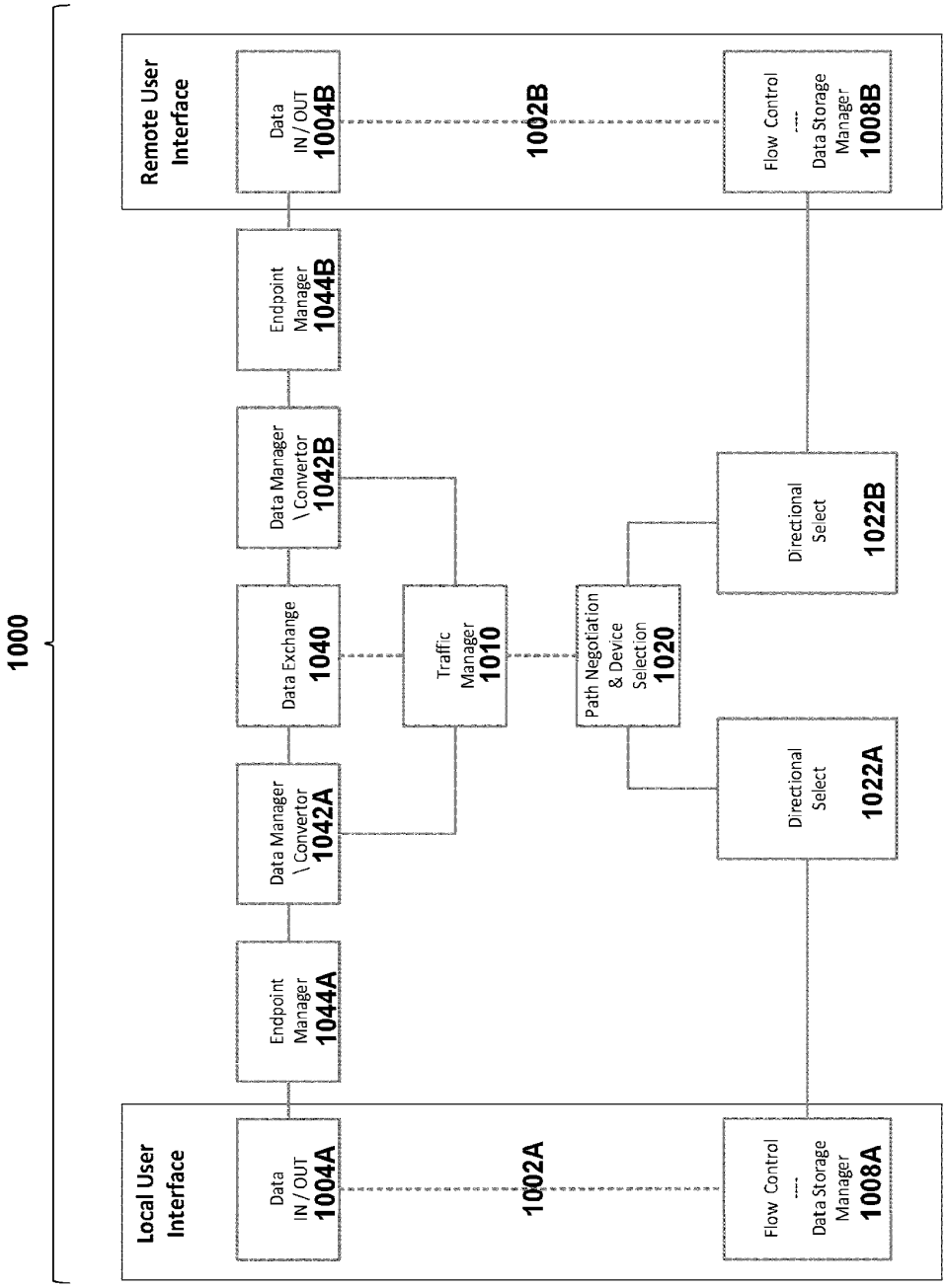

1000
Local User Interface
Data IN / OUT 1004A
1002A
Flow Control --- Data Storage Manager 1008A
Endpoint Manager 1044A
Data Manager \ Convertor 1042A
Data Exchange 1040
Traffic Manager 1010
Path Negotiation & Device Selection 1020
Directional Select 1022A
Directional Select 1022B
Data Manager \ Convertor 1042B
Endpoint Manager 1044B
Remote User Interface
Data IN / OUT 1004B
1002B
Flow Control --- Data Storage Manager 1008B

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2014/051179

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***H04L 12/46*** (2006.01), ***H04L 12/12*** (2006.01), ***H04L 12/40*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: H04L 12/46 (2006.01), H04L 12/12 (2006.01), H04L 12/40 (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Google Patent: USB Network controller; high speed file transfer; hosts; I/O devices; control bus; data bus; USB host to host networking; network interface card; network controller with dual I/O device controllers
Total Patent: transfer; data; first controller; second controller; host; send; receive; network; interface; control bus; data bus; USB; CONDOTTA, RENATO; WITTINGTON, CHRISTOPHER
QuestTel: host computer; input; output; device controller; link; transfer; data; network interface; USB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,740,176 (GUPTA, D. et al.) 14 April 1998 (14-04-1998) * column 13, line 59 to column 14, line 16; column 27, lines 13-15, 45-46; column 28, lines 19-31; FIGS. 14, 15 and 18*	1-20
Y	US 7,162,566 B2 (LIN, H.) 09 January 2007 (09-01-2007) * abstract; column 1, lines 49-60; column 1, line 67 to column 2, line 3; column 2, lines 13-16; column 3, lines 4-6; column 4, lines 38-44; column 5, lines 63-67; column 6, lines 31-52; column 7, lines 63-64; column 8, lines 13-15; FIGS. 1 and 6*	1-15 and 17
Y	US 2008/0109562 A1 (RAMAKRISHNAN, H. et al.) 08 May 2008 (08-05-2008) * paragraphs [0016] and [0043]; FIG. 3*	1-20

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 09 January 2015 (09-01-2015)	Date of mailing of the international search report 16 February 2015 (16-02-2015)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Albert Lau (819) 953-5206

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,601,109 B1 (BEALKOWSKI, R. et al.) 29 July 2003 (29-07-2003) * entire document*	
A	US 6,389,029 B1 (MCALEAR, J.) 14 May 2002 (14-05-2002) * entire document*	
A	US 6,654,817 B1 (HUANG, C.) 25 November 2003 (25-11-2003) * entire document*	

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2014/051179

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
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		AU2511695A	21 December 1995 (21-12-1995)
		CA2190590A1	07 December 1995 (07-12-1995)
		CN1151230A	04 June 1997 (04-06-1997)
		EP0760186A1	05 March 1997 (05-03-1997)
		IL113768D0	31 August 1995 (31-08-1995)
		JPH10501383A	03 February 1998 (03-02-1998)
		TW244407B	01 April 1995 (01-04-1995)
		TW254017B	11 August 1995 (11-08-1995)
		US5555244A	10 September 1996 (10-09-1996)
		US5673265A	30 September 1997 (30-09-1997)
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US2008109562A1	08 May 2008 (08-05-2008)	JP2010519785A	03 June 2010 (03-06-2010)
		JP4870819B2	08 February 2012 (08-02-2012)
		TW200839535A	01 October 2008 (01-10-2008)
		TWI378696B	01 December 2012 (01-12-2012)
		WO2008058254A2	15 May 2008 (15-05-2008)
		WO2008058254A3	04 December 2008 (04-12-2008)
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US6389029B1	14 May 2002 (14-05-2002)	AU1024900A	29 May 2000 (29-05-2000)
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		WO0028696A2	18 May 2000 (18-05-2000)
		WO0028696A3	16 November 2000 (16-11-2000)
		WO0028697A2	18 May 2000 (18-05-2000)
		WO0028697A3	26 October 2000 (26-10-2000)
		WO0137485A1	25 May 2001 (25-05-2001)
US6654817B1	25 November 2003 (25-11-2003)	None	

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(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WURZBURG, Henry** [US/US]; 12022 Carmel Park Lane, Austin, Texas 78727 (US). **BOHM, Mark R.** [US/US]; 8904 North Madrone Trail, Austin, Texas 78737 (US). **FU, Mark Y.** [US/US]; 5648 Forbes Drive, Newark, California 94560 (US).

(74) Agent: **MEYERTONS, HOOD, KIVLIN, KOWERT & GOETZEL, P.C.**; HOOD, Jeffrey C., P.O. Box 398, Austin, Texas 78767-0398 (US).

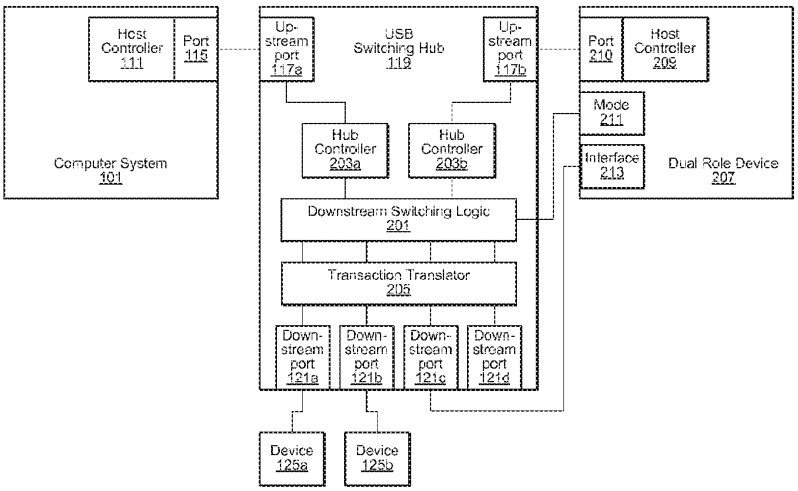
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
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[Continued on next page]

(54) **Title:** PERIPHERAL SHARING USB HUB FOR A WIRELESS HOST



(57) **Abstract:** In various embodiments, a wireless host and a wired host may communicate with downstream devices through a USB switching hub. A wireless host/wireless bridge may be temporarily physically coupled to an upstream port of the USB switching hub to complete association with another wireless bridge coupled to the USB switching hub as a downstream device through a downstream port. During association, the host and downstream wireless bridge may exchange an encryption key to be used for future wireless communications. After association, the wireless host may be disconnected from the USB switching hub to communicate remotely. In some embodiments, the wireless host may not need to be physically coupled to the USB switching hub during association.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

PERIPHERAL SHARING USB HUB FOR A WIRELESS HOST

BACKGROUND

Field of the Invention

[0001] The present invention relates generally to computer hardware and, more specifically, to Universal Serial Bus (USB) switching hubs.

Description of the Related Art

[0002] The Universal Serial Bus (USB) allows coupling of peripheral devices to a computer system. USB is a serial cable bus for data exchange between a host computer and a wide range of simultaneously accessible devices. The bus allows peripherals to be attached, configured, used, and detached while the host is in operation. For example, USB printers, scanners, digital cameras, storage devices, card readers, etc. may communicate with a host computer system over USB. USB based systems may require that a USB host controller be present in the host system, and that the operating system (OS) of the host system support USB and USB Mass Storage Class Devices.

[0003] USB devices may communicate over the USB bus at low-speed (LS), full-speed (FS), or high-speed (HS). A connection between the USB device and the host may include four wires (a power line, a ground line, and a pair of data lines (D+ and D-). When a USB device connects to the host, the USB device may first pull a D+ line high (the D- line if the device is a low speed device) using a pull up resistor on the D+ line. The host may respond by resetting the USB device. If the USB device is a high-speed USB device, the USB device may "chirp" by driving the D- line high during the reset. The host may respond to the "chirp" by alternately driving the D+ and D- lines high. The USB device may then electronically remove the pull up resistor and continue communicating at high speed. When disconnecting, full-speed devices may remove the pull up resistor from the D+ line (i.e., "tri-state" the line), while high-speed USB devices may tri-state both the D+ and D- lines.

[0004] A USB hub may be coupled to a USB host controller to allow multiple USB devices to be coupled to the host system through the USB host controller. In addition, other USB hubs may be coupled to the USB hub to provide additional USB device connections to the USB host controller.

[0005] Some dual role peripheral devices may include a slave controller and be capable of communicating with other peripheral devices coupled to them. For example, a dual role USB printer may be able to communicate directly with a USB camera to print pictures from the USB camera. The dual role USB printer may also be accessible (e.g., by a computer system) as a

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slave peripheral device. If a computer system and dual role peripheral device need to alternately access a peripheral device, the peripheral device may need to be unplugged from one device and coupled to the other. Prior art device switches may not work for high-speed peripheral devices. For example, mechanical switches may introduce too much capacitance or inductance to work with high-speed peripheral devices. High-speed peripheral devices also typically require smooth impedance to prevent ringing (mechanical switches introduce irregularities in the impedance that may cause ringing).

[0006] The Wireless USB specification (revision 1.0 and 1.1) defines wireless USB. Part of Wireless USB is the requirement for "association" where the USB host may be introduced to a device either by the user entering a code of some sort, or via a wired means so the host and the device can communicate over a secure means prior to communicating over the wireless medium. A media access controller (MAC) may have a device port on it for association and a main data connection port for data transfer after the radio has been associated. The device port may be a dedicated port for attachment to a USB host for association only, and may have no other functionality. The channelization scheme presented in the Wireless USB specification, version 1.1, also references the ability to share the radio with other communication protocols such as Bluetooth.

SUMMARY OF THE INVENTION

[0007] In various embodiments, communications between each of the downstream ports and two or more upstream ports may be controlled by a USB switching hub. In some embodiments, devices coupled to upstream ports (e.g., wired and/or wireless hosts) of a USB switching hub may enumerate the USB switching hub according to the total number of downstream ports on the USB switching hub. In some embodiments, when first upstream port is communicating with a first downstream port, a second upstream port may be communicating with a different downstream port (as determined by a communication configuration implemented in switching logic in the USB switching hub). In some embodiments, when the first upstream port is communicating with the first downstream port, the second upstream port may perceive the first downstream port as disconnected. For example, status registers coupled to the second upstream port may indicate the first downstream port is disconnected (i.e., to appear that no device is electrically connected to the first downstream port). The disconnect status may prevent the second upstream device from attempting to reset and connect to a downstream device coupled to the first downstream port while a separate upstream device is communicating through the first upstream port with the first downstream device. By enumerating the USB switching hub

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according to the total number of downstream ports, the upstream devices may not have to re-enumerate the hub (and correspondingly each device coupled to the hub) each time a downstream device is switched.

[0008] In various embodiments, a wireless host (e.g., a laptop with a wireless bridge and transceiver) and a wired host may communicate with downstream devices through the USB switching hub. Communications between the downstream devices and the wireless host may pass through wireless bridges coupled to wireless transceivers between the wireless host and the USB switching hub. In some embodiments, multiple wireless hosts may communicate with downstream devices through the USB switching hub through one or more wireless bridges coupled to one or more upstream ports of the USB switching hub.

[0009] In some embodiments, the USB switching hub may be used to perform association (i.e., exchanging an encryption key to insure secure communications) between the wireless host and a wireless bridge coupled to the USB switching hub. A wireless host/wireless bridge may be temporarily physically coupled to the upstream port to complete association with a wireless bridge coupled to the USB switching hub as a downstream device through a downstream port. Other association methods are also possible (e.g., exchanging a code manually between the two wireless bridges without temporarily physically coupling the two together). The wireless bridge that stays coupled to the USB switching hub during wireless communications may be internal to the USB switching hub. The wireless bridge may also communicate as a downstream device during association through a reversible port that may reverse to allow communications between the wireless bridge and the USB switching hub as an upstream device. During association, the wireless bridges may exchange an encryption key to be used for future wireless communications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A better understanding of the present invention may be obtained when the following detailed description is considered in conjunction with the following drawings, in which:

[0011] FIG. 1 illustrates a USB switching hub, according to an embodiment;

[0012] FIG. 2 illustrates a computer system coupled to a USB switching hub, according to an embodiment;

[0013] FIG. 3 illustrates a computer system and a dual role peripheral device coupled to a USB switching hub, according to an embodiment;

[0014] FIGs. 4a and 4b illustrate two communication configurations of the USB switching hub, according to an embodiment;

[0015] FIGs. 5a, 5b, and 5c illustrate additional communication configurations of the USB

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switching hub, according to an embodiment;

[0016] FIG. 6 illustrates unified functions within the USB switching hub, according to an embodiment;

[0017] FIG. 7 illustrates a method for switching access to a downstream port between two upstream ports, according to an embodiment;

[0018] FIG. 8 illustrates a USB switching hub with multiple status registers, according to an embodiment;

[0019] FIG. 9 shows a method for switching access to a downstream port between two upstream ports without reenumerating the USB switching hub, according to an embodiment;

[0020] FIG. 10 shows a method for monitoring a standby state to approve a communication switch, according to an embodiment;

[0021] FIG. 11 shows a method for monitoring hub transactions to approve a communication switch, according to an embodiment;

[0022] FIG. 12 shows a method for switching communications at a frame boundary, according to an embodiment;

[0023] FIG. 13 illustrates a computer system and a dual role peripheral device coupled to a USB switching hub, according to an alternate embodiment;

[0024] FIGs. 14a and 14b illustrate two communication configurations of the USB switching hub, according to an alternate embodiment;

[0025] FIGs. 15a, 15b, and 15c illustrate additional communication configurations of the USB switching hub, according to an alternate embodiment;

[0026] FIG. 16 illustrates a USB switching hub with multiple status registers, according to an alternate embodiment;

[0027] FIG. 17 illustrates an alternate embodiment of a computer system and a peripheral device coupled to a USB switching hub;

[0028] FIGs. 18a, 18b, and 18c illustrate the USB switching hub communicatively coupling to a wireless host, according to an embodiment;

[0029] FIGs. 18d and 18e illustrate various embodiments of the hub and switching logic;

[0030] FIG. 19 illustrates the USB switching hub with an internal wireless bridge, according to an embodiment;

[0031] FIG. 20 illustrates the USB switching hub with an internal wireless bridge and internal transceiver, according to an embodiment;

[0032] FIG. 21 illustrates the USB switching hub coupled to a plurality of wireless hosts,

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according to an embodiment;

[0033] FIG. 22 illustrates the USB switching hub with a reversible port, according to an embodiment;

[0034] FIG. 23 illustrates a method of using the USB switching hub to support a wireless host, according to an embodiment;

[0035] FIG. 24 illustrates a method for using the USB switching hub for associating a wireless host, according to an embodiment;

[0036] FIG. 25 illustrates a method for using the USB switching hub for supporting multiple wireless hosts, according to an embodiment;

[0037] FIG. 26 illustrates a method for using the USB switching hub with a reversing PHY to support a wireless bridge as a downstream device during association and an upstream device during regular communications, according to an embodiment;

[0001] Figures 27 and 28 illustrate exemplary systems suitable for implementing various embodiments of the invention;

[0002] Figure 29 is an exemplary block diagram illustrating one embodiment of a USB hub;

[0003] Figure 30 is a flowchart diagram illustrating one embodiment of a method for switching logic in a USB Hub, according to one embodiment of the invention;

[0004] Figure 31 is an exemplary block diagram illustrating one embodiment of a USB hub included in a USB device; and

[0005] Figure 32 is an exemplary block diagram illustrating one embodiment of a USB hub included in a USB device which is coupled to a computer system.

[0038] While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present invention as defined by the appended claims. Note, the headings are for organizational purposes only and are not meant to be used to limit or interpret the description or claims. Furthermore, note that the word "may" is used throughout this application in a permissive sense (e.g., having the potential to or being able to in some embodiments), not a mandatory sense (i.e., must). The term "include", and derivations thereof, mean "including, but not limited to". The term "coupled" means "directly or indirectly connected".

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DETAILED DESCRIPTION

[0039] FIG. 1 illustrates an embodiment of a USB switching hub. In various embodiments, USB switching hub 119 may control access between two or more upstream ports 117 on USB switching hub 119 and at least a subset of downstream ports 121 on USB switching hub 119. In some cases, a numeric label may be used to refer to a collection of similar elements, or to a generic version of the element (e.g., "downstream ports 121" may be used to reference one or more downstream ports 121a, 121b, 121c, and 121d).

[0040] In some embodiments, upstream devices coupled to upstream ports 117 may enumerate USB switching hub 119 according to the total number (N) of downstream ports 121. For example, USB switching hub 119 may be enumerated as a 4-port hub (corresponding to the four downstream ports 121). In some embodiments, communications between each of downstream ports 121 and upstream ports 117 may be controlled by USB switching hub 119. In some embodiments, when first upstream port 117a is communicating with first downstream port 121a, second upstream port 117b may communicate with second downstream port 121b. Second upstream port 117b may register first downstream port 121a as disconnected. For example, status registers coupled to second upstream port 117b may indicate first downstream port 121a is disconnected (i.e., to appear that no device is electrically connected to first downstream port 121a). The disconnect status may prevent second upstream device 117b from attempting to reset and connect to first peripheral device 121a coupled to first downstream device 121a while a separate upstream device is communicating through first upstream port 117a with first downstream device 125a. By enumerating USB switching hub 119 as a 4-port hub, the upstream devices may not have to re-enumerate USB switching hub 119 (and correspondingly each downstream and/or upstream device coupled to the USB switching hub) each time a downstream device is switched.

[0041] In some embodiments, only one upstream device may access any one downstream device at a time. In some embodiments, multiple upstream devices may access separate downstream devices at the same time. In some embodiments, different communication configurations may be implemented. For example, first upstream port 117a may be allowed access to the first three downstream ports (121a, 121b, and 121c) and second upstream port 117b may be allowed access to fourth downstream port 121d. Devices coupled to first upstream port 117a and second upstream port 117b may have enumerated USB switching hub 119 as a 4-port hub, but in this example, a device coupled to first upstream port 117a may register fourth downstream port 121d as disconnected while a device coupled to second upstream port 117b may register the first three

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downstream ports (121a, 121b, and 121c) as disconnected.

[0042] In a second communication configuration, first upstream port 117a may be allowed to access fourth downstream port 121d while second upstream port 117b may be allowed to access the first three downstream ports (121a, 121b, and 121c). Other communication configurations are also possible (e.g., in one communication configuration neither upstream port 117 may be allowed to access any downstream port 121). In some embodiments, USB switching hub 119, after receiving a control signal (e.g., from a computer, a different attached device, a person, a sensor, a logic internal to USB switching hub 119, etc.), may switch between the first communication configuration and the second communication configuration (or another communication configuration). In some embodiments, USB switching hub 119 may not receive a control signal before switching communication configurations (e.g., switching access for first downstream device 125a from first upstream port 117a to second upstream port 117b).

[0043] FIG. 2 illustrates an embodiment of computer system 101 coupled to USB switching hub 119. In some embodiments, computer system 101 (e.g., a personal computer (PC), laptop, server, etc.) may access multiple peripheral devices 125 coupled to USB switching hub 119. Computer system 101 may couple to USB switching hub 119 through upstream port 117a. Computer system 101 may receive and transmit signals, e.g., USB signals, through host controller 111 coupled to device port 115. While various embodiments may include computer system 101, it is to be understood that other devices that have a host controller may also access USB switching hub 119. Host controller 111, coupled to south bridge 113, may be coupled to other computer components (e.g., north bridge 105, central processing unit (CPU) 103, and system memory 107) through peripheral component interconnect (PCI) bus 109.

[0044] In some embodiments, USB switching hub 119 may have multiple downstream ports 121 for coupling to multiple peripheral devices 125. Peripheral devices 125 may include USB printers, scanners, digital cameras, digital camera docks, consumer audio/video, storage devices, and card readers, among others. In some embodiments, peripheral devices 125 may couple to USB switching hub 119 through interface 123. In some embodiments, interface 123 may be a PHY interface. Other interfaces may also be used (e.g., UTMI or ULPI). Upstream ports 117 and downstream ports 121 may also have interfaces.

[0045] FIG. 3 illustrates an embodiment of two upstream devices (e.g., computer system 101 and dual role peripheral device 207) coupled to USB switching hub 119. In some embodiments, USB switching hub 119 may include downstream switching logic 201, coupled to one or more hub controllers 203 (e.g., hub controllers 203a and 203b). Downstream switching logic 201 may

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also be coupled to transaction translator circuitry 205. Transaction translator 205 may be electronically coupled to downstream ports 121. In some embodiments, downstream switching logic 201 may switch between two or more communication configurations. Communication configurations may be implemented by downstream switching logic 201 routing communications between upstream ports 117 and downstream ports 121 while the communications are in the digital domain (as a result of the interfaces to/from USB switching hub 119). In some embodiments, communication configurations (e.g., hardwired in the USB switching hub) may be switched as determined by logic on the USB switching hub. Other communication configuration implementations are also contemplated.

[0046] In some embodiments, dual role peripheral device 207 may include a dual role USB printer or dual role USB Digital Versatile Disc (DVD) read/write drive, among others. In some embodiments, dual role peripheral device 207 may be coupled to an upstream port (e.g., upstream port 117b) of USB switching hub 119 through device port 210. Dual role peripheral device 207 may interface through upstream port 117b with other peripheral devices (downstream peripheral devices) coupled to USB switching hub 119 (e.g., using host controller 209 on dual role peripheral device 207). Dual role peripheral device 207 may also interface with other upstream devices (such as computer system 101) through a slave controller. For example, dual role peripheral device 207 may be coupled to USB switching hub 119 as a slave peripheral device (e.g., through downstream port 121c). In some embodiments, dual role peripheral device 207, coupled to the USB switching hub, may simultaneously act as a host to one or more peripheral devices and/or as slave peripheral device to a separate host.

[0047] In some embodiments, dual role peripheral device 207 may have an embedded host controller application to operate as a standalone system (e.g., to communicate with another peripheral device, such as a digital camera, without PC intervention). For example, a dual role USB printer may print pictures directly from a digital camera, coupled to a downstream port 121 on USB switching hub 119, without PC intervention. In some embodiments, USB switching hub 119 may alternately allow the computer system 101 or dual role peripheral device 207 to access one or more downstream devices (e.g., by switching between one or more communication configurations).

[0048] FIG. 4a illustrates an embodiment of a computer system 101 electronically coupled to multiple peripheral devices 125. In some embodiments, USB switching hub 119 may act like a switch coupling multiple internal "hubs" that may share one or more downstream ports. For example, each potential communication configuration of the USB switching hub may represent

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an internal "hub". In some embodiments, when computer system 101 is accessing peripheral device 125 (e.g., peripheral device 125a) coupled to USB switching hub 119, communications to/from the peripheral device may be processed through a first "hub" comprised of first upstream port 117a, hub controller 203a, transaction translator 205, and at least a subset of the downstream ports 121. A second "hub" may be comprised of second upstream port 117b, hub controller 203b, transaction translator 205, and at least a subset of the downstream ports 121. In one communication configuration, computer system 101 may connect to downstream ports 121a and 121c (through the first "hub"), and dual role peripheral device 207 may connect to downstream ports 121b and 121d (through the second "hub") (as seen in FIG. 4b). Other communication configurations are also contemplated. In some embodiments, communication configuration profiles designating which downstream devices to couple to each upstream port may be hardwired or implemented by software. For example, if implemented by software, communication configuration profiles for each upstream port (and/or upstream device) may be stored on a memory accessible to USB switching hub 119.

[0049] In some embodiments, computer system 101 and dual role peripheral device 207 may communicate through USB switching hub 119 simultaneously with separate downstream devices. For example, while computer system 101 communicates with device 125a (e.g., through the first "hub"), dual role peripheral device 207 may communicate with device 125b (e.g., through the second "hub"). In some embodiments, while peripheral device 125a is being accessed through the first "hub", a different upstream device may not be able to access peripheral device 125a (e.g., dual role peripheral device 207 may not be able to access peripheral device 125a while peripheral device 125a is being used by computer system 101). In some embodiments, a signal (e.g., from an external control block) may trigger downstream switching logic 201 to switch access for a subset of downstream ports 121 (e.g., downstream port 121a and/or 121c) on the first "hub" to the second "hub" (i.e., switch communication configurations). In some embodiments, dual role peripheral device 207 may send a control signal to USB switching hub 119. USB switching hub 119 may then switch communication configurations to connect one or more downstream ports to the dual role peripheral device. For example, when a user presses a button on dual role peripheral device 207 (e.g., a dual role printer), a signal may be sent through mode 211 to downstream switching logic 201 to switch access of device 125a from computer system 101 to dual role peripheral device 207 (i.e., to switch to a second communication configuration as seen in FIG. 4b). Computer system 101 may continue to communicate with downstream port 121c (and/or other downstream ports as determined by the

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second communication configuration).

[0050] In some embodiments, when activity is no longer detected between dual role peripheral device 207 and a downstream port (e.g., if dual role peripheral device 207 is turned off), downstream switching logic 201 may switch access of the downstream port to computer system 101 (i.e., switch to a different communication configuration). In some embodiments, downstream switching logic 201 may switch access of the downstream port to a different upstream device. In some embodiments, instead of detecting inactivity, a signal from dual role peripheral device 207 may signal USB switching hub 119 to switch. Other signals and/or logic may also be used in determining when to switch communication configurations.

[0051] In some embodiments, communication configurations may be software implemented. In some embodiments, a microprocessor coupled to or comprised in downstream switching logic 201 may dynamically determine, e.g., using a dynamic communication configuration profile, which downstream ports to electrically couple to each upstream port. For example, the microprocessor may read a stored communication configuration profile and attempt to connect upstream ports to downstream ports according to the communication configuration profile. The communication configuration profiles may be stored on a memory (e.g., an Electronically Erasable Programmable Read-Only Memory (EEPROM)) coupled to USB switching hub 119. In some embodiments, hub controllers 203 on USB switching hub 119 may have access to the communication configuration profiles.

[0052] In some embodiments, a priority logic may be used to switch communication configurations. Priority logic, or other logic used to grant access, may be internal or external to USB switching hub 119. In some embodiments, computer system 101 may be given priority over all of downstream ports 121 until an external control signal is sent from dual role peripheral device 207 to switch access of one or more downstream ports 121 to dual role peripheral device 207. In some embodiments, different control signals may be sent to trigger different communication configurations (i.e., to switch access of different downstream ports to dual role peripheral device 207).

[0053] In some embodiments, host negotiation logic may be used to determine which communication configuration to use. In some embodiments, a default communication configuration may be used until multiple upstream devices "request" access to the same downstream port. Host negotiation logic may be used to determine which communication configuration to use (i.e., which communication configuration gives a particular upstream port access to the "requested" downstream port).

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[0054] In some embodiments, a microprocessor in USB switching hub 119 may include a built in algorithm that auto detects downstream peripheral devices and determines how to connect the downstream peripheral devices. For example, instead of assigning a specific downstream port to an upstream port, a communication configuration profile may specify that the upstream port should have access to a digital camera if one is attached. The built in algorithm may auto-detect the digital camera when it is attached to one of the downstream ports and attach it to the appropriate upstream port (i.e., by switching to an appropriate communication configuration).

[0055] In some embodiments, when downstream switching logic 201 switches communication configurations, and control of a downstream port is switched from computer system 101 to dual role peripheral device 207, a connection between computer system 101 and respective peripheral device 125 (coupled to the downstream port to be switched) may be terminated by computer system 101. In some embodiments, communications between the downstream port to be switched and computer system 101 may be terminated by USB switching hub 119. Dual role peripheral device 207 may then connect to, enumerate, and communicate with the respective peripheral device 125 coupled to the switched downstream port.

[0056] Upstream devices may see downstream ports that they are not configured to attach to as unattached ports (i.e., active, but with no device connected). In some embodiments, if only a predetermined number of downstream ports is ever going to be attached to a particular upstream port (e.g., a number "x" ports), the upstream device may be signaled that the hub only has x ports. For example, if upstream port 117b is only going to be configured to attach to downstream ports 121c and 121d, a device attached to upstream port 117b may be signaled that USB switching hub 119 is only a two port hub.

[0057] FIGs. 5a, 5b, and 5c illustrate various embodiments of computer system 101 and two dual role peripheral devices coupled to USB switching hub 419. In some embodiments, multiple dual role peripheral devices may be coupled to USB switching hub 419. For example, dual role printer 407 may be coupled to USB switching hub 419 through upstream port 417b and dual role DVD read/write drive 467 may be coupled to USB switching hub 419 through upstream port 417c. Computer system 101 may be coupled to USB switching hub 419 through upstream port 417a. Each of the upstream devices may be coupled to a respective hub controller 403, downstream switching logic 401, and transaction translator 405. Downstream switching logic 401 may configure communications between each of the upstream devices (i.e., computer system 101, dual role printer 407, or dual role DVD read/write drive 467) and at least a subset of the peripheral devices 425.

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[0058] As seen in FIG. 5a, in one communication configuration profile, the computer system 101 may be connected to downstream ports 421a, 421b, 421e, and 421f. In an embodiment, dual role printer 407 may be configured to access downstream port 421c, and DVD read/write drive 467 may be configured not to access any downstream port 421. Dual role printer 407 may gain access (i.e., have the communication configuration switched to give it access) to downstream port 421b through several different methods. For example, a user may press a button on dual role printer 407. A signal may then be sent through mode 411 to downstream switching logic 401 in USB switching hub 419. Downstream switching logic 401 may switch to the communication configuration seen in FIG. 5b (which allows dual role printer 407 to access downstream port 421b). In some embodiments, if dual role printer 407 is turned off or becomes inactive, downstream switching logic 401 may switch access of downstream port 421b back to computer system 101 (i.e., switch back to the previous communication configuration). As seen in FIG. 5c, in one communication configuration, none of the upstream ports may be allowed to access any of the downstream ports.

[0059] FIG. 6 illustrates an embodiment of unified functions within the USB switching hub. In some embodiments, instead of separate hub controllers, unified hub controller 503 may be used. For example, instead of separate hub controllers handling communications for their respective upstream port, a unified hub controller may handle communications for each of the upstream ports. Similarly, unified transaction translator 505 may be used for each respective upstream port. Also, as seen in FIG. 6, in some embodiments, an upstream port switch 551 may be used. For example, the upstream port switch 551 may implement various communication configurations instead of a downstream switching logic.

[0060] In some embodiments, transaction translator(s) in the USB switching hub (e.g., USB switching hub 419 or USB switching hub 519) may allow upstream ports to communicate at different communication speeds relative to the other upstream ports. For example, one upstream port may be coupled only to high speed devices and, therefore, communicate at high speed, while a separate upstream port may be coupled to only full speed devices and, therefore, communicate at full speed. In some embodiments, upstream ports may be able to communicate with different downstream ports at different speeds because of the transaction translators.

[0061] FIG. 7 shows an embodiment of a method for switching access to a downstream port between two upstream ports on the USB switching hub. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other

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additional elements may also be performed as desired.

[0062] At 701, the USB switching hub may receive a signal (e.g., an external control signal) signaling the USB switching hub to switch between a first communication configuration and a second communication configuration. For example, switching communication configurations may switch access of a first downstream port from a first upstream port to a second upstream port. In some embodiments, a user may press a button on a dual role peripheral device coupled to the USB switching hub, and the dual role peripheral device may send an external control signal to the USB switching hub to signal the USB switching hub to switch between one or more communication configurations. In some embodiments, the signal may be internal (e.g., generated by logic internal to the USB switching hub).

[0063] At 703, communication between a host coupled to the first upstream port and the first peripheral device coupled to the first downstream port may be terminated. In some embodiments, communication may be terminated for a subset of the downstream peripheral devices.

[0064] At 705, the USB switching hub may switch between the first communication configuration and the second communication configuration to give access of the first downstream port to the second upstream port. In some embodiments, the communication configuration switch may affect access for a subset of the downstream peripheral devices.

[0065] At 707, the downstream peripheral device coupled to the first downstream port may be accessed through the second upstream port by the host coupled to the second upstream port. In some embodiments, the second upstream port may communicate with a subset of the downstream peripheral devices. For example, the host may enumerate and then communicate with the switched multiple downstream devices. In some embodiments, access between the first upstream port and a second downstream port may continue.

[0066] FIG. 8 illustrates a USB switching hub with multiple status registers, according to an embodiment. In some embodiments, upstream devices (e.g., computer system 101 and dual role device 207) may communicate with downstream devices 125 through downstream ports 121. In some embodiments, each upstream device may enumerate USB switching hub 119 as a 4-port hub (or according to the number of downstream ports 121 on the USB switching hub 119). In some embodiments, external signal 813 may signal downstream switching logic 201 to switch communications for a subset of downstream ports 121 (e.g., downstream ports 121a and 121b). When communications are being switched, a status register (e.g., a status register in a set of status registers 811a) may indicate a disconnect status for the previously connected downstream

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port). In some embodiments, communications between the downstream port and the second upstream device may then be established. For example, activity from downstream port 121a may indicate a connect event on a status register for downstream port 121a in the second set of status registers 811b. The second upstream device (e.g., dual role device 207) may detect the "connect" event when it poles status registers 811b and then reset the device coupled to downstream port 121a. While the second upstream device is communicating through downstream port 121a, other upstream devices coupled to other upstream ports may detect a "disconnect" for downstream port 121a when they poll their respective set of status registers 811.

[0067] In some embodiments, intelligent port routing switch (IPRS) 821 may delay switching communications for downstream port 125a if there is an active transfer in progress between downstream port 125a and first upstream port 117a. In some embodiments, IPRS 821 may delay switching communications for downstream port 125a if there is an active transfer in progress between downstream port 125 and second upstream port 117b. In some embodiments, IPRS 821 may be implemented in hardware and/or firmware on USB switching hub 119. In some embodiments, the IPRS may be implemented in software on computer system 101. The IPRS may include software and drivers that have knowledge of current USB traffic to delay a request to switch a device that is in use. In some embodiments, the IPRS may be entirely outside of any traffic monitoring internal to USB switching hub 119.

[0068] IPRS 821 may delay switching communications between other downstream ports 125 if there are pending or active transfers in progress. In some embodiments, IPRS 821 may monitor communications at the hub controller 203 level or may monitor communications at the downstream switching logic level. Other placements between downstream ports 121 and upstream ports 117 may also be used. In some embodiments, instead of relying on intelligent monitoring or an external method for delaying switching communications, IPRS 821 may operate to delay switching such that switching takes place at the USB frame boundary (when, by definition, no traffic is permitted to be in progress). In such embodiments, switching may be delayed until the frame boundary on a predetermined basis, not as a result of intelligent monitoring.

[0069] In some embodiments, external signal 813 (e.g., from a user, from computer system 101, or from mode 211 on dual role device 207) may signal downstream switching logic 201 to switch communications between a downstream port 121 and the upstream ports 117. Other sources of external signal 813 are also contemplated (e.g., the external signal may originate from

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a physical switch coupled to USB switching hub 119). In some embodiments, the physical switch may have switches, push buttons and/or other mechanical components to allow a user to assign one or more downstream ports 121 to specific upstream port 117. In some embodiments, external signal 813 may be sent from computer system 101. For example, an application executing on computer system 101 may allow a user to interact with computer system 101 to assign one or more downstream ports 121 to specific upstream port 117. In some embodiments, computer system 101 may also receive signals back from USB switching hub 119 to communicate with the user. For example, if there are transfers between a related downstream port and an upstream port, USB switching hub 119 may communicate this status to the user, and USB switching hub 119 may wait until it receives confirmation from the user to proceed with the switch (e.g., a signal may be sent from computer system 101 confirming the switch after a user selects a graphical "Proceed" box on a computer screen coupled to computer system 119.)

[0070] FIG. 9 shows an embodiment of a method for switching access to downstream port 121 between two upstream ports without reenumerating USB switching hub 119. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0071] At 901, a peripheral device may be coupled to a downstream port of a USB switching hub. In some embodiments, the peripheral device may be a USB device. The USB device may also be coupled to an upstream device (i.e., the USB device may be a dual role USB device).

[0072] At 903, a first upstream device may be coupled to first upstream port 117a of the USB switching hub 119.

[0073] At 905, a second upstream device may be coupled to second upstream port 117b of USB switching hub 119.

[0074] At 907, the first upstream device may enumerate USB switching hub 119 using a first hub configuration for USB switching hub 119. For example, if USB switching hub 119 has four downstream ports 121, the first upstream device may enumerate USB switching hub 119 as a 4-port hub. In some embodiments, the first upstream device may enumerate USB switching hub 119 with fewer downstream ports 121 than the total number of downstream ports 121 on USB switching hub 119 (e.g., if one or more downstream ports 121 is permanently inactive or reserved for another use).

[0075] At 909, the second upstream device may enumerate USB switching hub 119 using a hub configuration substantially similar to the first hub configuration for USB switching hub 119.

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[0076] At 911, the downstream port coupled to the peripheral device may be assigned to the second upstream port. In some embodiments, communications between the peripheral device and the first upstream port may be switched to the second upstream port. In some embodiments, if device 125a is a digital camera, it may be initially coupled to computer system 101 (i.e., communications to/from the digital camera may be routed to first upstream port 117a in downstream switching logic 201 while the communications are in the digital domain). External signal 813 (e.g., from a user through computer system 101) may signal downstream switching logic 201 to switch communications between device 125a and two upstream ports 117.

[0077] At 913, a disconnect status may be indicated on a status register, corresponding to the switched downstream port, coupled to hub controller 203a of first upstream port 117a. Communications may be terminated between downstream device 125a and an upstream device coupled to first upstream port 117a.

[0078] At 915, a connect event may be indicated on a status register, corresponding to the switched downstream port, coupled to hub controller 203b of second upstream port 117b. When second upstream device 207 (e.g., a dual role printer) reads the connect event on the status register, it will reset device 125a coupled to downstream port 121a. Downstream device 125a may connect to upstream device 207 for further communications (e.g., to print pictures directly from the digital camera).

[0079] At 917, switching communications of a downstream port 121 may be delayed if there is an active transfer in progress between a downstream port 121 and the first upstream port. Switching communications may be delayed by IPRS 821.

[0080] At 919, switching communications of a downstream port 121 may be delayed if there is an active transfer in progress between a downstream port 121 and second upstream port 117b. Switching communications may be delayed by IPRS 821.

[0081] FIG. 10 shows an embodiment of a method for monitoring a standby state to approve a communication switch. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0082] At 1001, IPRS 821 may monitor status registers 811 to determine if peripheral device 125 is actively being used by an upstream device. For example, IPRS 821 may determine if a corresponding status register has a "selective suspend" or a standby state indicated for corresponding downstream port 121.

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[0083] At 1003, downstream switching logic 201 may check IPRS 821 prior to making a switch for an indication as to whether there are current communications between a downstream port 121 to be switched or between downstream ports 121 coupled to upstream port 117 for which a downstream port 121 will be switched. In some embodiments, downstream switching logic 201 may query IPRS 821 to determine if multiple downstream ports 121 may be switched.

[0084] At 1005, IPRS 821 may indicate to downstream switching logic 201 whether a switch of communications for one or more downstream ports 121 may proceed. For example, logic on IPRS 821 may determine which downstream ports 121 the status should be checked (e.g., downstream ports 121 to be switched and downstream ports 121 coupled to the upstream port 117 being switched to). In some embodiments, IPRS 821 may check the corresponding status register when downstream switching logic 201 inquires as to a specific downstream port.

[0085] At 1007, if a "selective suspend" or a standby state is not indicated, IPRS 821 may continue to monitor the corresponding status register for a predetermined amount of time after IPRS 821 receives an inquiry from downstream switching logic 201 that a switch is desired. At the end of the predetermined amount of time, if the "selective suspend" or a standby state is still not indicated, IPRS 821 may indicate to downstream port controller 201 that it may switch despite the apparent active status. In some embodiments, if the "selective suspend" or a standby state is not indicated, an indication may be sent to computer system 101 to ask the user if a switch should be made despite the apparent active status of one or more affected peripheral devices 125. If the user approves the switch, downstream switching logic 201 may proceed with the switch.

[0086] FIG. 11 shows an embodiment of a method for monitoring hub transactions to approve a communication switch. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0087] At 1101, IPRS 821 may monitor transactions through USB switching hub 119 to determine if any of the communications are going to/from relevant peripheral devices (e.g., coupled to a downstream port 121 to be switched or already coupled to upstream port 117 for which peripheral device 125 will be switched to). In some embodiments, the presence of communications and the type of communications may be monitored by IPRS 821. IPRS 821 may monitor communications at any of various points of USB switching hub 119 (e.g., coupled to hub controllers 203, downstream switching logic 201, and/or coupled directly to downstream

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ports 121 and/or upstream ports 117). IPRS 821 may monitor communications using additional internal logic. In some embodiments, IPRS 821 may not interfere with communications between downstream ports 121 and upstream ports 117.

[0088] At 1103, downstream switching logic 201 may check IPRS 821 prior to making a switch for an indication as to whether there are current communications between a downstream port 121 to be switched or between downstream ports 121 coupled to upstream port 117 for which a downstream port 121 will be switched.

[0089] At 1105, IPRS 821 may indicate to downstream switching logic 201 whether a switch of communications for one or more downstream ports 121 may proceed.

[0090] FIG. 12 shows an embodiment of a method for switching communications at a frame boundary. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0091] At 1201, IPRS 821 may coordinate a communications switch by downstream switching logic 201 to occur on a frame boundary of communications between upstream port 117 and related downstream ports 121. In some embodiments, IPRS 821 may interface with one or more hub controllers 203 to determine the timing of the frame boundaries. For example, a microframe timer may be used. In some embodiments, IPRS 821 may interface with other parts of USB switching hub 119 to determine a time to affirm a request to switch from downstream switching logic 201.

[0092] At 1203, downstream switching logic 201 may check IPRS 821 prior to making a switch for an indication as to whether a frame boundary is occurring for communications to/from the relevant downstream ports 121.

[0093] At 1205, IPRS 821 may indicate to downstream switching logic 201 whether a switch of communications for one or more downstream ports 121 may proceed.

[0094] Referring again to FIGs. 3, 4a-4b, 5a-5c, and 8, it should be noted that the positions of the downstream switching logic (201 in FIGs. 3, 4a-4b and 8, and 401 in FIGs. 5a-5c) and the transaction translator logic (205 in FIGs. 3, 4a-4b and 8, and 405 in FIGs. 5a-5c) with respect to each other may be reversed, that is, the transaction translator logic may be configured between the hub controller(s) and the downstream switching logic. Furthermore, an individual transaction translator block may be configured for each upstream port (and corresponding hub controller.) Examples of alternate embodiments showing this configuration are found in FIGs. 13, 14a-14b, 15a-15c, and 16.

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[0095] FIG. 13 illustrates an alternate embodiment of the configuration shown in FIG. 3, in which two upstream devices (e.g., computer system 101 and dual role peripheral device 207) are coupled to USB switching hub 119. In some embodiments, USB switching hub 119 may include respective transaction translator circuitry 205a and 205b for each upstream port 117a and 117b, coupled to corresponding hub controller 203a and 203b, respectively. Transaction translator circuitry 205a and 205b may also be coupled to downstream switching logic 201, which may be electronically coupled to downstream ports 121. In some embodiments, downstream switching logic 201 may switch between two or more communication configurations. Communication configurations may be implemented by downstream switching logic 201 routing communications between upstream ports 117 and downstream ports 121 while the communications are in the digital domain (as a result of the interfaces to/from USB switching hub 119), as also described for the embodiment of FIG. 3. In some embodiments, communication configurations (e.g., hardwired in the USB switching hub) may be switched as determined by logic on the USB switching hub. Other communication configuration implementations are also contemplated.

[0100] As also described for the embodiment of FIG. 3, in some embodiments, dual role peripheral device 207 may include a dual role USB printer or dual role USB Digital Versatile Disc (DVD) read/write drive, among others. In some embodiments, dual role peripheral device 207 may be coupled to an upstream port (e.g., upstream port 117b) of USB switching hub 119 through device port 210. Dual role peripheral device 207 may interface through upstream port 117b with other peripheral devices (downstream peripheral devices) coupled to USB switching hub 119 (e.g., using host controller 209 on dual role peripheral device 207). Dual role peripheral device 207 may also interface with other upstream devices (such as computer system 101) through a slave controller. For example, dual role peripheral device 207 may be coupled to USB switching hub 119 as a slave peripheral device (e.g., through downstream port 121c). In some embodiments, dual role peripheral device 207, coupled to the USB switching hub, may simultaneously act as a host to one or more peripheral devices and/or as slave peripheral device to a separate host.

[0101] In some embodiments, dual role peripheral device 207 may have an embedded host controller application to operate as a standalone system (e.g., to communicate with another peripheral device, such as a digital camera, without PC intervention). For example, a dual role USB printer may print pictures directly from a digital camera, coupled to a downstream port 121 on USB switching hub 119, without PC intervention. In some embodiments, USB switching hub 119 may alternately allow the computer system 101 or dual role peripheral device 207 to access

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one or more downstream devices (e.g., by switching between one or more communication configurations).

[0102] FIGs. 14a and 14b illustrate alternate embodiments of the embodiments shown in FIGs. 4a and 4b of a computer system electronically coupled to multiple peripheral devices. In some embodiments, USB switching hub 119 may act like a switch coupling multiple internal "hubs" that may share one or more downstream ports. For example, each potential communication configuration of the USB switching hub may represent an internal "hub". In some embodiments, when computer system 101 is accessing peripheral device 125 (e.g., peripheral device 125a) coupled to USB switching hub 119, communications to/from the peripheral device may be processed through a first "hub" comprised of first upstream port 117a, hub controller 203a, transaction translator 205a, and at least a subset of the downstream ports 121. A second "hub" may be comprised of second upstream port 117b, hub controller 203b, transaction translator 205b, and at least a subset of the downstream ports 121. In one communication configuration, computer system 101 may connect to downstream ports 121a and 121c (through the first "hub"), and dual role peripheral device 207 may connect to downstream ports 121b and 121d (through the second "hub") (as seen in FIG. 14b). Other communication configurations are also contemplated. In some embodiments, communication configuration profiles designating which downstream devices to couple to each upstream port may be hardwired or implemented by software. For example, if implemented by software, communication configuration profiles for each upstream port (and/or upstream device) may be stored on a memory accessible to USB switching hub 119.

[0103] In some embodiments, computer system 101 and dual role peripheral device 207 may communicate through USB switching hub 119 simultaneously with separate downstream devices. For example, while computer system 101 communicates with device 125a (e.g., through the first "hub"), dual role peripheral device 207 may communicate with device 125b (e.g., through the second "hub"). In some embodiments, while peripheral device 125a is being accessed through the first "hub", a different upstream device may not be able to access peripheral device 125a (e.g., dual role peripheral device 207 may not be able to access peripheral device 125a while peripheral device 125a is being used by computer system 101). In some embodiments, a signal (e.g., from an external control block) may trigger downstream switching logic 201 to switch access for a subset of downstream ports 121 (e.g., downstream port 121a and/or 121c) on the first "hub" to the second "hub" (i.e., switch communication configurations). In some embodiments, dual role peripheral device 207 may send a control signal to USB

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switching hub 119. USB switching hub 119 may then switch communication configurations to connect one or more downstream ports to the dual role peripheral device. For example, when a user presses a button on dual role peripheral device 207 (e.g., a dual role printer), a signal may be sent through mode 211 to downstream switching logic 201 to switch access of device 125a from computer system 101 to dual role peripheral device 207 (i.e., to switch to a second communication configuration as seen in FIG. 14b). Computer system 101 may continue to communicate with downstream port 121c (and/or other downstream ports as determined by the second communication configuration).

[0104] In some embodiments, when activity is no longer detected between dual role peripheral device 207 and a downstream port (e.g., if dual role peripheral device 207 is turned off), downstream switching logic 201 may switch access of the downstream port to computer system 101 (i.e., switch to a different communication configuration). In some embodiments, downstream switching logic 201 may switch access of the downstream port to a different upstream device. In some embodiments, instead of detecting inactivity, a signal from dual role peripheral device 207 may signal USB switching hub 119 to switch. Other signals and/or logic may also be used in determining when to switch communication configurations.

[0105] In some embodiments, communication configurations may be software implemented. In some embodiments, a microprocessor coupled to or comprised in downstream switching logic 201 may dynamically determine, e.g., using a dynamic communication configuration profile, which downstream ports to electrically couple to each upstream port. For example, the microprocessor may read a stored communication configuration profile and attempt to connect upstream ports to downstream ports according to the communication configuration profile. The communication configuration profiles may be stored on a memory (e.g., an Electronically Erasable Programmable Read-Only Memory (EEPROM)) coupled to USB switching hub 119. In some embodiments, hub controllers 203 on USB switching hub 119 may have access to the communication configuration profiles.

[0106] In some embodiments, a priority logic may be used to switch communication configurations. Priority logic, or other logic used to grant access, may be internal or external to USB switching hub 119. In some embodiments, computer system 101 may be given priority over all of downstream ports 121 until an external control signal is sent from dual role peripheral device 207 to switch access of one or more downstream ports 121 to dual role peripheral device 207. In some embodiments, different control signals may be sent to trigger different communication configurations (i.e., to switch access of different downstream ports to dual role

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peripheral device 207).

[0107] In some embodiments, host negotiation logic may be used to determine which communication configuration to use. In some embodiments, a default communication configuration may be used until multiple upstream devices "request" access to the same downstream port. Host negotiation logic may be used to determine which communication configuration to use (i.e., which communication configuration gives a particular upstream port access to the "requested" downstream port).

[0108] In some embodiments, a microprocessor in USB switching hub 119 may include a built in algorithm that auto detects downstream peripheral devices and determines how to connect the downstream peripheral devices. For example, instead of assigning a specific downstream port to an upstream port, a communication configuration profile may specify that the upstream port should have access to a digital camera if one is attached. The built in algorithm may auto-detect the digital camera when it is attached to one of the downstream ports and attach it to the appropriate upstream port (i.e., by switching to an appropriate communication configuration).

[0109] In some embodiments, when downstream switching logic 201 switches communication configurations, and control of a downstream port is switched from computer system 101 to dual role peripheral device 207, a connection between computer system 101 and respective peripheral device 125 (coupled to the downstream port to be switched) may be terminated by computer system 101. In some embodiments, communications between the downstream port to be switched and computer system 101 may be terminated by USB switching hub 119. Dual role peripheral device 207 may then connect to, enumerate, and communicate with the respective peripheral device 125 coupled to the switched downstream port.

[0110] Upstream devices may see downstream ports that they are not configured to attach to as unattached ports (i.e., active, but with no device connected). In some embodiments, if only a predetermined number of downstream ports is ever going to be attached to a particular upstream port (e.g., a number "x" ports), the upstream device may be signaled that the hub only has x ports. For example, if upstream port 117b is only going to be configured to attach to downstream ports 121c and 121d, a device attached to upstream port 117b may be signaled that USB switching hub 119 is only a two port hub.

[0111] FIGs. 15a, 15b, and 15c illustrate various alternate embodiments of the embodiments shown in FIGs. 5a, 5b, and 5c of a computer system 101 and two dual role peripheral devices coupled to USB switching hub 419. In some embodiments, multiple dual role peripheral devices may be coupled to USB switching hub 419. For example, dual role printer 407 may be coupled

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to USB switching hub 419 through upstream port 417b and dual role DVD read/write drive 467 may be coupled to USB switching hub 419 through upstream port 417c. Computer system 101 may be coupled to USB switching hub 419 through upstream port 417a. Each of the upstream devices may be coupled to a respective hub controller 403 (403a, 403b and 403c, as shown), a respective transaction translator 405 (405a, 405b, and 405c, as shown), and downstream switching logic 401. Downstream switching logic 401 may configure communications between each of the upstream devices (i.e., computer system 101, dual role printer 407, or dual role DVD read/write drive 467) and at least a subset of the peripheral devices 425.

[0112] As seen in FIG. 15a, in one communication configuration profile, the computer system 101 may be connected to downstream ports 421a, 421b, 421e, and 421f. In an embodiment, dual role printer 407 may be configured to access downstream port 421c, and DVD read/write drive 467 may be configured not to access any downstream port 421. Dual role printer 407 may gain access (i.e., have the communication configuration switched to give it access) to downstream port 421b through several different methods. For example, a user may press a button on dual role printer 407. A signal may then be sent through mode 411 to downstream switching logic 401 in USB switching hub 419. Downstream switching logic 401 may switch to the communication configuration seen in FIG. 15b (which allows dual role printer 407 to access downstream port 421b). In some embodiments, if dual role printer 407 is turned off or becomes inactive, downstream switching logic 401 may switch access of downstream port 421b back to computer system 101 (i.e., switch back to the previous communication configuration). As seen in FIG. 15c, in one communication configuration, none of the upstream ports may be allowed to access any of the downstream ports.

[0113] FIG. 16 illustrates an alternate embodiment of the USB switching hub with multiple status registers shown in FIG. 8. In this embodiment, each hub controller (203a and 203b) is coupled to corresponding transaction translator circuitry (205a and 205b, respectively). Translator circuitry 205a and 205b, may be coupled to downstream switching logic 201, which may be electrically coupled to downstream ports 121a, 121b, 121c, and 121d. Switching hub 119 may operate according to the same principles and procedures as described for the embodiment of switching hub 119 shown in FIG. 8.

[0114] FIG. 17 illustrates another embodiment of the configuration shown in FIG. 13, in which two upstream devices (e.g., computer system 101 and dual role peripheral device 207) are coupled to USB switching hub 119. While in the embodiment of FIG. 13 (and in the embodiments of FIG. 3, FIGs. 4a-4b and FIGs. 14a-14b) the downstream control of USB

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switching hub 119 is linked with dual role device 207, alternate embodiments may be configured with other switching control means. For example, as illustrated in FIG. 17, switching control of USB switching hub 119 may be performed using a dedicated downstream device, for example HID class device 125e, coupled to a dedicated downstream port, for example dedicated downstream port 121e. Another control mechanism may comprise an additional HID device (not shown) configured at the hub controller level within the hierarchy of the configuration shown in FIG. 17 (for example, at hub controller 203a or 203b). However, operating the additional HID device for controlling the switching of USB switching hub 119 may require custom drivers and a USB-IF class extension to the hub class, which may be covered under a vendor-specific implementation. Mechanisms other than an HID may also be possible with a semi-custom hub driver. Alternatively, a composite device comprising a hub controller and HID controller may be configured to control switching of USB switching hub 119, shown in FIG. 17 as HID controller/HUB controller composite devices 204a and 204b. While FIG. 17 illustrates a variety of configurations associated with possible control mechanisms for controlling switching of USB switching hub 119, various embodiments may include only one of, or any combination of these configurations and/or mechanisms.

[0115] FIGs. 18a, 18b, and 18c illustrate the USB switching hub 119 communicatively coupling to a wireless host 1809, according to an embodiment. FIG. 18c illustrates an embodiment of the USB switching hub 119 communicatively coupled to a wireless host 1809 and a wired host 1801. The USB switching hub 119 may be operable to allow communication between multiple upstream devices (e.g., wired and/or wireless hosts) and downstream devices 125. For example, the USB switching hub 119 may facilitate communication between the wired host 1801, wireless host 1809, and downstream devices 125a, 125b, and 125c attached through downstream ports 121a, 121b, and 121c. In some embodiments, downstream devices 125 may be wireless USB devices. Other numbers and types of wired and/or wireless hosts and downstream devices are also contemplated. The USB switching hub 119 may implement various communication configurations through the hub and switching logic 1813 that allow the wired and/or wireless hosts to access subsets or all of the downstream devices 125a-c. For example, in one communication configuration, the wired host 1801 may access a downstream device (e.g., USB device 125a) substantially simultaneously as the wireless host 1809 is accessing another downstream device (e.g., USB device 125b). In some embodiments, the wired host 1801 and the wireless host 1809 may not substantially simultaneously access the same downstream device.

[0116] In some embodiments, wireless host 1809 (e.g., a laptop with a wireless bridge 1812 and

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transceiver 1808) may communicate with one or more downstream devices 125a-c through the USB switching hub 119. Communications between the downstream devices 125a-c and the wireless host 1809 may pass through wireless bridges 1810, 1812 coupled to wireless transceivers 1807, 1808 (respectively). Wired host 1801 may also communicate with one or more downstream devices 125a-c through the USB switching hub 119. In some embodiments, another wireless host may be communicatively coupled through upstream port 117a instead of wired host 1801.

[0117] As seen in FIGs. 18d and 18e, different configurations of the hub and switching logic 1813 may be used. The hub and switching logic 1813 may include hub controllers 203a and 203b (e.g., one for each upstream port) coupled to transaction translators 205a and 205b and downstream switching logic 201. In some embodiments, the order of the transaction translators 205a,b and downstream switching logic 201 may be reversed. Other configurations are also contemplated. FIG. 18e illustrates another embodiment of the hub and switching logic 1813 with status registers 811a and 811b coupled to the hub controllers 203a,b, respectively. IPRS 821 is also shown coupled to the hub controllers 203a,b. In addition, a single transaction translator 1899 is shown (in some embodiments, multiple transaction translators may be used). In some embodiments, the status registers 811a and 811b may be operable to indicate which downstream ports are "disconnected" for the respective communication configuration currently being implemented in the USB switching hub 119. In some embodiments, each upstream device may enumerate the USB switching hub according to its total number of downstream ports (other numbers of ports for enumeration are also contemplated). The downstream switching logic 201 may receive an external signal 813, e.g., to signal the hub and switching logic 1813 to switch communications for a subset of downstream ports 125a-c.

[0118] In some embodiments, wireless USB hosts and devices may use association to implement secure communications. Association may include making an initial connection between a host (e.g., host 1809/wireless bridge 1812) and a device (e.g., wireless bridge 1810), verifying the host and the device to each other, and deriving an initial encryption key for future communications. In some embodiments, a wireless host 1809 and the device (e.g., wireless bridge 1810) may use a temporary physical connection (e.g., by both physically coupling to the USB switching hub 119 and/or connecting through a cable as seen in FIG. 18b) to make the initial connection, verification, and key derivation. Wireless hosts and devices may use a symmetric encryption algorithm such as Wireless USB Advanced Encryption Standard (AES)-128 Counter with Cipher Block Chaining Message Authentication Code (CBC-MAC) (CCM) or

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Wireless USB AES-128 Counter with CBC-MAC (CCM). Other encryption methods such as public key encryption may also be used.

[0119] In some embodiments, the wireless bridge 1810 may include a downstream device port 1815 which may be coupled to a downstream port 121d of the USB switching hub 119. As seen in FIG. 18b, the wireless host 1809/wireless bridge 1812 may be temporarily physically coupled to the first upstream port (e.g., PHY 117a) to complete association with the wireless bridge 1810 coupled as a downstream device through downstream port 121d. In various embodiments, either or both the host 1809 and wireless bridge 1812 may be temporarily physically coupled to the first upstream port 117a as the host for association (e.g., wireless bridge 1812 may be coupled to first upstream port 117a to perform association with wireless bridge 1810 without being coupled to wireless host 1809 during association). Host 1809/wireless bridge 1812 and wireless bridge 1810 may exchange an encryption key (e.g., a symmetric key) through connection 1835 (e.g., host 1809/wireless bridge 1812 may send an encryption key to wireless bridge 1810 or wireless bridge 1810 may send an encryption key to host 1809/wireless bridge 1812). As used herein, the term "exchange" may be used to refer to a one-way transfer. As seen in FIG. 18c, the host 1809/wireless bridge 1812 may be physically disconnected from the USB switching hub 119 and the host 1809/wireless bridge 1812 and wireless bridge 1810 may use the encryption key for future wireless communications. In some embodiments, instead of being physically coupled to the USB switching hub 119, a code may be entered into the host 1809/wireless bridge 1812 (e.g., a code from the wireless bridge 1810). In some embodiments, the code may be read off of the wireless bridge 1810 and entered through a keypad into the host 1809/wireless bridge 1812. The host 1809/wireless bridge 1812 may generate an encryption key using the code (the wireless bridge 1810 may have generated the same encryption key using the code and a pre-established method). Other methods of association and key exchange are also contemplated. The wireless bridge 1810 may electronically attach to the wireless bridge 1812 by sending the host 1809/wireless bridge 1812 a message and then proceeding through an authenticating process involving their unique identifications (IDs) and the encryption key. Host software on host 1809/wireless bridge 1812 may be notified of the "attached" wireless bridge 1810 after the association process is completed. In some embodiments, downstream devices 125 may include one or more wireless downstream devices that may also proceed with association with the wireless bridge 1810 or wireless bridge 1812 (although, in some embodiments, the downstream devices 125 may not separately associate but may communicate through the wireless bridge 1810).

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[0120] In some embodiments, wireless hosts and devices may use the exchanged keys to authenticate each other during future connection requests (e.g., see the Wireless Universal Serial Bus Specification, Revision 1.0). The keys may also be used to encrypt and decrypt future transmissions. The device (e.g., wireless bridge 1810) and the host (e.g., host 1809/wireless bridge 1812) may establish a connection context (CC) with a unique host ID (CHID), a unique device ID (CDID), and connection key (CK) (a symmetric encryption key). In some embodiments, the CC may be created by a host device and sent to a device on the first connection (and/or by using an out-of-band method). The CK may be unique for each device for which the host is connected. The CK may be used to derive a pair-wise temporal key (PTK) through four-way handshakes (between the host and the device) for use by the host and device in encrypting/decrypting communications. During four-way handshakes, the host and the device may exchange a random nonce and an identifier of the key they are using. The device and host may then perform key generation using the random nonces to generate a message integrity code (MIC) that are also exchanged. If the device and host verify the received MIC (based on the CK), the device and host may know that they are communicating with a device/host that has the previously established key and therefore can be trusted. The device and host may also use the exchanged nonces to generate initial session keys (which may be used as PTKs for encryption/decryption of future communications between the host and the device). In some embodiments, the wireless bridge 1810 may handle encryption/decryption for communications from the downstream devices 125 (e.g., using one PTK for communications from the devices 125). In some embodiments, the separate keys may be used for communications from each device 125.

[0121] In some embodiments, a media access controller (MAC) 1805 may be included (as part of a data link layer for transporting data packets) on the wireless bridge 1810 to, for example, control access to the transceiver 1807. The MAC 1811 on wireless bridge 1812 may, for example, control access to the transceiver 1808. The data link layer may also include a logical link control (LLC) for multiplexing protocols and providing flow control over the transceivers 1807, 1808. MAC 1805 may be coupled to the USB switching hub 119 through host interface 1823 and upstream port 117b. MAC 1811 may be coupled to the host 1809 through host interface 1814.

[0122] In some embodiments, MACs 1805 and 1811 may insert source and destination addresses into transmitted frames to enable the receiving MAC to determine which frames are being sent to its device. These addresses may include MAC addresses (unique identifiers for the

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communicating devices). MACs 1805 and 1811 may also recognize the beginning and ending of frames received and transmitted and may detect transmission errors. Transmissions between wireless transceivers 1807 and 1808 may include token, data, and handshake packets (or packets containing a combination of these types). Other packet configurations are also contemplated. In some embodiments, the MACs 1805 and 1811 may work with the data link layer in their respective wireless bridges to encode/decode bit streams into/out of data packets and provide transmission protocol knowledge and management.

[0123] In some embodiments, wireless host 1809 may also communicate with other wireless devices in addition to the wired devices coupled to the USB switching hub 119. Wireless host 1809 may also communicate with other wired peripheral devices coupled to a device wire adapter.

[0124] FIG. 19 illustrates an embodiment of the USB switching hub 1921 with an internal wireless bridge 1910. As seen in FIG. 19, the wireless bridge 1910 with MAC 1905 may be internal to the USB switching hub 1921. In this embodiment, the downstream device port 1915 on the wireless bridge may also be internal and may be internally coupled to a downstream port of the hub and switching logic 1813. The internal connection 1935 may be used during the initial association with the wireless host 1809 (e.g., when the wireless host 1809 is initially physically coupled to upstream port 117a of the USB switching hub 1921). The MAC 1905 may communicate with the downstream devices 125 through main interface 1923 and hub and switching logic 1813. FIG. 20 illustrates an embodiment of the USB switching hub 2021 with an internal wireless bridge 1910 and internal transceiver 2007.

[0125] FIG. 21 illustrates an embodiment of the USB switching hub 2121 coupled to a plurality of wireless hosts 2109a, 2109b. Multiple wireless hosts 2109a, 2109b may be coupled to the USB switching hub 2121 through transceiver 2107 and their respective transceivers 2108a, 2108b to share downstream devices 125. The host 2109a and host 2109b may each be coupled separately to upstream port 117a to exchange an encryption key with wireless bridge 2110. Wireless bridge 2110 may be coupled to two or more upstream ports 2123a and 2123b of the USB switching hub 2121. The encryption keys may be exchanged through connection 1935 with downstream device port 2115 on the wireless bridge 2110. The wireless bridge 2110 may use each respective encryption key to communicate with the wireless hosts 2109a and 2109b when the wireless hosts 2109a and 2109b are not physically attached to the USB switching hub 2121. The MACs 2111a and 2111b may coordinate with MAC 2105 to communicate through transceivers 2107, 2108a, and 2108b. Wireless bridge 2110 may facilitate communications

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between the wireless hosts 2109a,b and the downstream devices 125 through upstream ports 2123a and 2123b. In some embodiments, each wireless host may communicate with a separate wireless bridge coupled to the USB switching hub 2121 (e.g., each separate wireless bridge coupled to a separate upstream port).

[0126] FIG. 22 illustrates an embodiment of the USB switching hub 2221 with a reversible port 2231. The USB switching hub 2221 reversible port 2231 may include switching logic operable to switch upstream and downstream logic to allow the reversible port 2231 to act as a downstream port or an upstream port when communicating through interface 2223 (e.g., see the discussion below with respect to FIGs. 27-32). The reversible port 2231 may perform as a downstream port to connect wireless bridge 2210 to the USB switching hub 2221 as a downstream device when the wireless host 1809 is physically coupled to the USB switching hub 2221 for association purposes (e.g., to exchange keys with wireless bridge 2210 through connection 2235). The reversible port 2231 may then switch over to operating as an upstream port for the wireless bridge 2210 when the wireless host 1809/wireless bridge 1812 is not physically coupled to the USB switching hub 2221 but is instead communicating with the downstream devices 125a, 125b, and 125c through the USB switching hub 2221 in a wireless fashion. Input directing a switch may be received from any of a variety of sources (e.g., logic within the USB switching hub 2221, wireless bridge 2210, a user, etc.), and may set or invoke a switching condition, which may then be detected by the USB switching hub 2221. In some embodiments, the reversible port 2231 may coordinate with the hub and switching logic 1813 to implement switching upstream and downstream logic as needed.

[0127] FIG. 23 illustrates a method of using the USB switching hub to support a wireless host, according to an embodiment. Various embodiments of the USB switching hub supporting a wireless host may be seen, for example, in FIGs. 18c and 19-22. The method shown in FIG. 23 is described below with respect to FIGs. 18a-c, but it is to be understood that the method is also applicable to other embodiments described above. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0128] At 2301, a wireless host 1809 may perform association with a wireless bridge 1810 coupled to the USB switching hub 119. The wireless host 1809 and wireless bridge 1810 performing association may each be coupled to a separate upstream port of the USB switching hub 119 (e.g., see FIG. 18b). After association, the wireless host 1809 may be removed from the

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upstream port 117a of the USB switching hub 119, and in some embodiments, a wired host 1801 may be coupled to the upstream port 117a.

[0129] At 2303, the wired host 1801 may enumerate the USB switching hub 119 using a first hub configuration for the USB switching hub 119. In some embodiments, the downstream devices 125 coupled to the USB switching hub 119 may be enumerated by the wired host 1801 when the USB switching hub 119 is enumerated.

[0130] At 2305, the wireless host 1809 may enumerate the USB switching hub 119 using a hub configuration substantially similar to the first hub configuration for the USB switching hub 119. In some embodiments, the downstream devices 125 coupled to the USB switching hub 119 may be enumerated by the wireless host 1809 when the USB switching hub 119 is enumerated.

[0131] At 2307, the wireless host 1809 may wirelessly communicate with at least a subset of a plurality of downstream devices 125 coupled to the USB switching hub 119 through the wireless bridge 1810.

[0132] At 2309, a wired host 1801 may communicate with at least a subset of a plurality of downstream devices 125 coupled to a USB switching hub 119. In some embodiments, the wireless host 1809 and the wired host 1801 may communicate substantially simultaneously with separate downstream devices 125 coupled to the USB switching hub 119.

[0133] At 2311, communications may be switched between at least one of the plurality of downstream devices 125 and the wired host 1801 to the wireless host 1809. In some embodiments, the USB switching hub 119 may not be re-enumerated when communications are switched. In some embodiments, communications may be switched between at least one of the plurality of downstream devices 125 and the wireless host 1809 to the wired host 1801.

[0134] At 2313, switching communications between the at least one of the plurality of downstream devices 125 and the wired host 1801 to the wireless host 1809 may be delayed if there is an active transfer in progress between the at least one of the plurality of downstream devices 125 and the wired host 1801, wherein switching communications is delayed by an intelligent port routing switch (e.g., see IPRS 821 in FIG. 18e). In some embodiments, communications may be similarly delayed when switching communications between the plurality of downstream devices 125 and the wireless host 1809 to the wired host 1801 if there is an active transfer in progress between the at least one of the plurality of downstream devices 125 and the wireless host 1809.

[0135] FIG. 24 illustrates a method for using the USB switching hub for associating a wireless host, according to an embodiment. The method shown in FIG. 24 is described below with

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respect to FIGs. 18a-c, but it is to be understood that the method is also applicable to other embodiments described above. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0136] At 2401, a first wireless host 1809 (which may include host 1809 and/or associated wireless bridge 1812) may be coupled to a first upstream port 117a of a USB switching hub 119. One or more downstream devices 125 may be coupled to downstream ports 121 of the USB switching hub 119.

[0137] At 2403, a second wireless bridge 1810 may be coupled to a downstream port 121d of the USB switching hub 119.

[0138] At 2405, the first wireless host 1809 and the second wireless bridge 1810 may perform association.

[0139] At 2407, the first wireless host 1809 may be decoupled from the first upstream port 117a. For example, see FIG. 18c in which wireless host 1809 has been decoupled from the USB switching hub 119 and wired host 1801 has been coupled to the upstream port 117a.

[0140] At 2409, the second wireless bridge 1810 may be coupled to a second upstream port 117b. The second wireless bridge 1810 may have been coupled to the second upstream port 117b prior to association.

[0141] At 2411, the first wireless host 1809 and the second wireless bridge 1810 may authenticate each other.

[0142] At 2413, the first wireless host 1809 and the second wireless bridge 1810 may communicate in a wireless fashion. The wireless bridge 1812 coupled to the wireless host 1809 may cooperate with wireless bridge 1810 coupled to USB switching hub 119 to allow communications between the wireless host 1809 and the downstream devices 125 coupled to the USB switching hub 119.

[0143] FIG. 25 illustrates a method for using the USB switching hub for supporting multiple wireless hosts, according to an embodiment. The method shown in FIG. 25 is described below with respect to FIG. 21, but it is to be understood that the method is also applicable to other embodiments described above. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

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[0144] At 2501, a first wireless host 2109a may be coupled to a first upstream port 117a of a USB switching hub 2121. One or more downstream devices 125 may be coupled to downstream ports 121 of the USB switching hub 2121.

[0145] At 2503, a second wireless bridge 2110 may be coupled to a downstream port of the USB switching hub 2121. In some embodiments, the downstream port may be internal to the hub (e.g., the wireless bridge 2110 may internally couple to the hub and switching logic 1813).

[0146] At 2505, the first wireless host 2109a (and/or wireless bridge 2112a) and the second wireless bridge 2110 may perform association.

[0147] At 2507, the first wireless host 2109a (and/or wireless bridge 2112a) may be decoupled from the first upstream port 117a.

[0148] At 2509, a second wireless host 2109b (and/or wireless bridge 2112b) may be coupled to the first upstream port 117a of the USB switching hub 2121.

[0149] At 2511, the second wireless host 2109b (and/or wireless bridge 2112b) and the second wireless bridge 2110 may perform association. In some embodiments, the second wireless bridge 2110 may use a separate encryption key when communicating with the first wireless host 2109a than when communicating with the second wireless host 2109b. The second wireless bridge 2110 may use different identifiers in communications for each of the first and second wireless hosts 2109a,b.

[0150] At 2513, the second wireless bridge 2110 may be coupled to a second upstream port(s). The second wireless bridge may have been coupled to the second upstream port(s) prior to association. In some embodiments, the second wireless bridge 2110 may be coupled to one upstream port per wireless host. For example, as seen in FIG. 21, wireless bridge 2110 is coupled through upstream port 2123a (for communications between wireless host 2109a and at least a subset of downstream devices 125) and upstream port 2123b (for communications between wireless host 2109b and at least a subset of downstream devices 125). In some embodiments, a separate wireless bridge may be used in the USB switching hub for each wireless host.

[0151] At 2515, the first wireless host 2109a and the second wireless bridge 2110 may authenticate each other.

[0152] At 2517, the second wireless host 2109b and the second wireless bridge 2110 may authenticate each other.

[0153] At 2519, the first wireless host 2109a and second wireless host 2109b may each communicate with the second wireless bridge 2110 in a wireless fashion. The first wireless host

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2109a and the second wireless host 2109b may communicate with downstream devices 125 coupled to the USB switching hub 2121 at substantially the same time (e.g., through two respective upstream ports 2123a,b coupled to second wireless bridge 2110). The second wireless bridge 2110 may coordinate communications to and from wireless bridges 2112a and 2112b to allow communication between the wireless hosts 2109a,b and the downstream devices 125. For example, unique identifiers may be used to identify communications between each wireless host and its respective downstream device(s). In some embodiments, first wireless host 2109a and second wireless host 2109b may communicate with separate wireless bridges each coupled to a different upstream port of the USB switching hub 2121.

[0154] FIG. 26 illustrates a method for using the USB switching hub (e.g., see USB switching hub 2221 in FIG. 22) with a reversible port 2231 to support a wireless bridge 2210 as a downstream device during association and an upstream device during regular communications, according to an embodiment. It should be noted that in various embodiments of the methods described below, one or more of the elements described may be performed concurrently, in a different order than shown, or may be omitted entirely. Other additional elements may also be performed as desired.

[0155] At 2601, a wireless host 1809 may be coupled to a first upstream port 117a of a USB switching hub 2221.

[0156] At 2603, a second wireless bridge 2210 may be coupled to a reversible port 2231 as a downstream device on the USB switching hub 2221. In some embodiments, the reversible port 2231 may be signaled to perform as a downstream port. Logic in the USB switching hub 2221 may be manipulated to support the reversible port 2231 as a downstream port.

[0157] At 2605, the wireless host 1809 and the second wireless bridge 2210 may perform association.

[0158] At 2607, the wireless host 1809 may be decoupled from the first upstream port 117a.

[0159] At 2609, the reversible port 2231 may be reversed (e.g., through a signal sent to the reversible port 2231 and/or USB switching hub 2221) and the second wireless bridge 2210 may then be used as an upstream device on the USB switching hub 2210.

[0160] At 2611, the wireless host 1809 and the second wireless bridge 2210 may authenticate each other.

[0161] At 2613, the wireless host 1809 and the second wireless bridge 2210 may communicate in a wireless fashion. The wireless bridge 1812 and second wireless bridge 2210 may coordinate to allow communications between the wireless host 1809 and the downstream devices 125

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coupled to the USB switching hub 2221.

[0162] Various embodiments of a system and method for reversing logic for reversible ports in USB hubs are presented below.

[0163] According to one embodiment, a USB hub may include upstream logic for sending and receiving information to and from a host controller, downstream logic for sending and receiving information to and from a USB device, a plurality of ports each operable to couple to upstream or downstream logic and one or more USB devices, and switching logic operable to switch upstream and downstream logic between a first port and a second port. In some embodiments, input may be received to the USB hub specifying a change in control of one or more devices coupled to the USB hub by a first device, e.g., coupled to a first port, to control by a second device, e.g., coupled to a second port. For example, if one of the devices is an on-the-go (OTG) or dual-role device, it may request, or be instructed, to act as the host controller of the USB hub. In this example, the input may be received from any of a variety of sources, and may set or invoke a switching condition, which may then be detected by the USB hub.

[0164] In some embodiments, the switching condition may be invoked mechanically, such as, for example, by flipping, i.e., switching on or off, a mechanical switch on the USB hub, or, alternatively, if the USB hub is included in a device, a switch on the device. In one embodiment, the switching condition may include a change in orientation of the connecting cables. More specifically, the USB connecting cable may have a default host controller connection (on one end) and a default device connection (on the other end). In this case, the switching condition may be invoked by reversing these two connections, e.g., via the change in pins associated with each of the connectors on each end of the cable may invoke the switching condition.

[0165] Alternatively, or additionally, a user or other system may invoke the switching condition via electronic means; for example, the user may choose from a plurality of possible buttons or options, e.g., depending on the number of devices coupled to the USB hub. For example, if the USB hub is included in a peripheral device, e.g., a cell phone, PDA, and/or a digital music player, among others, the user may be presented with a plurality of options on the display of the peripheral device and may invoke the switching condition by selecting one or more of the available options. More specifically, the peripheral device may include a menu associated with the USB hub; the user may select this menu, e.g., via a stylus, voice activation, and/or a keypad, among others means, and select from one or more options to invoke a specific change in host, e.g., by invoking the switching condition. Alternatively, the user may invoke the switching condition, e.g., similar to methods described above, among others, from a device coupled to the

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USB hub.

[0166] In some embodiments, the USB hub may automatically detect the switching condition. For example, the USB hub may have a sensing mechanism, e.g., present in the physical layer (PHY) of connections to the USB hub, specifically for detecting the switching condition. In one embodiment, the switching condition may include a change of impedance in one or more pins of one of the connections to the USB hub, e.g., one or more of the ports. For example, in one embodiment, the invoked switching condition, e.g., via the means described above, may include a change in impedance on the D+ and D- pins of the USB cable, e.g., connected to the peripheral device that is requesting logic reversal. As a specific example, normally two of the pins in the PHY may have an impedance of 15 kOhms, and after tying, for example, two pins together, the impedance may decrease to 7.5 kOhms. Correspondingly, the USB hub may detect this change in impedance as the switching condition. Thus, the USB hub may receive input invoking a switching condition indicating a change in logic in the hub.

[0167] It should be noted that in various embodiments where there are a plurality of upstream logics with associated host controllers, the input may also specify which of the coupled devices are to be controlled by the second device. In other words, as indicated above, the USB hub may have a plurality of host controllers, each controlling a respective subset of the coupled devices, possibly overlapping, and the input may specify that one or more of the coupled devices become host controllers for controlling other coupled devices, possibly including the old host controllers. In some embodiments, the input may specify a change in subsets of devices that are controlled by the new host controllers. Said another way, the input may specify that control of the plurality of coupled devices be changed to a new set of host controllers, and each of the new and/or old host controllers may control a new respective subset of the coupled devices.

[0168] Note that the input, the methods, and the switching conditions described herein may also apply to multiple host controllers. For example, the input may be received mechanically, e.g., via a switch, but in this case, the switch may have a plurality of options each associated with the new and old host controller(s) and the new controlled subset(s) of the coupled devices. Alternatively, or additionally, the input may be received electronically. Note further that switching conditions, and invoking thereof, are exemplary only and that other methods and switching conditions are envisioned. Thus, the USB hub may receive input specifying a change in control of the plurality of devices coupled to the USB hub from one or more host controllers to one or more other host controllers, e.g., previously acting as peripheral devices.

[0169] In one embodiment, the upstream logic included in the USB hub may be switched from

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receiving information from the first port, i.e., coupled to the old host controller, to receiving information from the second port, i.e., coupled to the new host controller. In other words, the USB hub may change control of the devices coupled to the hub from one device to another in response to the received input. In one embodiment, the hub may perform this change by decoupling the first port from the upstream logic, decoupling the second port from the downstream logic, and coupling the second port to the upstream logic. In some embodiments, the hub may also allow the old host controller to act as a peripheral device to the new host controller; in other words, the hub may couple the downstream logic, e.g., the downstream logic that was used by the second port, to the first port. Thus, the upstream and downstream logic may be effectively switched between a host controller and a device. Correspondingly, in various embodiments, the new host controller may act as host to other devices, e.g., possibly including the old host controller, coupled to the hub, e.g., each with associated downstream logic.

[0170] It should be noted that the switching is not limited to any particular two ports included in the hub, and, in fact, any of a plurality of logics associated with various ports may be switched. Thus, in one embodiment, any downstream logic, upstream logic, and/or other logics included in the USB hub may be switched.

[0171] Thus, the USB hub may switch the upstream and downstream logic(s) according to the received input.

[0172] Figure 27 illustrates an exemplary system suitable for implementing various embodiments. As shown, a device, e.g., device 50, may be coupled to a Universal Serial Bus (USB) hub, e.g., USB hub 80, or to USB switching hub 119 (as described with respect to FIGs. 1-26), which may in turn be coupled to a host computer system, e.g., computer system 82. In some embodiments, the device and/or the computer system may be coupled to each other, e.g., via the hub, via a network. For example, the computer system 82 and/or the device 50 may be at remote location(s) and may couple to the USB hub 80 via a network, e.g., an intranet network, a wide-area network (WAN), the Internet, etc.

[0173] The device 50 may be any of numerous devices capable of USB communication; for example, the device 50 may be or include a personal digital assistant (PDA), a portable digital music player, e.g., an IPOD™ as provided by Apple Computer Corporation, a cell phone, a printer, a digital camera, a video player, an audio device, a recording device, e.g., a digital voice recorder, a personal video recorder (PVR), a set-top box, an uninterrupted power supply (UPS), a mass-storage device, e.g., a hard drive, a zip drive, etc., a memory medium, e.g., flash memory, a thumb drive, etc., a keyboard, a mouse, a joystick, a communication device, e.g., a Bluetooth

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device, an Ethernet device, etc., a communication converter device, e.g., for converting signal formats, an additional USB hub, a computer system, and a monitor, among others. In preferred embodiments, the device may be a dual-role device, e.g., a USB OTG device. Note that the above list of devices and types of devices is exemplary only, and that other devices are also envisioned.

[0174] Additionally, the computer system 82 may be any of various computer types. For example, the computer system 82 may include at least one memory medium on which one or more computer programs or software components may be stored. The memory medium may also store operating system software, as well as other software for operation of the computer system. Various embodiments further include receiving or storing instructions and/or data implemented in accordance with the foregoing description upon a carrier medium. As shown, the computer system 82 may include one or more coupled input devices, e.g., a keyboard and mouse, as well as other input devices, and a display device for displaying graphics associated with software components executing on the computer system 82.

[0175] In various embodiments, the USB hub 80 may be any of various hubs. For example, the USB hub 80 may be an external hub, e.g., one whereby a host, such as the device 50 and/or the computer system 82, may control one or more other devices coupled to the hub. In one embodiment, the USB hub 80 may be a root hub. Additionally, or alternatively, the USB hub 80 may be included in the device 50 or the computer system 82. For example, the device may connect directly to a hub included in the computer system 82. Additionally, or alternatively, the device may itself include a USB hub for connecting to other USB devices, e.g., the computer system 82 or a hub in each of the device 50 and the computer system 82. In one embodiment, the USB hub may include or be a portion of a USB composite or compound device, e.g., similar to above where the USB hub 80 may be included in the device or computer system.

[0176] Figure 28 illustrates another exemplary system suitable for implementing various embodiments. As shown in Figure 28, the device 50 may be coupled to the USB hub 80, which may in turn be coupled to another device, e.g., device 75. The USB hub may be included in one or both of the device 50 and the device 75, i.e., one of the devices may include the USB hub, and the other device may also include a similar USB hub; additionally, the device 75 may be or include any of the above enumerated devices capable of USB communication, among others.

[0177] Furthermore, in one embodiment, the device 75 and the USB hub 80 may be internal to the device 50. For example, the device 50 may be a peripheral device such as a cell phone, a PDA, and/or a portable music player, among others, that includes the USB hub 80 for

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communication with internal and external devices. The cell phone, for example, may have any of numerous internal devices that may be coupled to the USB hub such as a camera, a hard drive or another memory medium, a Bluetooth device, a digital music file player, or any of various appropriate devices such as those described above, among others. Following this example, the cell phone may couple to an external system, such as a PDA, and an internal device, such as a digital camera, via the USB hub housed inside of the cell phone. Note that the above-described system(s) are exemplary only, and other devices and systems are envisioned such as those described herein, among others.

[0178] Figure 29 illustrates a block diagram of an exemplary USB hub, e.g., the USB hub 80, according to one embodiment. In some embodiments, peripheral device(s) may couple to the USB hub through interface(s). For example, the USB hub may include physical (PHY) interfaces, and/or other interfaces, e.g. USB 2.0 Transceiver Macrocell Interface (UTMI) or UTMI+ Low Pin Interface (ULPI), among others. In one embodiment, the USB hub may include a plurality of ports, e.g., ports 2910, 2920, 2930A, 2930B, and 2930C as shown in Figure 29, for coupling to one or more devices, e.g., the device 50, the device 75, and/or other device(s), e.g., using the interfaces described above, among others. Each port may be coupled to logic for interpreting and transmitting signals to and from the devices. For example, a host controller may be coupled to upstream logic, e.g., upstream port logic 2915, which may be operable to transmit and receive information specific to devices acting as hosts. Conversely, a device may be coupled to downstream logic, e.g., downstream port logics 2925, 2935A, 2935B, and 2935C, which may be operable to transmit and receive information specific to devices acting as peripheral devices. It should be noted that the hub may include one or more of each of these logics, among others. For example, in one embodiment, the USB hub may have a plurality of upstream logics associated with one or more host controllers, each of which may have separate or overlapping control over the USB devices coupled to the USB hub. Additionally, as indicated above, the USB hub may have a plurality of downstream logics associated with one or more peripheral devices.

[0179] Furthermore, in some embodiments, the USB hub may include hub logic, e.g., hub logic 2940, for receiving, transmitting, and interpreting information to and from at least one host controller and the devices. For example, the hub logic 2940 may be operable to intelligently route information from the host controller to the appropriate target device and vice-versa; additionally, the hub logic may be operable to resolve signal conflicts and collisions, e.g., signals sent from multiple devices at substantially the same time. In one embodiment, the USB hub may

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include one or more switches and/or switching logic(s), e.g., switching logics 2950A and 2950B, operable to couple and/or switch upstream or downstream logics associated with two or more devices as will be described in more detail below. Note that the switching logic may be separated into multiple components, such as, for example, the two components shown in Figure29, or combined into a single switching logic component. Alternatively, the switching logic may be stored in a memory medium and/or distributed throughout the USB hub. Note that, as shown in Figure 29, the switching logic may be associated with a first port, e.g., the port 2910, and a second port, e.g., the port 2920; however, this configuration is exemplary only, and, in fact, other systems and designs are contemplated. For example, the switching logic may be associated with any or all of the ports included in the USB hub thus allowing any of the included logics to be switched, e.g., during operation.

[0180] As an example, in some embodiments, the USB hub may include a first port coupled to a host controller with associated upstream logic and a second port coupled to a USB device with associated downstream logic. As indicated above, there may be one or more additional devices coupled to one or more additional ports included in the USB hub. Thus, the host controller may control a plurality of USB devices, e.g., by using the hub logic described above. If one of the USB devices is a dual-role device, it may request or be requested to become the host controller of the hub, e.g., to control the other USB devices coupled to the USB hub as described below.

[0181] Figure 30 illustrates an exemplary method for switching logic in a USB hub, such as the USB hub of Figure 29. The method shown in Figure 30 may be used in conjunction with any of the computer systems or devices described herein, among others. In various embodiments, some of the method elements shown may be performed concurrently, in a different order than shown, or may be omitted. Additional method elements may also be performed as desired. As shown, this method may operate as follows.

[0182] In 3002, input may be received to the USB hub, e.g., USB hub 80, specifying a change in control of one or more devices coupled to the USB hub 80 (e.g., via ports 2930A-2930C) by a first device, e.g., coupled to the first port 2910, to control by a second device, e.g., coupled to the second port 2920. For example, following the descriptions above, if one of the devices is an OTG or dual-role device, it may request, or be instructed, to act as the host controller of the USB hub. In this example, the input may be received from any of a variety of sources, and may set or invoke a switching condition, which may then be detected by the USB hub.

[0183] In some embodiments, the switching condition may be invoked mechanically, such as, for example, by flipping, i.e., switching on or off, a mechanical switch on the USB hub, or,

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alternatively, if the USB hub is included in a device, a switch on the device. In one embodiment, the switching condition may include a change in orientation of the connecting cables. More specifically, the USB connecting cable may have a default host controller connection (on one end) and a default device connection (on the other end). In this case, the switching condition may be invoked by reversing these two connections, e.g., via the change in pins associated with each of the connectors on each end of the cable may invoke the switching condition.

[0184] Alternatively, or additionally, a user or other system may invoke the switching condition via electronic means; for example, the user may choose from a plurality of possible buttons or options, e.g., depending on the number of devices coupled to the USB hub. For example, if the USB hub is included in a peripheral device, e.g., a cell phone, PDA, and/or a digital music player, among others, the user may be presented with a plurality of options on the display of the peripheral device and may invoke the switching condition by selecting one or more of the available options. More specifically, the peripheral device may include a menu associated with the USB hub; the user may select this menu, e.g., via a stylus, voice activation, and/or a keypad, among others means, and select from one or more options to invoke a specific change in host, e.g., by invoking the switching condition. Alternatively, the user may invoke the switching condition from a device coupled to the USB hub.

[0185] In some embodiments, the USB hub may automatically detect the switching condition. For example, the USB hub may have a sensing mechanism, e.g., present in the physical layer (PHY) of connections to the USB hub, specifically for detecting the switching condition. In one embodiment, the switching condition may include a change of impedance in one or more pins of one of the connections to the USB hub, e.g., one or more of the ports. For example, in one embodiment, the invoked switching condition, e.g., via the means described above, may include a change in impedance on the D+ and D- pins of the USB cable, e.g., connected to the peripheral device that is requesting logic reversal. As a specific example, normally two of the pins in the PHY may have an impedance of 15 kOhms, and after tying, for example, two pins together, the impedance may decrease to 7.5 kOhms. Correspondingly, the USB hub may detect this change in impedance as the switching condition. Thus, the USB hub may receive input invoking a switching condition indicating a change in logic in the hub.

[0186] It should be noted that in various embodiments where there are a plurality of upstream logics with associated host controllers, the input may also specify which of the coupled devices are to be controlled by the second device. In other words, the USB hub may have a plurality of host controllers, each controlling a respective subset of the coupled devices, possibly

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overlapping, and the input may specify that one or more of the coupled devices become host controllers for controlling other coupled devices, possibly including the old host controllers. In some embodiments, the input may specify a change in subsets of devices that are controlled by the new host controllers. Said another way, the input may specify that control of the plurality of coupled devices be changed to a new set of host controllers, and each of the new and/or old host controllers may control a new respective subset of the coupled devices.

[0187] For example, the USB hub may first include two host controllers, such as a computer and a PDA, and a plurality of peripheral devices, such as a cell phone, a printer, and a digital camera. In this example, the computer may control the printer and the cell phone, and the PDA may control the digital camera. Subsequently, the USB hub may receive input specifying that the cell phone become a new host controller, e.g., taking the place of the PDA, e.g., in order to print a picture. In this case, the input may specify that the new host controller, i.e., the cell phone, control the printer and the digital camera, and that the computer control the PDA. Thus, the input may specify a change in control from one or more host controllers, in this case, the PDA, to one or more of the peripheral devices, in this case, the cell phone. Additionally, the input may specify a new control set for each of the new controllers, e.g., the cell phone controlling the printer and the digital camera, and the computer controlling the PDA.

[0188] As a simple example, the USB hub may couple to a host controller and a plurality of USB devices, e.g., a dual-role digital music player device controlling a dual-role PDA, a keyboard, and a digital video recorder. In this example, the USB hub may receive input specifying that upstream logic for controlling the keyboard be coupled to the PDA, and that the digital music player continue to control the digital video recorder coupled to the USB hub. Thus, in some embodiments, the input may specify that the original host controller may control a new subset of the coupled devices, e.g., only the digital video recorder, and the new host controller control another subset, e.g., the keyboard.

[0189] Note that the input, the methods, and the switching conditions may also apply to multiple host controllers. For example, the input may be received mechanically via a switch, but in this case, the switch may have a plurality of options each associated with the new and old host controller(s) and the new controlled subset(s) of the coupled devices. Alternatively, or additionally, the input may be received electronically. Note further that the switching conditions, and invoking thereof, are exemplary only and that other methods and switching conditions are envisioned. Thus, the USB hub may receive input specifying a change in control of the plurality of devices coupled to the USB hub from one or more host controllers to one or

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more other host controllers, e.g., previously acting as peripheral devices.

[0190] In 3004, the upstream logic included in the USB hub may be switched from receiving information from the first port, i.e., coupled to the old host controller, to receiving information from the second port, i.e., coupled to the new host controller. In other words, the USB hub may change control of the devices coupled to the hub from one device to another in response to the received input. In one embodiment, the hub may perform this change by decoupling the first port from the upstream logic, decoupling the second port from the downstream logic, and coupling the second port to the upstream logic. In some embodiments, the hub may also allow the old host controller to act as a peripheral device to the new host controller; in other words, the hub may couple the downstream logic, e.g., the downstream logic that was used by the second port, to the first port. Thus, the upstream and downstream logic may be effectively switched between a host controller and a device. Correspondingly, in various embodiments, the new host controller may act as host to other devices, e.g., possibly including the old host controller, coupled to the hub, e.g., each with associated downstream logic. Further examples of this switching will be described in more detail below.

[0191] It should be noted that the switching is not limited to any particular two ports included in the hub, and, in fact, any of a plurality of logics associated with various ports may be switched. Thus, in one embodiment, any downstream logic may be switched with any upstream logic and/or other logics included in the USB hub.

[0192] Following the example regarding the computer, the PDA, and the cell phone, the USB hub may switch the upstream and downstream logic associated with the PDA and the cell phone respectively. The USB hub may also switch the control of the peripherals, e.g., the printer being controlled by the computer to being controlled by the cell phone, by rerouting the signals from the upstream logic of the computer to the upstream logic of the cell phone. In other words, the downstream logic associated with the printer may be switched from receiving signals from the computer to receiving signals from the cell phone. Thus, after the logic is switched, the cell phone may control the printer and the digital camera, and the computer may control the PDA.

[0193] Thus, the USB hub may switch the upstream and downstream logic(s) according to the received input.

[0194] Figures 31 and 32 illustrate exemplary block diagrams of a USB hub included in a USB device, e.g., device 3100. The device may be or include any of the above-described devices. The USB hub 3108 may include a plurality of ports, e.g., reversible ports 3110 and 3114 and downstream ports 3116 and 3118, for coupling to at least one host controller and one or more

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peripheral devices. The coupled devices may be internal or external to the USB device. The USB device may include logic for controlling devices and for acting as a peripheral device, e.g., dual-role host controller block 3104, which may be coupled to or included in a system-on-a-chip (SoC) 3102 that controls the peripheral device. In some embodiments, the peripheral device may include a mass-storage device, e.g., mass-storage 3106, e.g., a hard drive, for storing information. As shown, the mass storage device may be coupled to the SoC 3102 outside of the USB hub 3108; alternatively, the mass storage device may be coupled to the USB hub as an internal or external device, e.g., USB device 3120, 3122, or 3124. Furthermore, similar to above, the USB hub may include hub logic 3112, e.g., for routing signals between the host controller and the coupled devices.

[0195] As also shown, the USB hub may reverse at least two of the ports, e.g., reversible ports 3110 and 3114, e.g., using switching logic methods and conditions. Note that, this particular system is exemplary only, and, in fact, further embodiments are envisioned where any of the ports included in the USB hub may be reversible.

[0196] Figure 32 illustrates the USB device, e.g., the device 3100, coupled to a computer system, e.g., computer system 3202, e.g., similar to the computer system 82 described above. The computer system may include a USB host controller, e.g., USB host controller 3204, for managing and/or communicating with devices (e.g., USB devices 3122 and 3124) coupled to the computer system. The computer system may also include a port for coupling to other USB devices, e.g., port 3206. Thus, as shown, the computer system may couple to the peripheral device via the USB hub and may alternate as host controller of the coupled devices and device with the host controller included in the peripheral device. In other words, the computer system and/or the SoC 3102 may control respective subsets (or all) of the devices coupled to the USB hub. In one embodiment, the computer system may act as a host, and may control the mass storage device via the SoC. In other words, the computer system may control the mass storage device by sending commands through the SoC. In one embodiment, the SoC may interpret the commands and send corresponding commands to the mass storage device for the computer system. In embodiments where the mass storage device is coupled to the USB hub directly, the computer system may control the mass storage device without using the SoC.

[0197] As an example, the peripheral device may be a cell phone including an associated hard drive, e.g., the mass storage device 3106 as well as a digital camera and a Bluetooth device. The cell phone may have a USB port for coupling to other devices, in this case, the computer system. Thus, when the SoC acts as the host controller of the USB hub, the cell phone may control each

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of the coupled devices and communicate information to the host computer as a host controller. Upon receiving input specifying a change in control, the USB hub may switch respective upstream and downstream logics associated with the cell phone and the host computer. Subsequently, the host computer may control respective devices in the cell phone. For example, the host computer may update files on the hard drive, e.g., via the SoC, take pictures using the digital camera, and communicate using the Bluetooth device. Alternatively, as described above, the host controller may control a subset of these devices, and the SoC may continue to control another subset.

[0198] Thus, using the systems and methods described herein, a USB hub may change control of a plurality of coupled devices from a first device acting as a host controller to a second device, which was previously a peripheral device.

[0199] Embodiments of a subset or all (and portions or all) of the above may be implemented by program instructions stored in a memory medium or carrier medium and executed by a processor. A memory medium may include any of various types of memory devices or storage devices. The term "memory medium" is intended to include an installation medium, e.g., a Compact Disc Read Only Memory (CD-ROM), floppy disks, or tape device; a computer system memory or random access memory such as Dynamic Random Access Memory (DRAM), Double Data Rate Random Access Memory (DDR RAM), Static Random Access Memory (SRAM), Extended Data Out Random Access Memory (EDO RAM), Rambus Random Access Memory (RAM), etc.; or a non-volatile memory such as a magnetic media, e.g., a hard drive, or optical storage. The memory medium may comprise other types of memory as well, or combinations thereof. In addition, the memory medium may be located in a first computer in which the programs are executed, or may be located in a second different computer that connects to the first computer over a network, such as the Internet. In the latter instance, the second computer may provide program instructions to the first computer for execution. The term "memory medium" may include two or more memory mediums that may reside in different locations, e.g., in different computers that are connected over a network.

[0200] In some embodiments, a computer system at a respective participant location may include a memory medium(s) on which one or more computer programs or software components according to one embodiment of the present invention may be stored. For example, the memory medium may store one or more programs that are executable to perform the methods described herein. The memory medium may also store operating system software, as well as other software for operation of the computer system.

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[0201] Further modifications and alternative embodiments of various aspects of the invention may be apparent to those skilled in the art in view of this description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the general manner of carrying out the invention. It is to be understood that the forms of the invention shown and described herein are to be taken as embodiments. Elements and materials may be substituted for those illustrated and described herein, parts and processes may be reversed, and certain features of the invention may be utilized independently, all as would be apparent to one skilled in the art after having the benefit of this description of the invention. Changes may be made in the elements described herein without departing from the spirit and scope of the invention as described in the following claims.

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WHAT IS CLAIMED IS:

1. An apparatus, comprising:

a Universal Serial Bus (USB) switching hub, comprising:

a plurality of upstream ports; and

a plurality of downstream ports;

wherein a first upstream port of the plurality of upstream ports is operable to couple to a first host;

wherein a second upstream port of the plurality of upstream ports is operable to communicate with a wireless host;

wherein the at least a subset of downstream ports of the plurality of downstream ports are accessible to the first upstream port and the second upstream port.

2. The apparatus of any of the proceeding claims, wherein the USB switching hub further comprises:

downstream switching logic coupled between the plurality of upstream ports and the plurality of downstream ports;

wherein the plurality of downstream ports consists of N downstream ports;

wherein the downstream switching logic is configured to electronically switch communications between:

a) a downstream port of the plurality of downstream ports and a first upstream port of the plurality of upstream ports to

b) the downstream port of the plurality of downstream ports and a second upstream port of the plurality of upstream ports;

wherein the USB switching hub is configured to be enumerated with a substantially similar hub configuration through each of the plurality of upstream ports;

wherein the hub configuration includes N downstream ports.

3. The apparatus of any of the proceeding claims, wherein the USB switching hub is operable to switch communications without upstream devices coupled to the first upstream port and the second upstream being required to re-enumerate the USB switching hub.

4. The apparatus of any of the proceeding claims, wherein the second upstream port is coupled to a media access controller and a transceiver.

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5. The apparatus of any of the proceeding claims, further comprising a wireless bridge coupled to a downstream port of the USB switching hub for association with the wireless host when the wireless host is coupled to the first upstream port.

6. The apparatus of claim 5, wherein the wireless bridge is internal to the USB switching hub.

7. The apparatus of claim 6, wherein the wireless bridge and the transceiver are internal to the USB switching hub.

8. The apparatus of any of the proceeding claims, wherein the wireless host includes a media access controller and a transceiver.

9. The apparatus of any of the proceeding claims, wherein the second port comprises switching logic operable to switch upstream logic and downstream logic with respect to the second port and at least a subset of the plurality of downstream ports, respectively.

10. The apparatus of any of the proceeding claims, wherein the second upstream port is operable to communicatively couple to a plurality of wireless hosts.

11. The apparatus of any of the proceeding claims, wherein the first host is a second wireless host.

12. A method, comprising:

communicating between a wired host and at least a subset of a plurality of downstream devices coupled to a Universal Serial Bus (USB) switching hub; and

wirelessly communicating between a wireless host and at least a subset of a plurality of downstream devices coupled to the USB switching hub.

13. The method of claim 12, further comprising associating a wireless host with a wireless bridge coupled to a USB switching hub.

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14. The method of claim 13, wherein associating the wireless host comprises:

physically coupling the wireless host to a first upstream port of the USB switching hub;

physically coupling a wireless bridge to a downstream port of the USB switching hub; and

sending at least one encryption key from the wireless host to the wireless bridge through the USB switching hub.

15. The method of claim 13, wherein associating the wireless host comprises entering a code from one of the wireless host and the wireless bridge to the other of the wireless host and the wireless bridge.

16. The method of claim 13, wherein associating the wireless host comprises:

physically coupling the wireless host to a first upstream port of the USB switching hub;

physically coupling a wireless bridge to a downstream port of the USB switching hub; and

implementing an association protocol between the wireless host and the wireless bridge.

17. The method of any of claims 12-16, further comprising:

the wired host enumerating the USB switching hub using a first hub configuration for the USB switching hub;

the wireless host enumerating the USB switching hub using a hub configuration substantially similar to the first hub configuration for the USB switching hub; and

switching communications between at least one of the plurality of downstream devices and the wired host to the wireless host.

18. The method of claim 17, wherein the wireless host is not required to re-enumerate the USB switching hub when communications are switched.

19. The method of any of claims 12-18, wherein the wired host communicates with at least a subset of a plurality of downstream devices coupled to the USB switching hub substantially simultaneously with the wireless host communicating with at least a subset of a plurality of downstream devices coupled to the USB switching hub.

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20. A memory medium which stores program instructions that are executable to implement the method of any of claims 12 – 19.

21. A system, comprising:

a Universal Serial Bus (USB) switching hub, comprising:

a plurality of upstream ports;

a plurality of downstream ports; and

downstream switching logic coupled between the plurality of upstream ports and the plurality of downstream ports;

wherein a first upstream port of the plurality of upstream ports is operable to couple to a first host;

wherein a second upstream port of the plurality of upstream ports is operable to communicate with a second wireless host;

wherein the at least a subset of downstream ports of the plurality of downstream ports are accessible to the first upstream port and the second upstream port;

wherein the USB switching hub is configured to be enumerated with a substantially similar hub configuration by each of the plurality of upstream devices coupled to its respective one of the plurality of upstream ports.

22. The system of claim 21, wherein the USB switching hub is operable to switch communications without upstream devices coupled to the first host and the second wireless host being required to re-enumerate the USB switching hub.

23. The system of any of claims 21-22, further comprising delaying switching communications of the subset of the plurality of downstream ports if there is an active transfer in progress between the downstream port and the first upstream port, wherein switching communications is delayed by an intelligent port routing switch.

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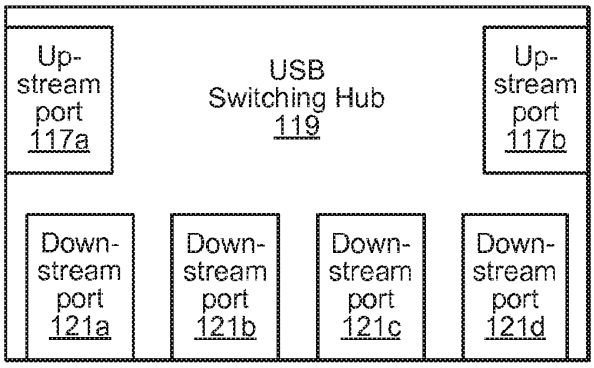

Up-stream port 117a
USB Switching Hub 119
Up-stream port 117b
Down-stream port 121a
Down-stream port 121b
Down-stream port 121c
Down-stream port 121d

FIG. 1

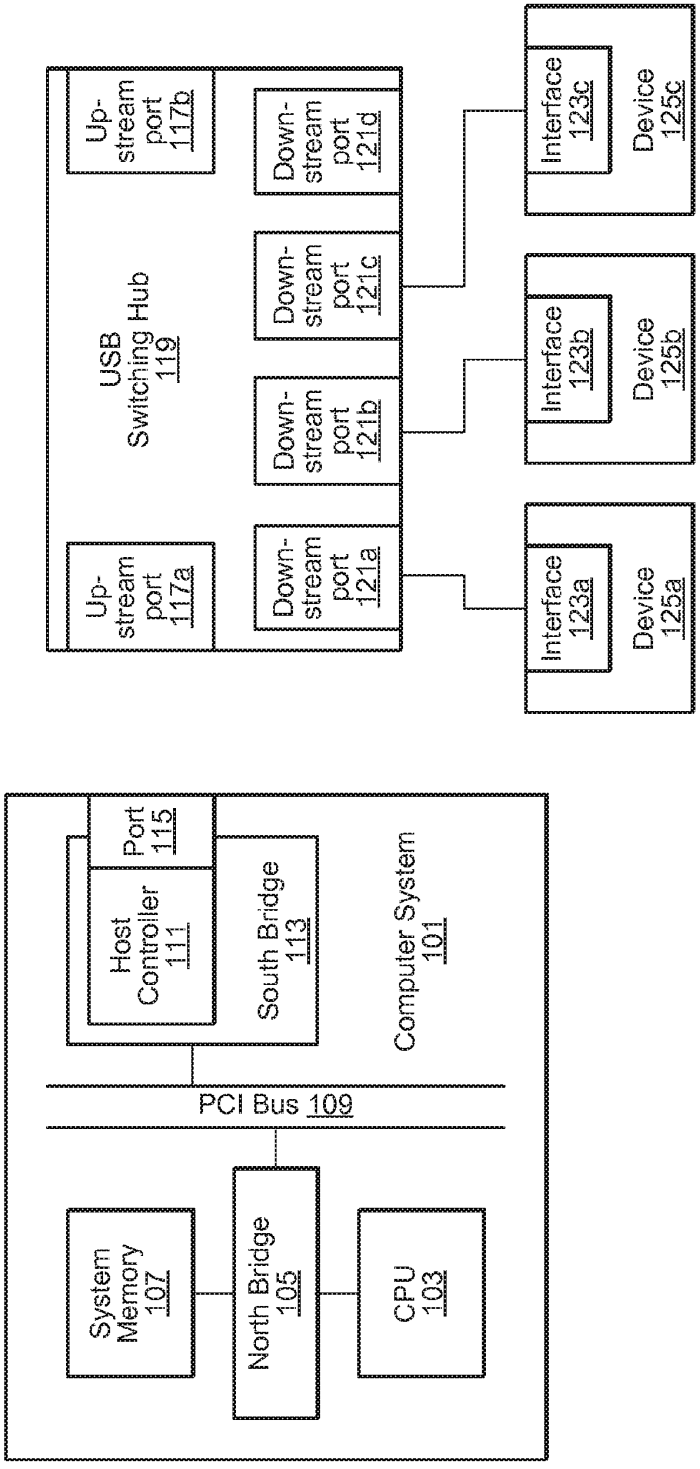

Computer System 101
Host Controller 111
Port 115
South Bridge 113
PCI Bus 109
System Memory 107
North Bridge 105
CPU 103
USB Switching Hub 119
Up-stream port 117a
Up-stream port 117b
Down-stream port 121a
Down-stream port 121b
Down-stream port 121c
Down-stream port 121d
Interface 123a
Interface 123b
Interface 123c
Device 125a
Device 125b
Device 125c

FIG. 2

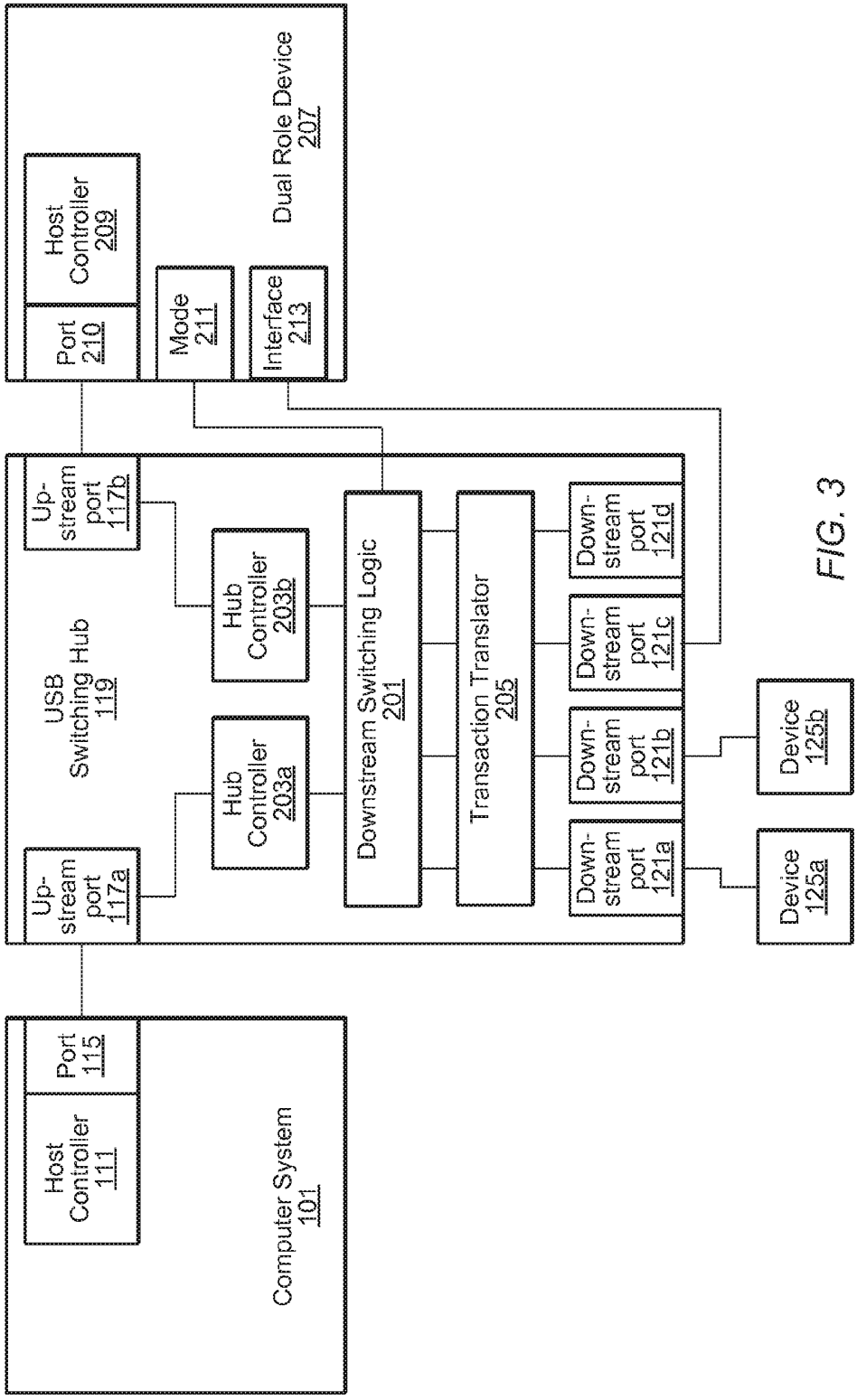

Dual Role Device 207
Host Controller 209
Port 210
Mode 211
Interface 213
USB Switching Hub 119
Up-stream port 117b
Up-stream port 117a
Hub Controller 203b
Hub Controller 203a
Downstream Switching Logic 201
Transaction Translator 205
Down-stream port 121d
Down-stream port 121c
Down-stream port 121b
Down-stream port 121a
Device 125b
Device 125a
Computer System 101
Host Controller 111
Port 115

FIG. 3

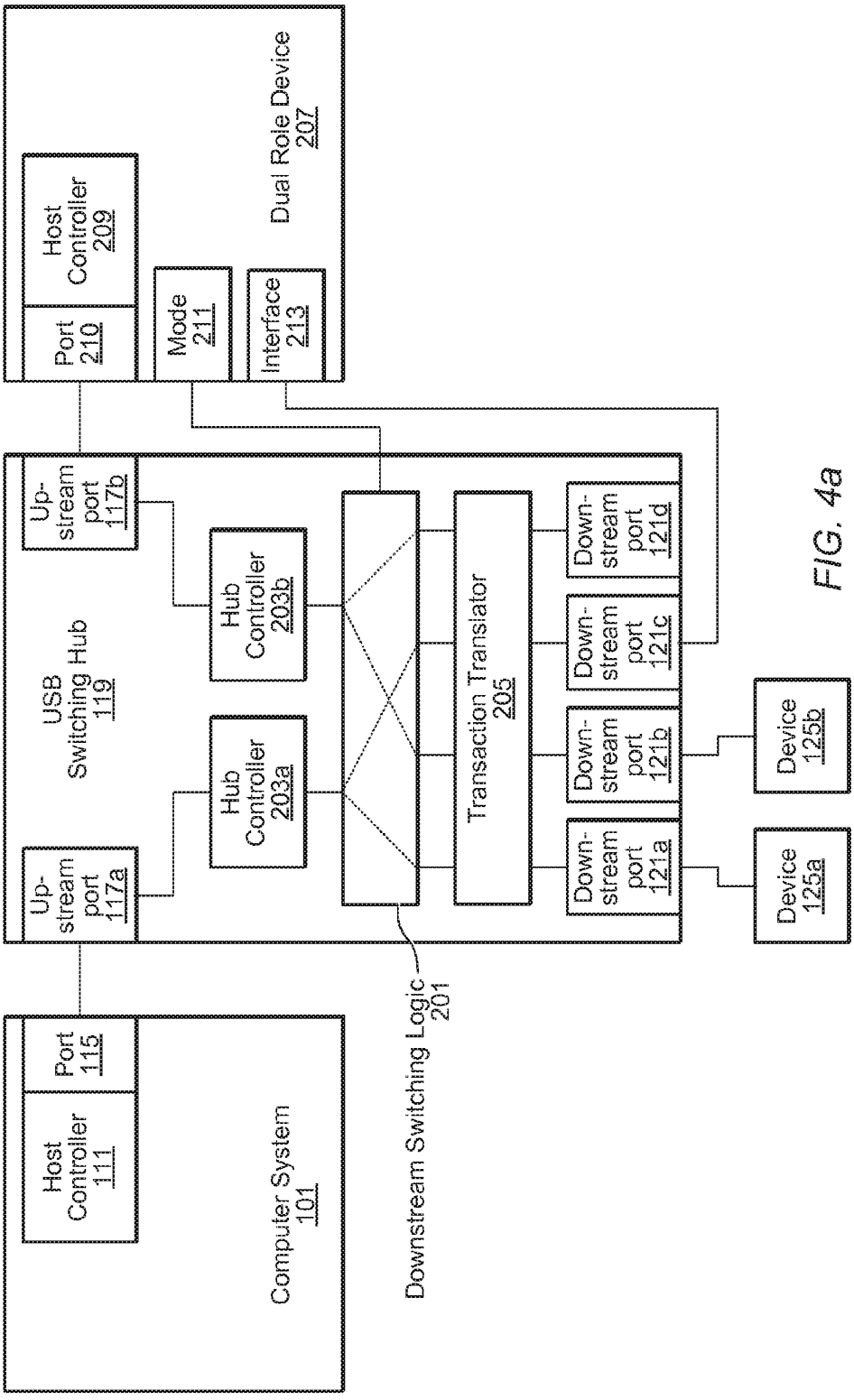


FIG. 4a

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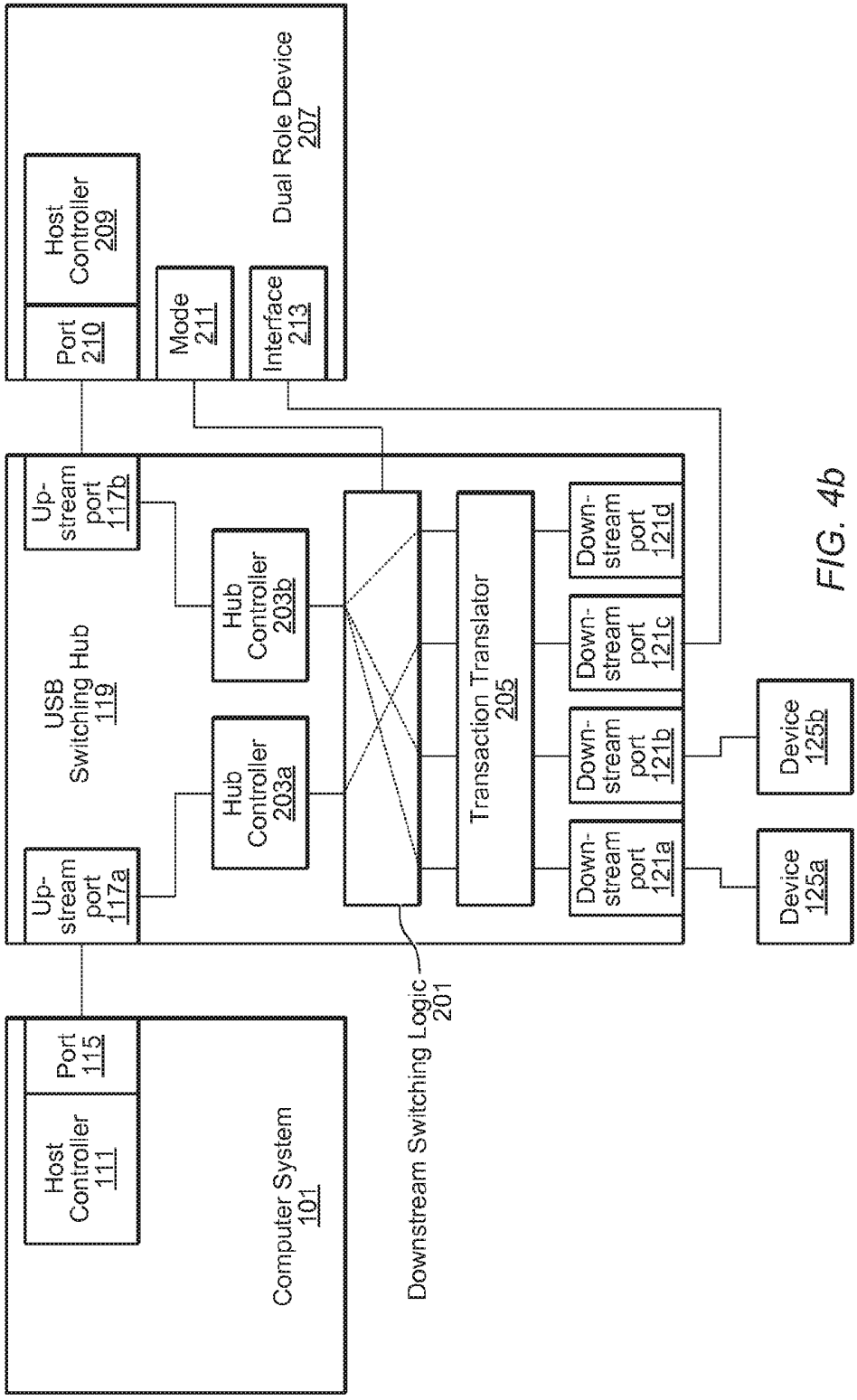

Dual Role Device 207
Host Controller 209
Port 210
Mode 211
Interface 213
USB Switching Hub 119
Up-stream port 117b
Up-stream port 117a
Hub Controller 203b
Hub Controller 203a
Transaction Translator 205
Down-stream port 121d
Down-stream port 121c
Down-stream port 121b
Down-stream port 121a
Device 125b
Device 125a
Downstream Switching Logic 201
Computer System 101
Host Controller 111
Port 115

FIG. 4b

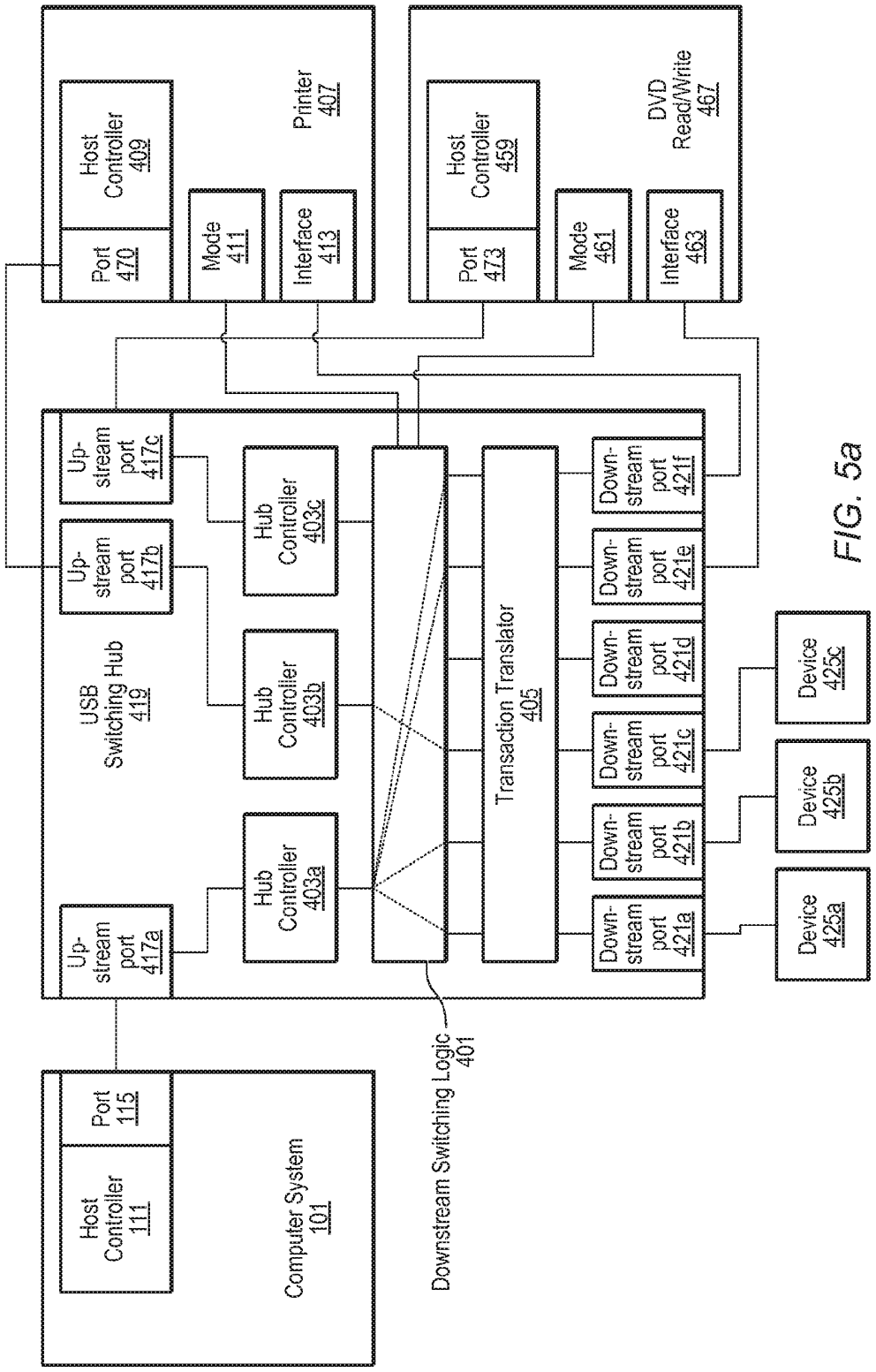

Computer System 101
Host Controller 111
Port 115
Downstream Switching Logic 401
USB Switching Hub 419
Up-stream port 417a
Up-stream port 417b
Up-stream port 417c
Hub Controller 403a
Hub Controller 403b
Hub Controller 403c
Transaction Translator 405
Down-stream port 421a
Down-stream port 421b
Down-stream port 421c
Down-stream port 421d
Down-stream port 421e
Down-stream port 421f
Device 425a
Device 425b
Device 425c
Printer 407
Port 470
Host Controller 409
Mode 411
Interface 413
DVD Read/Write 467
Port 473
Host Controller 459
Mode 461
Interface 463

FIG. 5a

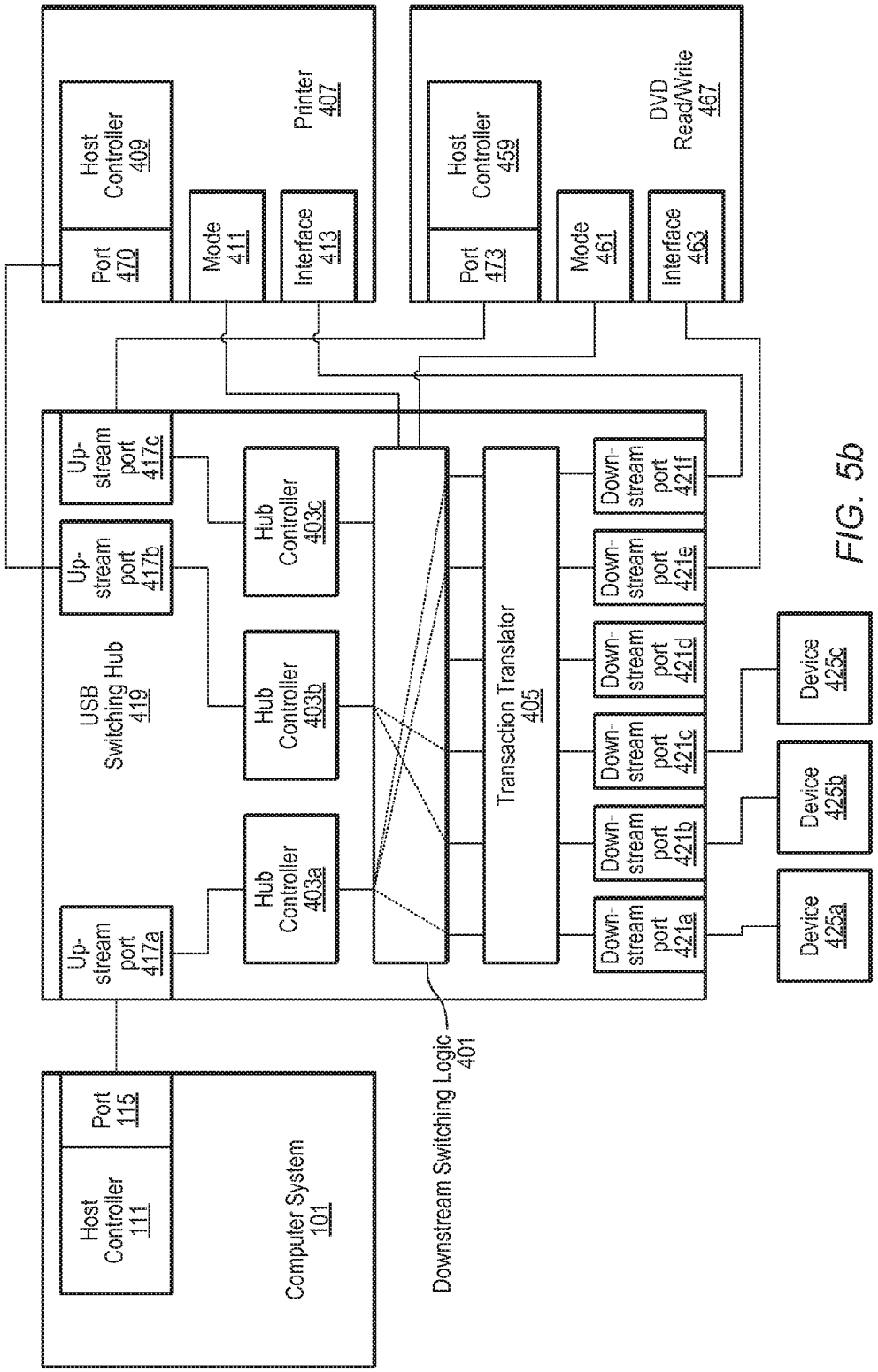

Printer 407
Host Controller 409
Port 470
Mode 411
Interface 413
DVD Read/Write 467
Host Controller 459
Port 473
Mode 461
Interface 463
USB Switching Hub 419
Up-stream port 417a
Up-stream port 417b
Up-stream port 417c
Hub Controller 403a
Hub Controller 403b
Hub Controller 403c
Transaction Translator 405
Down-stream port 421a
Down-stream port 421b
Down-stream port 421c
Down-stream port 421d
Down-stream port 421e
Down-stream port 421f
Device 425a
Device 425b
Device 425c
Downstream Switching Logic 401
Computer System 101
Host Controller 111
Port 115

FIG. 5b

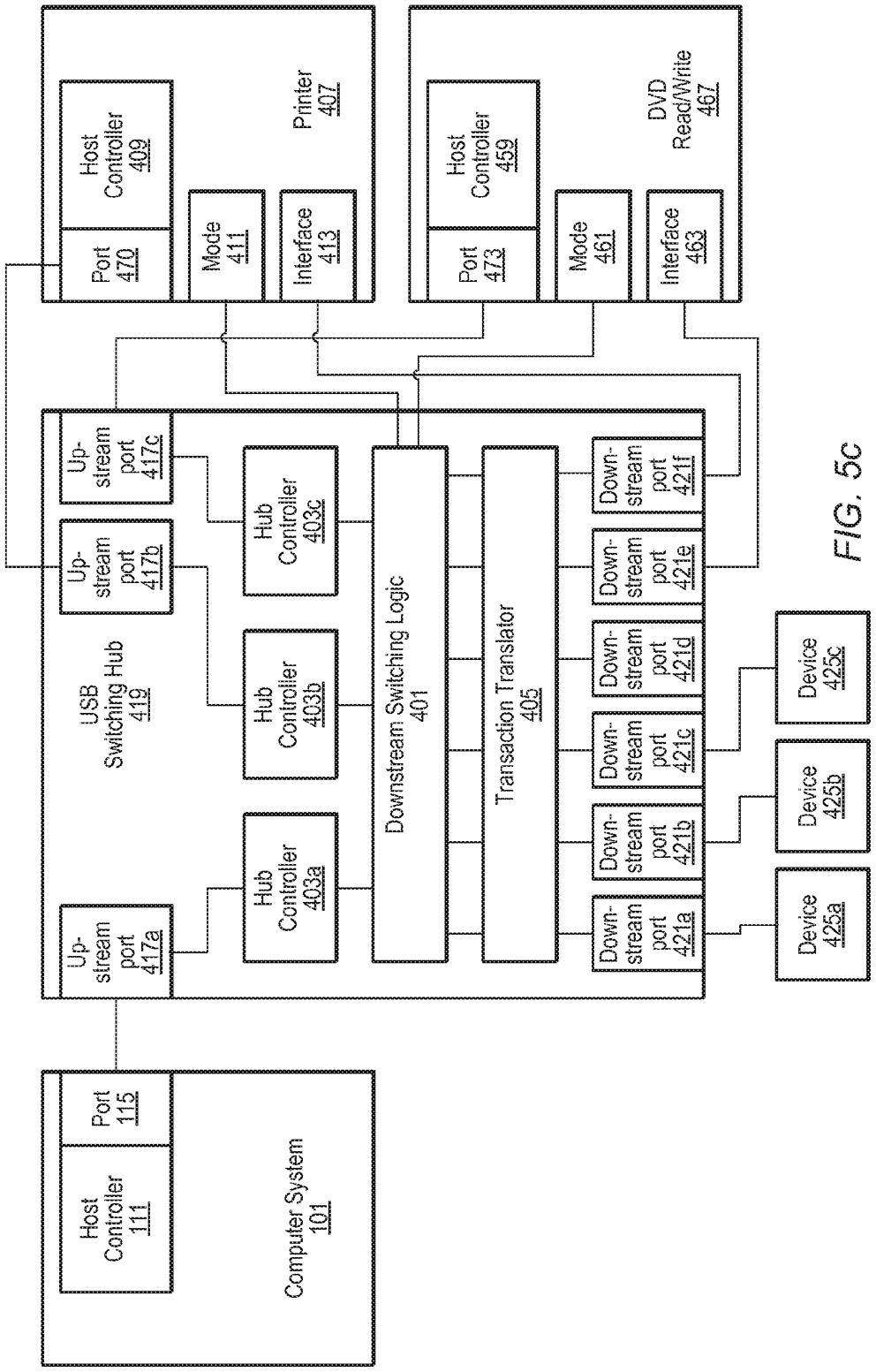

Computer System 101
Host Controller 111
Port 115
Printer 407
Host Controller 409
Port 470
Mode 411
Interface 413
DVD Read/Write 467
Host Controller 459
Port 473
Mode 461
Interface 463
USB Switching Hub 419
Up-stream port 417a
Up-stream port 417b
Up-stream port 417c
Hub Controller 403a
Hub Controller 403b
Hub Controller 403c
Downstream Switching Logic 401
Transaction Translator 405
Down-stream port 421a
Down-stream port 421b
Down-stream port 421c
Down-stream port 421d
Down-stream port 421e
Down-stream port 421f
Device 425a
Device 425b
Device 425c

FIG. 5c

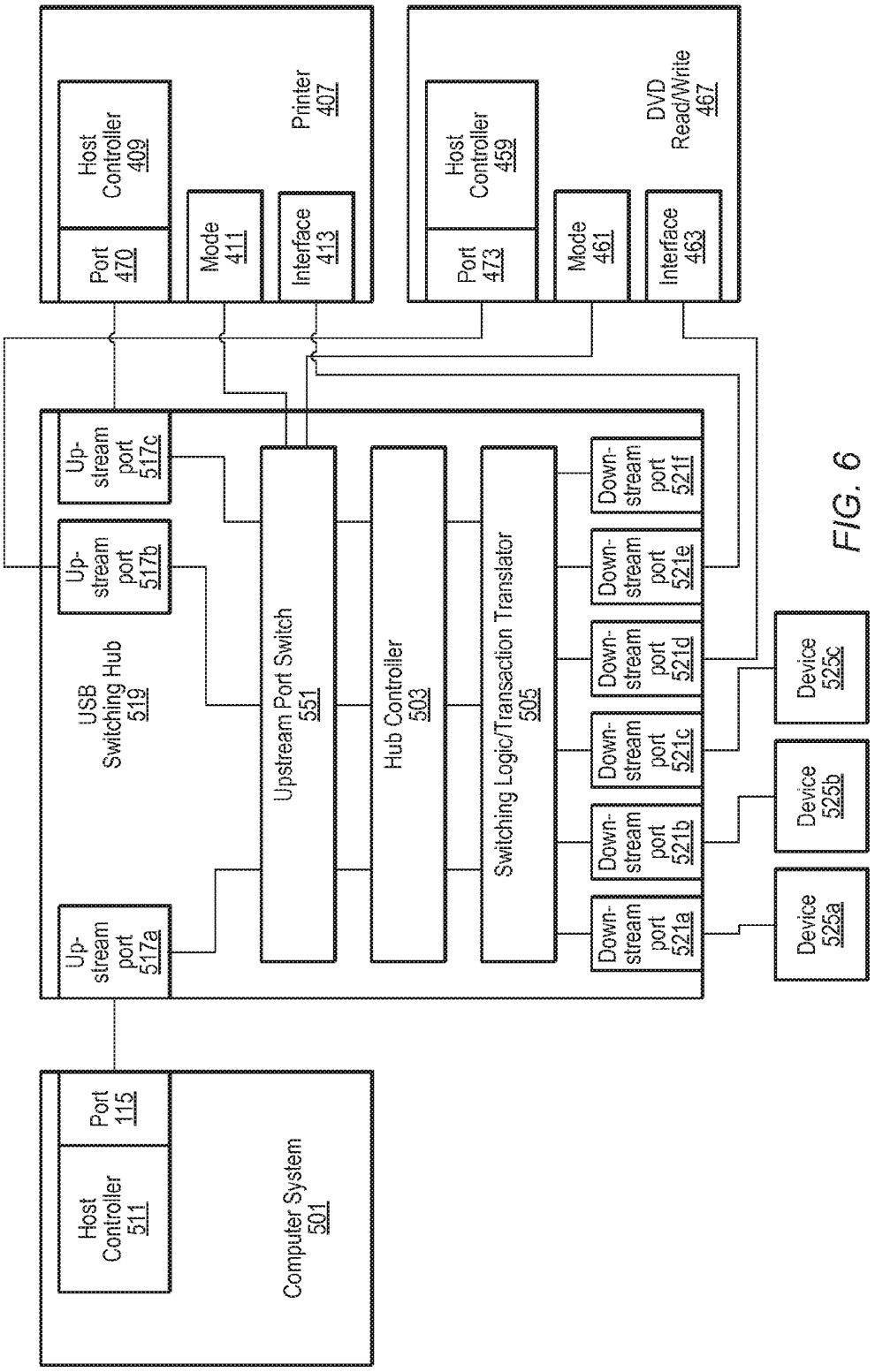

Computer System 501
Host Controller 511
Port 115
USB Switching Hub 519
Up-stream port 517a
Up-stream port 517b
Up-stream port 517c
Upstream Port Switch 551
Hub Controller 503
Switching Logic/Transaction Translator 505
Down-stream port 521a
Down-stream port 521b
Down-stream port 521c
Down-stream port 521d
Down-stream port 521e
Down-stream port 521f
Device 525a
Device 525b
Device 525c
Printer 407
Host Controller 409
Port 470
Mode 411
Interface 413
DVD Read/Write 467
Host Controller 459
Port 473
Mode 461
Interface 463

FIG. 6

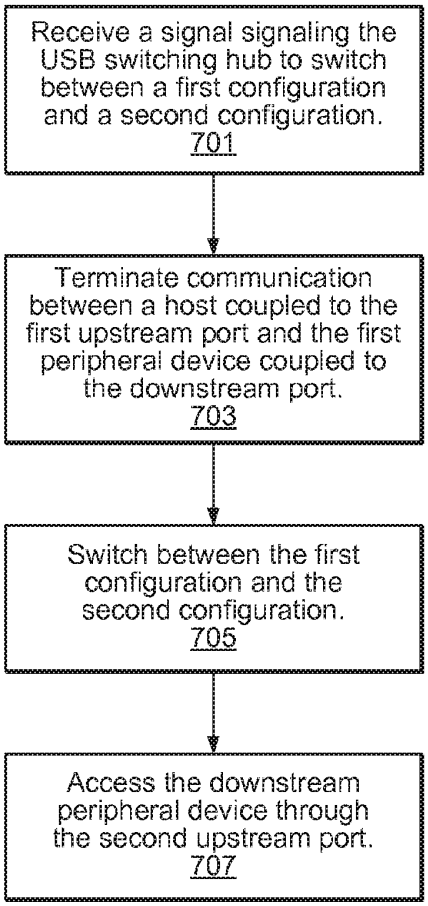

Receive a signal signaling the USB switching hub to switch between a first configuration and a second configuration.
701
Terminate communication between a host coupled to the first upstream port and the first peripheral device coupled to the downstream port.
703
Switch between the first configuration and the second configuration.
705
Access the downstream peripheral device through the second upstream port.
707

FIG. 7

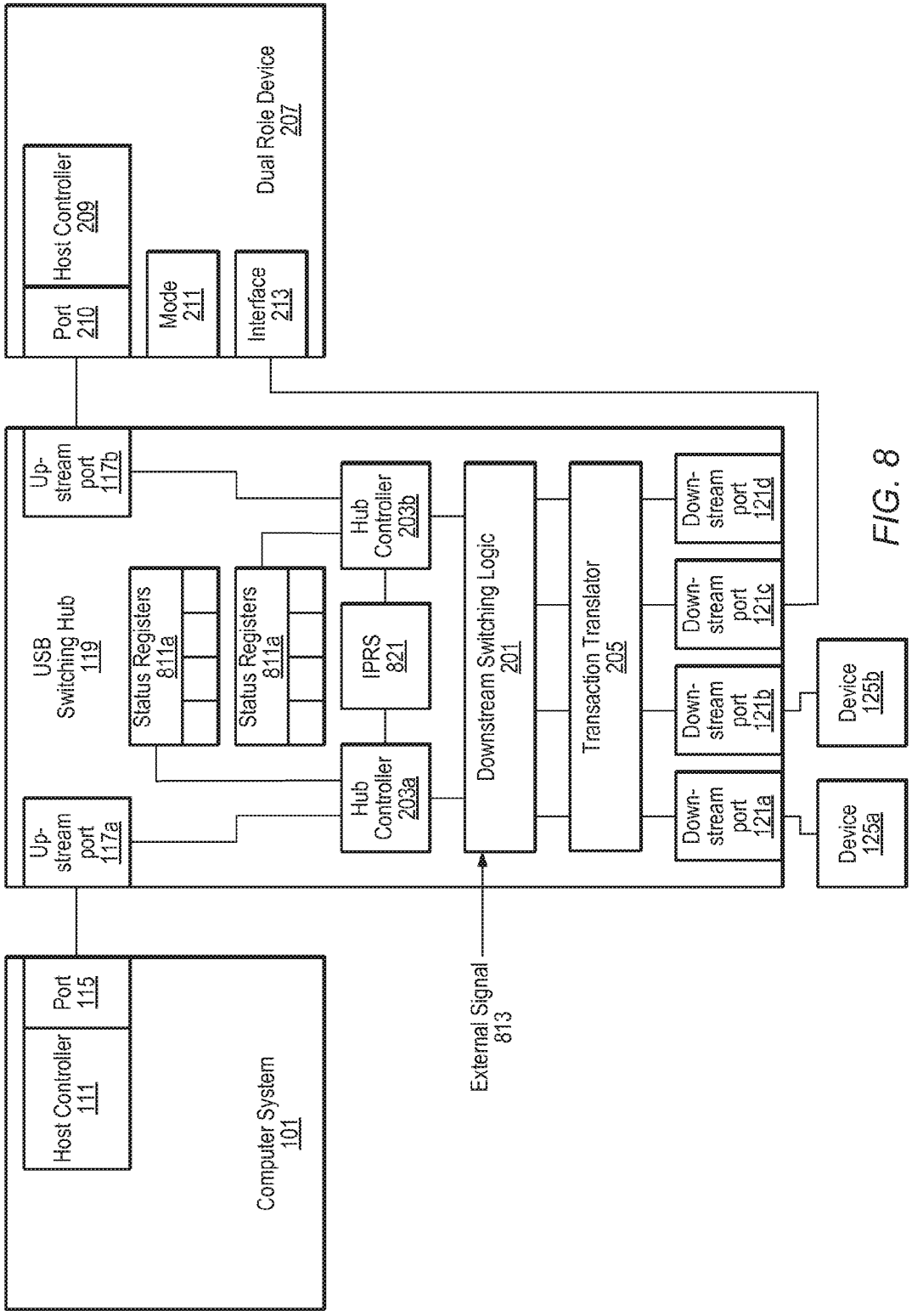

Dual Role Device 207
Host Controller 209
Port 210
Mode 211
Interface 213
USB Switching Hub 119
Up-stream port 117b
Up-stream port 117a
Hub Controller 203b
Hub Controller 203a
Status Registers 811a
Status Registers 811a
IPRS 821
Downstream Switching Logic 201
Transaction Translator 205
Down-stream port 121d
Down-stream port 121c
Down-stream port 121b
Down-stream port 121a
Device 125b
Device 125a
External Signal 813
Computer System 101
Host Controller 111
Port 115

FIG. 8

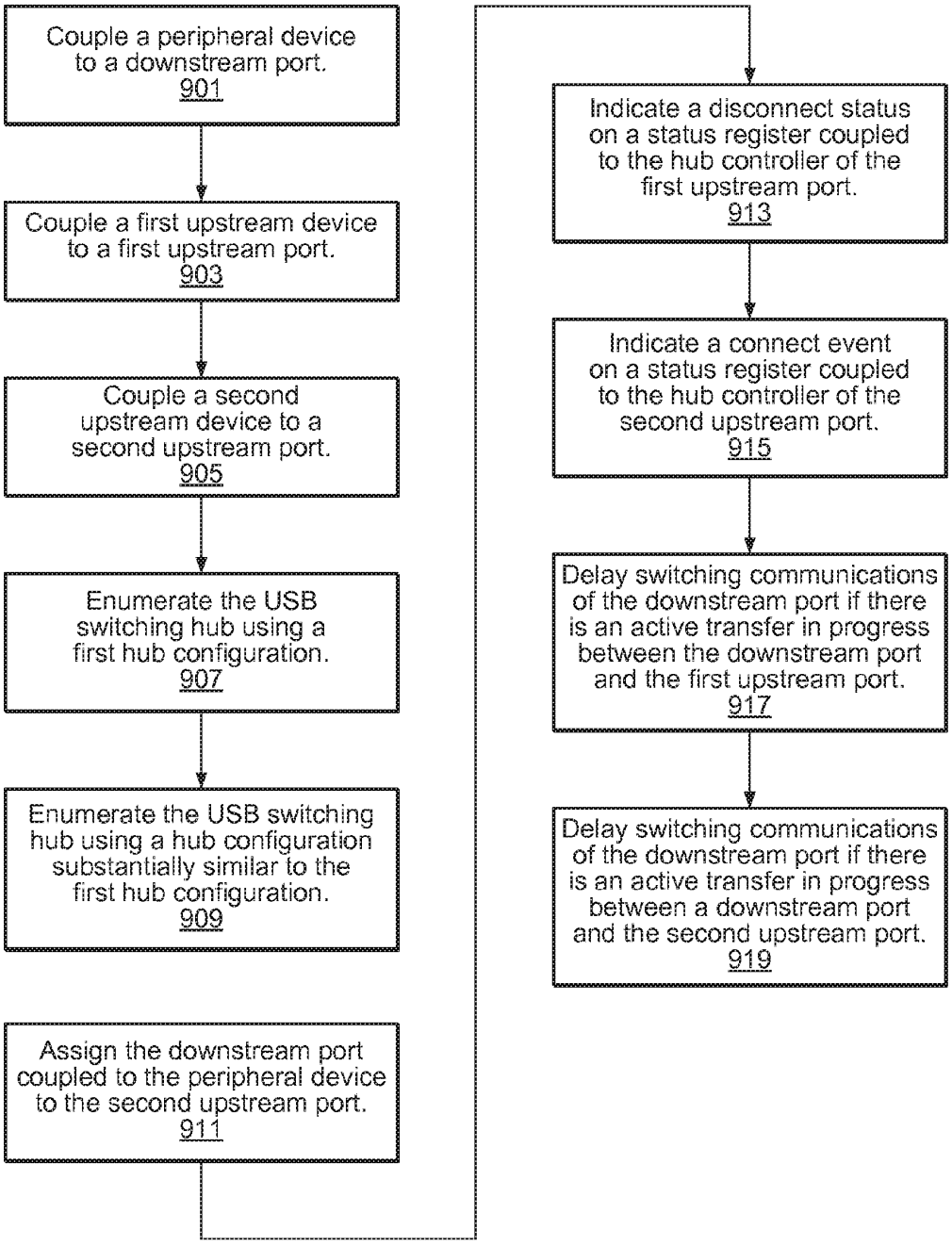

Couple a peripheral device to a downstream port. 901
Couple a first upstream device to a first upstream port. 903
Couple a second upstream device to a second upstream port. 905
Enumerate the USB switching hub using a first hub configuration. 907
Enumerate the USB switching hub using a hub configuration substantially similar to the first hub configuration. 909
Assign the downstream port coupled to the peripheral device to the second upstream port. 911
Indicate a disconnect status on a status register coupled to the hub controller of the first upstream port. 913
Indicate a connect event on a status register coupled to the hub controller of the second upstream port. 915
Delay switching communications of the downstream port if there is an active transfer in progress between the downstream port and the first upstream port. 917
Delay switching communications of the downstream port if there is an active transfer in progress between a downstream port and the second upstream port. 919

FIG. 9

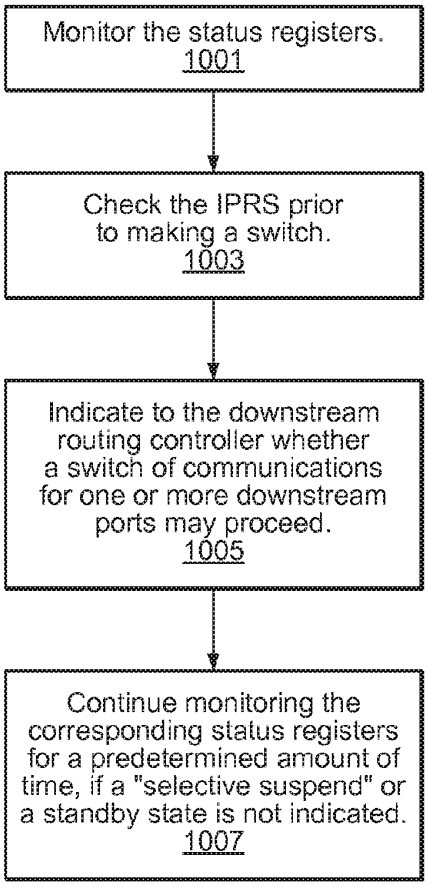

Monitor the status registers.
1001
Check the IPRS prior to making a switch.
1003
Indicate to the downstream routing controller whether a switch of communications for one or more downstream ports may proceed.
1005
Continue monitoring the corresponding status registers for a predetermined amount of time, if a "selective suspend" or a standby state is not indicated.
1007

FIG. 10

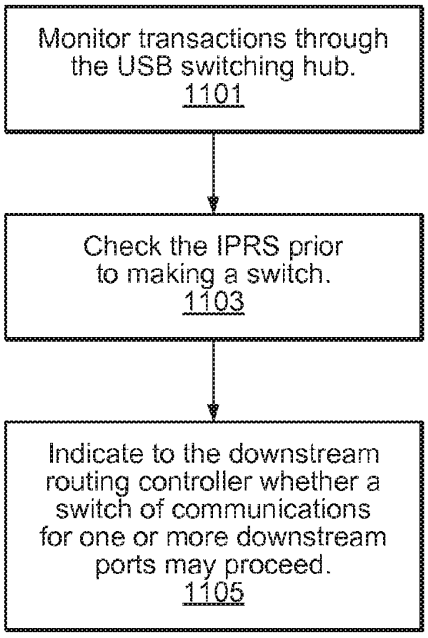

Monitor transactions through the USB switching hub.
1101
Check the IPRS prior to making a switch.
1103
Indicate to the downstream routing controller whether a switch of communications for one or more downstream ports may proceed.
1105

FIG. 11

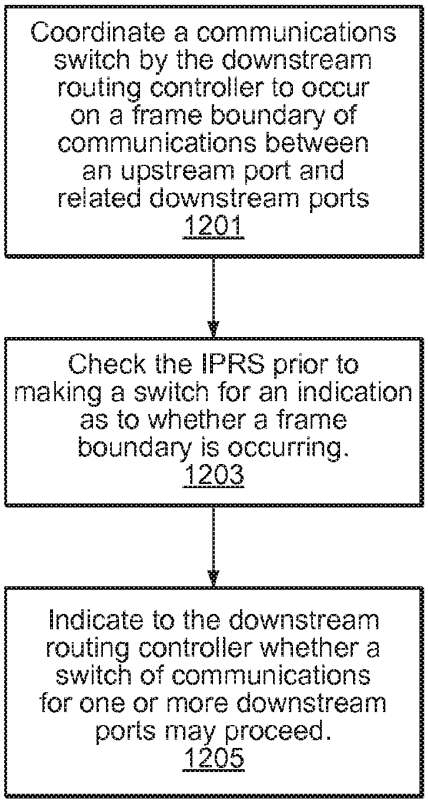

Coordinate a communications switch by the downstream routing controller to occur on a frame boundary of communications between an upstream port and related downstream ports
1201
Check the IPRS prior to making a switch for an indication as to whether a frame boundary is occurring.
1203
Indicate to the downstream routing controller whether a switch of communications for one or more downstream ports may proceed.
1205

FIG. 12

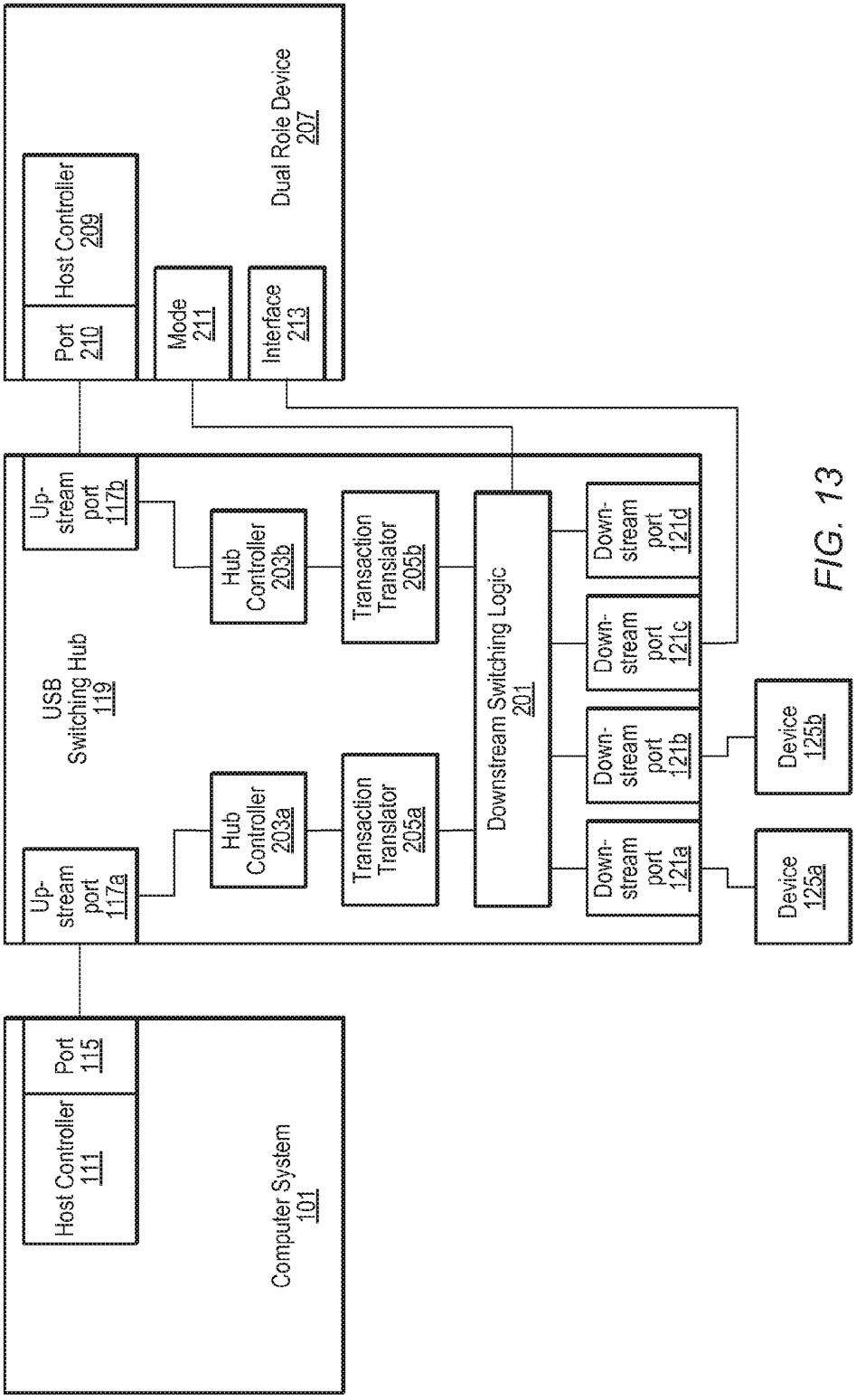

Computer System 101
Host Controller 111
Port 115
Up-stream port 117a
USB Switching Hub 119
Hub Controller 203a
Transaction Translator 205a
Downstream Switching Logic 201
Down-stream port 121a
Down-stream port 121b
Down-stream port 121c
Down-stream port 121d
Hub Controller 203b
Transaction Translator 205b
Up-stream port 117b
Port 210
Host Controller 209
Mode 211
Interface 213
Dual Role Device 207
Device 125a
Device 125b

FIG. 13

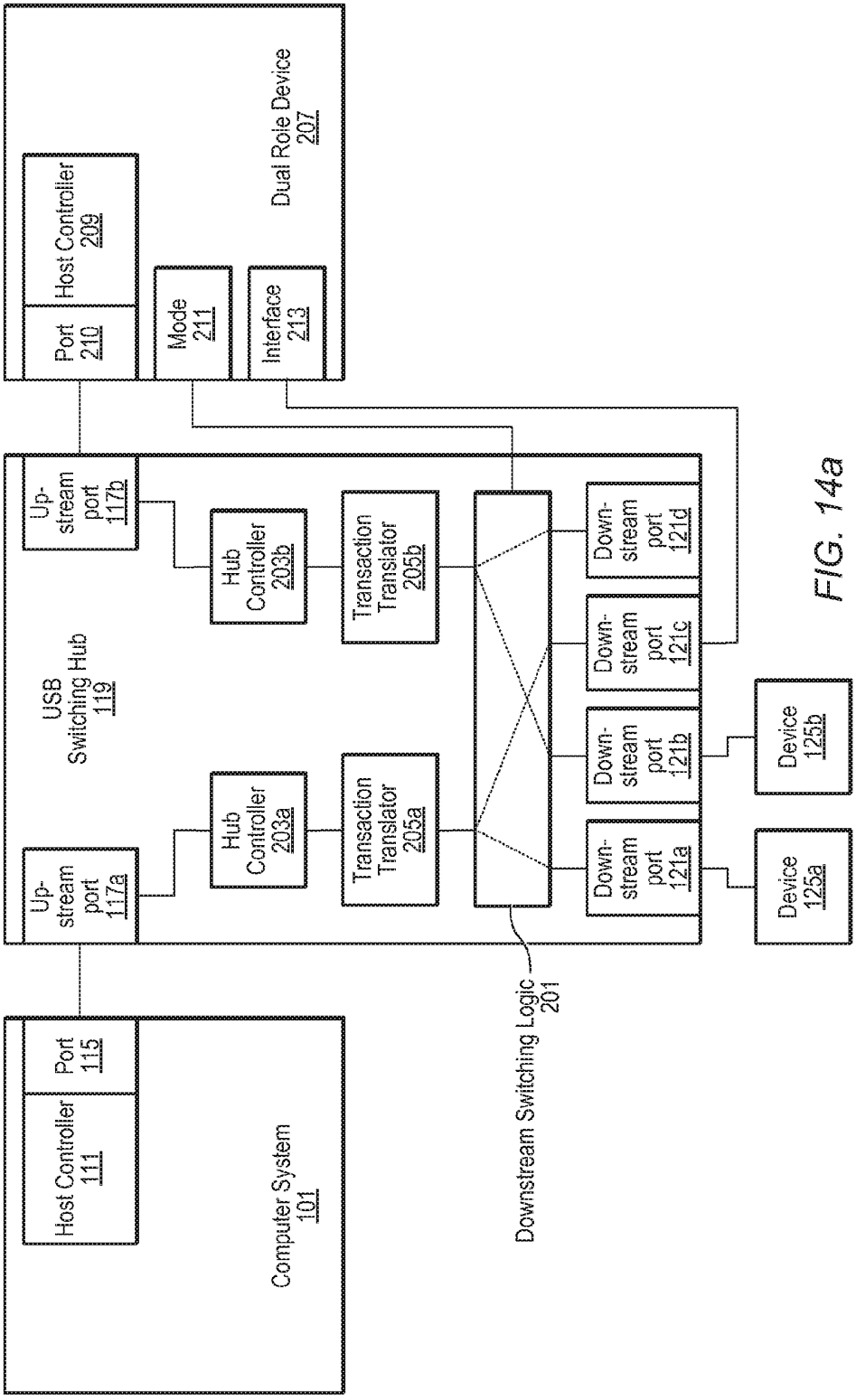

Computer System 101
Host Controller 111
Port 115
Dual Role Device 207
Host Controller 209
Port 210
Mode 211
Interface 213
USB Switching Hub 119
Up-stream port 117a
Up-stream port 117b
Hub Controller 203a
Hub Controller 203b
Transaction Translator 205a
Transaction Translator 205b
Downstream Switching Logic 201
Down-stream port 121a
Down-stream port 121b
Down-stream port 121c
Down-stream port 121d
Device 125a
Device 125b

FIG. 14a

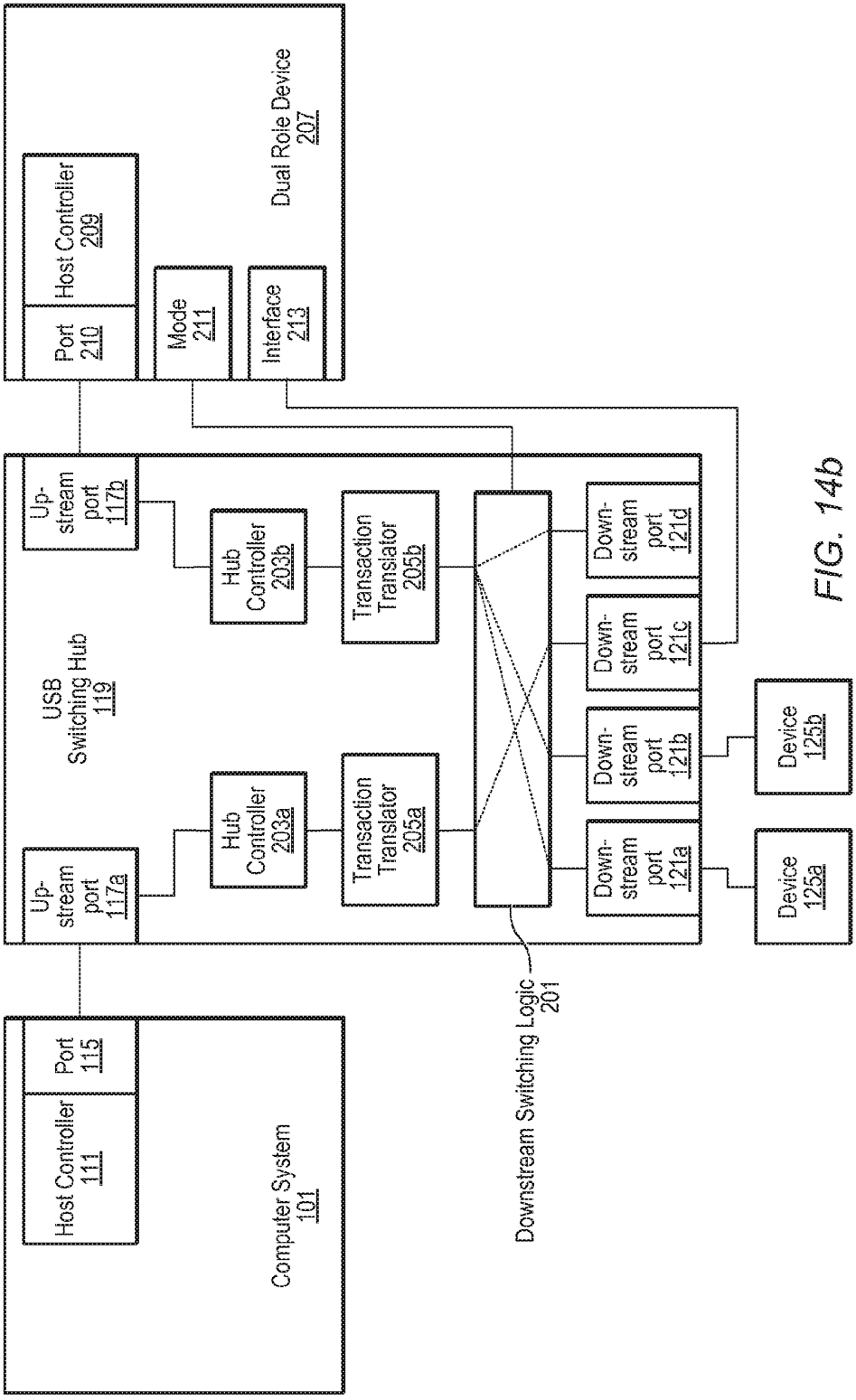

Dual Role Device 207
Host Controller 209
Port 210
Mode 211
Interface 213
USB Switching Hub 119
Up-stream port 117b
Hub Controller 203b
Transaction Translator 205b
Up-stream port 117a
Hub Controller 203a
Transaction Translator 205a
Down-stream port 121d
Down-stream port 121c
Down-stream port 121b
Down-stream port 121a
Device 125b
Device 125a
Downstream Switching Logic 201
Computer System 101
Host Controller 111
Port 115

FIG. 14b

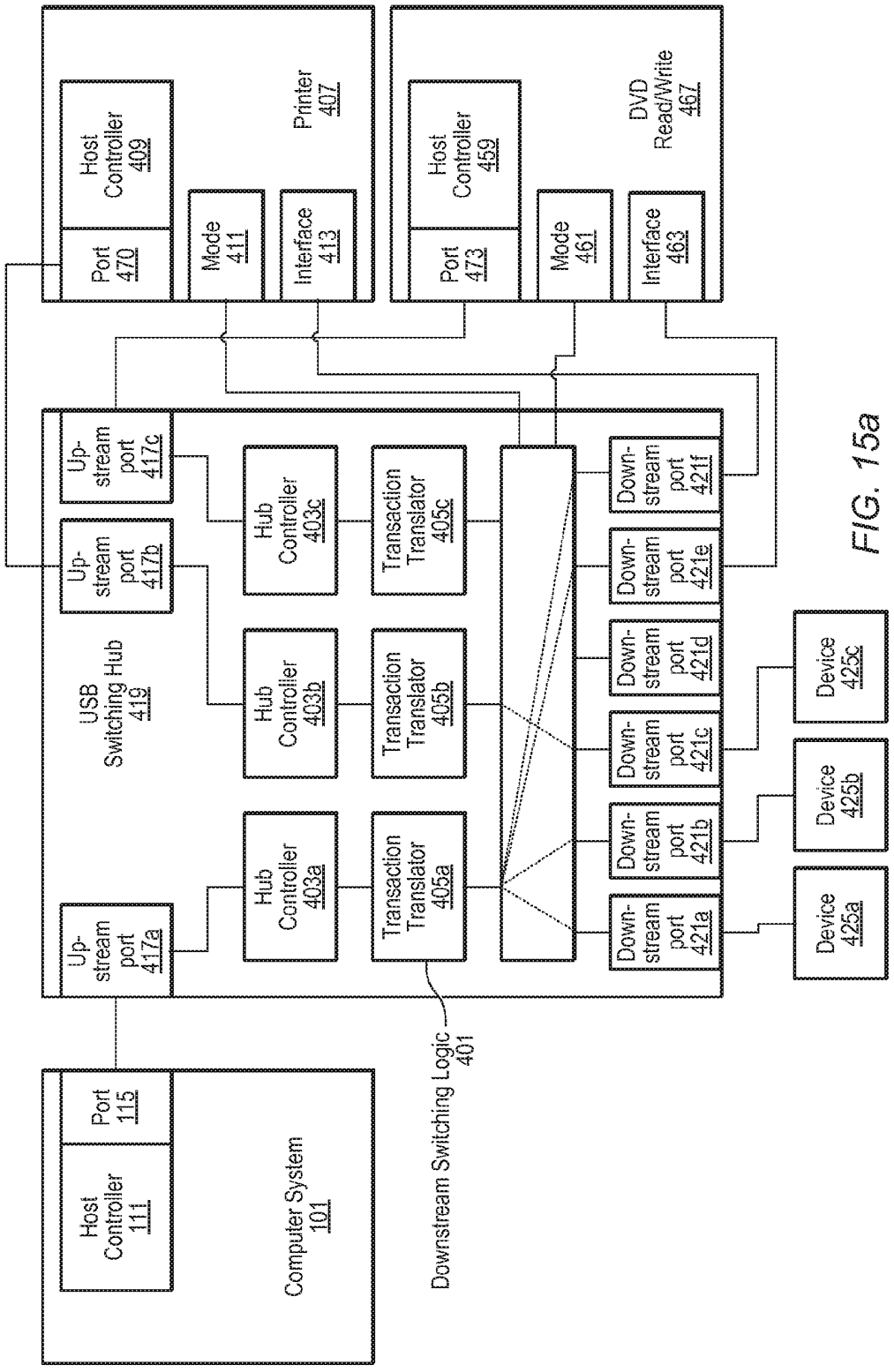

Printer 407
Host Controller 409
Port 470
Mode 411
Interface 413
DVD Read/Write 467
Host Controller 459
Port 473
Mode 461
Interface 463
USB Switching Hub 419
Up-stream port 417a
Up-stream port 417b
Up-stream port 417c
Hub Controller 403a
Hub Controller 403b
Hub Controller 403c
Transaction Translator 405a
Transaction Translator 405b
Transaction Translator 405c
Down-stream port 421a
Down-stream port 421b
Down-stream port 421c
Down-stream port 421d
Down-stream port 421e
Down-stream port 421f
Device 425a
Device 425b
Device 425c
Downstream Switching Logic 401
Computer System 101
Host Controller 111
Port 115

FIG. 15a

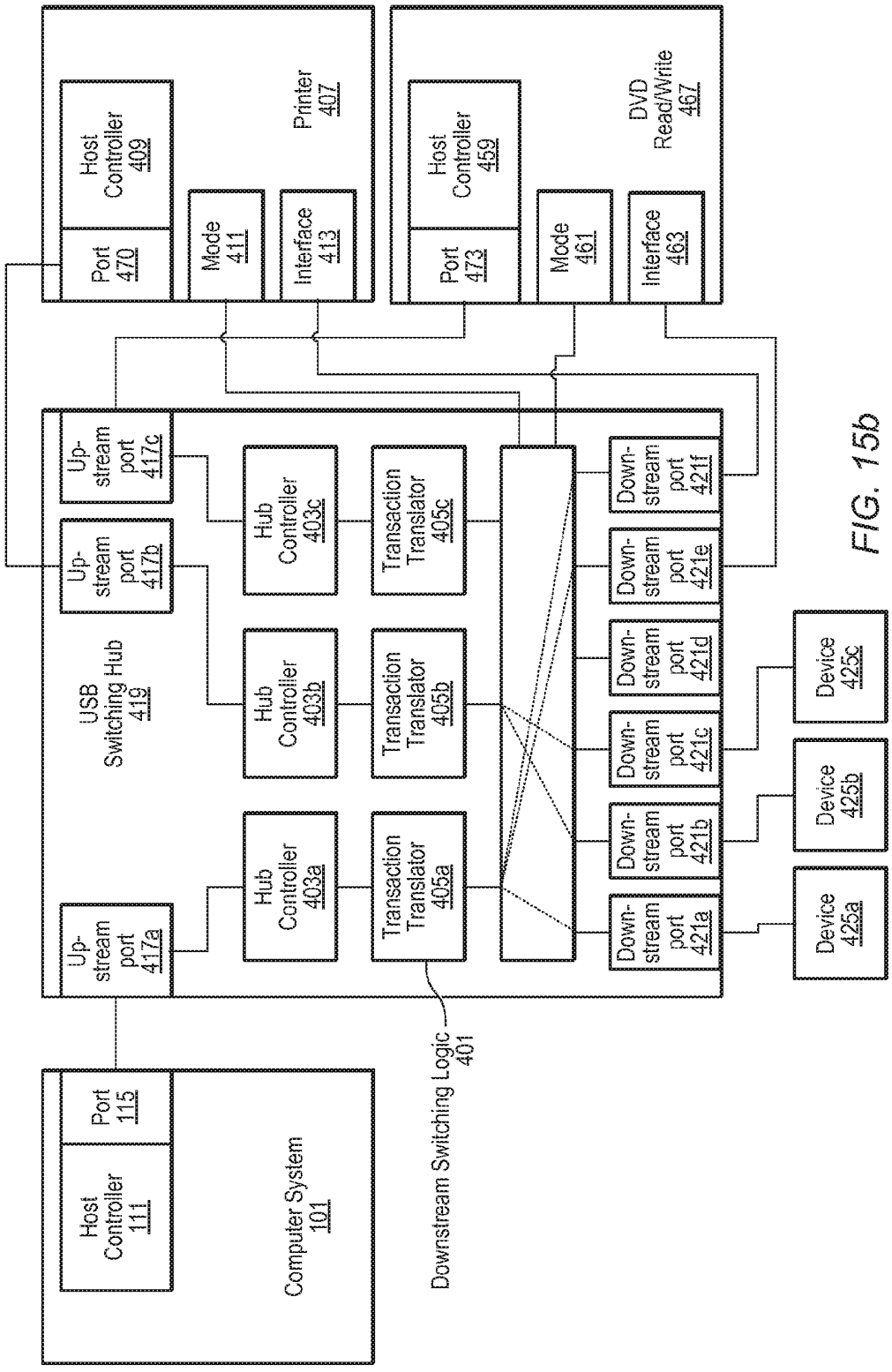

Computer System 101
Host Controller 111
Port 115
Downstream Switching Logic 401
USB Switching Hub 419
Up-stream port 417a
Up-stream port 417b
Up-stream port 417c
Hub Controller 403a
Hub Controller 403b
Hub Controller 403c
Transaction Translator 405a
Transaction Translator 405b
Transaction Translator 405c
Down-stream port 421a
Down-stream port 421b
Down-stream port 421c
Down-stream port 421d
Down-stream port 421e
Down-stream port 421f
Device 425a
Device 425b
Device 425c
Printer 407
Host Controller 409
Port 470
Mode 411
Interface 413
DVD Read/Write 467
Host Controller 459
Port 473
Mode 461
Interface 463

FIG. 15b

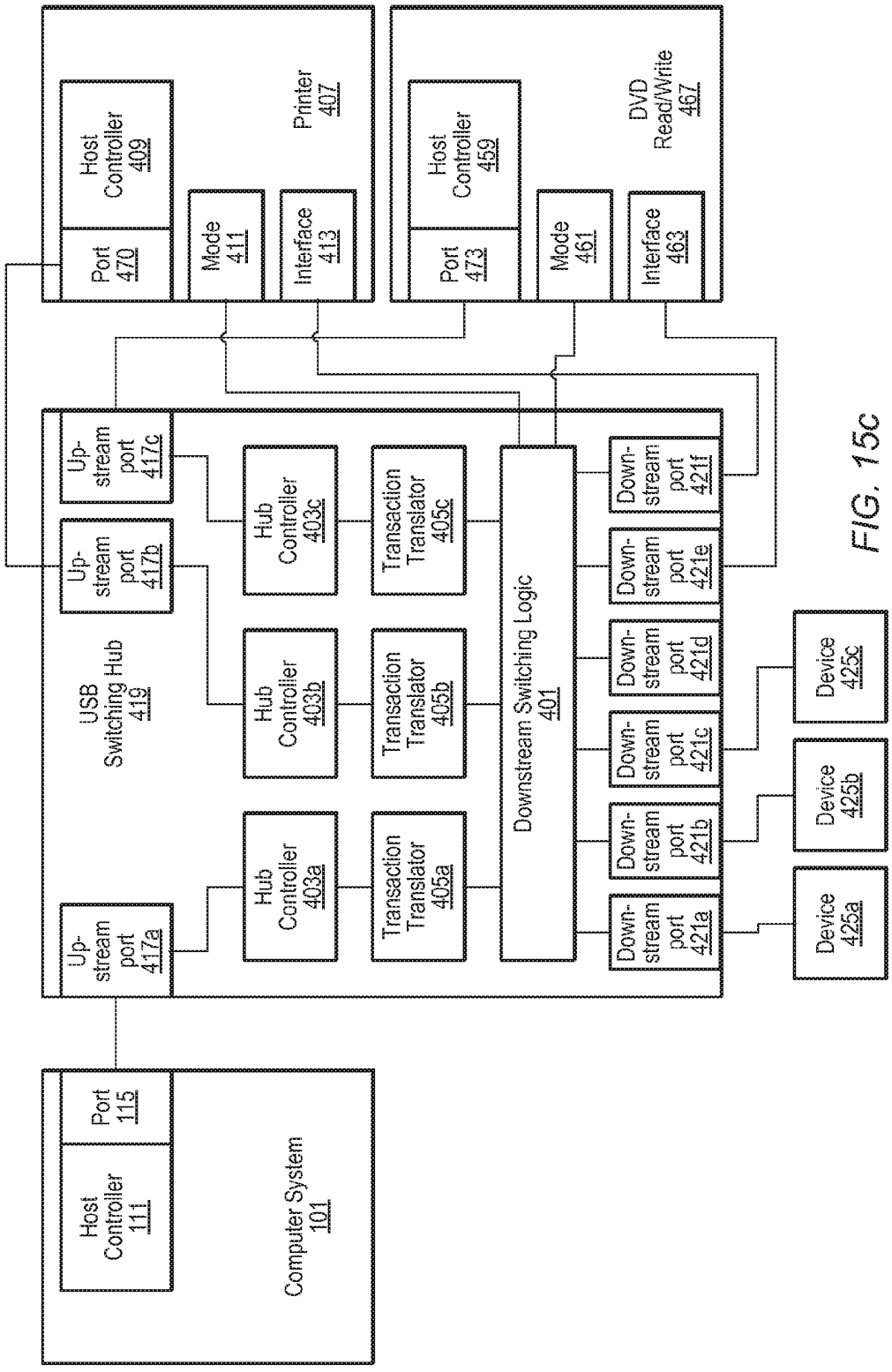

Computer System 101
Host Controller 111
Port 115
USB Switching Hub 419
Up-stream port 417a
Up-stream port 417b
Up-stream port 417c
Hub Controller 403a
Hub Controller 403b
Hub Controller 403c
Transaction Translator 405a
Transaction Translator 405b
Transaction Translator 405c
Downstream Switching Logic 401
Down-stream port 421a
Down-stream port 421b
Down-stream port 421c
Down-stream port 421d
Down-stream port 421e
Down-stream port 421f
Device 425a
Device 425b
Device 425c
Printer 407
Host Controller 409
Port 470
Mode 411
Interface 413
DVD Read/Write 467
Host Controller 459
Port 473
Mode 461
Interface 463

FIG. 15c

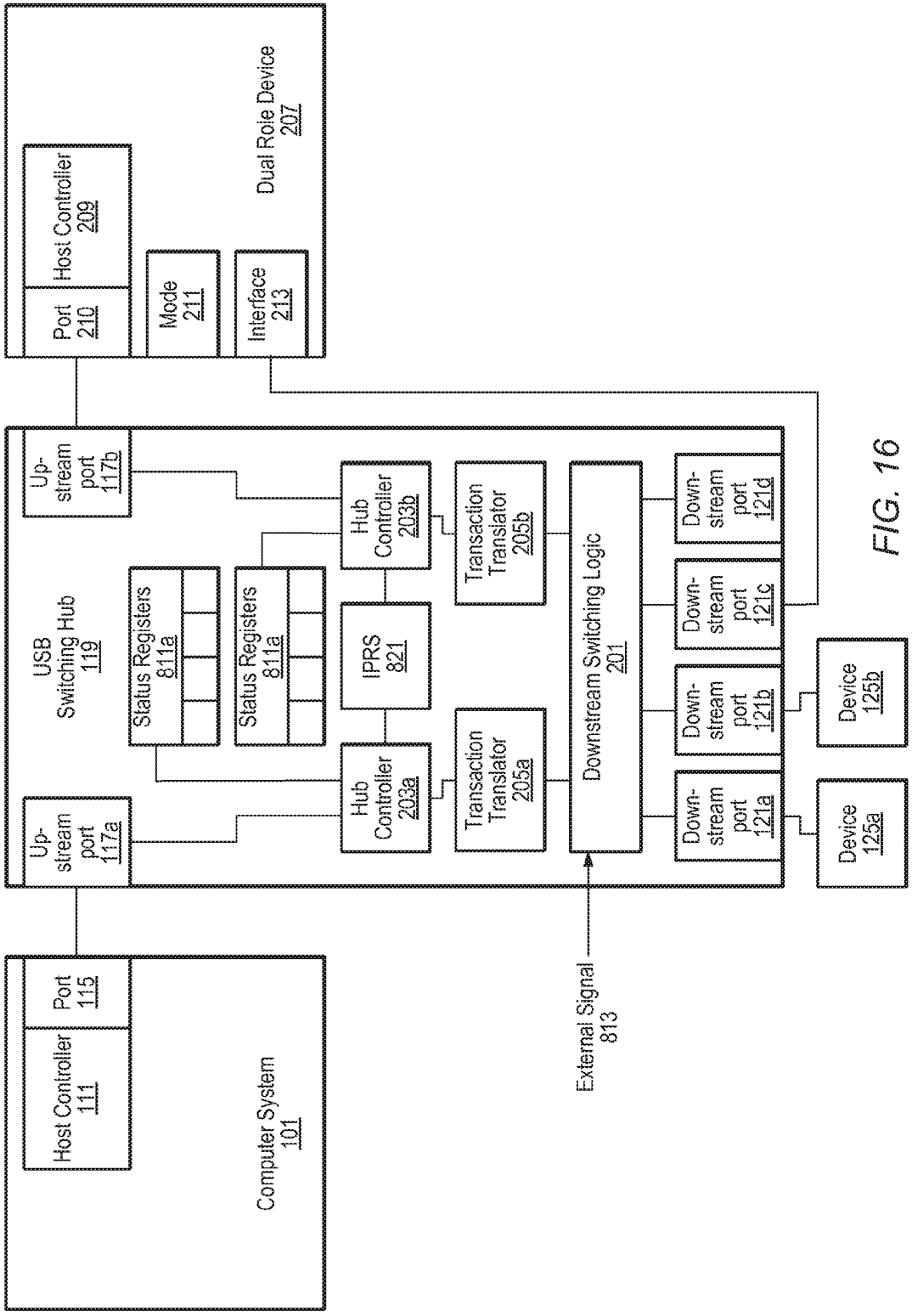


FIG. 16

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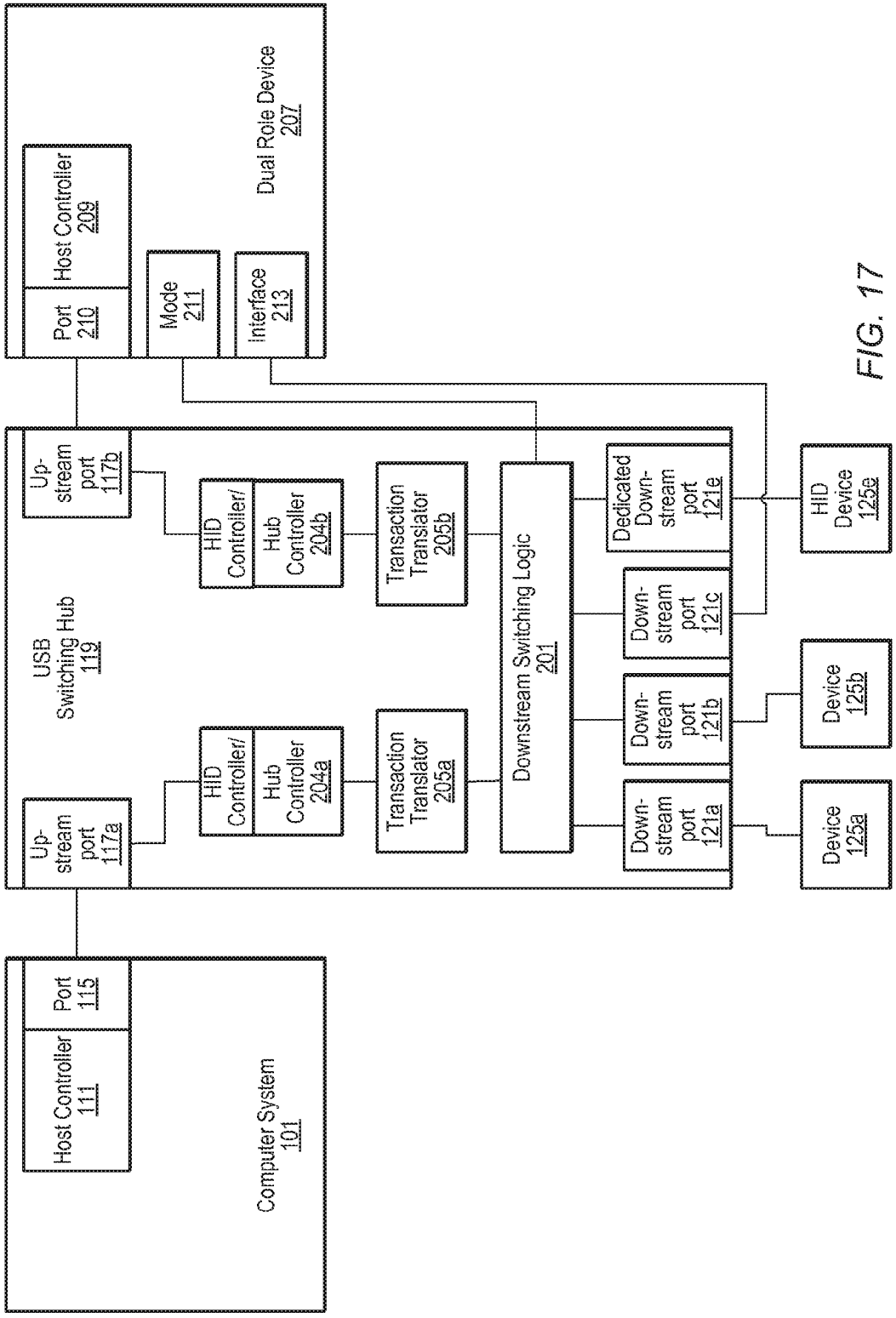

Computer System 101
Host Controller 111
Port 115
Dual Role Device 207
Host Controller 209
Port 210
Mode 211
Interface 213
USB Switching Hub 119
Up-stream port 117a
Up-stream port 117b
HID Controller/ Hub Controller 204a
HID Controller/ Hub Controller 204b
Transaction Translator 205a
Transaction Translator 205b
Downstream Switching Logic 201
Down-stream port 121a
Down-stream port 121b
Down-stream port 121c
Dedicated Down-stream port 121e
Device 125a
Device 125b
HID Device 125e

FIG. 17

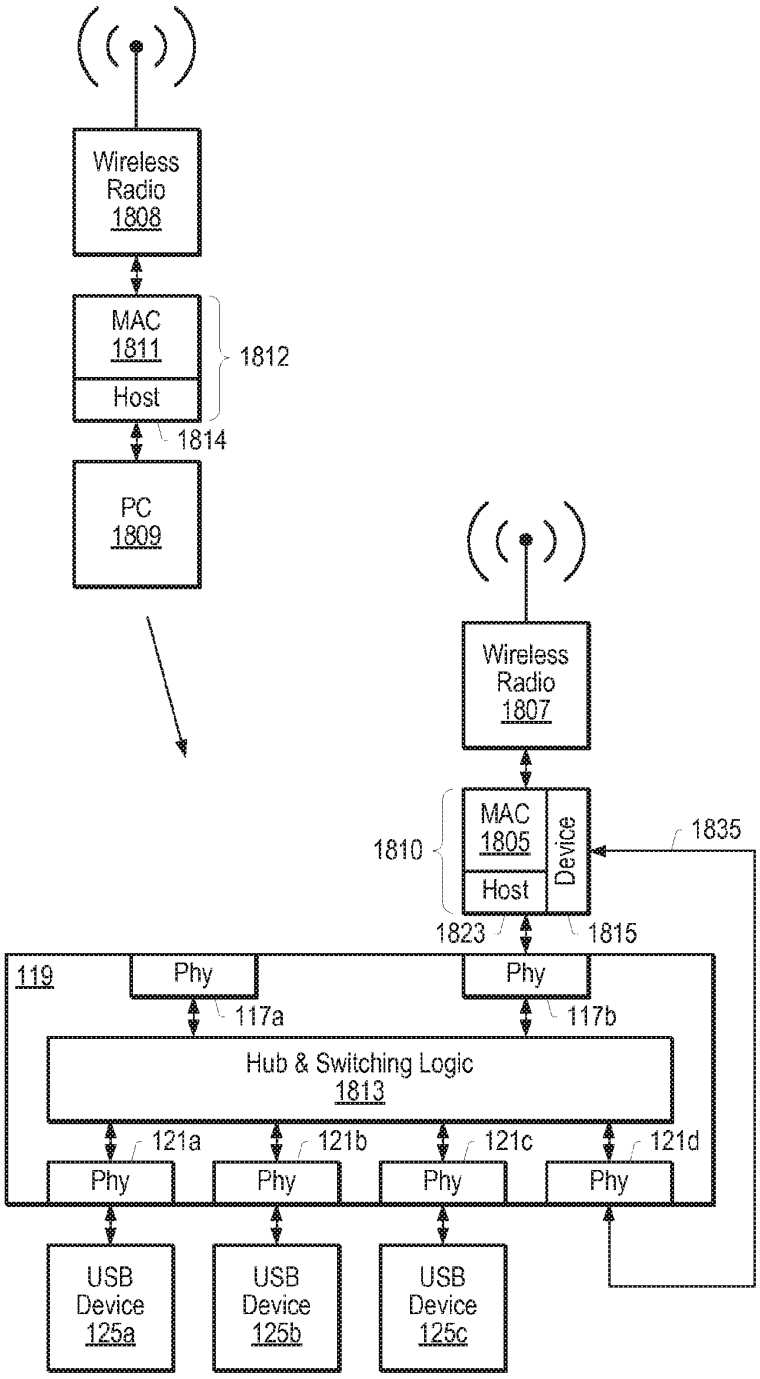

Wireless Radio 1808
MAC 1811
Host
1812
1814
PC 1809
Wireless Radio 1807
MAC 1805
Device
Host
1810
1835
1823
1815
119
Phy
Phy
117a
117b
Hub & Switching Logic 1813
121a
121b
121c
121d
Phy
Phy
Phy
Phy
USB Device 125a
USB Device 125b
USB Device 125c

FIG. 18a

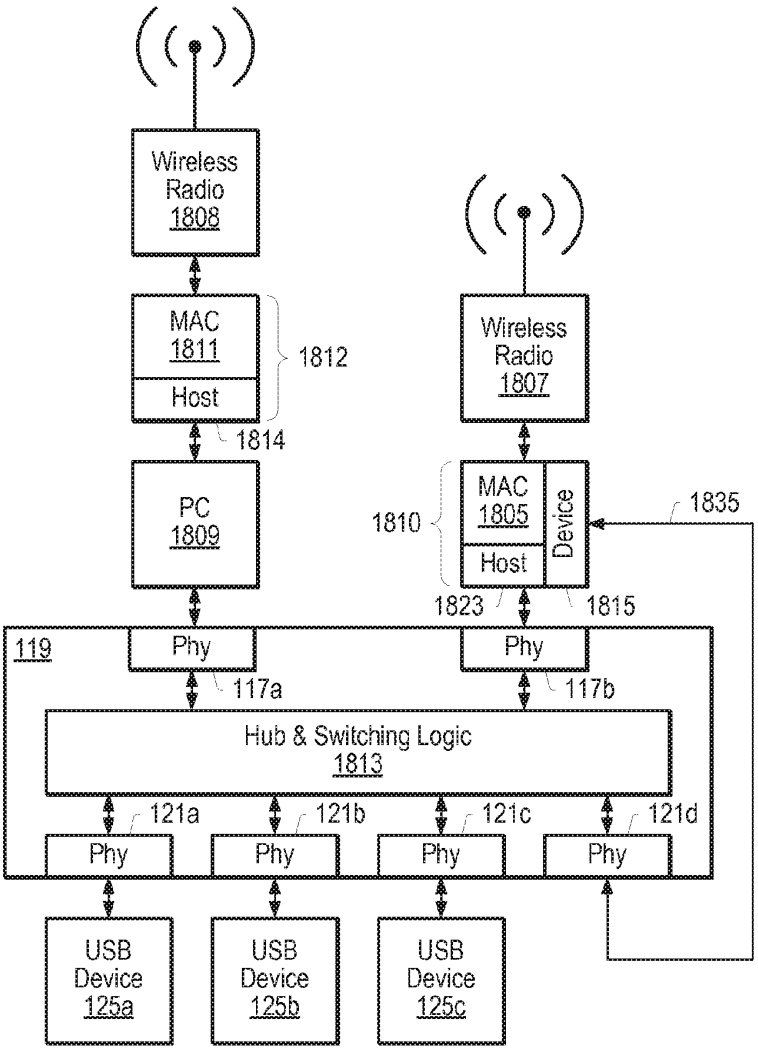

Wireless Radio 1808
MAC 1811
Host
1812
1814
PC 1809
Wireless Radio 1807
1810
MAC 1805
Device
Host
1835
1823
1815
119
Phy
Phy
117a
117b
Hub & Switching Logic 1813
121a
121b
121c
121d
Phy
Phy
Phy
Phy
USB Device 125a
USB Device 125b
USB Device 125c

FIG. 18b

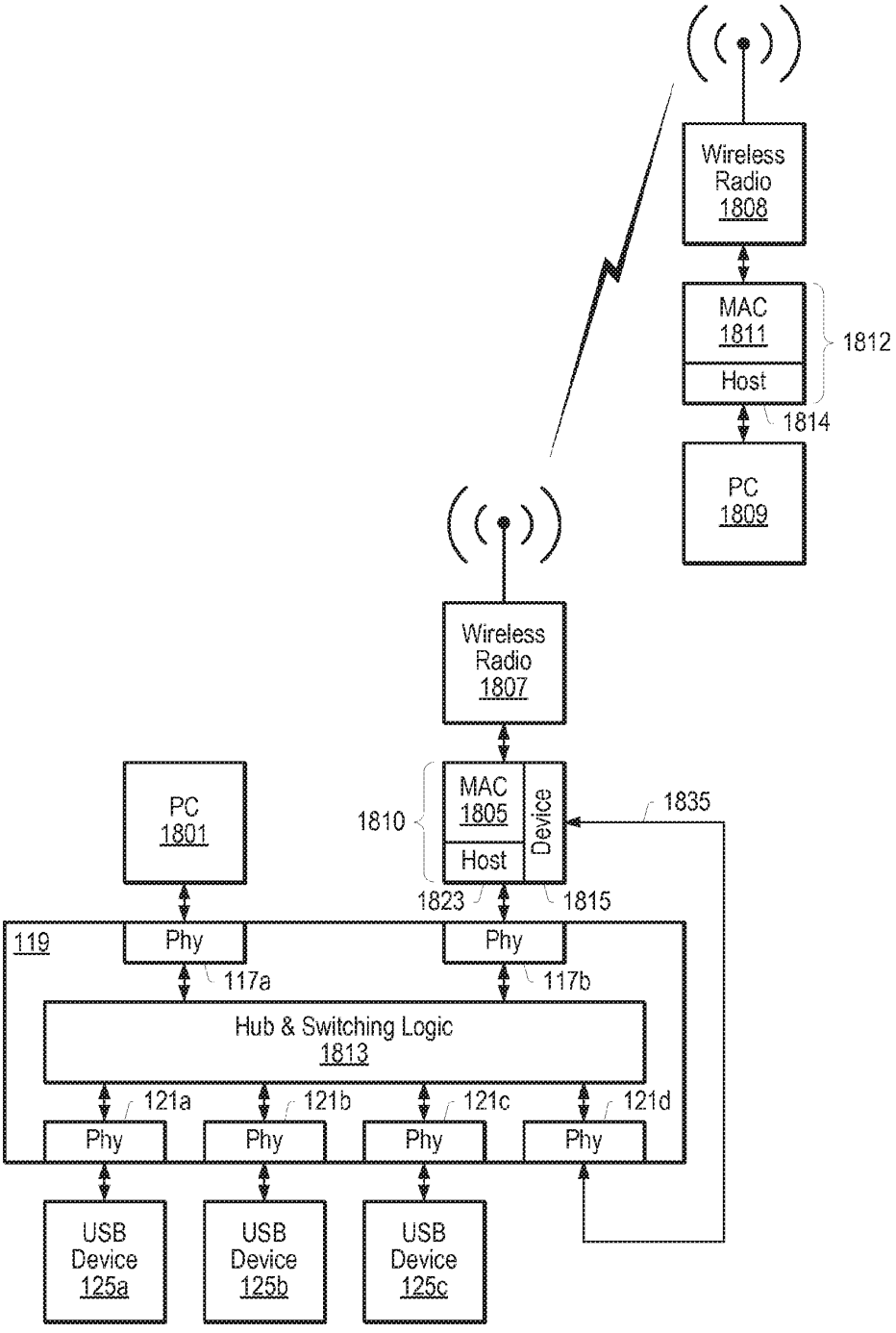

Wireless Radio 1808
MAC 1811
Host
1812
1814
PC 1809
Wireless Radio 1807
PC 1801
1810
MAC 1805
Device
Host
1835
1823
1815
119
Phy
Phy
117a
117b
Hub & Switching Logic 1813
121a
121b
121c
121d
Phy
Phy
Phy
Phy
USB Device 125a
USB Device 125b
USB Device 125c

FIG. 18c

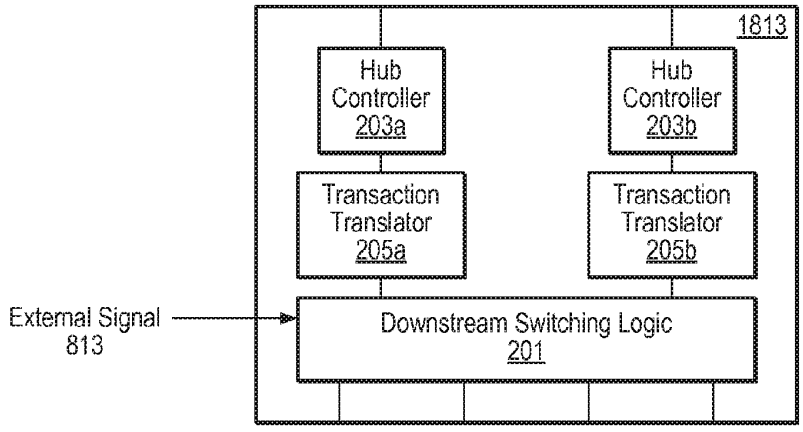


FIG. 18d

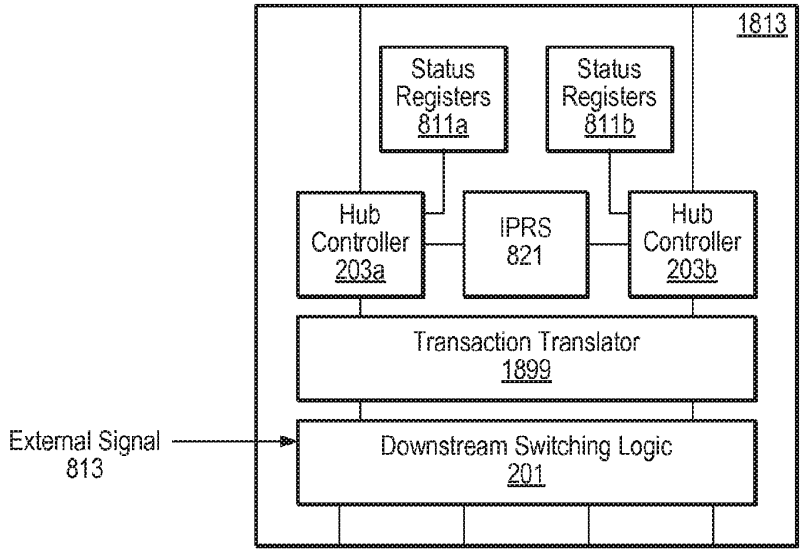


FIG. 18e

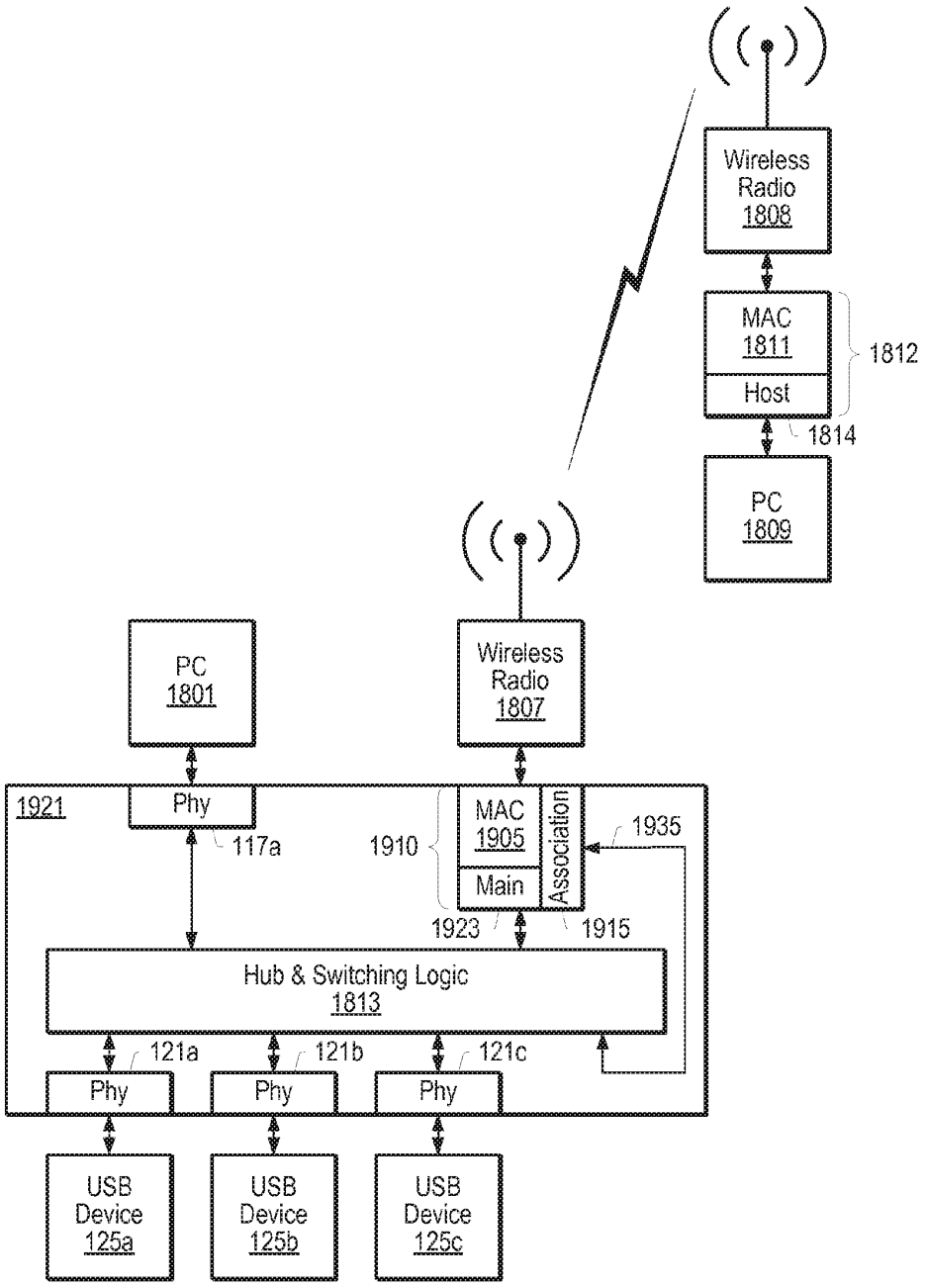


FIG. 19

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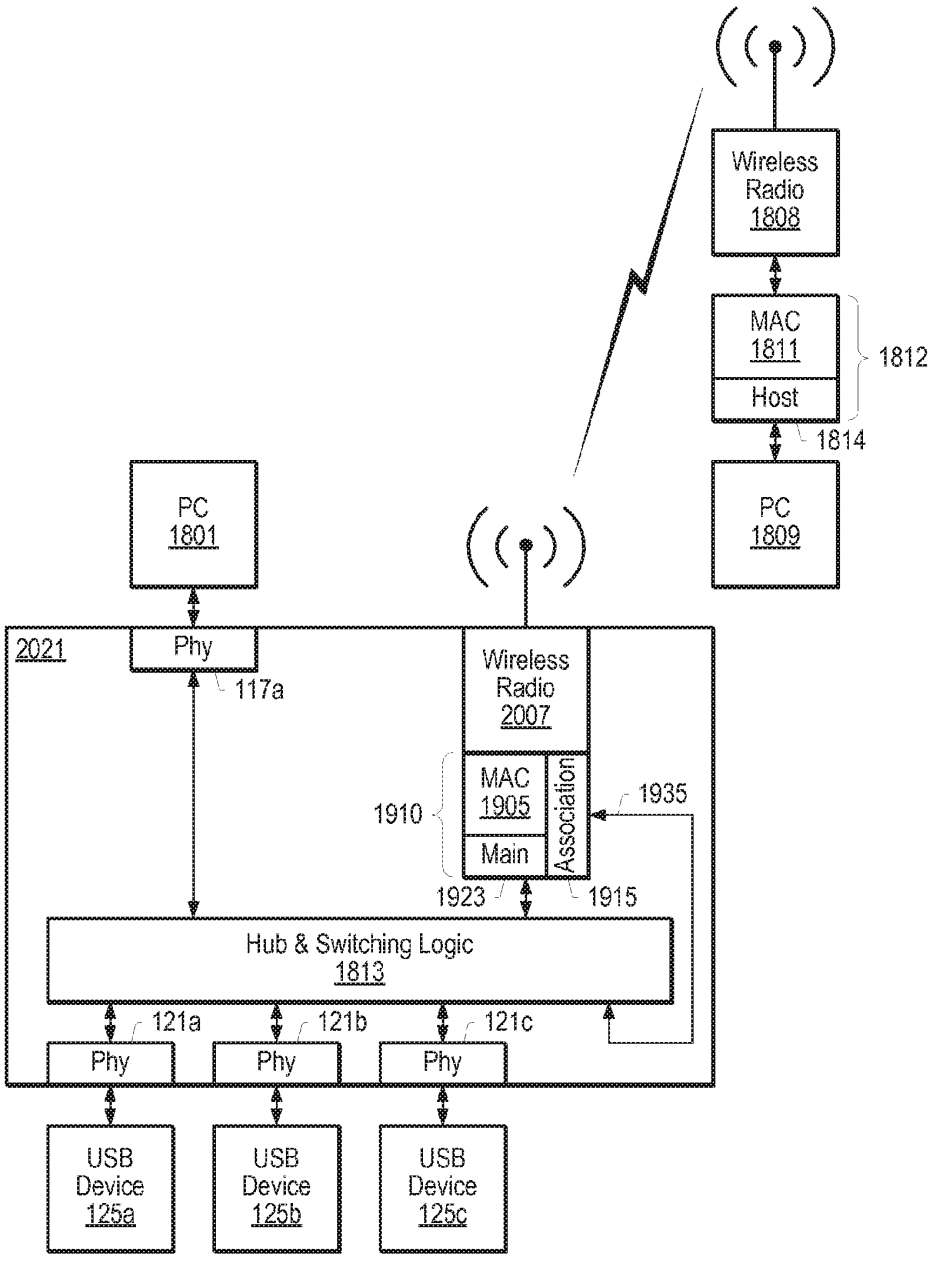

Wireless Radio 1808
MAC 1811
Host
1812
1814
PC 1809
PC 1801
2021
Phy
117a
Wireless Radio 2007
MAC 1905
Association
1910
1935
Main
1923
1915
Hub & Switching Logic 1813
121a
121b
121c
Phy
Phy
Phy
USB Device 125a
USB Device 125b
USB Device 125c

FIG. 20

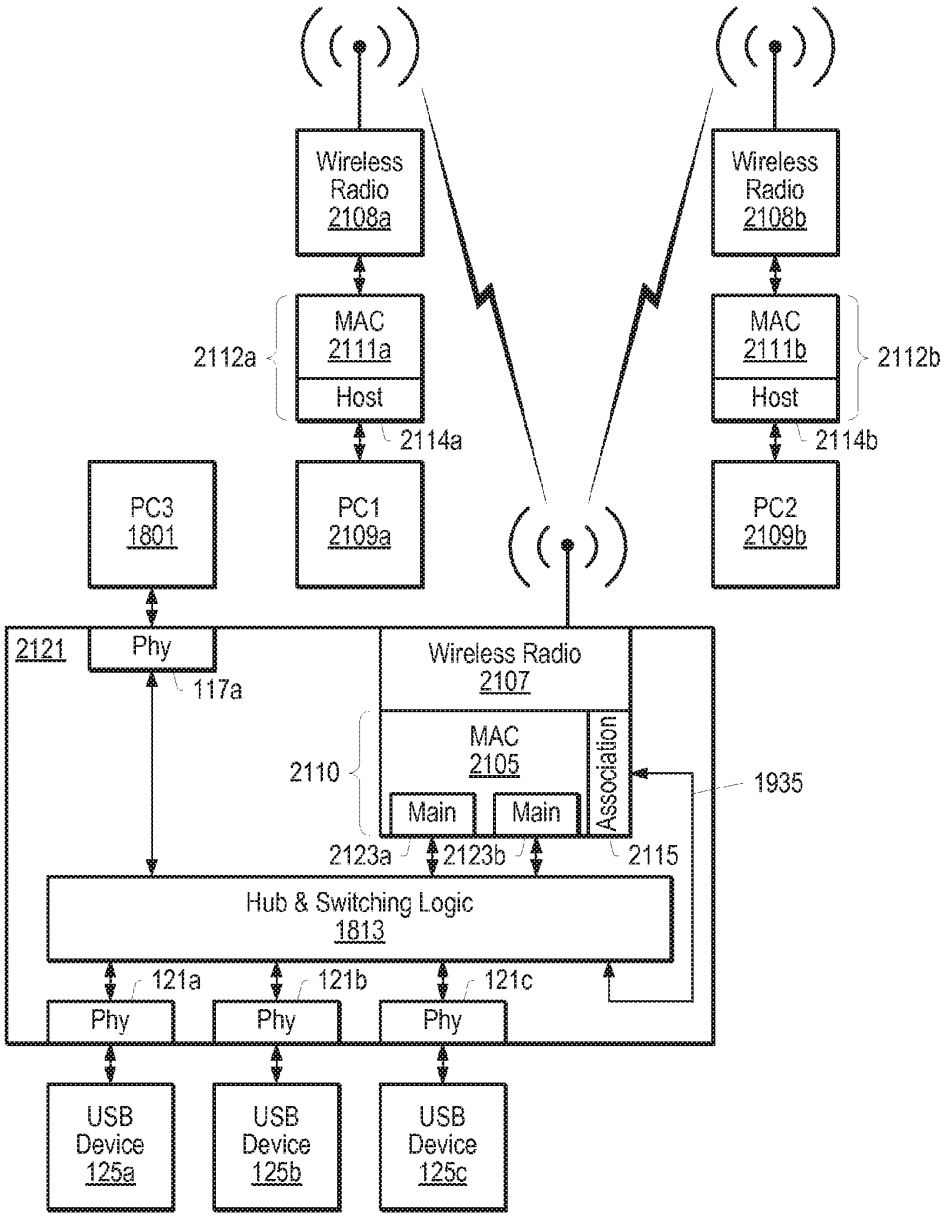

Wireless Radio 2108a
Wireless Radio 2108b
MAC 2111a
Host
2112a
MAC 2111b
Host
2112b
2114a
2114b
PC3 1801
PC1 2109a
PC2 2109b
2121
Phy
117a
Wireless Radio 2107
MAC 2105
Association
2110
Main
Main
1935
2123a
2123b
2115
Hub & Switching Logic 1813
121a
121b
121c
Phy
Phy
Phy
USB Device 125a
USB Device 125b
USB Device 125c

FIG. 21

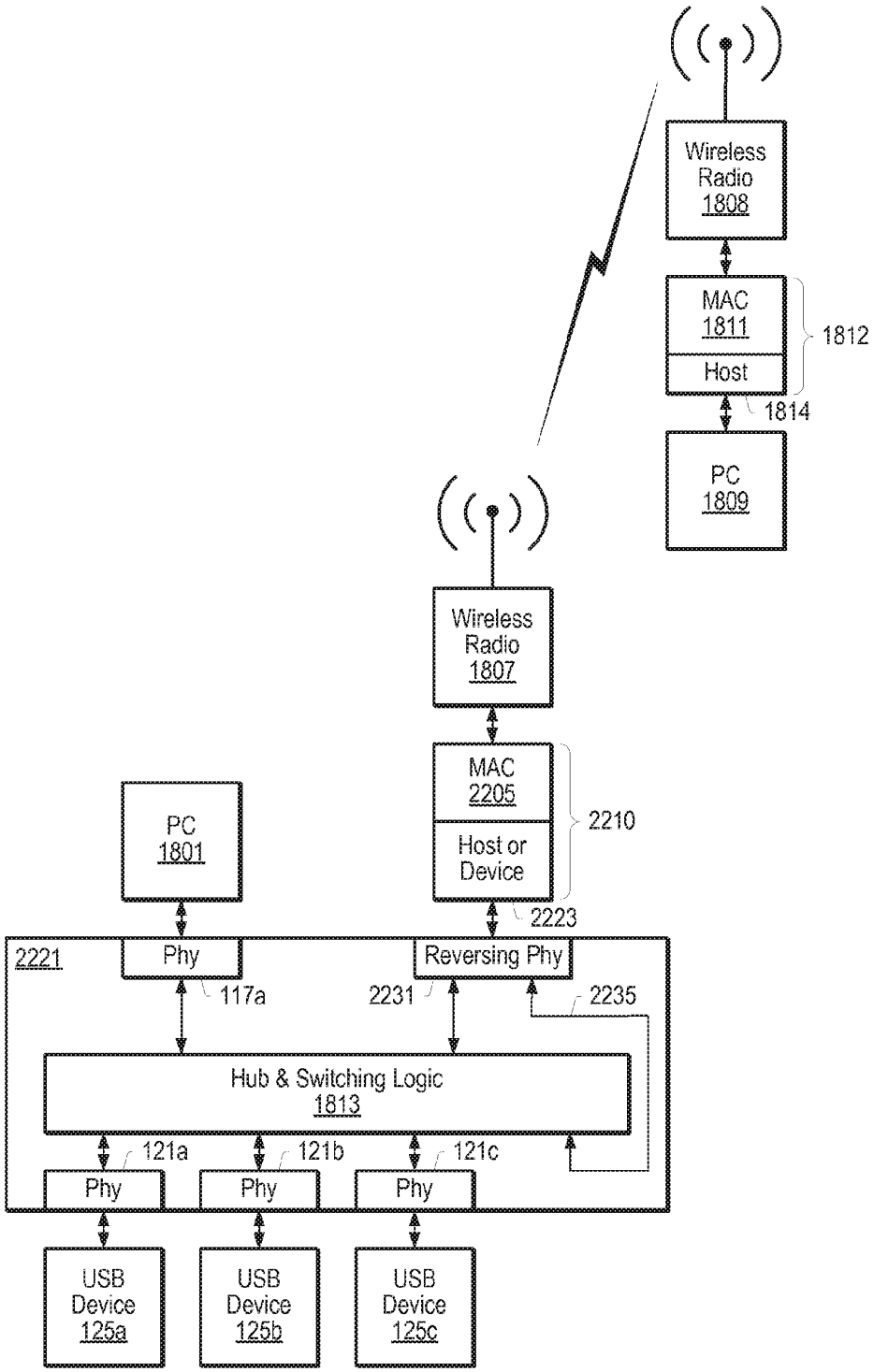

Wireless Radio 1808
MAC 1811
Host
1812
1814
PC 1809
Wireless Radio 1807
MAC 2205
Host or Device
2210
2223
PC 1801
2221
Phy
117a
Reversing Phy
2231
2235
Hub & Switching Logic 1813
121a
121b
121c
Phy
Phy
Phy
USB Device 125a
USB Device 125b
USB Device 125c

FIG. 22

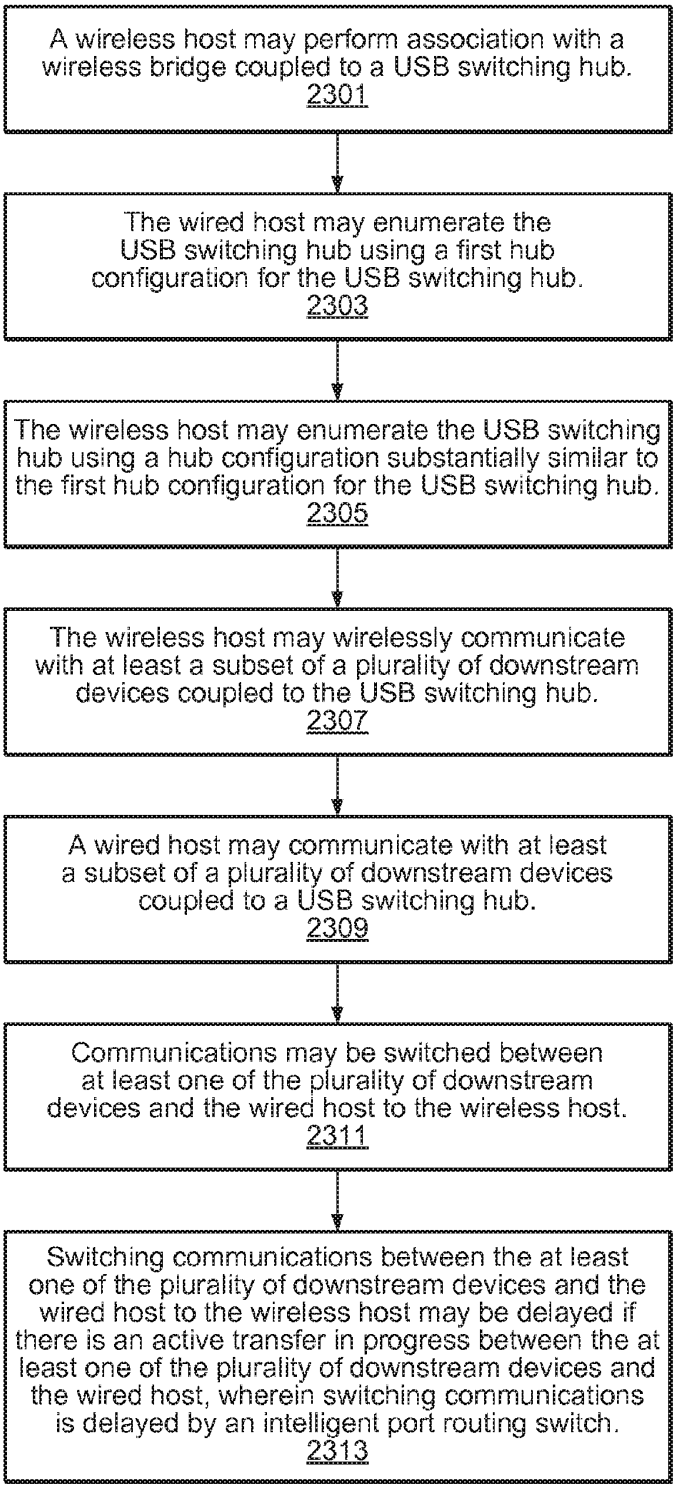


FIG. 23

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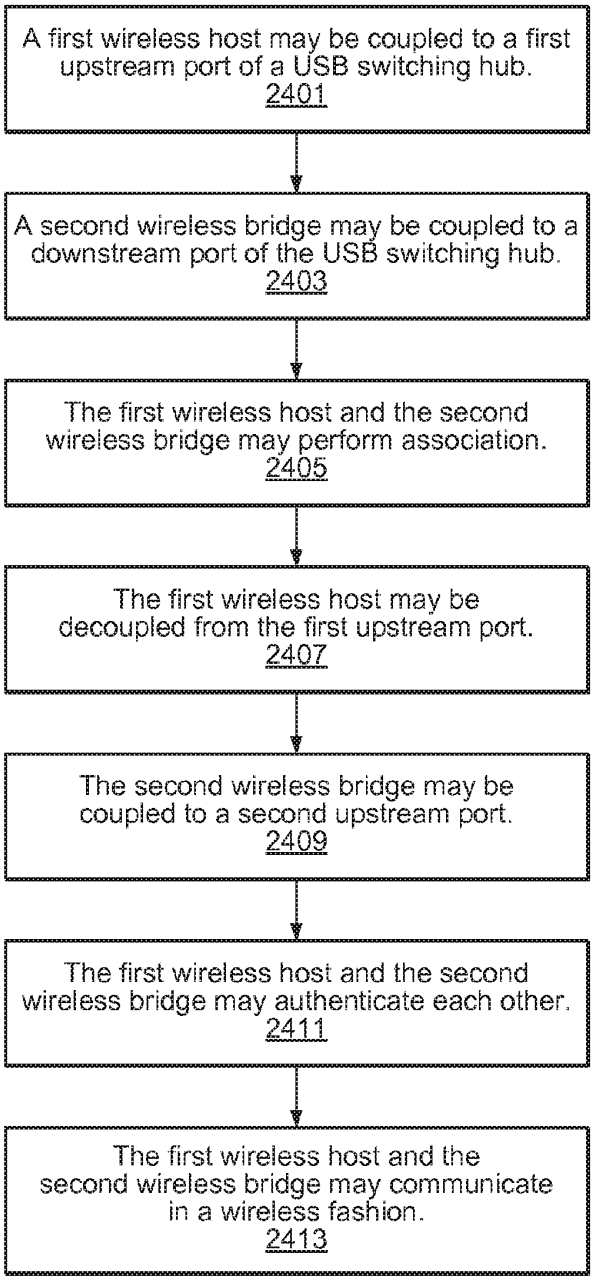

A first wireless host may be coupled to a first upstream port of a USB switching hub.
2401
A second wireless bridge may be coupled to a downstream port of the USB switching hub.
2403
The first wireless host and the second wireless bridge may perform association.
2405
The first wireless host may be decoupled from the first upstream port.
2407
The second wireless bridge may be coupled to a second upstream port.
2409
The first wireless host and the second wireless bridge may authenticate each other.
2411
The first wireless host and the second wireless bridge may communicate in a wireless fashion.
2413

FIG. 24

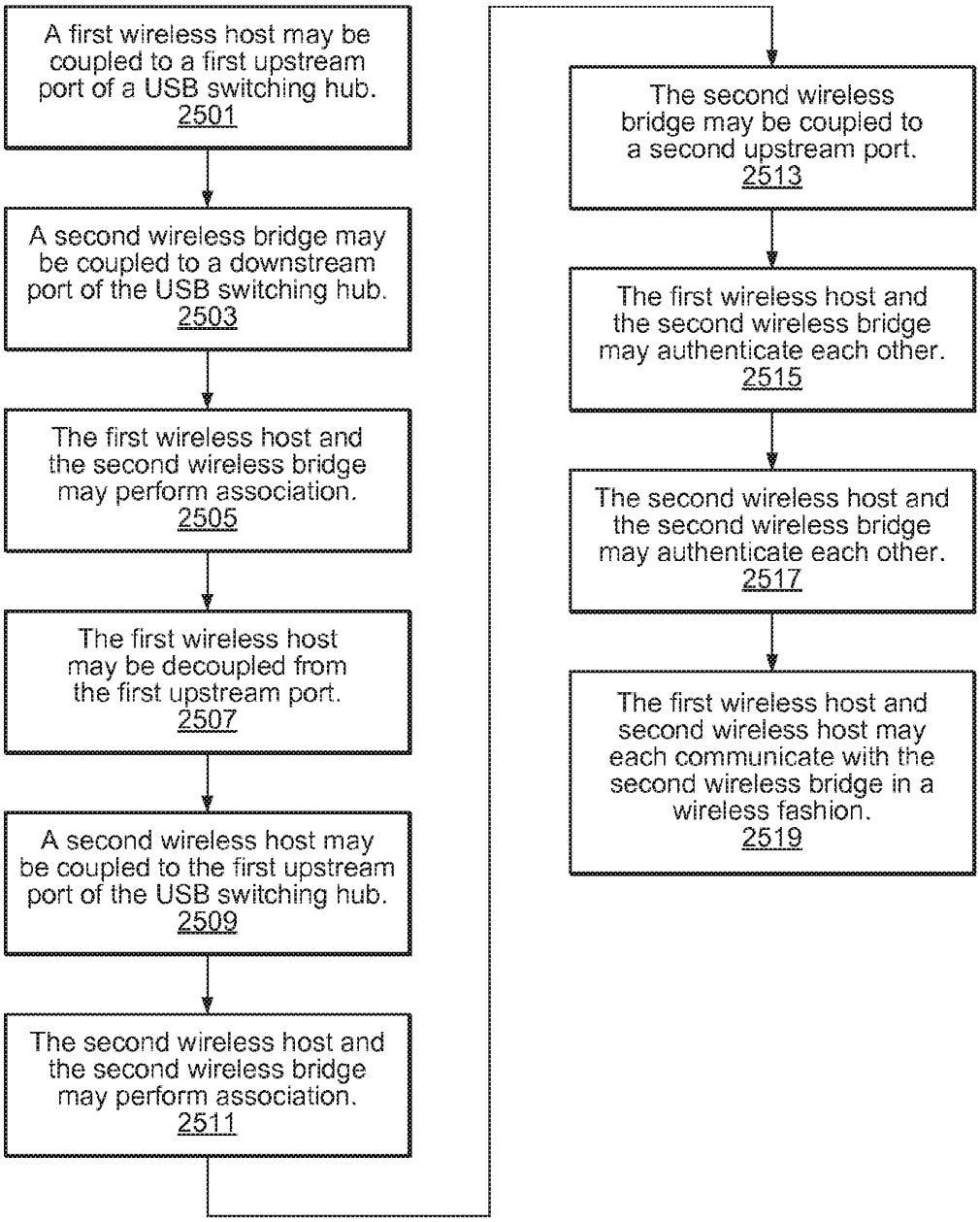

A first wireless host may be coupled to a first upstream port of a USB switching hub. 2501
A second wireless bridge may be coupled to a downstream port of the USB switching hub. 2503
The first wireless host and the second wireless bridge may perform association. 2505
The first wireless host may be decoupled from the first upstream port. 2507
A second wireless host may be coupled to the first upstream port of the USB switching hub. 2509
The second wireless host and the second wireless bridge may perform association. 2511
The second wireless bridge may be coupled to a second upstream port. 2513
The first wireless host and the second wireless bridge may authenticate each other. 2515
The second wireless host and the second wireless bridge may authenticate each other. 2517
The first wireless host and second wireless host may each communicate with the second wireless bridge in a wireless fashion. 2519

FIG. 25

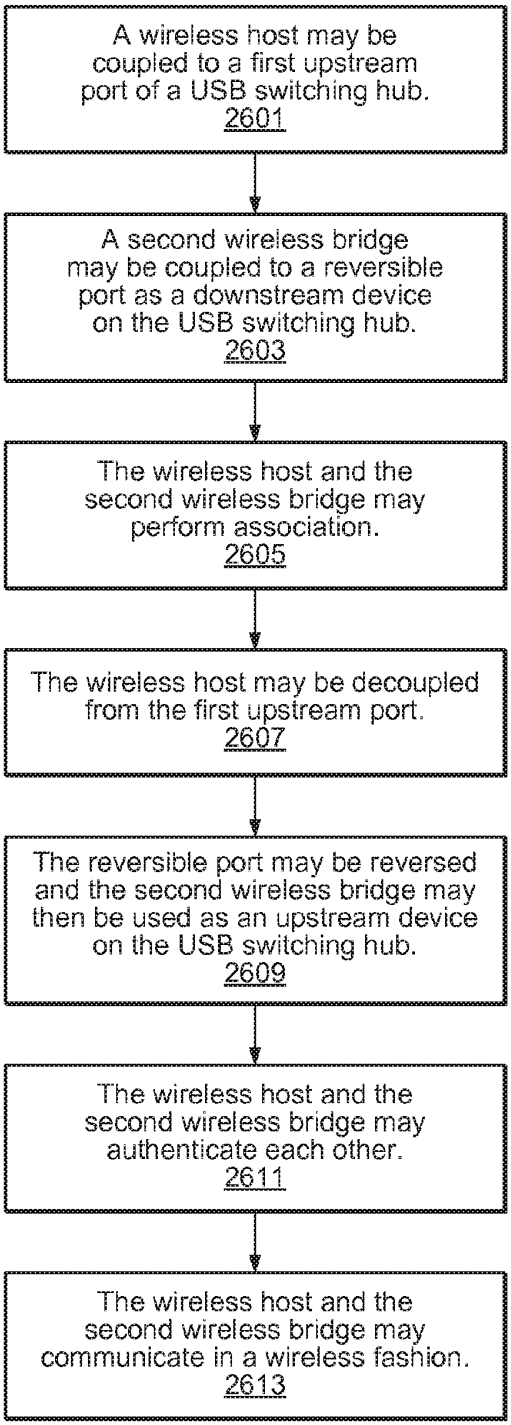

A wireless host may be coupled to a first upstream port of a USB switching hub.
2601
A second wireless bridge may be coupled to a reversible port as a downstream device on the USB switching hub.
2603
The wireless host and the second wireless bridge may perform association.
2605
The wireless host may be decoupled from the first upstream port.
2607
The reversible port may be reversed and the second wireless bridge may then be used as an upstream device on the USB switching hub.
2609
The wireless host and the second wireless bridge may authenticate each other.
2611
The wireless host and the second wireless bridge may communicate in a wireless fashion.
2613

FIG. 26

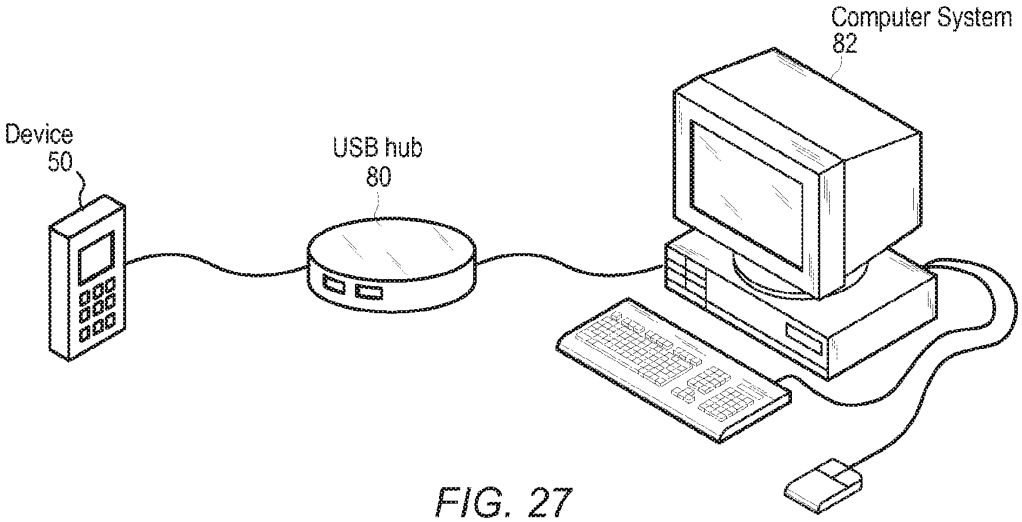

Computer System
82
Device
50
USB hub
80

FIG. 27

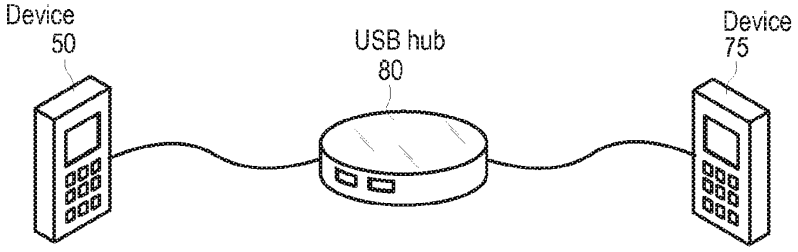

Device
50
USB hub
80
Device
75

FIG. 28

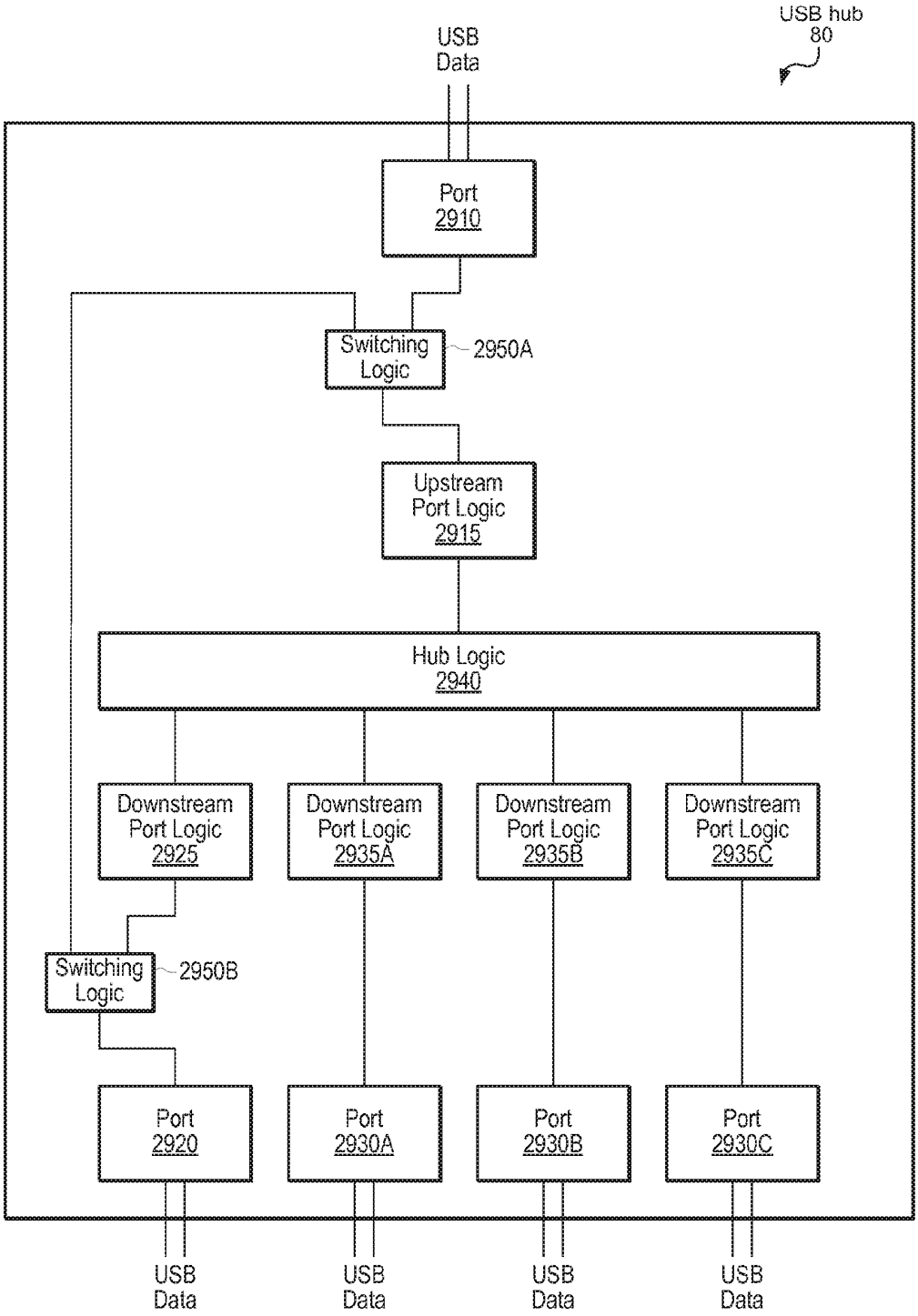

USB hub
80
USB
Data
Port
2910
Switching
Logic
2950A
Upstream
Port Logic
2915
Hub Logic
2940
Downstream
Port Logic
2925
Downstream
Port Logic
2935A
Downstream
Port Logic
2935B
Downstream
Port Logic
2935C
Switching
Logic
2950B
Port
2920
Port
2930A
Port
2930B
Port
2930C
USB
Data
USB
Data
USB
Data
USB
Data

FIG. 29

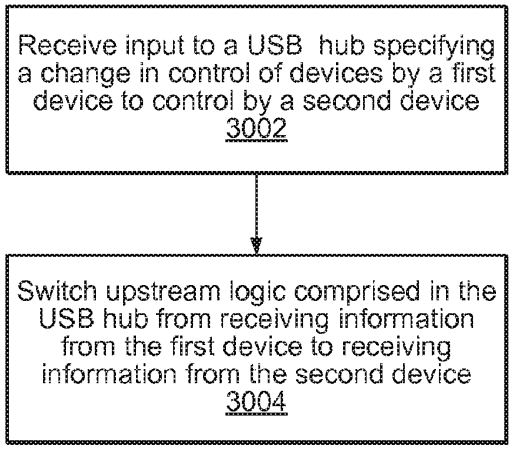


FIG. 30

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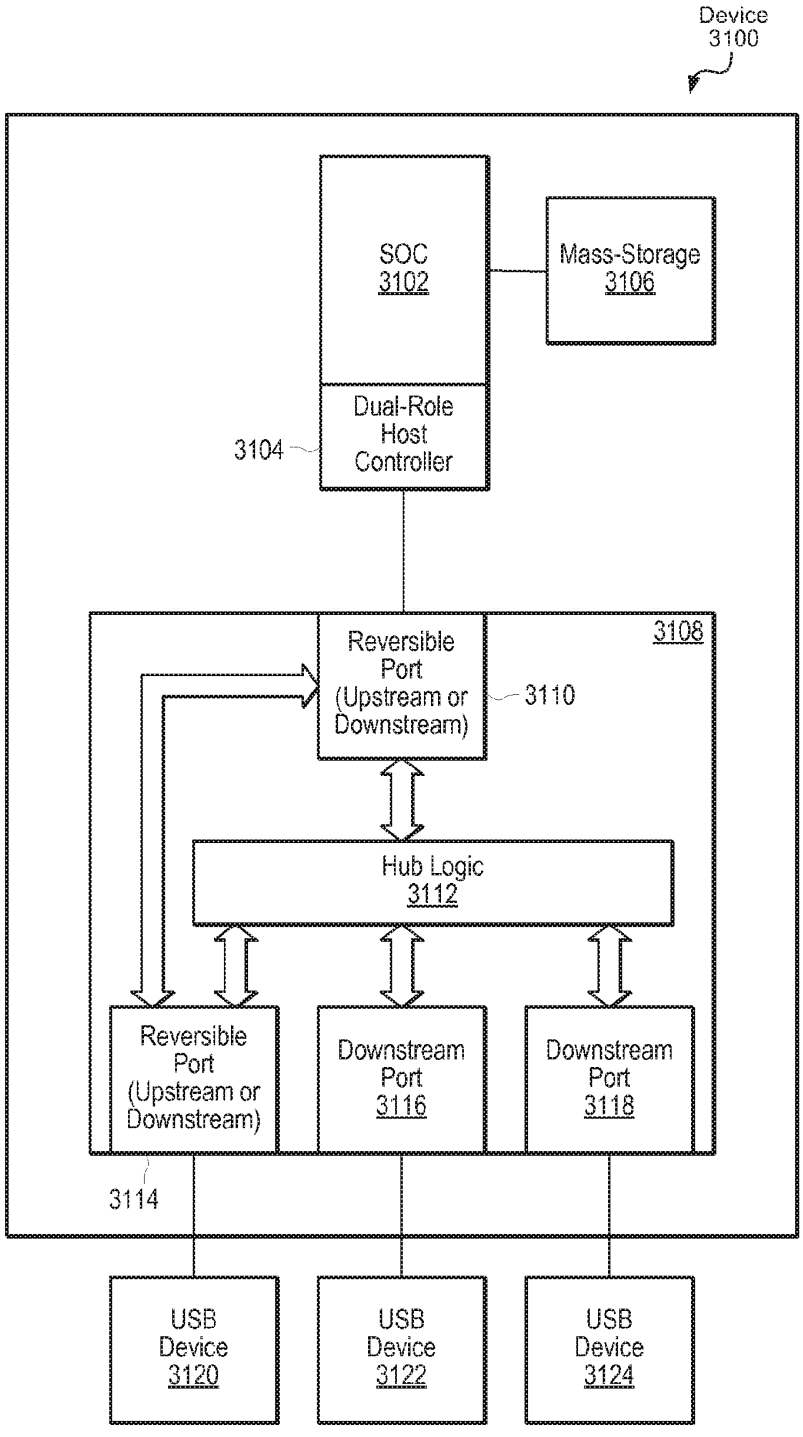


FIG. 31

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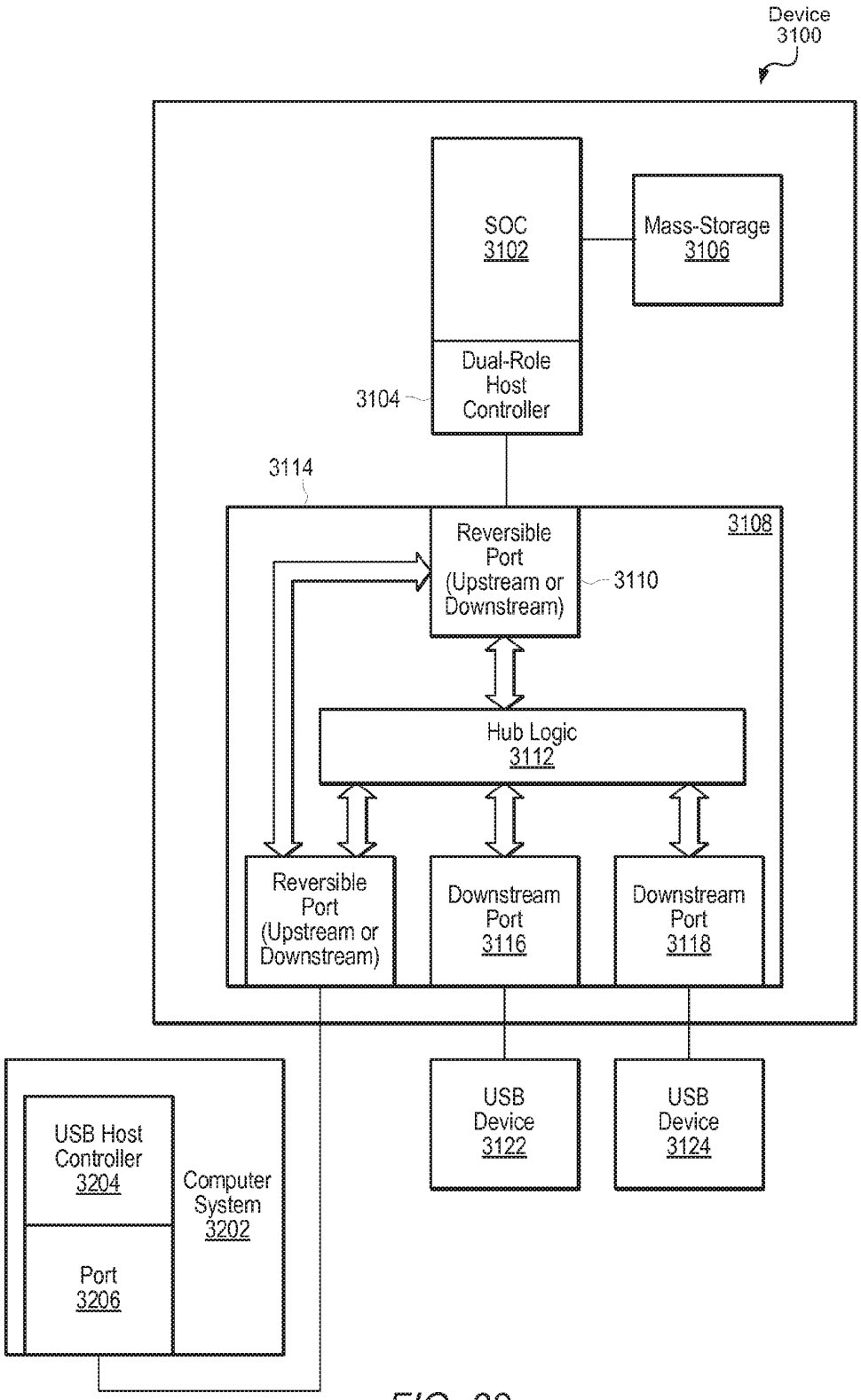


FIG. 32

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Espacenet

Bibliographic data: JP2003256351 (A) — 2003-09-12

USB HUB

Inventor(s): FURUKAWA TADAO ± (FURUKAWA TADAO)

Applicant(s): YAMAHA CORP ± (YAMAHA CORP)

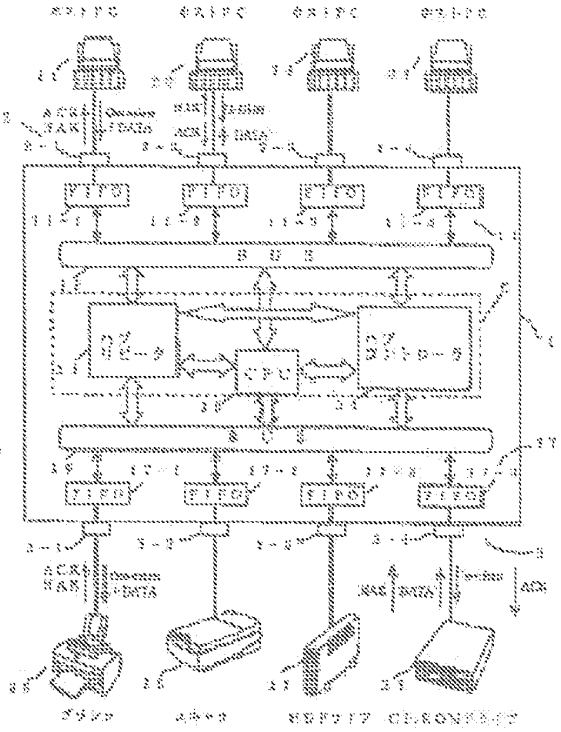
Classification: **- international:** ***G06F13/14;*** (IPC1-7): G06F13/14
- cooperative:

Application number: JP20020056792 20020304 Global Dossier

Priority number(s): JP20020056792 20020304

Abstract of JP2003256351 (A)

PROBLEM TO BE SOLVED: To provide an USB hub, in which a plurality of host computers is capable of jointly owning peripheral equipment and switching operations are needless. ;SOLUTION: The USB hub comprises; a plurality of connecting ports 2 capable of connecting with a plurality of host computers 21 to 24 that packet- transmit and receive data assigned addresses; a plurality of connecting ports 3 capable of connecting with a plurality of peripheral equipment 25 to 28 that packet-transmit and receive data assigned addresses; FIFO memories 11 and 17 temporarily storing packet data inputted from the ports 2 and 3; and a control circuit C establishing connection between the host computers 21 to 24 and peripheral equipment 25 to 28 and controlling transmission of data at the basis of address information of the peripheral equipment 25 to 28 added to the packet data stored in the FIFO memories 11 and 17. ;COPYRIGHT: (C)2003,JPO



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Microchip Ex. 1010, p. 201
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特開2003－256351
（Ｐ2003－256351Ａ）
(43)公開日　平成15年９月12日(2003.9.12)

(51)Int.Cl.⁷	識別記号	Ｆ Ｉ	ﾃｰﾏｺｰﾄﾞ(参考)
Ｇ０６Ｆ　13/14	３１０	Ｃ０６Ｆ　13/14	３１０Ｄ　５Ｂ０１４

審査請求　未請求　請求項の数４　ＯＬ　（全５頁）

(21)出願番号　特願2002－56792(Ｐ2002－56792)

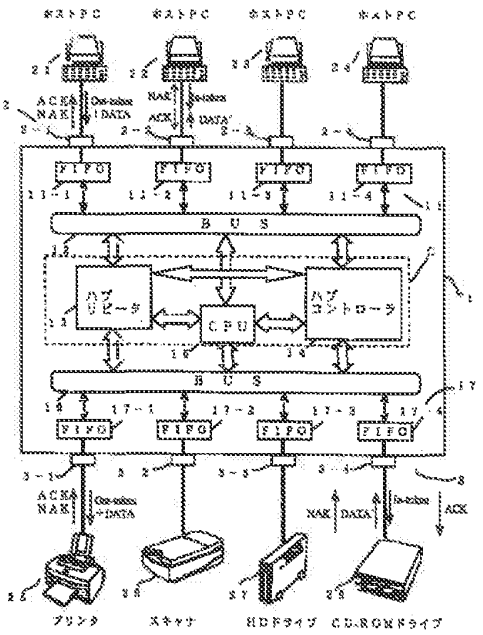
(22)出願日　平成14年３月４日(2002.3.4)

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ヤマハ株式会社
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静岡県浜松市中沢町10番１号　ヤマハ株式会社内
(74)代理人　100092820
弁理士　伊丹　勝

Ｆターム(参考)　5B014 HA11

(54)【発明の名称】　ＵＳＢハブ

(57)【要約】
【課題】　複数のホストコンピュータが周辺機器を共有することができ、かつ切替操作が不要なＵＳＢハブを提供する。
【解決手段】　アドレスを割り当てられデータをパケット送受信する複数台のホストコンピュータ２１－２４を接続可能とした複数個の接続ポート２と、アドレスを割り当てられデータを送受信する複数台の周辺機器２５－２８を接続可能とした複数個の接続ポート３と、これらのポート２，３から入力されるパケットデータを一時保持するＦＩＦＯメモリ１１，１７と、このＦＩＦＯメモリ１１，１７に保持されたパケットデータに付加された前記周辺機器２５－２８のアドレス情報に基づき、ホストコンピュータ２１－２４と前記周辺機器２５－２８との間の接続を確立しデータの転送を制御する制御回路Ｃとを備えた。



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【特許請求の範囲】
【請求項１】　アドレスを割り当てられパケットデータを送受信する複数台のホストコンピュータを接続可能とした複数個の第１ポートと、
アドレスを割り当てられパケットデータを送受信する複数台の周辺機器を接続可能とした複数個の第２ポートと、
これらの第１ポート及び第２ポートから入力される前記パケットデータを一時保持するＦＩＦＯメモリと、
このＦＩＦＯメモリに保持されたパケットデータに付加された前記周辺機器のアドレス情報に基づき、前記ホストコンピュータと前記周辺機器との間の接続を確立しデータの転送を制御する制御回路とを備えたことを特徴とするＵＳＢハブ。
【請求項２】　前記ＦＩＦＯメモリは、前記ホストコンピュータごとに設けられた請求項１に記載のＵＳＢハブ。
【請求項３】　前記ＦＩＦＯメモリは、前記周辺機器ごとに設けられた請求項１又は２に記載のＵＳＢハブ。
【請求項４】　前記制御回路は、前記周辺機器の１つに対し２台以上の前記ホストコンピュータからデータの送信又は受信の要求があった場合に、前記ホストコンピュータのうちの１つと前記周辺機器の１つとの間の接続を確立させ、他のホストコンピュータからのデータは接続中の前記ホストコンピュータでのデータの送信又は受信が完了するまで前記ＦＩＦＯメモリに一時保持させるようにした請求項１乃至３のいずれか１項に記載のＵＳＢハブ。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、ＵＳＢ（Universal Serial bus）インターフェースに対応した各種周辺機器を複数接続するためのＵＳＢハブに関し、さらに詳しくは、周辺機器だけでなく複数台のコンピュータを接続できるように構成したＵＳＢハブに関する。
【０００２】
【従来の技術】近年、コンピュータと周辺機器とを接続するインターフェースの方式として、ＵＳＢ規格のインターフェースが広く採用されている。コンピュータの電源を入れた状態で接続しても周辺機器の認識が可能であること（ホットプラグ）、階層的な接続をすることにより最大１２７個まで周辺機器を接続可能であるなど、コンピュータの利便性を向上させるのに役立っている。また、このようなＵＳＢ対応機器を複数同時に接続するための装置として、いわゆるＵＳＢハブも普及している。
【０００３】
【発明が解決しようとする課題】しかし、ＵＳＢインターフェースが複数台のホストコンピュータの存在を許さない規格となっていることから、ＵＳＢハブ自体も、単一のコンピュータのみが接続可能になっている。このため、複数のＰＣで１つの周辺機器を共有することは、ＵＳＢハブによっては困難であった。この点、特開2001-51939号公報に記載されたＵＳＢハブは、複数のホストコンピュータを選択的に周辺機器に接続する切替回路を備えており、これにより複数のホストコンピュータを同時に接続可能にしている。しかし、この構成では、複数のホストコンピュータが同時に周辺機器を利用することはできないし、周辺機器の使用を許可するホストコンピュータを切り換える際には逐一切替回路を動作させなければならない。また、切替を行う度に周辺機器のデバイスドライバをロード、アンロードしなければならないことから、切り替えに長い時間を要することになる。この発明は、上述した問題点に鑑みてなされたものであり複数のコンピュータが周辺機器を共有することができ、かつ切替操作が不要なＵＳＢハブを提供することを目的とする。
【０００４】
【課題を解決するための手段】上記目的達成のため、本発明に係るＵＳＢハブは、アドレスを割り当てられパケットデータを送受信する複数台のホストコンピュータを接続可能とした複数個の第１ポートと、アドレスを割り当てられパケットデータを送受信する複数台の周辺機器を接続可能とした複数個の第２ポートと、これらの第１ポート及び第２ポートから入力される前記パケットデータを一時保持するＦＩＦＯメモリと、このＦＩＦＯメモリに保持されたパケットデータに付加された前記周辺機器のアドレス情報に基づき、前記ホストコンピュータと前記周辺機器との間の接続を確立しデータの転送を制御する制御回路とを備えたことを特徴とする。
【０００５】この発明によれば、制御回路により、送信元のホストコンピュータ（又は周辺機器）と送信先の周辺機器（又はホストコンピュータ）との間の接続が前記アドレス情報に基づいて確立されるので、ＵＳＢインターフェースの下でも複数のホストコンピュータの存在が可能となる。また、接続の確立、解除するごとに逐一デバイスドライバをロード、アンロードする煩わしさが無い。
【０００６】この発明において、前記ＦＩＦＯメモリは、前記ホストコンピュータごとに設けるのが好適である。さらに、前記ＦＩＦＯメモリは、前記周辺機器ごとに設けるのが好適である。また、前記制御回路は、前記周辺機器の１つに対し２台以上の前記ホストコンピュータからデータの送信又は受信の要求があった場合に、前記ホストコンピュータのうちの１つと前記周辺機器の１つとの間の接続を確立させ、他のホストコンピュータからのデータは接続中の前記ホストコンピュータでのデータの送信又は受信が完了するまで前記ＦＩＦＯメモリに一時保持させるようにするとよい。このようにすることにより、複数のホストコンピュータからのデータが衝突することが回避される。

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【0007】
【発明の実施の形態】次に、本発明の実施の形態を、図面に基づいて説明する。図1は、本発明の実施の形態に係るUSBハブ1と、このUSBハブ1に接続された複数のホストコンピュータ（以下ホストPCという）21～24及び周辺機器（図1では、プリンタ25、スキャナ26、ハードディスクドライブ27、CD-ROMドライブ28としている）を示している。
【0008】USBハブ1は、複数のホスト側接続ポート2（2-1，2-2，2-3，2-4）と、複数の周辺機器側接続ポート3（3-1，3-2，3-3，3-4）と、複数のホスト側FIFOメモリ11（11-1，11-2，11-3，11-4）と、バス12と、ハブリピータ13と、コントローラ14と、CPU15と、バス16と、複数の周辺機器側FIFOメモリ17（17-1，17-2，17-3，17-4）とを備えている。
【0009】ホスト側接続ポート2-1，2-2，2-3，2-4は、それぞれホストPC21，22，23，24をUSBハブ1に対しUSB接続するためのものである。また、周辺機器側接続ポート3-1，3-2，3-3，3-4は、それぞれ周辺機器としてのプリンタ21，スキャナ22，HDドライブ23，CD-ROMドライブ24をUSBハブ1に対しUSB接続するためのものである。ホスト側FIFOメモリ11-1，11-2，11-3，11-4は、それぞれホスト側接続ポート2-1，2-2，2-3，2-4に接続されており、それぞれホストPC21-24から周辺機器25-28側に送信されるパケットデータ、及び周辺機器25-28側からホストPC21-24側へ転送されるパケットデータを一時保持する役割を有する。
【0010】バス12は、データを伝送するための通信経路である。ハブリピータ13、ハブコントローラ14、CPU15とは、全体としてホストPC21-24と周辺機器25-28との間のデータ伝送を制御する制御回路Cとして機能する。制御回路Cは、ホストPC21-24の1つから周辺機器25-28の1つに対しデータ転送の要求があった場合、その周辺機器の使用状況をチェックし、その周辺機器が使用可能である場合に当該ホストPCと周辺機器との間の接続をセットアップし、データ転送終了後接続を解除するなどの機能を有する。接続のセットアップは、要求元のホストPCと要求先の周辺機器との間で1対1に行われるので、要求先が重複しない限り、複数のホストPCが同時に周辺機器にアクセスすることが可能となっている。
【0011】ハブリピータ13は、ホストPC21-24と周辺機器25-28との間の接続をセットアップ又は解除する機能を有する部分であり、また、ハブコントローラ14は、ホストPC21からUSBハブ1へのデータ伝送を行うためのメカニズムを提供する部分である。また、CPU15は、USB規格に基づいたパケットデータのトラフィック制御及びデータ管理を行う。バス16は、データを伝送するための通信経路である。周辺機器側FIFOメモリ17-1，17-2，17-3，17-4は、それぞれ周辺機器側接続ポート3-1，3-2，3-3，3-4に接続されており、制御回路Cから周辺機器25-28に出力されるべきパケットデータ、及び周辺機器25-28からホストPC21-24側に転送されるパケットデータを一時保持する役割を有する。
【0012】次に、本実施の形態に係るUSBハブ1の作用を、図面に基づいて説明する。以下では、ホストPC21-24から周辺機器25-28へデータを送信する場合と、逆に周辺機器25-28からホストPC21-24にデータ送信する場合とで分けて説明する。
【0013】まず、ホストPC21-24から周辺機器25-28へデータを送信する場合を、図2に示すフローチャートに基づいて説明する。この場合、最初にデータ送信を希望するホストPCが、送信を希望するパケットデータDATA 及びout-tokenパケットを出力する（S1）。ここでは、ホストPC21からプリンタ25へデータが出力されるものとする。パケットデータDATAのヘッダには、送信先のプリンタ25のアドレスが付加されている。out-tokenパケットは、ホストPCが周辺機器へデータ転送を指示する場合に出力されるコマンドパケットであり、そのヘッダには送信先の周辺機器（この場合プリンタ25）のアドレスが付加されている。
【0014】次に、S2において、このパケットデータDATA及びout-tokenパケットが、ホスト側FIFOメモリ11-1に一時記憶される。CPU14は、このパケットデータDATAに付加されたプリンタ25のアドレスデータを取得する。次に、S3において、CPU15は、取得されたアドレスデータに係る周辺機器即ちプリンタ25が使用可能か否かをチェックする。すなわち、他のホストPC22-24との間でデータを伝送している途中であるか否かをチェックする。プリンタ25が使用不可能であれば、CPU15はホストPC15にデータの送受信が正常に行われなかったときに発行されるハンドシェークパケットNAKを出力し（S4）、処理はS1に戻る。
【0015】プリンタ25が使用可能であれば、CPU15は、ハブリピータ13に命令してホストPC21とプリンタ25との間の接続をセットアップさせると共に、ハブコントローラ14に命令して、ホスト側FIFOメモリ11-1に保持されたパケットデータDATA及びout-tokenパケットを周辺機器側FIFOメモリ17-1へ向けて出力させる（S5）。
【0016】次に、CPU15は、周辺機器側FIFOメモリ17-1に保持されたout-tokenパケットをプリンタ25に向けて出力させる（S6）。プリンタ25が

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このout-tokenパケットを受信しなかった場合（S7のN）には、CPU15はプリンタ25からNAK信号を受け取り、ホスト側FIFOメモリ11-1にこのNAK信号を送信し、S6に戻る（S7）。

【0017】プリンタ25がこのout-tokenパケットを受け取った場合（S7のY）、パケットデータDATAが周辺機器側FIFOメモリ17-1からプリンタ25に向けて転送される。転送が完了すると、ハンドシェークパケットACK（データの送受信が正常に行われたことを示す）がプリンタ25から周辺機器側FIFOメモリ11-1に出力される（S9）。ハンドシェークパケットACKは周辺機器側FIFOメモリ17-1に送られ、さらにホストPC21に受信され、これによりデータの送信手順が終了する（S10）。このように、あるホストPCが1つの周辺機器（例えばプリンタ25）にアクセスしている場合において、他のホストPCが当該周辺機器アクセスを要求した場合には、NAK信号の出力により先行のホストPCでの送受信が完了するまで他方のホストPCのデータはFIFOメモリ11により一時保持される。これにより、各ホストPCのデータの衝突が回避されている。

【0018】次に、周辺機器25-28からホストPC21-24にデータ送信する場合を図3に示すフローチャートに基づいて説明する。ここでは、CD-ROMドライブ25からホストPC22へデータが出力されるものとする。この場合、最初にデータ受信を希望するホストPC22が、in-tokenパケットを出力する（S11）。このin-tokenパケットは、周辺機器25-28側からホストPC21-24側へデータの転送を指示するためのコマンドパケットであり、そのヘッダには送信先の周辺機器（ここではCD-ROMドライブ28）のアドレスが付加されている。

【0019】次に、S12において、このin-tokenパケットが、ホスト側FIFOメモリ11-2に一時記憶される。CPU14は、このin-tokenパケットに付加されたCD-ROMドライブ28のアドレスデータを取得する。次に、S13において、CPU15は、取得されたアドレスデータに係る周辺機器即ちCD-ROMドライブ28が使用可能か否かをチェックする。すなわち、他のホストPC22-24との間でデータを伝送している途中であるか否かをチェックする。

【0020】CD-ROMドライブ25が使用不可能であれば（S13のN）、CPU15はホストPC22にデータの送受信が正常に行われなかったときに発行されるハンドシェークパケットNAKを出力し（S14）、処理はS11に戻る。

【0021】CD-ROMドライブ25が使用可能であれば（S13のY）、CPU15は、ハブリピータ13に命令してホストPC22とCD-ROMドライブ28との間の接続をセットアップさせると共に、ハブコントローラ14に命令して、ホスト側FIFOメモリ11-2に保持されたin-tokenパケットを周辺機器側FIFOメモリ17-4へ向けて出力させる（S15）。

【0022】次に、CPU15は、周辺機器側FIFOメモリ17-4に保持されたin-tokenパケットをCD-ROMドライブ28に向けて出力させる（S16）。CD-ROMドライブ28がこのin-tokenパケットを受信しなかった場合（S17のN）には、CPU15はCD-ROMドライブ28からNAK信号を受け取り、ホスト側FIFOメモリ11-2にこのNAK信号を送信し（S18）、S16に戻る。

【0023】CD-ROMドライブ28がこのin-tokenパケットを受け取った場合（S17のY）、CD-ROMドライブ28のデータDATA`が、周辺機器側FIFOメモリ17-4、制御回路C及びホスト側FIFOメモリ17-2を経てホストPC22に向けて転送される（S19）。ホストPC22は、データ受信に成功したら、ハンドシェークパケットACKをCD-ROMドライブ28に向けて出力し（S20）、これによりデータの受信手順が終了する（S21）。

【0024】

【発明の効果】以上説明したように、本発明によれば、複数のホストコンピュータが周辺機器を共有することができ、かつ切替操作が不要となり、ネットワーク環境を簡単に提供することができる。

【図面の簡単な説明】

【図1】 本発明の実施の形態に係るUSBハブ1並びにこれに接続されたホストコンピュータ及び周辺機器を示す。

【図2】 図1に示すUSBハブの作用を示すフローチャートである。

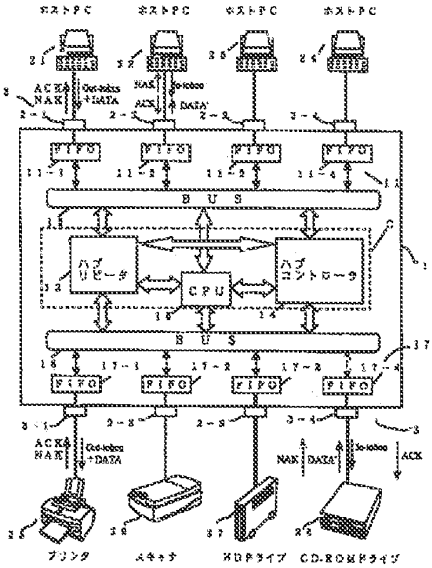
【図3】 図1に示すUSBハブの作用を示すフローチャートである。

【符号の説明】

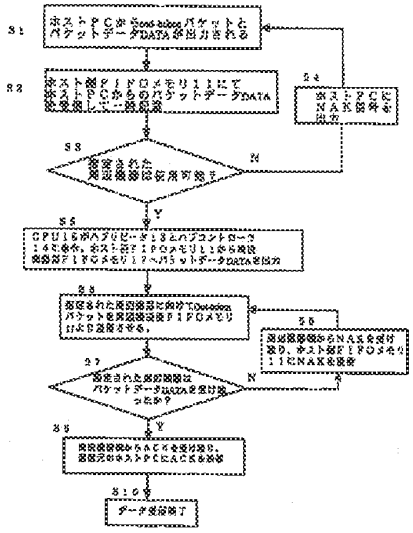
1　USBハブ
2、3　接続ポート
11、17　FIFOメモリ
12、16　バス
13　ハブリピータ
14　ハブコントローラ
15　CPU
C　制御回路
21-24　ホストPC
25　プリンタ（周辺機器）
26　スキャナ（周辺機器）
27　ハードディスクドライブ（周辺機器）
28　CD-ROMドライブ

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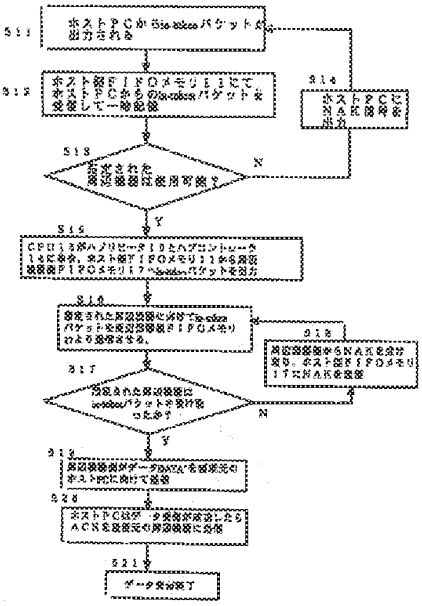
【図1】



【図2】



【図3】



Espacenet

Bibliographic data: TW470887 (B) — 2002-01-01

USB hub having multiple upstream ports and capable of switching between different hosts and computer system using the USB hub

Inventor(s): JANG LIANG-SHI [TW] ± (JANG, LIANG-SHI)

Applicant(s): WINBOND ELECTRONICS CORP [TW] ± (WINBOND ELECTRONICS CORP)

Classification: - **international:** *G06F13/36;* (IPC1-7): G06F13/36
- **cooperative:**

Application number: TW20000104360 20000310

Priority number (s): TW20000104360 20000310

Abstract of TW470887 (B)

There are provided an USB hub having multiple upstream ports and capable of switching between different hosts and a computer system using the USB hub. According to the requests of different computer hosts or the selection of manual switch, the usage right is switched to a computer host that requires using an USB hub, so that the computer host can control the data access of all the USB devices connected to the downstream port of the USB hub. The present invention can select and switch the computer host via the control of computer software, and achieve an automatic switching function. Furthermore, the software can determine whether the USB device currently in use is allowed to be switched, so as to avoid influencing its application function. Also, the function of the conventional data converter is integrated with the USB hub to effectively save the cost without having over-long cable and avoid switching noise. In addition, based on the number of the downstream ports of the USB hub, it is able to switch and use multiple USB devices.

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公告本

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類別	G06F 13/36

（以上各欄由本局填註）

A4
C4

470887

發明 新型 專利說明書

一、發明新型名稱	中文	具有多個上傳埠並可在不同主機間切換之 USB 集線器及使用該 USB 集線器之電腦系統
	英文	
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本紙張尺度適用中國國家標準（CNS）A4規格（210×297公釐）

裝 訂 線

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四、中文發明摘要（發明之名稱：具有多個上傳埠並可在不同主機間切換之USB集線器及使用該USB集線器之電腦系統）

一種具有多個上傳埠並可在不同主機間切換之 USB 集線器及使用該 USB 集線器之電腦系統，可依據不同電腦主機之要求或手動切換之選擇，在適當時機將其使用權切換給需使用 USB 集線器之電腦主機，使電腦主機可控制所有接在 USB 集線器之下傳埠的 USB 裝置資料存取。本發明可經由電腦軟體控制選擇切換之電腦主機，並可達到自動切換的功能，且軟體可判斷目前正被使用之 USB 裝置是否允許切換，避免影響其應用功能。同時將傳統資料轉換器之功能與 USB 集線器整合，可有效節省成本，並且無電纜過長之憂慮，可避免切換造成的雜訊。並可依據 USB 集線器之下傳埠的數量多寡，一次切換使用多個 USB 裝置。

英文發明摘要（發明之名稱：）

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（請先閱讀背面之注意事項再填寫本頁各欄）

裝 訂 線

本紙張尺度適用中國國家標準（CNS）A4規格（210×297公釐）

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五、發明說明（ / ）

本發明是有關於一種 USB 集線器，且特別是有關於一種具有多個上傳埠並可在不同主機間切換之 USB 集線器及使用該 USB 集線器之電腦系統，其可依據不同電腦主機之要求與手動切換之選擇，在適當時機將其使用權切換給需使用 USB 集線器之電腦主機，使電腦主機可控制所有接在 USB 集線器之下傳埠的 USB 裝置資料存取。

自從 IBM 公司發展出 PC XT 及 PC AT 的個人電腦之後，和 IBM PC 相容的個人電腦即被全世界普遍使用。在這期間，因爲半導體技術的進步，使個人電腦的功能越來越強，同時可用的設備也越來越多，例如：圖形化的作業系統的普及，滑鼠(Mouse)已是必備的設備，爲了將資料印出，印表機幾乎也是必備的，網際網路(Internet)的發達，在家中的使用者都需使用數據機(MODEM)來連接網路，而爲了避免電腦當機使工作成果付諸流水，會準備大容量的備份裝置定時備資料，或是想將圖形存入電腦，掃描器(Scanner)亦是普遍被使用的設備。

以上所提及的設備在個人電腦發展出來之後，陸續發展出來，直到目前，已是非常普遍，甚至是必備的設備。但是因爲每一項設備發展的目的不同，所處的環境亦不同，所以在設計時，依不同的考量而使用不同的介面。到了現在，在一部個人電腦若要使用前面所提的各項設備，電腦後面的連線將是非常可觀的，因爲幾乎每種設備都使用不同的介面，有些介面目前已是個人電腦的標準配備，如連接滑鼠的 RS232 串列介面，或是連接印表機的並列介

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五、發明說明（２）

面。但是有些介面則需另外安裝介面卡，例如連接大容量備份裝置大都使用 SCSI(Small Computer System Interface)介面，SCSI 介面即需另外安裝介面卡。又，有些設備更是使用專有的介面，如有些掃描器即是使用特殊的專有介面，必需安裝專屬的介面卡才可使用。因此在個人電腦中，必需提供許多插槽(Slot)以供安裝各種介面卡，而完成整個系統的連線之後，電腦後面的連線亦是十分可觀，並且凌亂無比。

由於上述的情況，乃發展出通用串列匯流排(Universal Serial Bus；以下簡稱 USB)介面的規格，其係爲一新興起之傳輸協定，USB 意圖將週邊至主機系統之傳輸方式統一化，使得未來週邊與主機之連結方式都透過 USB，以方便使用者連結各週邊與主機系統。

USB 希望各種設備都可使用統一的介面來連接，可簡化系統的安裝，並且電腦內部亦不需要預留太多的空間來安裝各種特殊的介面卡，另外 USB 介面亦有隨插即用(Plug & Play)的功能，即個人電腦可以自動偵測所連接的設備，並安裝相關的驅動程式(Driver)供使用者使用。此外，USB 介面的規格，具有線上即插即用(Hot Plug-in)的功能，可以在電腦運作當中，將設備連接上去，電腦主機皆可以自動偵測並安裝相關的程式，無需經過關機再重新開機的步驟，隨即可讓使用者使用新連上的週邊設備。同樣地，在週邊設備移除時，電腦主機亦可自動偵測並將相關的程式移除，以免使用者執行相關程式而產生錯誤。

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五、發明說明（3）

一般來說，一個 USB 系統只能有一個主控器(master)，其他所有週邊裝置都是附屬器(slave)，通常個人電腦(PC)中之 USB 主機控制器(Host Controller)是唯一的主控器，並掌控所有資料之傳輸。主機控制器使用表徵(tokens)及指令(commands)，USB 定義爲 Requests 來控制主控器(PC)與附屬器(週邊裝置)間資料之接收與傳送。

USB 集線器(Hub)界於 USB 主機控制器與週邊裝置(USB 裝置)之間爲星形拓撲(star topology)中，用以擴展週邊之關鍵組件，所有的 USB 裝置(device)或節點(node)例如鍵盤、滑鼠、印表機...等都必須接在集線器之下傳埠(downstream port)或是被整合在集線器中。通常集線器擁有一上傳埠(upstream port)接至上一層集線器或主機控制器之根部節點集線器(root Hub)，另有一個以上(含一個)之下傳埠用以擴充 USB 之裝置節點。

集線器提供兩個主要的功能，一是中繼器(Repeater)：用以將主機下傳的資料廣播(broadcast)至所有致能埠上之 USB 裝置，然後將 USB 裝置上傳的資料重覆於上傳埠送至主機；另一是連接(connection)與斷絕(disconnection)之偵測：集線器必須對 USB 裝置之熱拔插做偵測，並報告給主機以達到主機熱即插即用(Hot Plug & Play)之功能。

請參照第 1 圖與第 2 圖，其分別繪示的是習知一種電腦系統的連接示意圖。

如第 1 圖與第 2 圖所示，所有的 USB 裝置 14a~14n 分別連接在對應之集線器 12a~12f 的下傳埠 16a~16n 或是被整

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五、發明說明（4）

合在集線器(如第 2 圖之組合元件 20)中。集線器 12a~12f 分別擁有一上傳埠 18a~18f，並分別連接至上一層集線器或 USB 主機控制器 10 或電腦主機之根部節點集線器(root Hub)11。

由第 1 圖與第 2 圖可得知，由於個人電腦中之 USB 主機控制器控制所有 USB 裝置與個人電腦間資料之傳輸，所以對任一 USB 裝置而言，其只能被唯一之個人電腦使用，當有另一個人電腦欲透過 USB 匯流排使用此 USB 裝置時，必須重新將此 USB 裝置插入另一個人電腦之根部節點集線器或外部集線器之下傳埠，由此個人電腦取得 USB 裝置之控制權方能使用。

爲了解決上述問題，目前市面上的解決方法爲提供一轉換盒(switch box)，以手動方式來切換 USB 裝置接上被選擇之個人電腦，此種解決方案之電腦系統的連接示意圖如第 3 圖所示，包括個人電腦 21 與 22、轉換盒 24 及 USB 裝置 26。舉例來說，USB 裝置 26 目前是被個人電腦 21 所使用，假如個人電腦 22 欲使用 USB 裝置 26 時，必須以手動方式切換轉換盒 24 上之開關，使 USB 裝置 26 透過轉換盒 24 連接至個人電腦 22，此時個人電腦 22 即可使用 USB 裝置 26。然而，依照第 3 圖所示之架構及其切換方法，具有以下的缺點：

1. 人爲切換不方便。

2. 無法判斷切換之適當時機，有可能影響正在使用此 USB 裝置之應用軟體功能。

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五、發明說明（ 5）

3. 必須使用額外的轉換盒，成本高。

4. 延長電纜(cable)與使用過多的插座插頭，易產生雜訊。

5. 違反 USB 規格，有可能使 USB 裝置至集線器之電纜路徑超過 5 公尺。

6. 只能切換使用單一 USB 裝置。

請參照第 4 圖，其繪示的習知一種電腦系統的連接示意圖，包括個人電腦 31 與 32、資料轉換器(data switcher)34 及 USB 裝置 36a~36c。

第 4 圖與第 3 圖之最大不同點在於，透過第 4 圖之資料轉換器 34，可一次將連接於資料轉換器 34 上之多台 USB 裝置 36a~36c 切換給單一個人電腦使用。然而，必須注意的是，當資料轉換器 34 只連接這三台 USB 裝置 36a~36c 時，個人電腦 31 與 32 就分別必須使用三條 USB 電纜 37a~37c 與 38a~38c 來連接至資料轉換器 34。假如連接資料轉換器 34 之 USB 裝置的數量很多時，此時個人電腦 31、32 與資料轉換器 34 間之 USB 電纜的使用數量勢必非常可觀。

有鑒於此，本發明提出一種具有多個上傳埠並可在不同主機間切換之USB集線器，包括多數個上傳埠、多數個下傳埠、連結佈線器、轉換控制器與傳統USB集線器。這些上傳埠分別用以提供實際之連結至不同之電腦主機中，而所有下傳埠分別用以提供實際之連結至不同之USB裝置中。連結佈線器連接至所有上傳埠其中含有指令解譯器(74)

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五、發明說明（6）

和多工器(72)，指令解譯器用以解碼來自個別電腦主機送來的指令，並回應相關的資料給電腦主機，同時送出解析後之結果訊號給轉換控制器(52)。轉換控制器(52)依據此控制訊號切換多工器(72)使其選擇指令所指定之上傳埠連接至USB集線器(54)之集線器中繼器(60)，其中被切換連接至集線器中繼器(60)之上傳埠係爲集線器埠，其他未連接者則爲裝置埠，而集線器埠所接之電腦主機擁有USB集線器之控制權，並控制所有接在USB集線器之下傳埠的USB裝置資料存取。轉換控制器連接所有上傳埠與連結佈線器，用以依據指令解析之結果訊號與手動開關來切換多工器，轉換控制器並於多工器切換完成後，送一開關控制訊號至所有上傳埠(46a~46n)，此控制訊號使上傳埠之電阻(64)先開路(open)再閉路(close)，而造成先斷絕再連接之機制，使連接上傳埠之主機分別對新的集線器埠和其他裝置埠重新認定，其中只有接在集線器埠的主機認定其下接有集線器並可使用此集線器下之裝置，其他接在裝置埠之主機認定其下接一單純之USB裝置用以傳送要求使用集線器之指令至連結佈線器(50)。

此外，本發明提出一種電腦系統，包括多數台電腦主機、多數台 USB 裝置與一 USB 集線器。上述 USB 集線器具有數個上傳埠與數個下傳埠，各上傳埠分別連接至各電腦主機中，以及各下傳埠分別連接至各 USB 裝置中，且 USB 集線器用以上傳由各 USB 裝置送來的資料及下傳由各電腦主機送來的資料。其中，在正常操作下，僅有一台電

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五、發明說明（7）

腦主機具有 USB 集線器之使用權，代表此電腦主機可控制所有接在 USB 集線器之下傳埠的 USB 裝置資料存取。當有另一台電腦主機送出集線器要求指令給 USB 集線器，要求使用 USB 集線器及控制 USB 集線器下接之 USB 裝置時，USB 集線器會進入集線器仲裁狀態，並在適當時機後將其使用權轉交給此另一台電腦主機，此時該另一台電腦主機即具有 USB 集線器之使用權，並可控制所有接在 USB 集線器之下傳埠的 USB 裝置資料存取，達到不同電腦主機切換使用 USB 集線器之目的。另，USB 集線器可具有手動切換開關，經由控制此手動切換開關也可達到不同電腦主機切換使用 USB 集線器之目的。

本發明提出之 USB 集線器，由於具有多個上傳埠且本身具有切換與仲裁功能，故可依據不同電腦主機之要求與手動切換之選擇，在適當時機將其使用權切換給需使用 USB 集線器之電腦主機，使電腦主機可控制所有接在 USB 集線器之下傳埠的 USB 裝置資料存取，換言之，本發明依據 USB 集線器之下傳埠的數量多寡，可一次切換使用多個 USB 裝置。因此，本發明可經由電腦軟體控制選擇切換之電腦主機，並可達到自動切換的功能，且軟體可判斷目前正被使用之 USB 裝置是否允許切換，避免影響其應用功能。同時，將傳統資料轉換器之功能與 USB 集線器整合，可有效節省成本，並且無電纜過長之憂慮，可避免切換造成的雜訊。

爲讓本發明之上述和其他目的、特徵、和優點能更明

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五、發明說明（ 8 ）

顯易懂，下文特舉較佳實施例，並配合所附圖式，作詳細說明如下：

圖式之簡單說明：

第 1 圖繪示的是習知一種電腦系統的連接示意圖；

第 2 圖繪示的是習知另一種電腦系統的連接示意圖；

第 3 圖繪示的是習知再一種電腦系統的連接示意圖；

第 4 圖繪示的是習知又一種電腦系統的連接示意圖；

第 5 圖繪示的是依照本發明一較佳實施例的一種使用具有多個上傳埠之 USB 集線器，並可在不同電腦主機間切換之電腦系統的連接示意圖；

第 6 圖繪示的是依照第 5 圖之具有多上傳埠之 USB 集線器 44 的詳細結構圖；

第 7 圖繪示的是依照第 6 圖之傳統 USB 集線器 54 的詳細結構圖；

第 8 圖繪示的是依照第 6 圖之 USB 集線器 44 之每一上傳埠的詳細結構圖；

第 9 圖繪示的是依照第 6 圖之 USB 集線器 44 之連結佈線器的詳細結構圖；以及

第 10 圖繪示的是依照第 6 圖之 USB 集線器 44 之轉換控制器的詳細結構圖。

圖式之標號說明：

10、50a~50n：USB 主機控制器

11：根部節點集線器

12a~12f：集線器

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五、發明說明（9）

14a~14n、26、36a~36c、42a~42n：USB 裝置

16a~16n：下傳埠

18a~18f：上傳埠

20：組合元件

21、22、31、32、40a~40n：個人電腦

24：轉換盒

34：資料轉換器

37a~37c、38a~38c：USB 電纜

44：本發明之具有多上傳埠之 USB 集線器

46a~46n：上傳埠

48a~48n：下傳埠

50：連結佈線器

52：轉換控制器

54：傳統 USB 集線器

60：集線器中繼器

62：集線器控制器

64：電阻

66：USB 收發器

68：USB 訊號端 DP

70：USB 訊號端 DM

72：多工器

74：指令解譯器

76：組合邏輯控制器

實施例

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五、發明說明（10）

爲了有效解決多台個人電腦切換使用多個 USB 裝置所面臨的問題，並且由於所有的 USB 裝置都必須經由集線器再往上接至使用此 USB 裝置之個人電腦(PC)，因此本發明乃利用此一特性，提供一個含有多個上傳埠之集線器，並透過內建於此集線器中之轉換控制器與個別 PC 中之控制軟體來選擇切換何者使用集線器，並控制和使用接上此集線器之 USB 裝置，其相關描述將於下詳細討論。

請參照第 5 圖，其繪示的是依照本發明一較佳實施例的一種使用具有多個上傳埠之 USB 集線器，並可在不同電腦主機間切換之電腦系統的連接示意圖。

本發明之電腦系統的組成要件主要包括多數台個人電腦 40a~40n、多數個 USB 裝置 42a~42n 與一具有多上傳埠之 USB 集線器 44，其中任一 USB 裝置 42a~42n 可以是鍵盤、滑鼠、印表機...等週邊裝置。USB 集線器 44 具有多數個上傳埠 46a~46n 與多數個下傳埠 48a~48n。每一個人電腦 40a~40n 分別透過其內部之 USB 主機控制器 50a~50n 連接至 USB 集線器 44 之一上傳埠 46a~46n，以及每一 USB 裝置 42a~42n 分別連接至 USB 集線器 44 之一下傳埠 48a~48n，如第 5 圖所示。

請參照第 6 圖，其繪示的是依照第 5 圖之具有多上傳埠之 USB 集線器 44 的詳細結構圖。

如先前所述，USB 集線器 44 具有多數個上傳埠 46a~46n 與多數個下傳埠 48a~48n，其中上傳埠 46a~46n 可被轉換控制器 52 控制其斷絕/連接之時序，USB 集線器 44

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係由一連結佈線器(link router)50、一轉換控制器 52 與一傳統 USB 集線器 54 所組成。連結佈線器 50 連接 USB 集線器 44 之上傳埠 46a~46n、轉換控制器 52 與傳統 USB 集線器 54。轉換控制器 52 控制上傳埠 46a~46n 之斷絕、連接時序，且其可經由外部之手動切換來改變其控制狀態。

請參照第 7 圖，其繪示的是依照第 6 圖之傳統 USB 集線器 54 的詳細結構圖。

USB 集線器 54 係由一集線器中繼器 60 與一集線器控制器 62 所組成，且兩者相互連接。集線器中繼器 60 之功能爲上傳由下傳埠 48a~48n 送來的資料，以及下傳由連結佈線器 50(第 6 圖)送來之表徵、指令及資料。集線器控制器 62 提供 USB 集線器 54 之狀態給電腦主機(例如第 5 圖之個人電腦 40a)，電腦主機依據 USB 集線器 54 之不同狀態控制下傳埠 48a~48n。

請參照第 8 圖，其繪示的是依照第 6 圖之 USB 集線器 44 之每一上傳埠 46a~46n 的詳細結構圖。

在第 8 圖中，以上傳埠 46a 爲例來說明。USB 集線器 44 之上傳埠 46a 包括一電阻 64、一 USB 收發器 66、訊號端 DP 68 與訊號端 DM 70。電阻 64 之兩端分別耦接至一電壓源 VDD 與訊號端 DP 68，且電阻 64 接收來自轉換控制器 52 之一 ON/OFF 控制信號，並依據此 ON/OFF 控制信號來決定上傳埠 46a 之連接狀態，其中 ON 代表連接(connection)而 OFF 代表斷絕(disconnection)，以及電阻 64 之阻值例如是 1.5K 歐姆(Ω)，電壓源 VDD 之電壓值例如是 3.3 伏特

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五、發明說明（12）

(V)。USB 收發器 66 之一端連接至連結佈線器 50，另一端連接至訊號端 DP 68 與訊號端 DM 70，用以接收來自連結佈線器 50(或訊號端 68、70)的資料訊息，並將此資料訊息傳送至連接端 68、70(或連結佈線器 50)。

換言之，USB 集線器 44 之每一上傳埠 46a~46n 用以提供實際之連結至不同個人電腦 40a~40n 之 USB 主機控制器 50a~50n，且每一上傳埠 46a~46n 內含有一連接/斷絕之機制，由轉換控制器 52 控制不同上傳埠 46a~46n 之連接或斷絕。而 USB 集線器 44 之每一下傳埠 48a~48n 則用以提供實際之連結至 USB 裝置 42a~42n，且每一下傳埠 42a~42n 內含有一裝置附加/分離(attach/detach)偵測線路(未繪示出)，如熟習者所知，用以判斷下傳埠 48a~48n 之狀態並通知主機控制器作爲埠狀態之更新。

請參照第 9 圖，其繪示的是依照第 6 圖之本發明 USB 集線器 44 之連結佈線器 50 的詳細結構圖。

連結佈線器 50 包括一多工器(MUX)72 與一指令解譯器(Command Parser)74。多工器 72 連結於上傳埠 46a~46n 與傳統 USB 集線器 54 間，此 N 選一之多工器 72 由轉換控制器 52 之輸出控制，被選擇到之上傳埠 46a~46n 稱爲集線器埠(Hub port)，其他則稱爲裝置埠(Device port)。集線器埠所接之 USB 主機控制器擁有 USB 集線器 44 之控制權，並控制所有接在此 USB 集線器 44 之下傳埠 48a~48n 的 USB 裝置 42a~42n 資料存取。指令解譯器 74 用以解碼裝置埠和集線器埠從各個人電腦 40a~40n 之主機控制器 50a~50n 送來

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的指令，並回應相關的資料給主機控制器 50a~50n，同時，指令解譯器 74 會將解析之結果送至轉換控制器 52 作爲控制之部分依據。

請參照第 10 圖，其繪示的是依照第 6 圖之本發明 USB 集線器 44 之轉換控制器 52 的詳細結構圖。

轉換控制器 52 經由其內部之組合邏輯控制器 76 接收指令解譯器 74 之結果加上手動切換之選擇，產生控制多工器 72 之訊號來決定何者是集線器埠，同時輸出控制信號至上傳埠 46a~46n，並在集線器埠、裝置埠切換時，對相關之埠做斷絕/連接之控制。

本發明之實施方法將詳細描述於下，並請同時配合參照第 5 圖至第 10 圖。

在完成電源開啓(power on)或重設(reset)之起始化(Initialization)動作之後，所有的上傳埠 46a~46n 爲連接狀態。之後，轉換控制器 52 依據手動切換之設定(亦即選擇第 10 圖之 S0~SN 其中之一)，控制連結佈線器 50 中之多工器 72 選擇上傳埠 46a~46n 其中之一爲集線器埠(例如上傳埠 46a)，此集線器埠 46a 連結之 USB 主機控制器 50a 控制經由多工器 72 連結之 USB 集線器 54，此時 USB 主機控制器 50a 所屬之個人電腦 40a 具有 USB 集線器 54 之使用權，並控制 USB 集線器 54 所連接 USB 裝置 48a~48n 資料之傳輸。此外，手動切換爲可選擇的(optional)，當無手動切換時，轉換控制器 52 可預設某一上傳埠(例如上傳埠 46a)爲集線器埠，欲使用 USB 集線器 44 之個人電腦必須連接至此手

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動切換設定或預設之上傳埠。

當接至集線器埠之 USB 主機控制器使用 USB 集線器 44 時，指令解譯器 74 接收經裝置埠送來之指令並回應相關之訊息給此裝置埠上接之 USB 主機控制器，使 USB 主機控制器視指令解譯器 74 爲單一之 USB 裝置，並可分辨個別個人電腦送來的指令。若其中之一個人電腦(例如個人電腦 40n)欲使用 USB 集線器 44 及控制 USB 集線器 44 下接之 USB 裝置 48a~48n 時，其 USB 主機控制器 50n 送出一特別之指令(集線器要求指令 HRQ)給指令解譯器 74，指令解譯器 74 解析個人電腦 40n 送來之集線器要求指令後進入集線器仲裁狀態(HARB)，並回應此狀態給所有的 USB 主機控制器 50a~50n。接著，個人電腦 40a 判斷切換 USB 集線器 44 之適當時機後，送出另一特別之指令(集線器確認指令 HACK)給指令解譯器 74，指令解譯器 74 將指令及狀態轉換成控制信號(HRQ/HACK/HARB)給轉換控制器 52 控制 USB 集線器 44 之切換。

當個人電腦 40n 產生之 HRQ 指令啓動(active)後，且個人電腦 40a 產生之 HACK 指令啓動時，轉換控制器 52 對上傳埠 46a 與 46n 做斷絕動作後，控制多工器 72 切換至上傳埠 46n，最後再將上傳埠 46a 與 46n 做連接動作。經過多工器 72 切換後重新連接 USB 主機控制器 50a、50n 之上傳埠 46a 與 46n，達到集線器埠與裝置埠互換之目的。同時，個人電腦 40n 上之 USB 主機控制器 50n 取得 USB 集線器 44 之所有權，並控制 USB 集線器 44 下接之 USB 裝置

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48a~48n，達成不同個人電腦(40a、40n)切換使用 USB 集線器 44 之目的。

對於 USB 主機控制器之實施步驟如下所述。USB 主機控制器先判斷本身是否已控制 USB 集線器 44，若是，則當另一 USB 主機控制器要求使用 USB 集線器 44 時，會使轉換控制器 52 進入仲裁狀態，並通知個人電腦。此時，個人電腦決定是否可被切換，若是允許被切換的話，則送出集線器確認指令 HACK 通知轉換控制器 52 做切換。反之，若不允許被切換的話，則先將 USB 集線器 44 下接之 USB 裝置 48a~48n 之驅動程式(driver)卸載(unload)，或對相關之應用軟體做必要之處理。

若此一 USB 主機控制器目前不控制 USB 集線器 44，可於應用軟體的控制下決定是否提出 USB 集線器 44 之要求，而提出之條件、時間可依使用者設定配合轉換控制器 52 達到自動切換的功能。另，在送出集線器要求指令 HRQ 之前，需先判斷轉換控制器 52 是否正處於仲裁狀態，以避免要求信號被錯失(miss)。

對於轉換控制器 52 之實施步驟如下所述。轉換控制器 52 內有一計時器(未繪示出)，用以計時在手動切換指定或預設之上傳埠上，是否接上 USB 主機控制器，若無，則該上傳埠無法於計時超過一段時間(Timeout)內收到指令，表示上傳埠未接到任何 USB 主機控制器或 USB 主機控制器接在非指定之埠上。轉換控制器 52 即進行所有上傳埠 46a~46n 反覆搜尋之動作，若 USB 主機控制器接在另一上

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傳埠或者中途才被接上，則搜尋動作能正確將其設定爲集線器埠(46a)，並使用 USB 集線器 44。在集線器埠使用 USB 集線器 44 時，其他裝置埠(46n)可經由軟體控制自動或由使用者指定由 USB 主機控制器 50n 送出集線器要求指令 HRQ，經由轉換控制器 52、USB 主機控制器 50a 與 50n 之互動而切換 USB 集線器 44 之使用權。

上述轉換控制器 52 實行的方法，可以是微控制器或硬體結合控制邏輯，以及指令解譯器 74 實行的方法，可以是微控制器或硬體狀態機制。

綜上所述，本發明具有以下的優點：

1. 經由軟體控制選擇切換之個人電腦，並可達到自動切換的功能。

2. 軟體可判斷目前正被使用之 USB 裝置是否允許切換，避免影響其應用功能。

3. 將傳統資料轉換器之功能與 USB 集線器整合，可有效節省成本。

4. 無電纜過長之憂慮，並可避免切換造成的雜訊。

5. 依據集線器下傳埠的數量多寡，可一次切換多個 USB 裝置。

雖然本發明已以較佳實施例揭露如上，然其並非用以限定本發明，任何熟習此技藝者，在不脫離本發明之精神和範圍內，當可作各種之更動與潤飾，因此本發明之保護範圍當視後附之申請專利範圍所界定者爲準。

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六、申請專利範圍

1.一種具有多個上傳埠並可在不同主機間切換之 USB 集線器，包括：

複數個上傳埠，該些上傳埠可分別被控制其斷絕/連接之時序，且各該上傳埠分別用以提供實際之連結至一不同之電腦主機中；

複數個下傳埠，各該下傳埠分別用以提供實際之連結至一不同之 USB 裝置中；

一連結佈線器，連接該些上傳埠，該連結佈線器用以解碼來自各該電腦主機送來的指令，並回應相關的資料給各該電腦主機，同時送出解析後之一結果訊號，且該連結佈線器接收一控制訊號，並依據該控制訊號切換該連結佈線器之一多工器指向該些上傳埠其中之一；

一轉換控制器，連接該些上傳埠與該連結佈線器，用以依據該結果訊號與/或一手動切換，產生該控制訊號來控制各該上傳埠之斷絕/連接狀態；以及

一傳統 USB 集線器，用以上傳由該些下傳埠送來的資料及下傳經由該連結佈線器送來的集線器埠資料，並提供其本身之狀態給連接該集線器埠之電腦主機，使該電腦主機依據該傳統 USB 集線器之不同狀態控制該些下傳埠。

2.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中各該上傳埠包括：

一電阻，該電阻之兩端分別耦接至一電壓源與一訊號端 DP，且該電阻接收來自該轉換控制器之該控制信號，並依據該控制信號來決定各該上傳埠之斷絕/連接狀態；以及

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六、申請專利範圍

一 USB 收發器，該 USB 收發器之一端連接至該連結佈線器，其另一端連接至該訊號端 DP 與一訊號端 DM，用以與連接該上傳埠之電腦主機間上傳或下傳資料。

3.如申請專利範圍第 2 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該電阻之阻值包括 1.5K 歐姆或其他合乎 USB 規格之阻值。

4.如申請專利範圍第 2 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該電壓源之電壓值包括 3.3 伏特或其他合乎 USB 規格之電壓值。

5.如申請專利範圍第1項所述之具有多個上傳埠並可在不同主機間切換之USB集線器，其中該連結佈線器包括：

一多工器，連結於該些上傳埠與該傳統 USB 集線器間，該多工器係由該轉換控制器之輸出控制，指向其中一上傳埠與傳統 USB 集線器相連接，被選擇到之該上傳埠稱爲集線器埠，其他則稱爲裝置埠；以及

一指令解譯器，用以解碼該些上傳埠從各該電腦主機送來的指令，並回應相關的資料給各該電腦主機，同時將解析之結果送至該轉換控制器中作爲控制之部分依據。

6.如申請專利範圍第 5 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該指令解譯器包括微控制器或其他可解譯指令之機制。

7.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該轉換控制器包括

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六、申請專利範圍

一組合邏輯控制器，用以經由該組合邏輯控制器接收來自該連結佈線器之該結果訊號或/與該手動切換之選擇，產生該控制訊號來決定哪一該上傳埠是集線器埠，同時輸出該控制信號至該些上傳埠，並在集線器埠與裝置埠切換時，對相關之埠做斷絕/連接之控制。

8.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該傳統 USB 集線器包括：

一集線器中繼器，用以上傳由該些下傳埠送來的資料及下傳由該連結佈線器送來的資料；以及

一集線器控制器，連接該集線器中繼器，該集線器控制器用以提供該傳統 USB 集線器之狀態給該些電腦主機，使該些電腦主機依據該傳統 USB 集線器之不同狀態控制該些下傳埠。

9.如申請專利範圍第1項所述之具有多個上傳埠並可在不同主機間切換之USB集線器，其中各該上傳埠內含有一連接/斷絕之機制，由該轉換控制器控制不同之各該上傳埠的連接與斷絕。

10.如申請專利範圍第1項所述之具有多個上傳埠並可在不同主機間切換之USB集線器，其中各該下傳埠內含有一裝置附加/分離偵測線路，用以判斷各該下傳埠之狀態並通知該些電腦主機作為埠狀態之更新。

11.如申請專利範圍第1項所述之具有多個上傳埠並可在不同主機間切換之USB集線器，其中各該電腦主機分別

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六、申請專利範圍

具有一USB主機控制器，連接至各該上傳埠中，以透過該USB主機控制器控制該USB集線器。

12.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該電腦主機包括個人電腦與可控制 USB 傳輸協定之任何平台。

13.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中各該 USB 裝置包括鍵盤、滑鼠、印表機等週邊裝置其中之一。

14.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中該轉換控制器包括微控制器與其他可產生該控制訊號之邏輯。

15.如申請專利範圍第 1 項所述之具有多個上傳埠並可在不同主機間切換之 USB 集線器，其中當該連結佈線器依據該控制訊號切換該多工器指向該些上傳埠其中之一時，被切換連接之該上傳埠係爲集線器埠，其他未連接者則爲裝置埠，而該集線器埠所接之該電腦主機擁有該 USB 集線器之控制權，並控制所有接在該 USB 集線器之該些下傳埠的該些 USB 裝置資料存取。

16.一種電腦系統，包括：

複數台電腦主機；

複數台 USB 裝置；以及

一 USB 集線器，具有複數個上傳埠與複數個下傳埠，各該上傳埠分別連接至各該電腦主機中，以及各該下傳埠分別連接至各該 USB 裝置中，該 USB 集線器用以上傳由各

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六、申請專利範圍

該 USB 裝置送來的資料及下傳由各該電腦主機送來的資料；

其中，在正常操作下，僅有一台該電腦主機具有該 USB 集線器之使用權，代表該電腦主機可控制所有接在該 USB 集線器之該些下傳埠的該些 USB 裝置資料存取，當有另一台該電腦主機送出一集線器要求指令給該 USB 集線器，要求使用該 USB 集線器及控制該 USB 集線器下接之該些 USB 裝置時，該 USB 集線器會進入一集線器仲裁狀態，並在一適當時機後將其使用權轉交給該另一台該電腦主機，此時該另一台該電腦主機即具有該 USB 集線器之使用權，並可控制所有接在該 USB 集線器之該些下傳埠的該些 USB 裝置資料存取，達到不同該電腦主機切換使用該 USB 集線器之目的。

17.如申請專利範圍第 16 項所述之電腦系統，其中該 USB 集線器可具有一手動切換開關，經由控制該手動切換開關可達到不同該電腦主機切換使用該 USB 集線器之目的。

18.如申請專利範圍第 16 項所述之電腦系統，其中該 USB 集線器包括：

一連結佈線器，連接該些上傳埠，該連結佈線器用以解碼來自各該電腦主機送來的指令，並回應相關的資料給各該電腦主機，同時送出解析後之一結果訊號，且該連結佈線器接收一控制訊號，並依據該控制訊號切換連接至該些上傳埠之一，其中，被切換連接之該上傳埠係爲集線器

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六、申請專利範圍

埠，其他未連接者則爲裝置埠，而集線器埠所接之該電腦主機擁有該 USB 集線器之控制權，並控制所有接在該 USB 集線器之該些下傳埠的該些 USB 裝置資料存取；

一轉換控制器，連接該些上傳埠與該連結佈線器，用以依據該結果訊號與一手動切換，產生該控制訊號來控制各該上傳埠與該連結佈線器之連接狀態；以及

一傳統 USB 集線器，用以上傳由該些下傳埠送來的資料及下傳由該連結佈線器送來的資料，並提供其本身之狀態給該些電腦主機，使該些電腦主機依據該傳統 USB 集線器之不同狀態控制該些下傳埠。

19.如申請專利範圍第 18 項所述之電腦系統，其中該 USB 集線器之各該上傳埠包括：

一電阻，該電阻之兩端分別耦接至一電壓源與一訊號端 DP，且該電阻接收來自該轉換控制器之該控制信號，並依據該控制信號來決定各該上傳埠之斷絕/連接狀態；以及

一 USB 收發器，該 USB 收發器之一端連接至該連結佈線器，其另一端連接至該訊號端 DP 與一訊號端 DM，用以與連接該上傳埠之電腦主機間上傳或下傳資料。

20.如申請專利範圍第 18 項所述之電腦系統，其中該連結佈線器包括：

一多工器，連結於該些上傳埠與該傳統 USB 集線器間，該多工器係由該轉換控制器之輸出控制，被選擇到之該上傳埠稱爲集線器埠，其他則稱爲裝置埠；以及

一指令解譯器，用以解碼該些上傳埠從各該電腦主機

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六、申請專利範圍

送來的指令，並回應相關的資料給各該電腦主機，同時將解析之結果送至該轉換控制器中作爲控制之部分依據。

21.如申請專利範圍第 20 項所述之電腦系統，其中該指令解譯器包括微控制器或其他可解譯指令之機制。

22.如申請專利範圍第 18 項所述之電腦系統，其中該轉換控制器包括一組合邏輯控制器，用以經由該組合邏輯控制器接收來自該連結佈線器之該結果訊號與該手動切換開關之選擇，產生該控制訊號來決定哪一該上傳埠是集線器埠，同時輸出該控制信號至該些上傳埠，並在集線器埠與裝置埠切換時，對相關之埠做斷絕/連接之控制。

23.如申請專利範圍第 18 項所述之電腦系統，其中該傳統 USB 集線器包括：

一集線器中繼器，用以上傳由該些下傳埠送來的資料及下傳由該連結佈線器送來的資料；以及

一集線器控制器，連接該集線器中繼器，該集線器控制器用以提供該傳統 USB 集線器之狀態給該些電腦主機，使該些電腦主機依據該傳統 USB 集線器之不同狀態控制該些下傳埠。

24.如申請專利範圍第16項所述之電腦系統，其中各該上傳埠內含有一連接/斷絕之機制，由一轉換控制器控制不同之各該上傳埠的連接與斷絕。

25.如申請專利範圍第16項所述之電腦系統，其中各該下傳埠內含有一裝置附加/分離偵測線路，用以判斷各該下傳埠之狀態並通知該些電腦主機作爲埠狀態之更新。

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六、申請專利範圍

26.如申請專利範圍第16項所述之電腦系統，其中各該電腦主機分別具有一USB主機控制器，連接至各該上傳埠中，以透過該USB主機控制器控制該USB集線器。

27.如申請專利範圍第 16 項所述之電腦系統，其中該電腦主機包括個人電腦與可控制 USB 傳輸協定之任何平台。

28.如申請專利範圍第 16 項所述之電腦系統，其中各該 USB 裝置包括鍵盤、滑鼠、印表機等週邊裝置其中之一。

29.如申請專利範圍第 18 項所述之電腦系統，其中該轉換控制器包括微控制器與其他可產生該控制訊號之邏輯。

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裝

訂

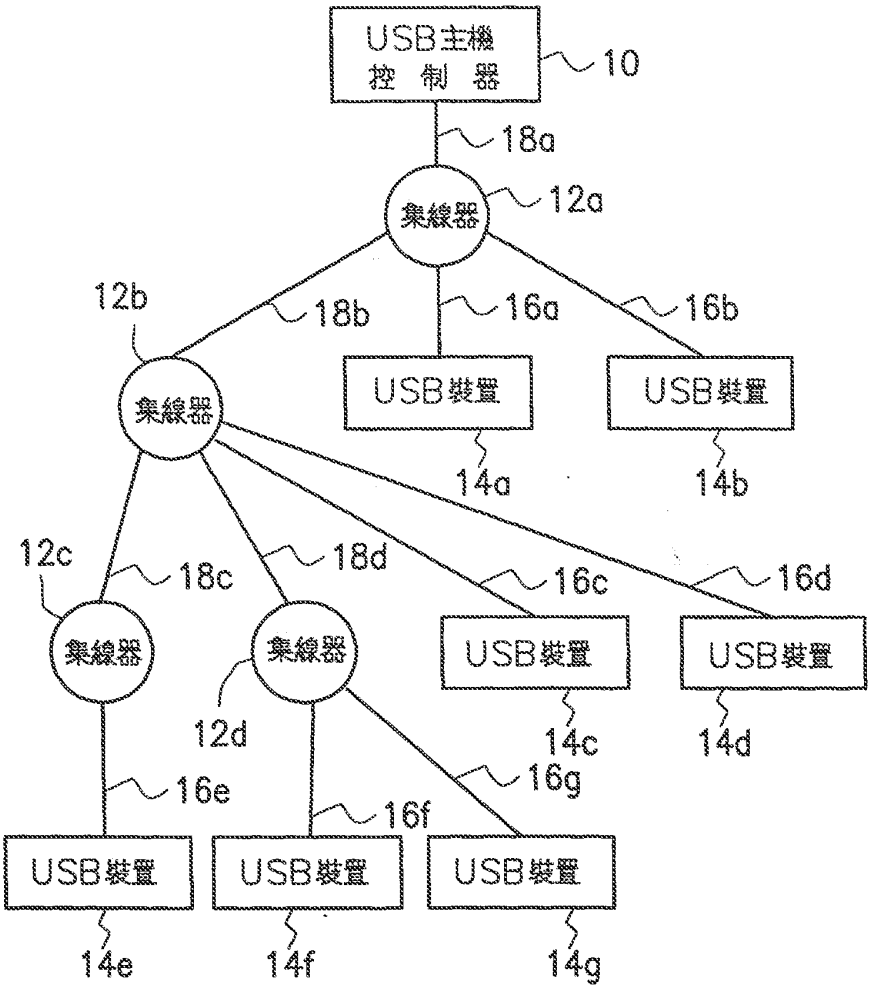
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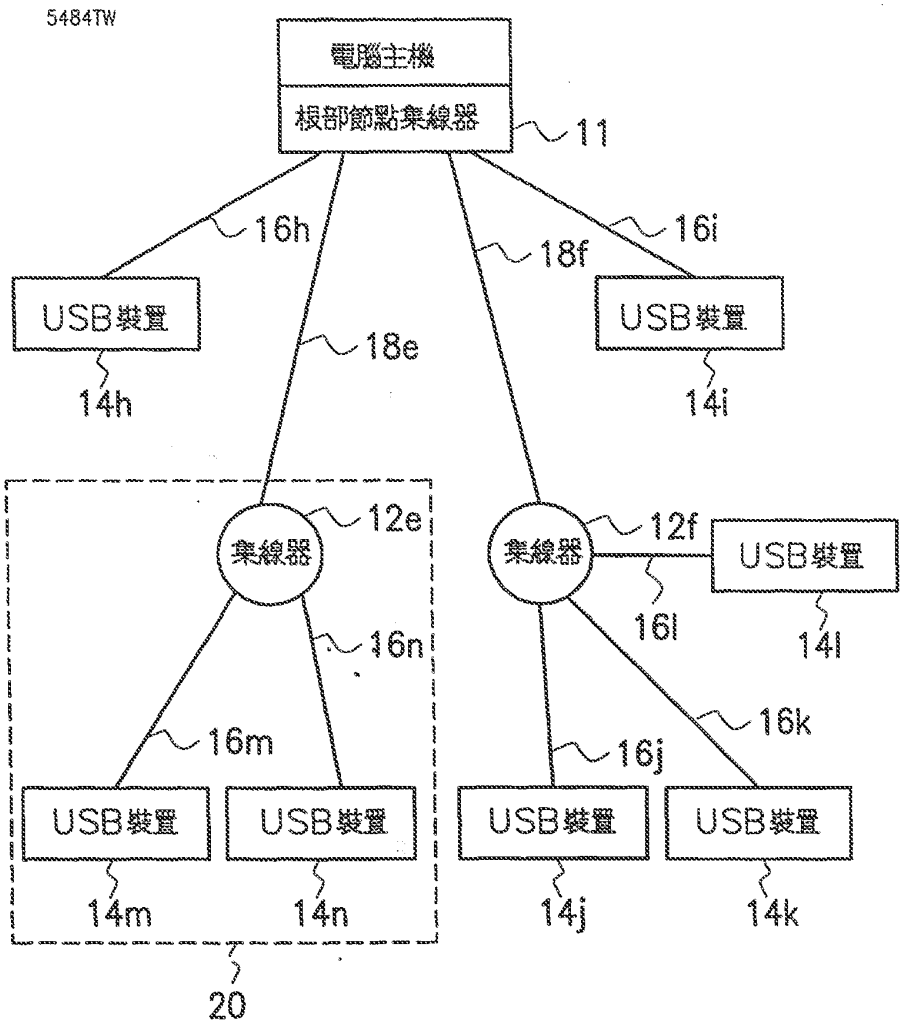
Microchip Ex. 1010, p. 233
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5484TW

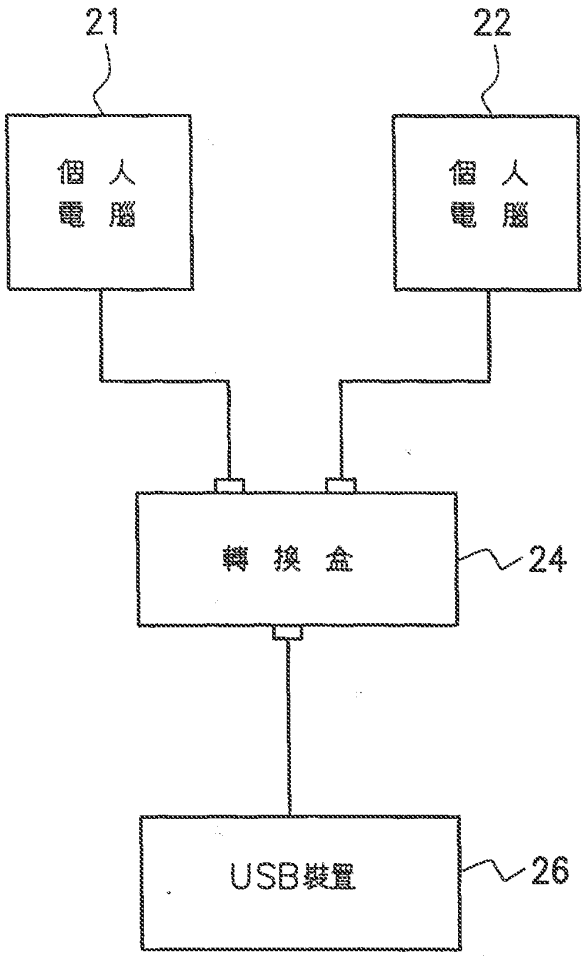


第 1 圖

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5484TW
電腦主機
根部節點集線器
11
16h
18f
16i
USB裝置
USB裝置
18e
14h
14i
12e
集線器
集線器
12f
USB裝置
16n
16l
14l
16k
16m
16j
USB裝置
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14m
14n
14j
14k
20

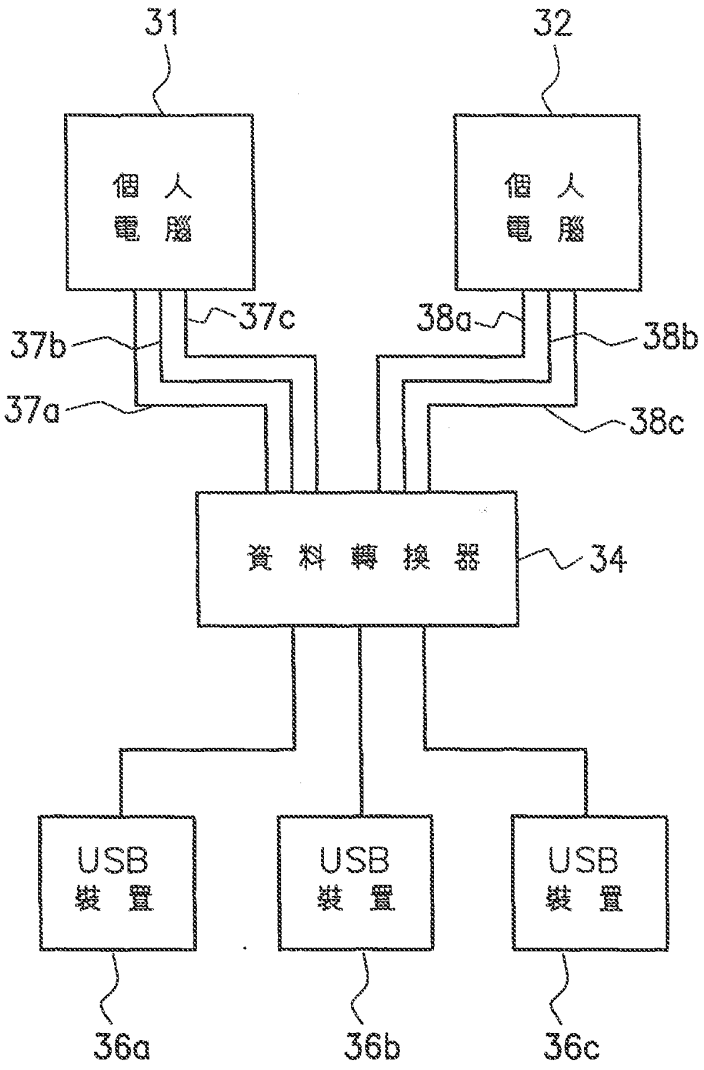
第 2 圖



第 3 圖

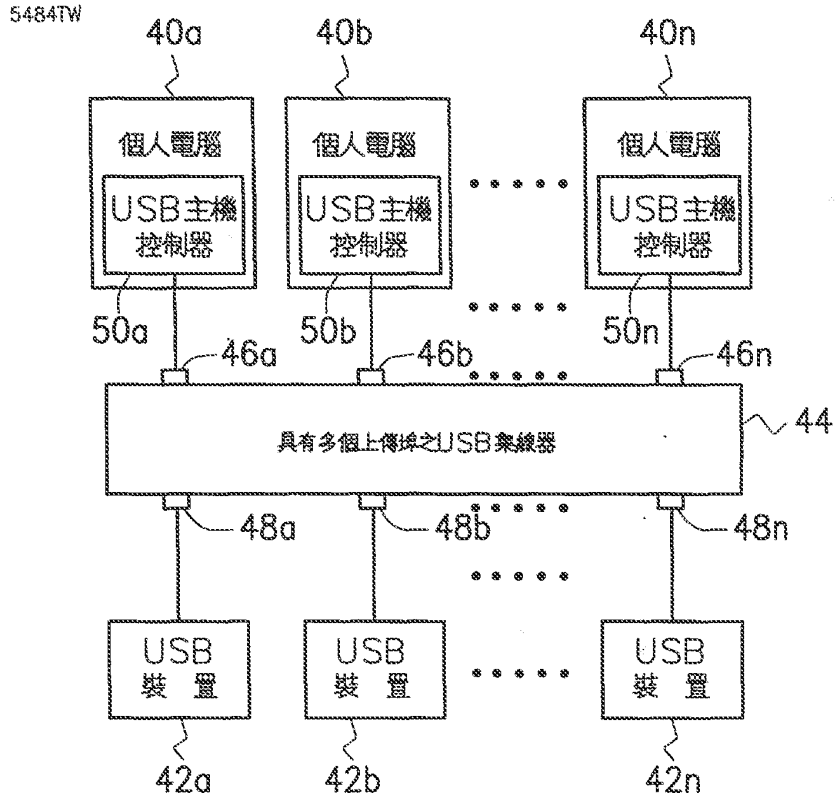
Microchip Ex. 1010, p. 236
Microchip v. Aptiv
IPR2024-00495

5484TW

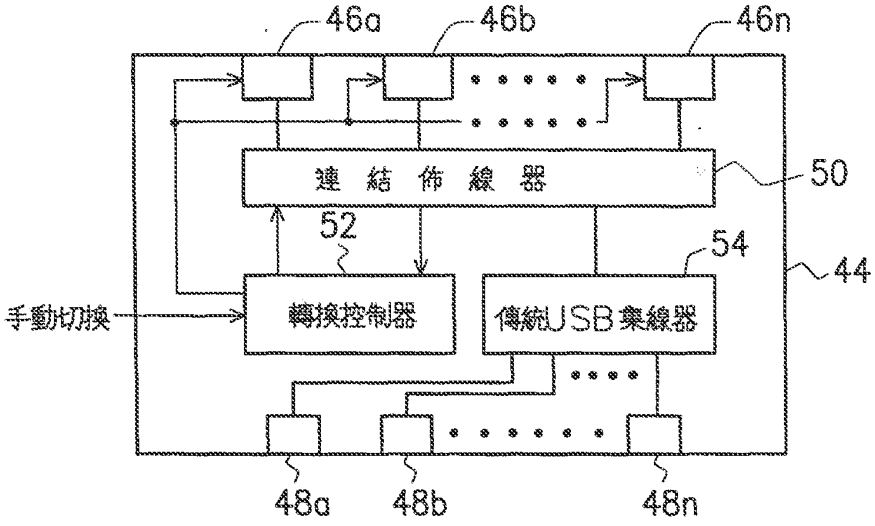


第 4 圖

Microchip Ex. 1010, p. 237
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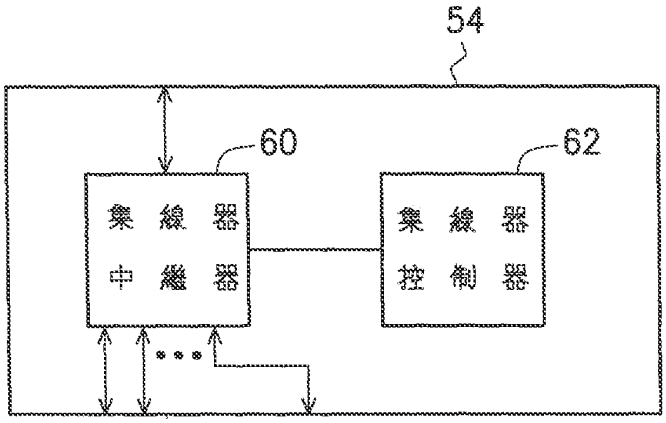

5484TW
40a
40b
40n
個人電腦
USB主機控制器
50a
50b
50n
46a
46b
46n
具有多個上傳埠之USB集線器
44
48a
48b
48n
USB裝置
42a
42b
42n

第 5 圖

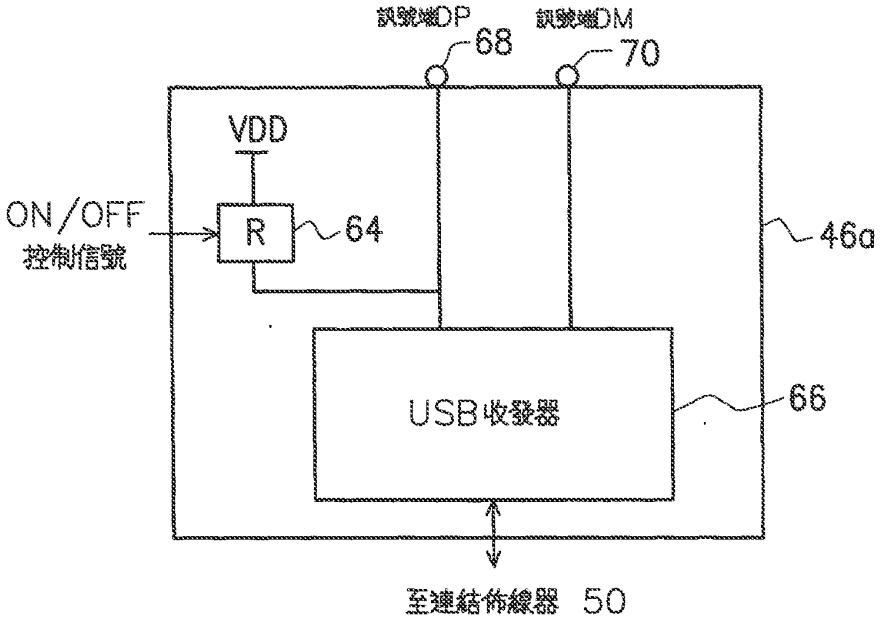

46a
46b
46n
連結佈線器
50
52
54
44
手動切換
轉換控制器
傳統USB集線器
48a
48b
48n

第 6 圖

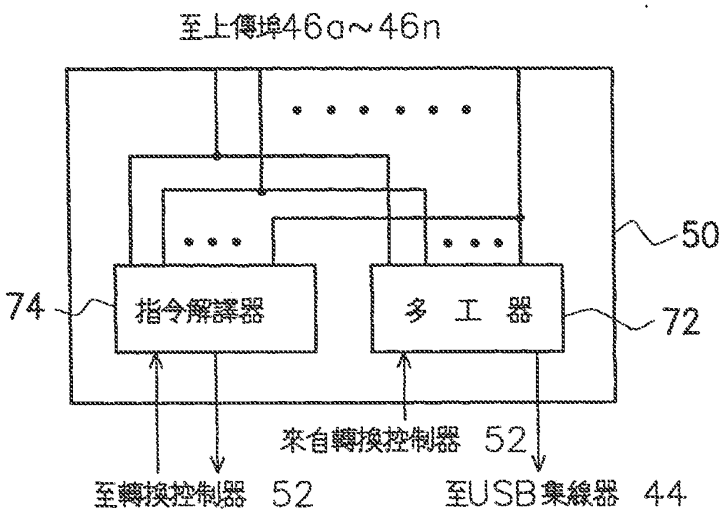
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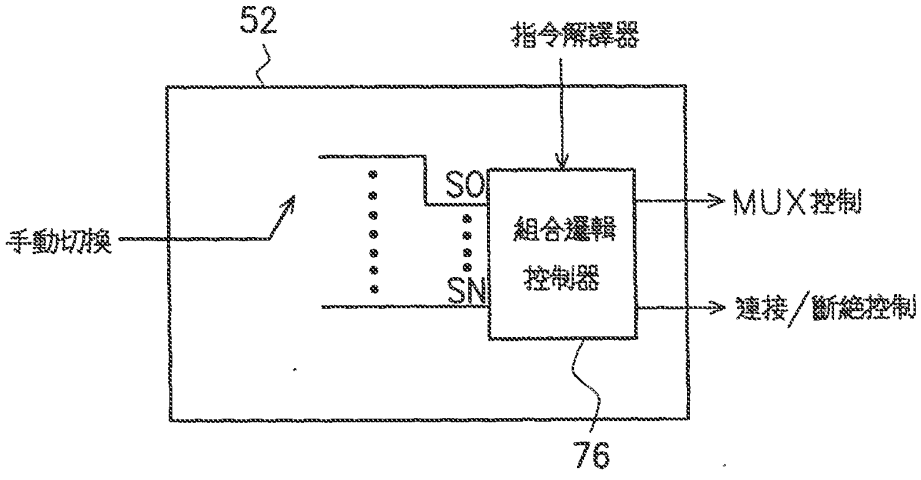
第 7 圖



第 8 圖


至上傳埠46a~46n
50
74
指令解譯器
多 工 器
72
來自轉換控制器 52
至轉換控制器 52
至USB集線器 44

第 9 圖


52
指令解譯器
S0
SN
組合邏輯
控制器
MUX控制
連接/斷絕控制
手動切換
76

第 10 圖

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Filer:	Robert James Myers/Kandace Powell
Attorney Docket Number:	DP-322037 CON 3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1720**

Electronic Acknowledgement Receipt

EFS ID:	37526690
Application Number:	16660083
International Application Number:	
Confirmation Number:	1000
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Customer Number:	22851
Filer:	Robert James Myers/Kandace Powell
Filer Authorized By:	Robert James Myers
Attorney Docket Number:	DP-322037 CON 3
Receipt Date:	22-OCT-2019
Filing Date:	
Time Stamp:	14:55:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1720
RAM confirmation Number	E20190LE56060733
Deposit Account	500831
Authorized User	Kandace Powell
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	DP322037CON3_ADS_aia0014.pdf	1823438 62f1651bf0b1f6eb9d0b6d46f898faa692658cee	no	9
Warnings:					
Information:					
2	Power of Attorney	DP322037CON3_POA_aia0080.pdf	80566 87bf244fb55b485bb0494294dd131bf40743a7a4	no	2
Warnings:					
Information:					
3	Assignee showing of ownership per 37 CFR 3.73	DP322037CON3_373c_aia0096.pdf	118363 d1e6861bbdf177e2fc996f2c24de7d79059ea0e4	no	3
Warnings:					
Information:					
4		DP322037CON3_appl.pdf	85766 572f67bc8382caa58c87a8007831d505fa06cdf7	yes	22

Multipart Description/PDF files in .zip description

Document Description	Start	End
Abstract	22	22
Claims	18	21
Specification	1	17

Warnings:					
Information:					
5	Drawings-only black and white line drawings	DP322037CON3_Drawings.pdf	1911749 fdc890ec7c74505a0b1032f1b6530be18eee7f08	no	8

Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	DP322037CON3_ids.pdf	613599 597e6203a15cd87a10cdb844ce5c82bfa3912b54	no	7
Warnings:					
Information:					
7	Foreign Reference	WO2015081448A1.pdf	4064100 f6231d621145c974b06d6f39a944e9864c3cdeec	no	66
Warnings:					
Information:					
8	Foreign Reference	WO2007147114A2.pdf	9804613 84da8a13b0fb2a03492649011f069b431d67e669	no	91
Warnings:					
Information:					
9	Foreign Reference	JP2003256351A.pdf	363907 1b143dcd17808d53d1ae62ca68eff1695c85254c	no	7
Warnings:					
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Information:					
10	Foreign Reference	TW470887B.pdf	1294193 ed253bb1798570a3ccf36be2259094133aad7656	no	34
Warnings:					
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Information:					
11	Non Patent Literature	FFI_RAPPORT.pdf	1453059 e3b3f0d5e22d290df810528c6645b82bf6cb2003	no	45
Warnings:					
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Information:					

12	Non Patent Literature	APC_USB_2_0.pdf	125704 4d59c3bbe22f3d9e5d9821a958eac37336bfa4a3	no	3
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Information:					
13	Non Patent Literature	USB_2_0_Autoswitch.pdf	322479 22df3c2118dceb0cf68b2a15f3acdde4539708a5	no	10
Warnings:					
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Information:					
14	Non Patent Literature	Peripheral_Sharing.pdf	206082 a42a649c73f5ea7f4802b2dcb68f35fbd95f0519	no	7
Warnings:					
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Information:					
15	Non Patent Literature	NPL_DOC_5_XP1544046A_1_of_2.pdf	13258958 55267a9c3c3288f466f0099e1b5e709eac202b11	no	325
Warnings:					
Information:					
16	Non Patent Literature	NPL_DOC_5_XP1544046A_2_of_2.pdf	11417880 23082057eeacea71b83c2c29b7c30dcb36bf59f7	no	325
Warnings:					
Information:					
17	Fee Worksheet (SB06)	fee-info.pdf	35080 3d2146483a7c29a94092a33c86124c1e5c67a35d	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	46979536	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert	M.	Voto	

Residence Information (Select One) • US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Clarkston	MI	US

Mailing Address of Inventor:

Address 1	7054 Oakhurst Ridge
Address 2	
City	Clarkston
State/Province	MI
Postal Code	48348
Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Shyambabu		Yeda	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Rochester Hills	MI	US

Mailing Address of Inventor:

Address 1	2134 Cattail Circle
Address 2	
City	Rochester Hills
State/Province	MI
Postal Code	48309
Country i	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Craig		Petku	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

Microchip Ex. 1010, p. 248
Microchip v. Aptiv
IPR2024-00495

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

City	Clarkston	State/Province	MI	Country of Residence	US

Mailing Address of Inventor:

Address 1	5188 Iroquois Court		
Address 2			
City	Clarkston	**State/Province**	MI
Postal Code	48348	**Country**	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	22851		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS		
Attorney Docket Number	DP-322037 CON 3	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	8	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Microchip Ex. 1010, p. 249
Microchip v. Aptiv
IPR2024-00495

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	◯ Limited Recognition (37 CFR 11.9)
Customer Number	22851		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
	Continuation of	15441775	2017-02-24	

Prior Application Status	Patented			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15441775	Continuation of	15268728	2016-09-19	9619420	2017-04-11

Prior Application Status	Patented			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15268728	Continuation of	14487947	2014-09-16	9460037	2016-10-04

Prior Application Status				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
14487947	Claims benefit of provisional	61/882915	2013-09-26	

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

Microchip Ex. 1010, p. 250
Microchip v. Aptiv
IPR2024-00495

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Microchip Ex. 1010, p. 252
Microchip v. Aptiv
IPR2024-00495

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Aptiv Technologies Limited		
Mailing Address Information For Applicant:			
Address 1	Erin Court		
Address 2	Bishop's Court Hill		
City	St. Michael	**State/Province**	
Country	BB	Postal Code	14004
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Robert J. Myers/			Date (YYYY-MM-DD)	2019-10-22
First Name	Robert	Last Name	Myers	Registration Number	69783

Additional Signature may be generated within this form by selecting the Add button. Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	DP-322037 CON 3
	Application Number	
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Microchip v. Aptiv
IPR2024-00495

505734826 10/22/2019

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT5781640

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
ROBERT M. VOTO	10/21/2019
SHYAMBABU YEDA	10/21/2019
CRAIG PETKU	10/21/2019

RECEIVING PARTY DATA

Name:	APTIV TECHNOLOGIES LIMITED
Street Address:	ERIN COURT
Internal Address:	BISHOP'S COURT HILL
City:	ST. MICHAEL
State/Country:	BARBADOS
Postal Code:	14004

PROPERTY NUMBERS Total: 1

Property Type	Number
Application Number:	16660083

CORRESPONDENCE DATA

Fax Number:

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 248-813-1203
Email: kandace.k.powell@aptiv.com
Correspondent Name: APTIV TECHNOLOGIES LIMITED
Address Line 1: P.O. BOX 5052
Address Line 2: M/C 483-400-502
Address Line 4: TROY, MICHIGAN 48007-5052

ATTORNEY DOCKET NUMBER:	DP-322037 CON 3
NAME OF SUBMITTER:	ROBERT J. MYERS
SIGNATURE:	/Robert J. Myers/
DATE SIGNED:	10/22/2019
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 2

source=DP322037CON3_Comb_Decl_Assign_signed#page1.tif
source=DP322037CON3_Comb_Decl_Assign_signed#page2.tif

DocuSign Envelope ID: 86FA4BBD-13FA-4792-8C72-20B2F458BC60

Combined Declaration and Assignment for Utility Patent and Design Patent Applications

DECLARATION

Docket No.: **DP-322037 CON 3**

Title of Invention: **FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS**

As a below named inventor, I hereby declare that this declaration is directed to:

☒ The attached application, or

☐ United States Application Number or PCT International Application Number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. §1001 by fine or imprisonment of not more than five (5) years, or both.

ASSIGNMENT

Pursuant to an agreement with my employer, I formally assign to APTIV TECHNOLOGIES LIMITED, the entire right, title, and interest, in all countries, in the improvements set forth in the attached application or in the United States Application Number of PCT International Application Number listed above for which I executed a declaration dated as indicated below.

Hereby executed by the undersigned on the date opposite the undersigned name:

Legal Name Of Inventor: DocuSigned by: Robert M. Voto 4447937785AF44A... Date: 10/21/2019

Robert M. Voto

DocuSign Envelope ID: 86FA4BBD-13FA-4792-8C72-20B2F458BC60

Legal Name Of Inventor

DocuSigned by:
Shyambabu Yeda
9AB7C1737116E6E4D9...

Date: 10/21/2019

Shyambabu Yeda

Legal Name Of Inventor

DocuSigned by:
Craig Petku
8CB18DB82F384E7...

Date: 10/21/2019

Craig Petku

United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :C46910

Sale Accounting Date:11/07/2019

Sale Item Reference Number	Effective Date
16660083	10/22/2019

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I2019A7822481557	1201	INDEPENDENT CLAIMS IN EXCESS OF 3	$920.00	Deposit Account

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/660,083

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	11 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	5 minus 3 =	* 2				x 460 =	920
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2640

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/660,083	10/22/2019		2640	DP-322037 CON 3	11	5

CONFIRMATION NO. 1000

22851
Aptiv Technologies Limited
P.O. Box 5052
M/C 483-400-502
Troy, MI 48007-5052

FILING RECEIPT

OC000000112300864

Date Mailed: 11/12/2019

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Robert M. Voto, Clarkston, MI;
Shyambabu Yeda, Rochester Hills, MI;
Craig Petku, Clarkston, MI;

Applicant(s)

Aptiv Technologies Limited, St. Michael, BARBADOS;

Power of Attorney: The patent practitioners associated with Customer Number 22851

Domestic Priority data as claimed by applicant

This application is a CON of 15/441,775 02/24/2017
which is a CON of 15/268,728 09/19/2016 PAT 9619420
which is a CON of 14/487,947 09/16/2014 PAT 9460037
which claims benefit of 61/882,915 09/26/2013

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Microchip Ex. 1010, p. 263
Microchip v. Aptiv
IPR2024-00495

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 11/07/2019
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/660,083**
Projected Publication Date: 02/20/2020
Non-Publication Request: No
Early Publication Request: No
Title

FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Microchip v. Aptiv
IPR2024-00495

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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IPR2024-00495

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/660,083	10/22/2019	Robert M. Voto	DP-322037 CON 3

CONFIRMATION NO. 1000

22851
Aptiv Technologies Limited
P.O. Box 5052
M/C 483-400-502
Troy, MI 48007-5052

PUBLICATION NOTICE

OC000000114851370

Title:FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

Publication No.US-2020-0057739-A1
Publication Date:02/20/2020

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

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Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Microchip Ex. 1010, p. 266
Microchip v. Aptiv
IPR2024-00495

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
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NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	16/660,083
Filing Date	October 22, 2019
First Named Inventor	Robert M. Voto
Title	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
Art Unit	
Examiner Name	
Attorney Docket Number	7021.145US4

SIGNATURE of Applicant or Patent Practitioner

Signature	/Michael A. Collins/	Date (Optional)	December 15, 2020
Name	Michael A. Collins	Registration Number	59135
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 171991

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Aptiv Technologies Limited

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Robert E. Ray/	Date (Optional)	7/1/2020
Name	Robert E. Ray		
Title	Assistant Secretary		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

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Electronic Acknowledgement Receipt

EFS ID:	41430481
Application Number:	16660083
International Application Number:	
Confirmation Number:	1000
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Customer Number:	22851
Filer:	Michael Allen Collins/LaTasha Hill
Filer Authorized By:	Michael Allen Collins
Attorney Docket Number:	DP-322037 CON 3
Receipt Date:	18-DEC-2020
Filing Date:	22-OCT-2019
Time Stamp:	12:55:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	7021145US4_POA.pdf	238224 9626aa9b412fc2f0dc5b603581da4b0c8545d059	no	2

Warnings:

Information:	
Total Files Size (in bytes):	238224

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/660,083	10/22/2019	Robert M. Voto	7021.145US4

CONFIRMATION NO. 1000

171991
Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

POA ACCEPTANCE LETTER

OC000000122174445

Date Mailed: 12/22/2020

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 12/18/2020.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/mteklemichael/

Microchip Ex. 1010, p. 271
Microchip v. Aptiv
IPR2024-00495

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/660,083	10/22/2019	Robert M. Voto	DP-322037 CON 3

CONFIRMATION NO. 1000

22851
Aptiv Technologies Limited
P.O. Box 5052
M/C 483-400-502
Troy, MI 48007-5052

POWER OF ATTORNEY NOTICE

OC000000122174396

Date Mailed: 12/22/2020

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 12/18/2020.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/mteklemichael/

Microchip Ex. 1010, p. 272
Microchip v. Aptiv
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/660,083	10/22/2019	Robert M. Voto	7021.145US4	1000

171991 7590 02/18/2021

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

EXAMINER	
UNELUS, ERNEST	

ART UNIT	PAPER NUMBER
2181	

NOTIFICATION DATE	DELIVERY MODE
02/18/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@billionarmitage.com

Microchip Ex. 1010, p. 273
Microchip v. Aptiv
IPR2024-00495

Office Action Summary	Application No. 16/660,083	Applicant(s) Voto et al.	
	Examiner ERNEST UNELUS	Art Unit 2181	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on Election over the phone on 02/10/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-11 is/are pending in the application.

5a) Of the above claim(s) 11 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-10 is/are rejected.

8) ☐ Claim(s) 1-4 and 7 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 10/22/2019 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 10/22/2019.

3) ☑ Interview Summary (PTO-413) Paper No(s)/Mail Date 02/10/2021.

4) ☐ Other: _____.

Microchip Ex. 1010, p. 274
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IPR2024-00495

DETAILED ACTION

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

This application contains claims directed to the following patentably distinct **species 1** (claims 1-10) and **2** (claim 11). The species are independent or distinct because invention 1 is directed to a hub to dynamically switch/route a USB device connection between USB Device mode and USB Host mode, wherein the route of a signal of the device changes based on the mode of the device, invention 2 is directed to a hub having multiple hosts and multiple USB devices, wherein a host is selected to simultaneously broadcast data to multiple USB devices. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no generic.

There is a search and/or examination burden for the patentably distinct species as set forth above because at least the following reason(s) apply:

Invention 1 is directed to a hub to dynamically switch/route a USB device connection between USB Device mode and USB Host mode, wherein the route of a signal of the device changes based on the mode of the device, invention 2 is directed to a hub having multiple hosts

and multiple USB devices, wherein a host is selected to simultaneously broadcast data to multiple USB devices.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or a grouping of patentably indistinct species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species or grouping of patentably indistinct species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing them to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

During a telephone interview with Mr. Robert Myers (Attorney Registration Number 69,783) on 02/10/21, a provisional election was made without traverse to prosecute invention 1 claims 1-10.

The instant application having Application No. 16/660,083 has a total of 10 elected claims pending in the application; there are 4 independent claims and 6 dependent claims, which are ready for examination by the examiner.

INFORMATION CONCERNING OATH/DECLARATION

Oath/Declaration

The applicant's oath/declaration has been reviewed by the examiner and is found to conform to the requirements prescribed in **37 C.F.R. 1.63.**

INFORMATION CONCERNING DRAWINGS

Drawings

The applicant's drawings submitted are acceptable for examination purposes.

ACKNOWLEDGEMENT OF REFERENCES CITED BY APPLICANT

As required by **M.P.E.P. 609(C)**, the applicant's submissions of the Information Disclosure Statement 10/22/19 is acknowledged by the examiner and the cited reference has been considered in the examination of the claims now pending. As required by **M.P.E.P 609 C(2)**, a copy of the PTOL-1449 initialed and dated by the examiner is attached to the instant office action.

OBJECTIONS TO THE CLAIMS

Claim 1-4 and 7 are objected to as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As per **claim 1**, limitations "*routing the second USB signal from a second USB host via a USB bridge to said first USB host, and routing the second USB signal from a USB device via a USB hub to said first USB host*" because they recite one signal, the second USB signal from a second USB host and a USB device. It's not clear if there's a mode change of the 'USB host' or the 'USB device'. Correction is needed.

As per **claim 7**, it's depended on claim 8, which follows claim 7. Correction is needed.

REJECTIONS BASED ON PRIOR ART

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van*

Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 1-11 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-17 of U.S. Patent No. 9,460,037; claims 1-20 of U.S. Patent No. 9,619,420 and claims 1-6 of U.S. Patent No. 10,545,899. Although the claims at issue are not identical, they are not patentably distinct from each other because the claims mentioned and

claims 1-11 of present application are directed to a hub to dynamically switch/route a USB device connection between USB Device mode and USB Host mode and a host simultaneously accessing multiple USB devices.

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

1. **Claims 1-10** are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Wright (US pat. 7,502,878), hereinafter, "Wright".

At the outset, Applicant is reminded that claims subject to examination will be given their broadest reasonable interpretation in light of the supporting disclosure. In re Morris, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023,1027-28 (Fed. Cir. 1997). With this in mind, the discussion will focus on how the terms and relationships between the terms in the claims are met by the references.

2. As per **claim 1**, Wright discloses a method for providing efficient communications among USB components of a data communication system that includes multiple USB hosts and multiple USB devices **(see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines**

54-59), said method comprising the steps of: providing a first input port **(receptacle 40A, as disclose in col. 5, line 66 to col. 6, line 9 and fig. 4)** for receiving a first USB signal from a first USB host **(USB host 31A transmitting data on receptacle 40A; see col. 5, line 66 to col. 6, line 9 and fig. 5)**; providing a second input port **(receptacle 40B)** for receiving a second USB signal **(a type B USB host 31B transmitting data on receptacle 40B; see col. 5, line 66 to col. 6, line 9 and fig. 5)**; routing the second USB signal from a second USB host **(a type B USB host 31B)** via a USB bridge **(multiplexer 36)** to said first USB host, and routing the second USB signal from a USB device via a USB hub **(hub logic 38)** to said first USB host **(see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**.

3. As per **claim 2**, Wright discloses "The method according to claim 1" **[See rejection to claim 1 above]**, wherein said second USB signal from the second USB host is not routed to the first USB host via the USB hub **(see fig. 5)**.

4. As per **claim 3**, Wright discloses wherein the second USB signal is routed via only one of the USB bridge or the USB hub **(see fig. 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**.

5. As per **claim 4**, Wright discloses wherein the second USB signal from the second USB host is transmitted to the first USB host via the USB bridge and the USB hub **(see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**.

6. As per **claims 5 and 8**, Wright discloses a method, comprising the steps of: providing a first USB port **(receptacle 40A of figs. 4 and 5)** for communication with a USB host **(a USB host 31A transmitting data) (see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**; providing a second USB port **(receptacle 40B)** for communicating with a consumer device **(an A type USB host 31B)**; providing a signal detection circuit **(a controller of hub logic 38, as disclose in col. 5, lines 62-65 and col. 6, line 52)** for receiving USB signals from the consumer device via said second USB port **(see col. 5, lines 62-65 and col. 6, line 52)**; determining, via the signal detection circuit, whether the USB signals emanating from the consumer device indicate that the consumer device is operating in a USB host mode **(to be a B type USB host device)** and if so, routing said USB signals via a USB bridge **(multiplexer 36)** to said first USB port **(see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**; determining, via the signal detection circuit, whether the USB signals emanating from the consumer device indicate that the consumer device is operating in a USB device mode and if so, routing said USB signals via a USB hub to said first USB port **(see above, which selected USB host mode)**.

7. As per **claim 6**, Wright discloses a USB communication management method for interconnecting sources of USB signals, said method comprising the steps of: receiving first USB host signals from a first USB host **(a USB host 31A transmitting data) (see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**; receiving second USB signals from a second USB signal source **(a B type USB host 31B) (see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**; determining whether the second USB signals emanate from a second USB host; routing the second USB signals emanating from the second USB host

via a USB bridge **(multiplexer 36)** to said first USB host **(see col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**; and routing the second USB signals not determined to emanate from a USB host **(hub logic 38)** via a USB hub to said first USB host **(see col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**.

8. As per **claim 7**, Wright discloses, further comprising the steps of: determining whether the second USB signals emanate from a USB device; and routing the second USB signals determined to emanate from the USB device via a USB hub **(hub logic 38)** to said first USB host **(see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**.

9. As per **claim 9**, Wright discloses further comprising the steps of: determining whether the second USB signal emanates from a USB device; and establishing the second communication path via a USB hub between said first USB host and said second USB signal source if said second USB signal is determined to emanate from the USB device **(see figs. 2, 4 and 5 and col. 5, line 42 to col. 6, line 21 and col. 6, lines 54-59)**.

10. As per **claim 10**, Wright discloses wherein the first communication path does not include a USB hub and wherein the second communication path does not include a USB bridge **(note, there's no communication if the device is not connected; see figs. 4 and 5)**.

RELEVANT ART CITED BY THE EXAMINER

The following prior art made of record and not relied upon is cited to establish the level of skill in the applicant's art and those arts considered reasonably pertinent to applicant's disclosure. See **MPEP 707.05(c)**.

The following reference teaches a method to enable a USB Host system to connect to multiple devices through a USB Hub having ports that can be changed from downstream to upstream, dual ports: US Pub. 2007/0255885 (Bohm et al.)

CLOSING COMMENTS

CONCLUSION

a. STATUS OF CLAIMS IN THE APPLICATION

The following is a summary of the treatment and status of all claims in the application as recommended by **M.P.E.P. 707.07(i):**

a (1) CLAIMS REJECTED IN THE APPLICATION

Per the instant office action, claims 1-10 have received a first action on the merits and are subject of a first action non-final.

b. DIRECTION OF FUTURE CORRESPONDENCES

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Ernest Unelus whose telephone number is (571) 272-8596. The examiner can normally be reached on Monday to Friday 9:00 AM to 5:00PM.

IMPORTANT NOTE

If attempts to reach the above noted Examiner by telephone are unsuccessful,

the Examiner's supervisor, Mr. Idriss Alrobaye, can be reached at the following telephone number: Area Code (571) 270-1023.

The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through private PAIR only. For more information about the PMR system, see her//pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217- 91 97 (toll-free).

/Ernest Unelus/
Primary Examiner
Art Unit 2181

Examiner-Initiated Interview Summary	**Application No.** 16/660,083	**Applicant(s)** Voto et al.		
	Examiner ERNEST UNELUS	**Art Unit** 2181	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
ERNEST UNELUS	Primary Examiner	Telephonic
Robert Myers	Attorney	

Date of Interview: 10 February 2021

Issues Discussed:

Election/Restriction

This application contains claims directed to the following patentably distinct species 1 (claims 1-10) and 2 (claim 11). The species are independent or distinct because invention 1 is directed to a hub to dynamically switch/route a USB device connection between USB Device mode and USB Host mode, wherein the route of a signal of the device changes based on the mode of the device, invention 2 is directed to a hub having multiple hosts and multiple USB devices, wherein a host is selected to simultaneously broadcast data to multiple USB devices.
During a telephone interview with Mr. Robert Myers (Attorney Registration Number 69,783) on 02/10/21, a provisional election was made without traverse to prosecute invention 1 claims 1-10.

/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

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Notice of References Cited	Application/Control No. 16/660,083	Applicant(s)/Patent Under Reexamination Voto et al.	
	Examiner ERNEST UNELUS	Art Unit 2181	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20070255885-A1	11-2007	Bohm; Mark R.	G06F13/4022	710/316
*	B	US-7502878-B1	03-2009	Wright; David G.	G06F13/4022	710/37
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	Art Unit
	ERNEST UNELUS	2181

CPC - Searched*		
Symbol	Date	Examiner
G06F 13/4022, 385, 4045, 4282; G06F 2213/4004, 3812 and G06F 11/3051	02/12/2021	E.U.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
EAST search: US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	02/12/2021	E.U.
Inventor search utilizing PE2E and EAST	02/12/2021	E.U.
CPC search of G06F 13/4022, 385, 4045, 4282; G06F 2213/4004, 3812 and G06F 11/3051	02/12/2021	E.U.

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	

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	16/660,083	Voto et al.
	Examiner	Art Unit
	ERNEST UNELUS	2181

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/12/2021								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	N								

Microchip Ex. 1010, p. 289
Microchip v. Aptiv
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PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16/660,083
Filing Date	
First Named Inventor	Robert M. Voto, et al.
Art Unit	
Examiner Name	
Attorney Docket Number	DP-322037 CON3

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8447890	B1	2013-05-21	LeTourneur et al.	
	2	8447598	B2	2013-05-21	Chutorash et al.	
	3	7627708	B2	2009-12-01	Bohm et al.	
	4	7523243	B2	2009-04-21	Bohm et al.	
	5	7478191	B2	2009-01-13	Wurzburg et al.	
	6	7280802	B2	2007-07-10	Grady	
	7	7130656	B2	2006-10-31	Okagaki et al.	
	8	6957287	B2	2005-10-18	Lou et al.	

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Microchip Ex. 1010, p. 290
Microchip v. Aptiv
IPR2024-00495

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16/660,083
	Filing Date	
	First Named Inventor	Robert M. Voto, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	DP-322037 CON3

	9	6934793	B2	2005-08-23	Ying et al.	
	10	6732219	B1	2004-05-04	Broyles	
	11	6073188	A	2000-06-06	FLEMING SCOTT M	
	12	7502878	B1	2009-02-10	WRIGHT	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20150089092	A1	2015-03-26	Voto et al.	
	2	20130106750	A1	2013-05-02	Kurosawa	
	3	20130053003	A1	2013-02-28	King, II	
	4	20120290859	A1	2012-11-15	Saladin et al.	
	5	20120191811	A1	2012-07-26	Ng et al.	

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Microchip Ex. 1010, p. 291
Microchip v. Aptiv
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	
	First Named Inventor	Robert M. Voto, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	DP-322037 CON3

	6	20120134506	A1	2012-05-31	DeBiasio et al.	
	7	20110124300	A1	2011-05-26	Sinai	
	8	20110054721	A1	2011-03-03	Goodrich et al.	
	9	20090117890	A1	2009-05-07	Jacobsen et al.	
	10	20080005262	A1	2008-01-03	Wurzburg et al.	
	11	20070156293	A1	2007-07-05	Kellzi et al.	
	12	20070086724	A1	2007-04-19	Grady et al.	
	13	20070067553	A1	2007-03-22	Chang	
	14	20060206650	A1	2006-09-14	Chang	
	15	20060056401	A1	2006-03-16	Bohm et al.	
	16	20040243755	A1	2004-12-02	Lee et al.	

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Microchip Ex. 1010, p. 292
Microchip v. Aptiv
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	Art Unit	
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	Attorney Docket Number	DP-322037 CON3

	17	20040088449	A1	2004-05-06	Sakaki	
	18	20040019732	A1	2004-01-29	Overtoom et al.	
	19	20030167345	A1	2003-09-04	Knight et al.	

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	1	2015081448	WO	A1	2015-06-11	CONDOTTA et al.		
	2	2007147114	WO	A2	2007-12-21	WURZBURG et al.		
	3	2003256351	JP	A	2003-09-12	FURUKAWA TADAO		
	4	470887	TW	B	2002-01-01	JANG LIANG-SHI		

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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Microchip Ex. 1010, p. 293
Microchip v. Aptiv
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	DP-322037 CON3

	1	"FFI Rapport-A STUDY OF COMPUTER INTERFACES FOR SOLDIER SYSTEMS", Lars Erik Olsen & Joakin Flathagen, Norwegian Defence Research Establishment, October 10, 2005	
	2	"USB 2.0 Autoswitch User's Manual", Lindy Electronics Limited & Lindy-Elektronic GMBH, September 2002	
	3	"APC USB 2.0 Host Controller - Device Driver Download", http://www.liutilities.com/devicedriver/apcusb20hostcontroller/, July 2002	
	4	"Peripheral-Sharing Hardware Suits Education's Needs to a 'T'", Terian Tyre, T H E Journal (Technological Horizons In Education), October 1988	
	5	"UNIVERSAL SERIAL BUS SPECIFICATION REVISION 2.0", UNIVERSAL SERIAL BUS SPECIFICATION" no. REV. 2.0, 27 April 2000	

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Examiner Signature	/ERNEST UNELUS/	Date Considered	02/12/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Microchip Ex. 1010, p. 294
Microchip v. Aptiv
IPR2024-00495

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	
	First Named Inventor	Robert M. Voto, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	DP-322037 CON3

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert J. Myers/	Date (YYYY-MM-DD)	2019-10-22
Name/Print	Robert J. Myers	Registration Number	69,783

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Microchip Ex. 1010, p. 296
Microchip v. Aptiv
IPR2024-00495

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	15	((dual or swap$4) with port).ab. and usb with downstream with upstream with (dual or swap$4 or mode) and usb with (hub or adapt$3) and G06F13/4022,4045,385.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:42
L2	1	((dual or swap$4) with port).ab. and usb with downstream with upstream with (dual or swap$4 or mode) and usb with (hub or adapt$3) and G06F2213/4005,3812.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:42
L3	129	usb with downstream with upstream with (dual or swap$4 or mode) and usb with (hub or adapt$3) and G06F13/4022,4045,385.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:43
L5	14	usb with downstream with upstream with (dual or swap$4 or mode) and usb with (hub or adapt$3) and G06F11/3051.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:44
L6	20	usb with downstream with upstream with (dual or swap$4 or mode) and usb with (hub or adapt$3) and G06F2213/4004,3812.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:44
L7	74	usb with downstream with upstream with (dual or swap$4 or mode) and usb with (hub or adapt$3) and G06F13/4282.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:44

L8	33	usb with (downstream or upstream or plurality or multiple or second or another) with (port or plug interface) with (hub or adapt$3) and bypass$4 with (host or master or initiat$3 or slave) with (peripheral or device or port or plug interface) and G06F13/4022,4045,385,4282.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:45
L9	4	usb with (downstream or upstream or plurality or multiple or second or another) with (port or plug interface) with (hub or adapt$3) and bypass$4 with (host or master or initiat$3 or slave) with (peripheral or device or port or plug interface) and G06F2213/4004,3812.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:45
L10	17,493	G06F13/4022.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:45
L11	24,094	G06F13/385.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:46
L12	5,306	G06F11/3051.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:46
L13	55	Shyambabu Yeda.in. or Robert Voto.in. or Craig Petku.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	NEAR	ON	2021/02/12 21:46
L14	2	13 and usb with (downstream or upstream or plurality or multiple or second or another) with (port or plug interface) with (hub or adapt$3) and bypass$4 with (host or master or initiat$3 or slave) with (peripheral or device or port or plug interface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/02/12 21:48

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16660083
Filing Date	2019-10-22
First Named Inventor	Voto
Art Unit	2181
Examiner Name	Unelus Ernest
Attorney Docket Number	7021.145US4

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	1	20070255885	A1	2007-11-01	Bohm et al.	

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	1	2473123	GB	A	2011-03-02	Lydon, et al.		

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Microchip Ex. 1010, p. 300
Microchip v. Aptiv
IPR2024-00495

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16660083
	Filing Date	2019-10-22
	First Named Inventor	Voto
	Art Unit	2181
	Examiner Name	Unelus Ernest
	Attorney Docket Number	7021.145US4

	1	Examination Report for IN Application No. 201647014322, dated December 17, 2020, 5 pages	

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	Examiner Name	Unelus Ernest
	Attorney Docket Number	7021.145US4

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A certification statement is not submitted herewith.

SIGNATURE

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Signature	/Robert Myers/	Date (YYYY-MM-DD)	2021-03-05
Name/Print	Robert Myers	Registration Number	69783

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Microchip Ex. 1010, p. 302
Microchip v. Aptiv
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Microchip Ex. 1010, p. 303
Microchip v. Aptiv
IPR2024-00495

(12) UK Patent Application (19) GB (11) 2473123 (13) A

(43) Date of A Publication 02.03.2011

(21) Application No: 1014178.6

(22) Date of Filing: 25.08.2010

(30) Priority Data:
(31) 12551824 (32) 01.09.2009 (33) US

(51) INT CL:
G06F 13/38 (2006.01)

(56) Documents Cited:
WO 2006/107509 A
WO 2004/034266 A
US 6920569 A
US 6516205 B
US 20080222341 A
US 20060080490 A
US 20040225836 A
US 20040088449 A

(58) Field of Search:
INT CL G06F
Other: EPODOC, WPI.

(71) Applicant(s):
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(72) Inventor(s):
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Lawrence G Bolton

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(54) Title of the Invention: **Device-dependent selection between modes for asymmetric serial protocols**
Abstract Title: **Method for personal computing devices to determine if they should act as the host or the peripheral, when connected to another device.**

(57) Disclosed is a method by which a personal computing device, such as a smart phone or PDA, can establish a suitable connection with another device or accessory. The method starts when the device is connected to the accessory, the device determines if there is a mode-selecting signal from the accessory. The signal indicating whether the device should operate in a first mode eg as a USB device, or operate in a second mode eg as a USB host in an asymmetric communication protocol. If a signal is received the device operates in the mode indicated, otherwise it operates in the first mode. The signal may be generated by sensing the resistance between a pair of device identification pins of the connector, such that if the sensed value satisfies a first criterion the second mode of operation is indicated. If the sensed value satisfies a second criterion the device operates as a user interface, otherwise it operates as a mass storage device.

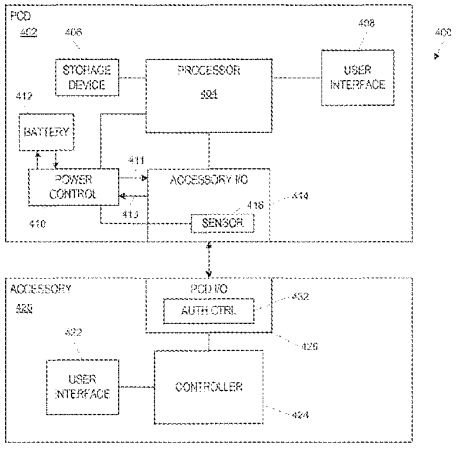


FIG. 4

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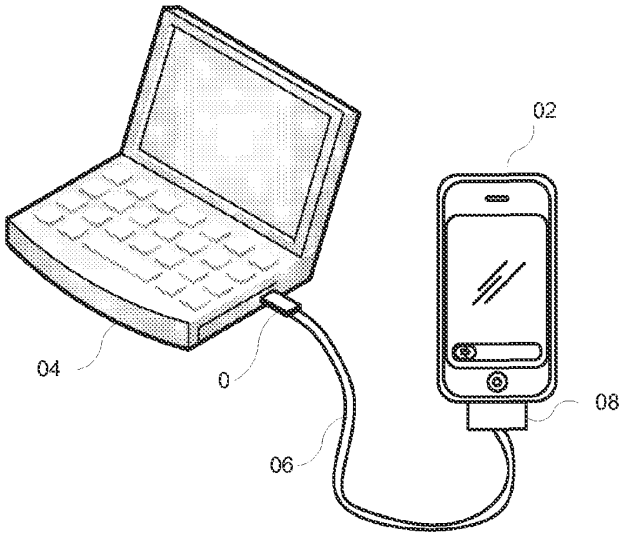


FIG. 1

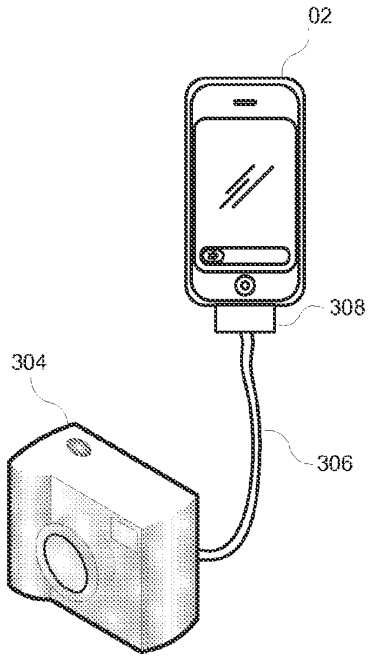


FIG. 3

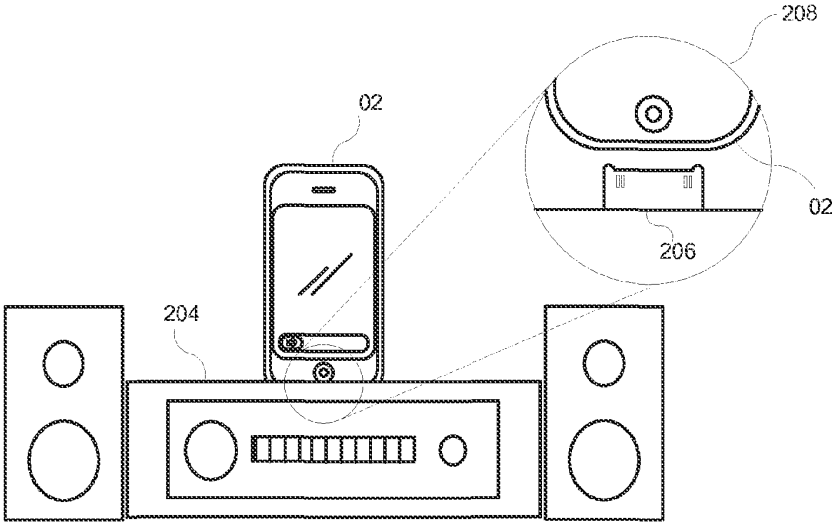


FIG. 2

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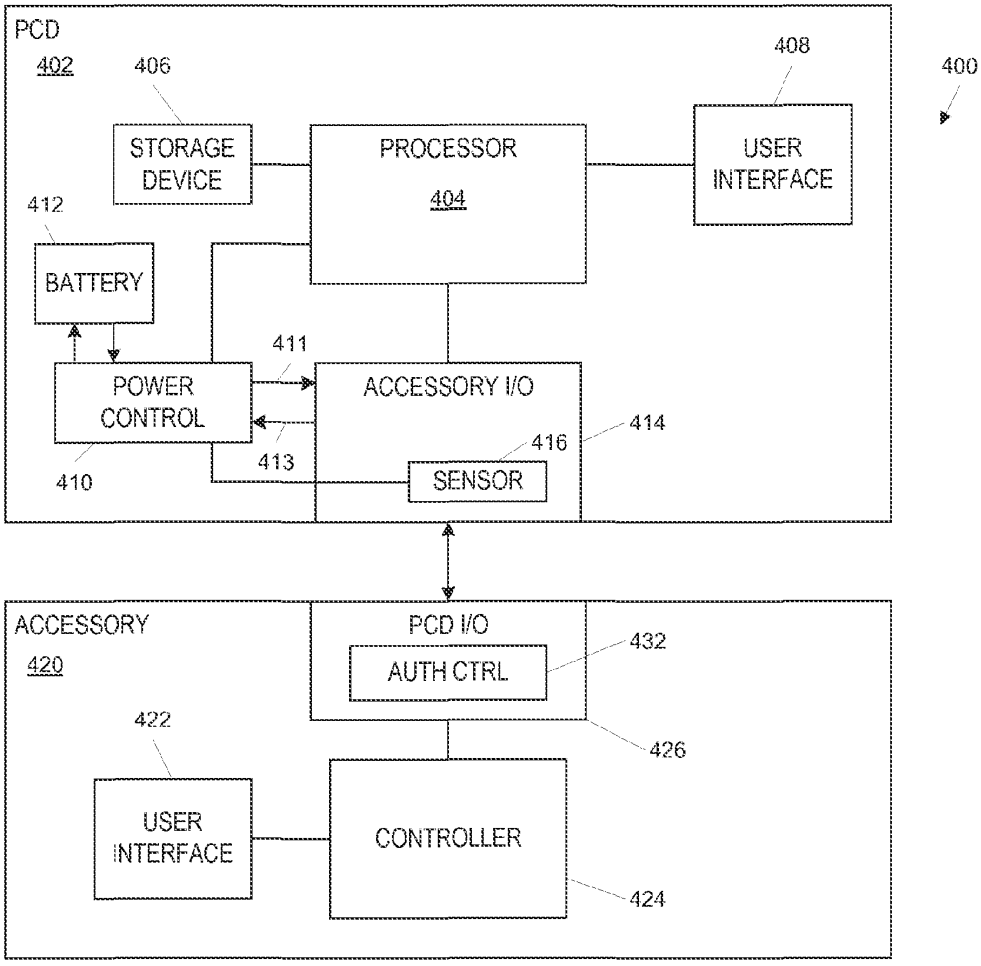


FIG. 4

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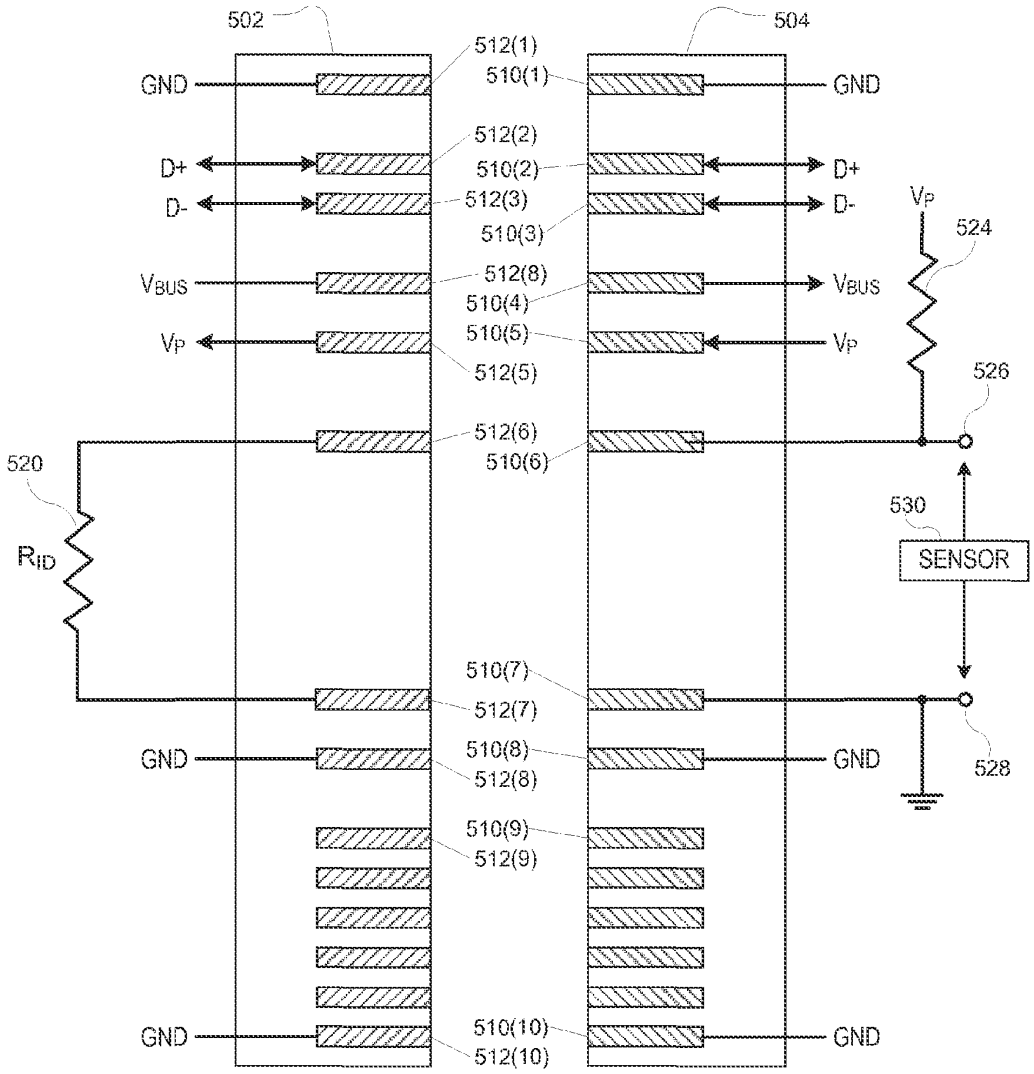


FIG. 5

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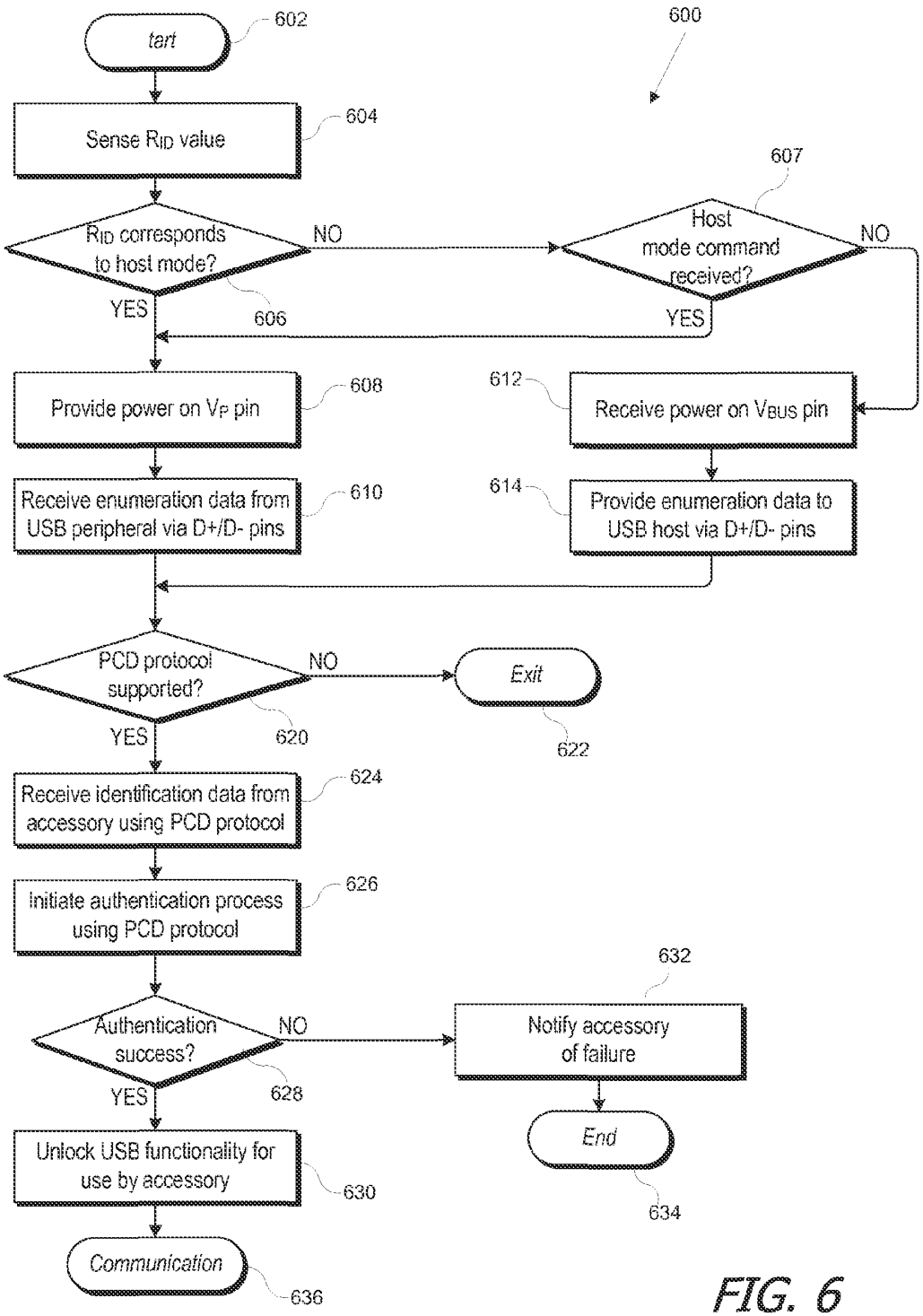


FIG. 6

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DEVICE-DEPENDENT SELECTION BETWEEN MODES FOR ASYMMETRIC SERIAL PROTOCOLS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Application No. 12/551,824 entitled "DEVICE-DEPENDENT SELECTION BETWEEN MODES FOR ASYMMETRIC SERIAL PROTOCOLS", filed on September 1, 2009.

BACKGROUND

[0002] The present disclosure relates generally to portable communication devices that communicate with accessory devices using serial protocols and in particular to device-dependent selection by the portable communication device between modes (or roles) of an asymmetric serial protocol.

[0003] In recent years, a number of portable communication devices (PCDs) have been developed. Examples of PCDs include, for example, portable media players, mobile phones, personal digital assistants (PDAs), portable e-mail devices, video game players, portable navigation units relying on Global Positioning System (GPS) satellite data, and multi-function devices that can integrate numerous functions such as media storage and playback, mobile phone, Internet access, e-mail, personal information management, game play, GPS/navigation capability, and the like. Examples of multi-function PCDs include various iPhone® and iPod® models manufactured and sold by Apple Inc., assignee of the present application, as well as other portable electronic devices made and sold by other manufactures and distributors under their respective brand names.

[0004] PCDs are frequently docked with other electronic devices, referred to herein as "accessories." For example, from time to time, a user may dock a PCD with a personal computer to synchronize media content and/or metadata, personal data, and the like. A user may at other times dock the same PCD with other electronic devices, such as an in-vehicle media system, a speaker dock, or the like. The user may also dock the PCD with a charger that provides power to the PCD but does not include other data or information sharing capability.

[0005] To facilitate communication between PCDs and accessories, it is common to rely on standard point-to-point communication protocols, such as Universal Serial Bus (USB). The

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USB specification (promulgated by USB Implementers Forum, Inc. and available at their website, www.usb.org) specifies two signal contacts, referred to as D+ and D-, for data transmission and two additional contacts for power, referred to as V_{BUS} and specified as 5.0 volts (V), and ground. In a USB connection, a "USB host" delivers power to the V_{BUS} contact while a "USB device" relies on the USB host to provide the V_{BUS} power.

BRIEF SUMMARY

[0006] USB is an asymmetric communication protocol, in the sense that the USB host and USB device use the connection contacts differently. This can create problems when connecting a PCD to different accessories at different times, as some accessories may prefer the PCD to act as USB host while other accessories prefer the PCD to act as a USB device. For example, when some PCDs connect to a computer via USB, the computer acts as USB host and provides power that can be used to charge the PCD. However, if a PCD connects to another portable electronic apparatus, such as a digital camera, the other apparatus may expect that it will be able to act as the USB device, in which case the PCD would need to act as a USB host. If the PCD cannot switch to a USB host mode, its ability to connect to different accessories may be limited.

[0007] Certain embodiments of the present invention provide PCDs that can automatically switch into one or another mode of an asymmetric communication protocol depending on the type of accessory connected. In some embodiments, the accessory (which can be any electronic apparatus that connects to a PCD) can signal its preference for whether the PCD should operate in a first mode or a second mode of the asymmetric protocol. Such signaling can be achieved, e.g., using a hardware mechanism such as an identification resistor or a software mechanism such as a command protocol. The PCD can detect this preference and configure itself in the operating mode identified by the accessory. Thus, for example, if the asymmetric communication protocol is a USB protocol, the accessory can indicate whether the PCD should operate as a USB host or a USB device.

[0008] In some embodiments, the PCD can conform precisely to a standard protocol such as USB when operating in one mode (e.g., USB device mode) but deviate from that protocol when operating in another mode (e.g., USB host mode). For example, in accordance with standard USB protocols, the USB host supplies 5.0 V of power on a V_{BUS} line to the USB device. A PCD can receive 5.0 V of power when operating as a USB device but supply a lower voltage (e.g., 3.3 V) when operating as a USB host. This can reduce power consumption by the PCD.

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[0009] The following detailed description together with the accompanying drawings will provide a better understanding of the nature and advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 illustrates a PCD docked with a computer according to an embodiment of the present invention.

[0011] FIG. 2 illustrates a PCD docked with a sound system according to an embodiment of the present invention.

[0012] FIG. 3 illustrates a PCD docked with a digital camera according to an embodiment of the present invention.

[0013] FIG. 4 is a block diagram of a system according to an embodiment of the present invention.

[0014] FIG. 5 is a simplified connection diagram illustrating connections that can be provided between an accessory and a PCD according to an embodiment of the present invention.

[0015] FIG. 6 is a flow diagram of a process for establishing a connection to an accessory according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0016] Certain embodiments of the present invention provide PCDs that can automatically switch into one or another mode of an asymmetric communication protocol depending on the type of accessory connected. In some embodiments, the accessory (which can be any electronic apparatus that connects to a PCD) can signal its preference for whether the PCD should operate in a first mode or a second mode of the asymmetric protocol. Such signaling can be achieved, e.g., using a hardware mechanism such as an identification resistor or a software mechanism such as a command protocol. The PCD can detect this preference and configure itself in the operating mode identified by the accessory. Thus, for example, if the asymmetric communication protocol is a USB protocol, the accessory can indicate whether the PCD should operate as a USB host or a USB device.

[0017] FIGs. 1-3 illustrate a PCD docked (or connected) to accessories according to embodiments of the present invention. In FIG. 1, PCD 102 is docked with computer 104 via cable 106. Cable 106 in this embodiment can include wires to carry the standard USB signals

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(D+, D-, VBUS, and ground) and can also include other wires. In one embodiment, connector 108 connects cable 106 to a mating receptacle (not explicitly shown) on a bottom surface of PCD 102. The mating receptacle of PCD 102 may include a larger number of pins than is required for USB communication (e.g., 30 pins in one embodiment), as described below with reference to FIG. 4. The additional pins can increase the range of accessories with which PCD 102 can be docked and the types of information that PCD 102 can exchange with an accessory when docked. In one embodiment, connector 110 connects cable 106 to a mating receptacle (not explicitly shown) on a side surface of computer 104. Connector 110 can be, for example, a standard USB connector, and the mating receptacle can be a standard USB receptacle. In the configuration of FIG. 1, computer 104 can act as a USB host while PCD 102 acts as a USB device.

[0018] In FIG. 2 , PCD 102 is docked with sound system 204. Docking can be accomplished by providing docking connector 206 (shown in inset 208) on a top surface of sound system 204 and inserting docking connector 206 into the mating receptacle (not explicitly shown) of PCD 102. In this configuration, docking connector 206 may include mating pins corresponding to some or all of the pins in the mating receptacle of PCD 102. Depending on the implementation of sound system 204, it may be desirable for PCD 102 to present a USB host configuration or a USB device configuration.

[0019] In FIG. 3, PCD 102 is docked with digital camera 304 via cable 306. In some embodiments, cable 306 can be similar to cable 106 of FIG. 1. Connector 308 connects cable 306 to a mating receptacle (not explicitly shown) of PCD 102. Digital camera 304 can provide a USB receptacle or a receptacle with additional pins to receive a connector (not shown) at one end of cable 306. In some embodiments, digital camera 304 can only operate as a USB device, in which case it is desirable for PCD 102 to present a USB host configuration.

[0020] It will be appreciated that the PCD/accessory connections described herein are illustrative and that variations and modifications are possible. A PCD can connect to a wide range of other electronic apparatus, and the term "accessory" as used herein refers generally to any electronic apparatus with which a PCD can be connected. A PCD can operate in either a USB host or USB device mode when connected to a USB-compliant accessory. As described below, the operating mode that a PCD presents to an accessory can be controlled using accessory identification pins provided on the mating receptacle of PCD 102 and corresponding pins on cable connector 106 or docking connector 206.

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[0021] FIG. 4 is a block diagram of a system 400 according to an embodiment of the present invention. System 400 can include PCD 402 (e.g., implementing PCD 102 of FIGs. 1-3) and an accessory 420 (e.g., implementing any one of accessories 104, 204, 304 of FIGs. 1-3).

[0022] PCD 402 in this embodiment can provide communication and/or media playback capability. PCD 402 can include processor 404, storage device 406, user interface 408, power control module 410, battery 412, and accessory input/output (I/O) interface 414. PCD 402 can also include other components (not explicitly shown) to provide various enhanced capabilities. For example, in some embodiments PCD 402 can include radio frequency (RF) transceiver components for accessing wireless voice and/or data networks (e.g., using cellular telephone technology, advanced data network technology such as 3G or EDGE, WiFi (IEEE 802.11 family standards), or other mobile communication technologies, or any combination thereof), a GPS receiver, and/or other components.

[0023] Storage device 406 can be implemented, e.g., using disk, flash memory, or any other non-volatile storage medium. In some embodiments, storage device 406 can store media assets such as audio, video, still images, or the like, that can be played by PCD 402. Storage device 406 can also store other information such as a user's contacts (names, addresses, phone numbers, etc.); scheduled appointments and events; notes; and/or other personal information. In some embodiments, storage device 406 can store one or more application programs to be executed by processor 404 (e.g., video game programs, personal information management programs, etc.).

[0024] User interface 408 may include input devices such as a touch pad, touch screen, scroll wheel, click wheel, dial, button, switch, keypad, microphone, or the like, as well as output devices such as video screen, indicator lights, speakers, headphone jacks, or the like, together with supporting electronics (e.g., digital-to-analog or analog-to-digital converters, signal processors, or the like). A user can operate input devices of user interface 408 to invoke the functionality of PCD 402 and can view and/or hear output from PCD 402 via output devices of user interface 408.

[0025] Processor 404, which can be implemented as one or more integrated circuits (e.g., a conventional microprocessor or microcontroller), can control the operation of PCD 402. In various embodiments, processor 404 can execute a variety of programs in response to program code and can maintain multiple concurrently executing programs or processes. At

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any given time, some or all of the program code to be executed can be resident in processor 404 and/or in storage media such as storage device 406.

[0026] Through suitable programming, processor 404 can provide various functionality for PCD 402. For example, in response to user input signals provided by user interface 408, processor 404 can operate a database engine to navigate a database of media assets stored in storage device 406 in response to user input and display lists of selected assets. Processor 404 can respond to user selection of an asset (or assets) to be played by transferring asset information to a playback engine also operated by processor 404, thus allowing media content to be played. Processor 404 can also operate other programs to control other functions of PCD 402.

[0027] Power control module 410 provides power management capability for PCD 402. For example, power control module 410 can deliver power from battery 412 to accessory I/O interface 414 via line 411 and to other components of PCD 402 (connections not shown). Power control module 410 can also receive power via accessory I/O interface 414 and line 413 and deliver received power to various components of PCD 402 (connections not shown); received power can also be delivered to battery 412, thereby allowing battery 412 to be recharged via accessory I/O interface 414. In some embodiments, power control module 410 can be implemented using programmable or controllable circuits operating in response to control signals generated by program code executing on processor 404 or as a separate microprocessor or microcontroller.

[0028] In some embodiments, power control module 410 is responsive to signals from sensor 416 in accessory I/O interface 414. As described below, sensor 416 can generate a signal indicative of the type of accessory connected, and power control module 410 can use this information to determine, e.g., whether to distribute power from battery 412 or received power from the accessory. Power control module 410 can also provide other power management capabilities, such as regulating power consumption of other components of PCD 402 based on the source and amount of available power, monitoring stored power in battery 412 and generating user alerts if the stored power drops below a minimum level, and so on.

[0029] Accessory I/O interface 414 can allow PCD 402 to communicate with various accessories. For example, accessory I/O interface 414 might support connections to a computer (e.g., as shown in FIG. 1), an external speaker dock (e.g., as shown in FIG. 2), a digital camera (e.g., as shown in FIG. 3), a radio tuner (e.g., FM, AM and/or satellite), an in-vehicle entertainment system, an external video device, or the like. In accordance with

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some embodiments of the invention, accessory I/O interface 414 can determine whether to operate in USB host or USB device mode when connected to an accessory. As described below, sensor 416 can be used to detect identifying information from a connected accessory, and this identifying information can be used to select an operating mode.

[0030] In some embodiments, accessory I/O interface 414 can include a connector, such as a 30-pin connector corresponding to the connector used on iPod® and iPhone® products, as well as supporting circuitry. The connector can provide connections for power and ground as well as for various wired communication interfaces such as USB, FireWire, and/or universal asynchronous receiver/transmitter (UART). Thus, accessory I/O interface 414 can support multiple communication channels, and a given accessory can use any or all of these channels.

[0031] Accessory 420 includes controller 424, user interface 422, and PCD I/O interface 426. Accessory 420 is representative of a broad range of electronic apparatus to which PCD 402 can be connected, and it is understood that accessories can vary widely in capability, complexity and form factor. Various accessories may include components not shown in FIG. 4, including but not limited to storage devices (disk, memory, etc.); video screens, speakers, or ports for connecting to external audio/video devices; camera components such as lenses, image sensors, and controls for same (e.g., aperture, zoom, exposure time, frame rate, etc.); microphones for recording audio (either alone or in connection with video recording); and so on.

[0032] Controller 424 can include, e.g., a microprocessor or microcontroller executing program code to perform various functions associated with accessory 420. For example, where accessory 420 is a personal computer system (e.g., as shown in FIG. 1), the program code can include an operating system, a driver program associated with a USB port, and a content management program that allows a user to control what content is stored on PCD 402 by interacting with user interface 422 of accessory 420. In the case of a personal computer, program code executed by controller 424 can also include various application programs completely unrelated to PCD 402. In some embodiments where accessory 420 is a sound system (e.g., as shown in FIG. 2), program code executed by controller 424 can include programs for digital audio decoding, analog or digital audio processing, and the like. In some embodiments where accessory 420 is a digital camera (e.g., as shown in FIG. 3), program code executed by controller 424 can include programs that allow a user to control the camera to capture images, display images, transfer image data to another electronic apparatus, etc.

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[0033] User interface 422 may include input controls such as a touch pad, touch screen, scroll wheel, click wheel, dial, button, switch, keypad, microphone, or the like, as well as output devices such as video screen, indicator lights, speakers, headphone jacks or the like, together with supporting electronics (e.g., digital-to-analog or analog-to-digital converters, signal processors or the like). A user can operate the various input controls of user interface 422 to invoke the functionality of accessory 420 and can view and/or hear output from accessory 420 via user interface 422.

[0034] PCD I/O interface 426 can allow accessory 420 to communicate with PCD 402 (or another PCD). In accordance with some embodiments of the invention, PCD I/O interface 426 can incorporate a USB interface. For example, PCD I/O interface 426 can provide a standard, mini, or micro USB port. In other embodiments, PCD I/O interface 426 can include a connector that mates directly with a connector included in PCD 402, such as a 30-pin connector that mates with the connector used on various iPod® products. Such a connector can be used to supply power to PCD 202 or receive power from PCD 202, to receive audio and/or video signals in analog and/or digital formats, and to communicate information via various interfaces such as USB, UART, and/or FireWire.

[0035] Accessory 420 can be any electronic apparatus that interacts with PCD 402, including but not limited to any of the examples shown in FIGs. 1-3. In some embodiments, accessory 420 can provide remote control over operations of PCD 402, or a remote user interface that can include both input and output controls (e.g., a display screen). Accessory 420 in various embodiments can control any function of PCD 402 and can also receive media content from PCD 402 and present such content to the user (e.g., through audio speakers and/or video display screen, depending on the type of media content). In other embodiments, PCD 402 can control operations of accessory 420, such as retrieving image data from a digital camera incorporated into accessory 420, initiating an image capture operation, etc.

[0036] It will be appreciated that the system configurations and components described herein are illustrative and that variations and modifications are possible. The PCD and/or accessory may have other capabilities not specifically described herein (e.g., mobile phone, global positioning system (GPS), broadband data communication, Internet connectivity, etc.).

[0037] Further, while the PCD and accessory are described herein with reference to particular blocks, it is to be understood that these blocks are defined for convenience of description and are not intended to imply a particular physical arrangement of component parts. Further, the blocks need not correspond to physically distinct components. Blocks can

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be configured to perform various operations, e.g., by programming a processor or providing appropriate control circuitry, and various blocks might or might not be reconfigurable depending on how the initial configuration is obtained. Embodiments of the present invention can be realized in a variety of apparatus including electronic devices implemented using any combination of circuitry and software.

[0038] Accessory I/O interface 414 of PCD 402 and PCD I/O interface 426 of accessory 420 allow PCD 402 to be connected with accessory 420 and subsequently disconnected from accessory 420. As used herein, PCD 402 and accessory 420 are "connected" whenever a communication channel is open between PCD I/O interface 426 and accessory I/O interface 414. Such connection can be achieved via direct physical connection, e.g., with mating connectors; indirect physical connection, e.g., via a cable; and/or wireless connection, e.g., via Bluetooth. PCD 402 and accessory 420 are said to be "docked" whenever an electrical connection is established between pins of PCD I/O interface 426 and corresponding pins of accessory I/O interface 414. Docking can be achieved directly, e.g., with mating connectors, or indirectly, e.g., via a cable. In the case of an indirect connection, the connectors for accessory 420 and PCD 402 need not have corresponding form factors or numbers or arrangements of pins.

[0039] In some embodiments, PCD 402 and accessory 420 can communicate while connected (e.g., docked) by exchanging commands and data according to a PCD-specific protocol. The commands and data can be communicated, e.g., using USB Human Interface Device (HID) as a transport or using another transport provided by accessory I/O interface 414 and PCD I/O interface 426. The PCD-specific protocol defines a format for messages to be exchanged between PCD 202 and accessory 220. For instance, the PCD-specific protocol may specify that each message (also referred to herein as a command) is sent in a packet with a header and an optional payload. The header provides basic information (e.g., a start indicator, length of the packet, and a command code identifying a command to be processed by the recipient), while the payload provides any data associated with the command; the amount of associated data can be different for different commands, and some commands may provide for variable-length payloads. In some embodiments, the commands may be defined such that any particular command code is valid in only one direction. The packet can also include error-detection or error-correction codes as known in the art.

[0040] The accessory protocol can define a number of "lingoes," where a "lingo" is a group of related commands that can be supported (or unsupported) by various classes of accessories. In one embodiment, a command code can include a first byte identifying the

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lingo to which the command belongs and a second byte identifying the particular command within the lingo. Other command structures may also be used. It is not required that all accessories, or all PCDs to which an accessory can be connected, support every lingo defined within the accessory protocol.

[0041] In some embodiments, every accessory 420 and every PCD 402 that use the PCD-specific protocol support at least a "general" lingo that includes commands common to the PCD and all accessories. The general lingo can include commands enabling the PCD and the accessory to identify and authenticate themselves to each other and to provide general information about their respective capabilities, including which (if any) other lingoes each supports. The general lingo can also include authentication commands that the PCD can use to verify the purported identity and capabilities of the accessory (or vice versa), and the accessory (or PCD) may be blocked from invoking certain (or all) commands or lingoes if the authentication is unsuccessful. In addition, in some embodiments the PCD can block the accessory from using USB functionality of the PCD if authentication is unsuccessful.

[0042] A PCD-specific protocol can also include various other lingoes, such as a simple remote lingo that allows accessory 420 to send a command indicating a function of PCD 402 to be invoked, a remote user interface lingo that can be used to communicate commands and data related to replicating all or part of a user interface of PCD 402 on accessory 420 (thereby supporting a more advanced remote control), a tuner lingo that allows a user to control a tuner accessory 420 by operating PCD 402, a storage lingo that allows accessory 420 to store data on PCD 402, and so on. Any lingo or combination of lingoes or other commands or groups of commands can be used in connection with a PCD-specific protocol.

[0043] In some embodiment, the PCD-specific protocol can provide a software-based mechanism that allows an accessory to communicate a desired configuration for an asymmetric protocol to the PCD. For example, in the case where the asymmetric protocol is USB, the commands can include a *GetUSBMode* command, a *ReturnUSBMode* command and a *SetUSBMode* command. The *GetUSBMode* command can be sent by the accessory to the PCD to request the current USB operating mode of the PCD. The PCD can respond with the *ReturnUSBMode* command, whose payload can include a parameter indicating the current USB mode (for example, USB host, USB device, or unconfigured). A *SetUSBMode* command can be sent by the accessory to change the USB mode; the payload of this command can include a parameter indicating the desired USB mode. Other commands can also be provided, and such commands can be part of a general lingo or a special-purpose lingo as desired.

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[0044] In one embodiment using software mechanisms to control a USB configuration, the PCD and accessory can first connect using a transport (e.g., UART or a wireless transport) other than USB. The accessory can then send commands of the PCD-specific protocol to determine the current USB mode of the PCD and/or to request that the PCD switch to the desired mode.

[0045] In other embodiments, hardware mechanisms can be used to control configuration of the asymmetric protocol. By way of illustration, FIG. 5 is a simplified connection diagram illustrating connections that can be provided between an accessory and a PCD according to an embodiment of the present invention. An accessory-side connector 502 is represented on the left and a PCD-side connector 504 on the right. In some embodiments, accessory-side connector 502 can be part of PCD I/O interface 426 of accessory 402 of FIG. 4, and PCD-side connector 504 can be part of accessory I/O interface 414 of PCD 402 of FIG. 4. In other embodiments, features of accessory-side connector 502 can be incorporated, e.g., into connector 108 of FIG. 1, with only pins relevant to operation of the accessory being connected to wires of cable 106.

[0046] In this example, PCD-side connector 504 provides a number of pins 510. (Herein, multiple instances of like objects are denoted with reference numbers identifying the object and parenthetical numbers identifying the instance where needed.) These pins include a number of ground (GND) pins 510(1), 510(2), 510(8) and 510(10); USB D+ pin 510(2) and D- pin 510(3) for exchanging USB signals with the accessory; V_{BUS} pin 510(4) that can receive power (e.g., at 5.0 V) from an accessory; V_P pin 510(5) that can provide power (e.g., at 3.3 V) to an accessory; and accessory identification pins 510(6) and 510(7). Other pins, e.g., pin 510(9) can provide signals not relevant to the present description, such as UART signals, FireWire signals, audio and/or video output signals to the accessory in digital and/or analog formats, audio input signals from the accessory, and so on. In one embodiment, PCD-side connector 504 can have a total of 30 pins; the number and arrangement of pins can be varied as desired. In some embodiments, ground pins 510(1), 510(2), 510(8) and 510(10) can be made longer than all other pins 510 so that the ground connections are first to be made and last to be broken as PCD-side connector 504 engages with and disengages from accessory-side connector 502. Such a configuration can reduce the risk of electrical damage to a PCD during docking and undocking.

[0047] Similarly, accessory-side connector 502 provides a number of pins 512. These pins include ground pins 512(1), 512(2), 512(8) and 512(10); USB D+ pin 512(2) and D- pin 512(3) for exchanging USB signals with the accessory; V_{BUS} pin 512(4) that can provide

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power (e.g., at 5.0 V) to a PCD; V_P pin 512(5) that can receive power (e.g., at 3.3 V) from a PCD; and accessory identification pins 512(6) and 512(7). Other pins, e.g., pin 512(9) can provide signals not relevant to the present description, such as UART signals, FireWire signals, audio and/or video input signals from the PCD in digital and/or analog formats, audio output signals to the PCD, and so on. In one embodiment, accessory-side connector 502 can have a total of 30 pins; the number and arrangement of pins can be varied as desired.

[0048] As shown, PCD-side connector 504 and accessory-side connector 502 provide the electrical connections required for a standard USB connection (bidirectional D+ and D- signals, V_{BUS}, and ground), although not necessarily in a form factor compliant with USB standards. Accessories that provide a USB port with a standard form factor can be connected to PCD-side connector 504 using a cable (not shown in FIG. 5) that passes through the USB signals from accessory-side connector 502 to a standard USB connector (not shown). Any pins of accessory-side connector 502 that are not actually connected to the accessory can be left floating or terminated to prevent line noise as appropriate, or unused signal contacts may simply be omitted.

[0049] FIG. 5 illustrates a technique that can be used in one embodiment to identify whether the PCD should operate in a USB host or USB device mode when connected to an accessory by using signals generated on accessory identification pins 510(6) and 510(7). Specifically, accessory-side connector 502 includes identification resistor 520 connected between pins 512(6) and 512(7). On PCD-side connector 504, pin 510(6) is connected via a pull-up resistor 524 to a reference voltage (e.g., V_P, although a different voltage can also be used). Pin 510(7) is connected to ground.

[0050] In operation, when accessory-side connector 502 is connected to PCD-side connector 504, electrical contact is achieved between pins 512(6) and 510(6) and between pins 512(7) and 510(7). A voltage difference develops between nodes 526 and 528, and this difference is detected by sensor 530 (e.g., implementing sensor 416 of FIG. 4). Since pull-up resistor 524 is fixed, the voltage difference corresponds to the resistance (R_{ID}) of identification resistor 520. Thus, sensor 530 can detect the resistance R_{ID}. In some embodiments, sensor 530 can output an analog or digital signal indicative of the resistance. In the embodiment of FIG. 4, this signal can be delivered to power control module 410; the sensor signal can also be delivered to processor 404 and/or other components of PCD 402.

[0051] In one embodiment, different resistance values R_{ID} are associated with different USB operating modes of the PCD. For instance, a first resistance value can indicate that the

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PCD should operate in a USB host mode while a second resistance value can indicate that the PCD should operate in a USB device mode. Certain embodiments may also use other resistance values to provide other information. For example, the USB standard defines various configurations that a USB device can present to a USB host, such as "human interface device" (HID) configuration or "mass storage device" configuration. Different resistance values R_{ID} can be associated with each of these USB device configurations. Accordingly, the same PCD can present a USB host mode to a first accessory, a USB device mode in an HID configuration to a second accessory, and a USB device mode in a mass storage configuration to a third accessory, depending on the resistance R_{ID} detected between pins 510(6) and 510(7) by sensor 530.

[0052] In some embodiments, some accessories can have connectors 502 that do not provide an identification resistor 520. For example, pins 512(6) and 512(7) can be shorted together, or they can be disconnected from each other. In such embodiments, the absence of resistor 520 can be detected by sensor 530 and interpreted as a request for the PCD's "default" mode of operation. In one embodiment, the PCD operates in a mass-storage USB device mode by default and only switches to USB host mode if the specific resistance R_{ID} associated with PCD-as-USB host configuration is detected.

[0053] It will be appreciated that the connector configuration described herein is illustrative and that variations and modifications are possible. Different numbers and/or arrangements of pins can be substituted. The connector form factors may also vary. In the embodiment shown in FIG. 5, the PCD provides power on one pin when it is the USB host but receives power on a different pin when it is the USB device. Different accessories can thus connect to one power pin or the other, depending on whether the accessory is the USB device or the USB host, and do not need to (but may) connect to both. In other embodiments, the same pin can be operated bidirectionally, with the PCD either receiving or supplying a voltage on that pin depending on whether it is the USB host or the USB device. Further, although in some embodiments, the power level is different between PCD-as-USB host and PCD-as-USB device modes, this is also not required. If the PCD as USB host does provide different power, any accessories operating as USB devices can be configured to accept the power as provided. For example, an accessory may have a battery or connect to an external power source if it requires more power than the PCD provides. Further, the PCD may use signal levels on the USB D+/D- lines that are limited to a maximum voltage level equal to the V_P line, and accessories can be configured to detect these voltage levels.

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[0054] In some embodiments, the accessory can simply provide a standard USB interface with a USB connection port having any standard form factor. The accessory may be fixedly configured to operate as either a USB host or a USB device. For purposes of connecting the accessory to a PCD implementing the identification scheme of FIG. 5, a cable such as cable 106 of FIG. 1 or cable 306 of FIG. 3 can be configured with the appropriate resistor disposed within the PCD connector (e.g., connector 108 of FIG. 1 or connector 308 of FIG. 3). If the accessory operates as a USB host, the V_{BUS} pin of connector 502 can be connected to the USB V_{BUS} pin. If the accessory operates as a USB device, the V_P pin of connector 502 can be connected to the USB V_{BUS} pin.

[0055] In some embodiments, an accessory can select or change its identification resistance R_{ID} to request different USB modes at different times. For example, an accessory with which a PCD can dock may provide both a user input device (e.g., keyboard, mouse) or other apparatus that presents as a USB device and a pass-through to a personal computer or other apparatus that presents as a USB host. Except when the PCD is actually in communication with the USB host, it can be instructed by the accessory to operate in USB host mode. In some embodiments, the accessory can dynamically switch the resistance R_{ID} during operation. The PCD can monitor the identification pins, detect a change in R_{ID}, and switch its USB mode accordingly.

[0056] Further, some accessories may be equipped with a standard USB On-the-Go receptacle that includes an ID pin in addition to the four standard USB pins; the ID pin indicates to the USB On-the-Go accessory whether it should operate as a USB host or USB device. For coupling a PCD to such an accessory, a special role-selecting adapter can be provided (e.g., as a cable or unitary connector). One end of the adapter can include a connector that mates with the PCD and supplies a resistance R_{ID} across the appropriate pins to indicate which USB mode the PCD should operate in. The other end of the adapter can include a connector that mates with the USB On-the-Go receptacle of the accessory and ties the ID pin to indicate that the accessory should operate in the other USB mode. Thus, for example, if R_{ID} at one end of the adapter indicates that the PCD should operate as USB host, the USB On-the-Go ID pin at the other end would indicate that the accessory should operate as USB device.

[0057] FIG. 6 is a flow diagram of a process 600 for establishing a connection to an accessory according to an embodiment of the present invention. Process 600 can be implemented, e.g., in program code executing on processor 404 of PCD 402 (FIG. 4), in dedicated control logic within accessory I/O interface 414, or in any combination thereof.

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[0058] Process 600 starts (block 602) when accessory I/O 414 interface detects that contact has been established between its connector pins (e.g., pins 510 of connector 504 in FIG. 5) and corresponding pins of an accessory connector (e.g., pins 512 of connector 502). At block 604, sensor 530 can sense the resistance R_{ID} across accessory identification pins 510(6) and 510(7).

[0059] At block 606, it is determined whether the sensed resistance R_{ID} corresponds to the resistance associated with a request for the USB host mode of the PCD. If so, then the PCD enters the USB host mode. If not, then at block 607, it is determined whether a host mode command (e.g., a *SetUSBMode* command requesting USB host mode) has been received from the accessory. If the USB connection is not currently configured such that the accessory can use it to send PCD-specific protocol commands, another transport that has been configured (e.g., UART or a wireless transport) can be used for the command. If a host mode command is received at block 607, the PCD can enter the USB host mode even if no resistance R_{ID} or a resistance R_{ID} not associated with host mode was sensed at block 606.

[0060] Thus, the PCD can entersUSB host mode either in response to sensing the appropriate resistance R_{ID} at block 606 or receiving a command requesting host mode at block 607. Entering host mode can include various actions. For example, at block 608, the PCD can provide power to the accessory, e.g., via V_P pin 510(5). The power provided to the accessory can be the same as or different from standard USB power levels, as described above. At block 610, the PCD can receive enumeration data from the accessory (which is operating in USB device mode) via D+/D- pins 510(2), 510(3). Enumeration can be implemented according to USB standards, with the accessory providing various identifiers such as a vendor identifier and a model identifier. In some embodiments, the enumeration data can also include data specific to interaction with the PCD, such as whether the accessory supports communication using a PCD-specific protocol via the USB connection.

[0061] On the other hand, if block 606 results in a determination that the sensed resistance R_{ID} does not correspond to the resistance associated with a request for the USB host mode of the PCD and block 607 results in a determination that no command requesting USB host mode has been received, then the PCD can enter a USB device mode. For example, at block 612, the PCD can receive USB power (e.g., 5 V) from the accessory, e.g., via V_{BUS} pin 510(4). At block 614, the PCD can provide enumeration data to the accessory (which is acting as a USB host) via D+/D- pins 510(2), 510(3). Similarly to the case where the PCD is acting as USB host, enumeration can be implemented according to USB standards, in this

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case with the PCD providing various identifiers such as a vendor identifier and a model identifier.

[0062] After enumeration completes, the PCD and accessory can begin to exchange signals via the USB D+ and D- pins, regardless of which of the two is the USB host. Thus, for example, the PCD can provide USB digital audio to the accessory, or the accessory can transfer various data files to or from the PCD, or the like.

[0063] In some embodiments, the PCD can control the availability of USB functionality after enumeration. For example, at block 620, regardless of whether the PCD or accessory acts as USB host, the PCD can determine whether the accessory supports communication using a PCD-specific protocol via the USB port or in some instances another port. If the PCD-specific protocol is not supported, then process 600 can exit (block 622). In some embodiments, the PCD can permit the accessory to use at least some USB functionality even if the PCD-specific protocol is not supported; in other embodiments, the PCD locks out further USB communication with any accessory that does not support the PCD-specific protocol.

[0064] If the PCD-specific protocol is supported, then at block 624, the PCD can receive identification data from the accessory. This data can include, e.g., a list of which lingoes of the PCD-specific protocol are supported by the accessory, information as to the accessory's preferences for initial configuration (such as whether various inputs and/or outputs should be enabled or disabled), and so on. In some embodiments, the identification data can be sent by the accessory using one or more commands of a general lingo of a PCD-specific protocol via the USB transport link that has been established.

[0065] At block 626, the PCD can initiate an authentication process with the accessory. In some embodiments, the authentication operation can include verifying a digital certificate provided by the accessory and testing a cryptological digital signature provided by the accessory against a public key associated with the digital certificate. In some embodiments, authentication operations may be facilitated using an authentication controller that can be embedded into PCD I/O interface 432 of accessory 420 as shown in FIG. 4. In other embodiments, an authentication controller may be embedded in a cable connecting the accessory to the PCD, and authentication for the USB connection can be provided by a controller that communicates using pins other than the USB pins.

[0066] At block 628, it is determined whether the authentication process succeeded. If so, then at block 630, the PCD can unlock USB functionality for use by the accessory. For

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example, in some embodiments, the PCD can permit the accessory to enumerate and send certain commands of the PCD-specific protocol via the USB port without first having successfully authenticated. Following block 630, communication can continue (block 636) until the connection is terminated. In some embodiments, an established USB connection can be used at block 636 to exchange commands of the PCD-specific protocol with USB as the transport.

[0067] In some embodiments, communication at block 636 can include changing the mode of the USB connection. In some embodiments, after initially establishing a configuration for the USB connection, the accessory can change the established configuration, e.g., by changing R_{ID} or by sending a *SetUSBMode* command. Depending on implementation, sending of a *SetUSBMode* command using USB as the transport might or might not be supported; if it is not, another transport (e.g., UART or wireless) can be used.

[0068] If, at block 628, it is determined that the authentication process failed, then at block 632, the PCD can notify the accessory of the authentication failure, and process 600 can end (block 634). In this case, the PCD can block the accessory from accessing PCD functionality such as commands of the PCD-specific protocol or USB functions such as file access, digital audio transfer, or the like. Unauthorized USB functions can be blocked, e.g., by the PCD refusing to respond to requests from the accessory (or sending error messages in response to such requests) and/or by the PCD not initiating certain USB operations such as audio output. In some embodiments, the PCD can selectively block or permit access to USB functionality regardless of whether it is currently operating in USB host or USB device mode.

[0069] It will be appreciated that the process described herein is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted. For example, in some embodiments, the accessory and PCD can initially establish communication using a transport other than USB (e.g., UART or a wireless transport) and can perform the authentication process of the PCD-specific protocol before configuring the USB connection. In some embodiments of this kind, the PCD can disregard accessory requests for a particular USB configuration if the authentication fails.

[0070] Some embodiments may provide only hardware control of the USB mode (e.g., using an identification resistor), only software control (e.g., using a mode-selection command of a PCD-specific protocol), or a combination of the two. For example, an identification resistor can be used to establish an initial configuration, which can later be changed by a

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mode-selection command. Alternatively, the PCD can disregard (or treat as error) any received mode-selection command that conflicts with a mode selected based on an identification resistor.

[0071] In some embodiments, a PCD operating in USB host mode can support multiple concurrently connected USB devices. If, in such an arrangement, an accessory requests that the PCD switch to USB device mode while other USB devices are connected, the PCD can disregard the request and/or generate an error message to the requesting accessory.

[0072] Embodiments described herein thus provide flexible communication between a PCD and a range of different accessories by allowing the PCD to operate in either a USB host or USB device mode and allowing the accessory to signal its preferred mode to the PCD.

[0073] While the invention has been described with respect to specific embodiments, one skilled in the art will recognize that numerous modifications are possible. For example, a "PCD" refers generally to any portable electronic device with any form of communication and/or media playback capability; a broad range of functionality may be incorporated. Similarly, the term "accessory" includes any electronic device capable of docking or otherwise connecting with a PCD.

[0074] USB is used herein as an example of an asymmetric protocol, where the term "asymmetric protocol" refers generally to a protocol for connecting two electronic devices in which each electronic device plays a distinct role. In the context of USB, the roles are commonly known as "host" and "device," and that terminology is used herein to distinguish two different roles. However, it is understood that a variety of asymmetric protocols exist and the roles can be identified under other nomenclature (such as "master" and "slave" or "A-type" and "B-type" or "first mode" and "second mode"). Techniques similar to those described herein can be applied to any other asymmetric protocol, thus allowing a connected PCD to change its role on a per-connection basis. Accordingly, the present invention is not limited to the context of USB but can be used in connection with any asymmetric protocol and any transport including wired and/or wireless transports.

[0075] Embodiments of the present invention can be realized using any combination of dedicated components and/or programmable processors and/or other programmable devices. The various processes described herein can be implemented on the same processor or different processors in any combination. Accordingly, where components are described as being configured to perform certain operations, such configuration can be accomplished, e.g., by designing electronic circuits to perform the operation, by programming programmable

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electronic circuits (such as microprocessors) to perform the operation, or any combination thereof. Processes can communicate using a variety of techniques including but not limited to conventional techniques for interprocess communication, and different pairs of processes may use different techniques, or the same pair of processes may use different techniques at different times. Further, while the embodiments described above may make reference to specific hardware and software components, those skilled in the art will appreciate that different combinations of hardware and/or software components may also be used and that particular operations described as being implemented in hardware might also be implemented in software or vice versa.

[0076] Computer programs incorporating various features of the present invention may be encoded on various computer readable storage media; suitable media include magnetic disk or tape, optical storage media such as compact disk (CD) or DVD (digital versatile disk), flash memory, and the like. Computer readable media encoded with the program code may be packaged with a compatible electronic device, or the program code may be provided separately from electronic devices (e.g., via Internet download).

[0077] Thus, although the invention has been described with respect to specific embodiments, it will be appreciated that the invention is intended to cover all modifications and equivalents within the scope of the following claims.

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WHAT IS CLAIMED IS:

1. A method for use in a portable communication device, the method comprising:

establishing a connection to an accessory;

determining whether a mode-selecting signal is received from the accessory, the mode-selecting signal indicating whether the portable communication device is to operate in a first mode or a second mode of an asymmetric communication protocol;

in the event that the mode-selecting signal is received from the accessory, operating the portable communication device in the mode indicated by the mode-selecting signal; and

in the event that the mode-selecting signal is not received from the accessory, operating the portable communication device in the first mode of the asymmetric communication protocol.

2. The method of claim 1 wherein the connection to the accessory is established using a connector having a plurality of pins and wherein determining whether the mode-selecting signal is received from the accessory includes:

sensing a resistance across two pins of the plurality of pins; and

determining whether the sensed resistance satisfies a first criterion,

wherein the second mode is indicated in the event that the sensed resistance satisfies the first criterion.

3. The method of claim 2 wherein the two pins that are used for sensing the resistance are used exclusively for sensing the resistance.

4. The method of claim 2 wherein the asymmetric communication protocol is a Universal Serial Bus (USB) protocol, the first mode corresponds to a device mode of the USB protocol, and the second mode corresponds to a host mode of the USB protocol.

5. The method of claim 4 further comprising:

determining whether the sensed resistance satisfies a second criterion,

wherein operating the portable communication device in a first mode of the asymmetric communication protocol includes:

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operating the portable communication device in a Human Interface Device configuration of a device mode of the USB protocol in the event that the sensed resistance satisfies the second criterion; and

operating the portable communication device in a mass storage configuration of the device mode of the USB protocol in the event that the sensed resistance does not satisfy the second criterion.

6. The method of claim 1 wherein the portable communication device further supports a device-specific protocol, the method further comprising:

initiating an authentication operation with the accessory according to the device-specific protocol;

determining whether the authentication operation is successful; and

in the event that the authentication operation is not successful, blocking the accessory from using at least one function associated with the asymmetric communication protocol.

7. The method of claim 1 wherein the connection to the accessory is established using a connector having a plurality of pins and wherein:

operating the portable communication device in the first mode includes receiving a first voltage level on a first power pin of the plurality of pins, and

operating the portable communication device in the second mode includes providing a second voltage level on a second power pin of the plurality of pins, wherein the first voltage level is greater than the second voltage level.

8. The method of claim 1 wherein determining whether a mode-selecting signal is received from the accessory includes determining whether a mode-selecting command has been received from the accessory.

9. A portable communication device comprising:

a processor;

a power control module coupled to the processor; and

an accessory interface coupled to the processor and the power control module, the accessory interface including:

a connector having a plurality of pins, the plurality of pins including a data pin associated with an asymmetric communication protocol, a power input pin

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coupled to the power control module, a power output pin coupled to the power control module, and a pair of accessory identification pins; and

a sensor connected to detect a resistance applied across the pair of accessory identification pins and configured to generate an identification signal indicative of the detected resistance,

wherein the power control module is configured to determine, based on the identification signal, whether to provide a first power to the power output pin or to receive a second power from the power input pin; and

wherein the accessory interface is configured to determine, based at least in part on the identification signal, whether to operate in a first mode or a second mode of the asymmetric communication protocol.

10. The portable communication device of claim 9 wherein the asymmetric communication protocol is a USB protocol.

11. The portable communication device of claim 9 wherein the power control module is further configured such that the first power and the second power are at different voltage levels.

12. The portable communication device of claim 9 wherein the accessory interface is further configured to receive a mode-selection command from the accessory and to determine whether to operate in the first mode or the second mode of the asymmetric communication protocol based in part on the identification signal and in part on the received mode-selection command.

13. A portable communication device comprising:

a processor; and

an accessory interface coupled to the processor, the accessory interface being configured to selectively operate in a first mode or a second mode of an asymmetric communication protocol,

the accessory interface being further configured to receive a mode-selection command from the accessory and to determine, based at least in part on the mode-selection command, whether to operate in the first mode or the second mode of the asymmetric communication protocol.

14. The portable communication device of claim 13 wherein the asymmetric communication protocol is a USB protocol.

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15. The portable communication device of claim 13 wherein the accessory interface includes a connector having a plurality of pins, the plurality of pins including a power input pin and a power output pin, the portable communication device further comprising:

a power control module coupled to the power input pin and the power output pin,

the power control module being configured to receive power from the power input pin when the accessory interface is operating in the first mode of the asymmetric communication protocol and to provide power to the power output pin when the accessory interface is operating in the second mode of the asymmetric communication protocol.

16. An accessory for use with a portable communication device, the accessory comprising:

a controller operable in a device mode of a Universal Serial Bus (USB) protocol;

a connector coupled to the controller and adapted to connect to a portable communication device, the connector having a plurality of pins, the plurality of pins including a USB power pin, a USB ground pin, two USB data pins, and a pair of accessory identification pins; and

a resistor connected between the accessory identification pins, wherein the resistor has a resistance value indicating to the portable communication device that the portable communication device should operate in a host mode of the USB protocol.

17. The accessory of claim 16 wherein the plurality of pins further includes a power input pin to receive power from the portable communication device.

18. The accessory of claim 17 wherein the power received from the portable communication device is at a lower voltage level than a standard USB voltage level.

19. The accessory of claim 18 wherein the power received from the portable communication device is at a voltage level of approximately 3.3 volts.

20. A method for use in an accessory, the method comprising:

establishing a connection to a portable communication device, wherein the portable communication device is switchable between a first mode and a second mode of an asymmetric communication protocol;

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sending a first command to the portable communication device, the first command specifying a first requested mode of operation to be used by the portable media device, the first requested mode being one of the first mode or the second mode,

wherein in the event that the accessory operates in the first mode of the asymmetric communication protocol, the requested mode is the second mode, and wherein in the event that the accessory operates in the second mode of the asymmetric communication protocol, the requested mode is the first mode; and

communicating with the portable media device using the asymmetric communication protocol.

21. The method of claim 20 further comprising:

prior to sending the first command, selecting the requested mode based at least in part on a current configuration of the accessory.

22. The method of claim 20 wherein the first command is sent using a transport that is independent of the asymmetric communication protocol.

23. The method of claim 20 further comprising:

sending a second command to the portable communication device, the second command specifying a second requested mode of operation to be used by the portable media device, the second requested mode being different from the first requested mode.

24. A method for use in an accessory, the method comprising:

establishing a connection to a portable communication device using a connector having a plurality of pins, wherein the portable communication device is switchable between a first mode and a second mode of an asymmetric communication protocol;

applying a resistance across a first pin and a second pin of the plurality of pins, wherein the resistance has a value indicating to the portable communication device that the accessory operates in the first mode of the asymmetric communication protocol;

receiving power from the portable communication device via a third pin of the plurality of pins; and

communicating with the portable communication device using the first mode of the asymmetric communication protocol.

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25. The method of claim 24 wherein the asymmetric communication protocol is a Universal Serial Bus (USB) protocol and the first mode is a device mode of the USB protocol.

26. The method of claim 25 wherein receiving the power from the portable communication device includes receiving the power at a voltage level lower than a standard voltage level of the USB protocol.

27. The method of claim 25 wherein communicating with the portable communication device using the first mode of the asymmetric communication protocol includes sending USB-compliant enumeration data to the portable communication device.

28. The method of claim 27 further comprising, after sending the USB-compliant enumeration data:

sending a command to the portable communication device, wherein the command is one of a plurality of commands of a device-specific protocol supported by the portable communication device,

wherein sending the command includes using the asymmetric communication protocol as a transport.

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Application No:	GB1014178.6	**Examiner:**	Mr David Maskery
Claims searched:	1 - 28	**Date of search:**	15 December 2010

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	1 and 6 - 8	WO 2006/107509 A (SYMBOL TECH) See paragraphs 16 - 22.
Y	8	US 2008/0222341 A (LIN et AL) See whole document.
Y	8	US 2004/0225836 A (LIN) See whole document.
Y	8	US 2004/0088449 A (SAKAKI) See whole document.
A	-	US 6920569 A (WAUTERS et AL) See whole document.
A	-	US 6516205 B (NEC CORP) See whole document.
A	-	WO 2004/034266 A (NOKIA CORP) See pages 2 to 4 and 6.
A	-	US 2006/0080490 A (TANG) See whole document.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

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Worldwide search of patent documents classified in the following areas of the IPC

G06F

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

International Classification:

Subclass	Subgroup	Valid From
G06F	0013/38	01/01/2006

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Electronic Acknowledgement Receipt

EFS ID:	42102144
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International Application Number:	
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Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	7021145US4_SIDS.pdf	612127 ca19b6063717f8d4185c925ffb943cae6c5ca8a8	no	4

Warnings:

Information:					
2	Foreign Reference	GB2473123A.pdf	4726520 0b0e7304c33f8a1b7f6441c8e18719b9ff23e68e	no	32
Warnings:					
Information:					
3	Non Patent Literature	NPL_EXAM-REPORT.pdf	201522 5901aa04471641 6c6e9cbdc529fea9752c6c35c7	no	5
Warnings:					
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Robert M. Voto, et al.	Examiner:	Ernest Unelus
Application No.:	16/660,083	Group Art Unit:	2181
Filed:	October 22, 2019	Docket No.:	7021.145US4
Due Date:	May 18, 2021	Confirmation No:	1000
Title:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS		

This paper is being filed electronically with the U.S. Patent Office

AMENDMENT AND RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In connection with the above-identified application, the Non-Final Office Action mailed on February 18, 2021:

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Remarks begin on page 5 of this paper.

Electronic Acknowledgement Receipt

EFS ID:	42737976
Application Number:	16660083
International Application Number:	
Confirmation Number:	1000
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Customer Number:	171991
Filer:	Robert James Myers/LaTasha Hill
Filer Authorized By:	Robert James Myers
Attorney Docket Number:	7021.145US4
Receipt Date:	17-MAY-2021
Filing Date:	22-OCT-2019
Time Stamp:	13:50:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		7021145US4_AMEND.pdf	58274 561cae6149b28345fc18106fa7bf64b3832d9492	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	5	9
	Claims	2	4
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Warnings:			
Information:			
	Total Files Size (in bytes):	58274	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

REMARKS

The present amendment is responsive to the Non-Final Office Action of February 18, 2021. Claims 1-2 and 4-8 have been amended and claims 3 and 11 have been cancelled. Following entry of the preceding amendments, claims 1, 2, and 4-10 are pending.

Election/Restrictions

Applicant hereby confirms the election of Species I (claims 1-10) made by Applicant's representative Robert Myers during a telephone call with Examiner Ernest Unelus on February 10, 2021. This election of Species I is made without traverse and Species II (claim 11) is cancelled.

Claim Objections

Claims 1-4 and 7 were objected as being indefinite for failing to particularly point out and distinctly claim the subject matter in which is regarded as the invention.

Applicant respectfully submits that the objection to claims 1-4 is obviated by the amendment of claim 1 to recite "receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode" and "receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode".

Applicant further submits that the objection to claim 7 is obviated by the amendment of claim 7 to be dependent upon claim 6. Applicant respectfully requests that the objections to claims 1-4 and 7 be reconsidered and withdrawn.

Claim Rejections – 35 U.S.C. §102

Claims 1-2 and 4-10 were rejected as being anticipated by Wright (US Pat. No. 7,502,878).

For an invention to be anticipated, it must be demonstrated that *each and every element* of the claimed invention is present in the "four corners" of a single prior art, either expressly described therein or under the principle of inherency. *Lewmar Marine Inc. v Barient Inc.*, 3 USPQ2d 1766, 1767-1768 (Fed. Cir. 1987) (emphasis added). The absence from a prior art reference of any claimed element negates anticipation. *Kloster Speedsteel AB v. Crucible, Inc.*, 230 USPQ 81, 84 (Fed. Cir. 1986).

Amended claim 1 recites: "A method for providing efficient communications among USB components of a data communication system that includes a first input port, a second input port, a USB host, a USB bridge distinct from the USB hub, an embedded USB host, and a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, said method comprising the steps of:

receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode;

routing the first USB signal from the USB device via the USB bridge to the embedded USB host;

receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode; and

routing the second USB signal from the USB device via a USB hub to the embedded USB host, wherein the first and second USB signals are routed via only one of the USB bridge or the USB hub".

The Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, a first USB signal from the USB host 31B to the USB host 31A passes only through the multiplexer 36 while a second USB signal from the USB device 42 to the USB host 31A passes through both the hub logic 36 *and* the multiplexer 36. Wright does not show that the first and second USB signals are routed via *only one* of the USB bridge or the USB hub. Since Wright does not show each and every element of amended claim 1, it is not anticipated. Claims 2 and 4 depend upon claim 1 and are allowable therewith.

Amended claim 5 recites, in part, "determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB host mode and if so, routing said USB signals via a USB bridge to said first USB port while bypassing the USB hub" and "determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB device mode and if so, routing said USB signals via a USB hub to said first USB port while bypassing the USB bridge".

Again, the Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, the USB signals are routed from the USB host 31B to the USB host 31A only through the multiplexer 36 while the USB signals are routed from the USB device 42 to the USB host 31A through both the hub logic 36 *and* the multiplexer 36. Wright does not show routing the USB signals via the hub logic 38 to the first USB port 40E connected to the USB device 42 while bypassing the multiplexer 36. Since Wright does not show each and every element of amended claim 5, it is not anticipated.

Amended claim 6 recites, in part, "routing the second USB signals not determined to emanate from a USB host via a USB hub to said first USB host, wherein the second USB signal bypass the USB bridge".

Once more, the Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, a first USB signal from the USB host 31B to the USB host 31A passes only through the multiplexer 36 while a second USB signal from the USB device 42 to the USB host 31A passes through both the hub logic 36 *and* the multiplexer 36. Wright does not show routing the USB signals via hub logic 38 to the USB device 42 connected to the first port 40E while bypassing the multiplexer 36. Since Wright does not show each and every element of amended claim 6, it is not anticipated. Claim 7 depends upon claim 6 and is allowable therewith.

Amended claim 8 recites, in part, "establishing a first communication path via a USB bridge between said first USB host and said second USB signal source which bypasses a USB hub if said second signal emanates from the second USB host" and "establishing a second communication path via a USB hub between said first USB host and said second USB signal source which bypasses the USB bridge if said second USB signal is determined not to emanate from the second USB host".

Yet again, the Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, a first communication path from the USB host 31B to the USB host 31A that passes only through the multiplexer 36 while a second communication path from the USB device 42 to the USB host 31A passes through both the hub logic 36 *and* the multiplexer 36. Wright does not show establishing a second communication path from the USB device 42 to the USB host 31A which bypasses the

multiplexer 36 when the second USB signal is determined not to emanate from the USB host 31B. Claims 9 and 10 depend upon claim 8 and are allowable therewith.

Claim Rejections – Nonstatutory Double Patenting

The Office has concluded that claims 1-2 and 4-10 are unpatentable over claims 1-17 of U.S. Patent No. 9,460,037, claims 1-20 of U.S. Patent No. 9,619,420, and claims 1-6 of U.S. Patent No. 10,545,899. Therefore, the Office has provisionally rejected these claims on the ground of nonstatutory obviousness-type double patenting.

Applicant acknowledges the rejection and its provisional nature as the current claims are not under an indication of allowance. At such time when the claims are allowed, Applicant will address the rejection.

Applicant notes that there are other arguments that may be presented to overcome the objections and rejections made in this Office Action, but those additional arguments have not been presented here in the interest of brevity. Applicant reserves the right to present any of these additional arguments in a later filed response or brief.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at (952) 697.2641 to facilitate prosecution of this application.

Please charge any additional fees or credit any overpayment to Deposit Account No. 50-3141 being used for payment today.

Respectfully submitted,

Billion & Armitage
7401 Metro Blvd., Suite 425
Minneapolis, MN 55439
(952) 697.2630 – main phone
(952) 697.2631 – facsimile

Dated: May 17, 2021

By /Robert J. Myers/
Robert J. Myers
Reg. No. 69,783

RJM/cas

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (Currently amended) A method for providing efficient communications among USB components of a data communication system that includes ~~multiple USB hosts and multiple USB devices~~ a first input port, a second input port, a USB host, a USB bridge distinct from the USB hub, an embedded USB host, and a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, said method comprising the steps of:

   ~~providing a first input port for~~ receiving a first USB signal from ~~a first USB host~~ the USB device via the USB port while the USB device is operating in the USB host mode;

   ~~providing a second input port for~~ routing the first USB signal from the USB device via the USB bridge to the embedded USB host;

   receiving a second USB signal~~;routing the second USB signal~~ from ~~a second~~ the USB ~~host~~ device via [[a]] the USB ~~bridge to said first~~ port while the USB ~~host,~~ device is operating in the USB device mode; and

   routing the second USB signal from [[a]] the USB device via a USB hub to ~~said first USB host~~ the embedded USB host, wherein the first and second USB signals are routed via only one of the USB bridge or the USB hub.

2. (Currently amended) The method according to claim 1, wherein said ~~second~~ first USB signal from the ~~second~~ USB ~~host is not routed~~ device to the ~~first~~ embedded USB host ~~via~~ bypasses the USB hub.

3. (Cancelled)

4. (Currently amended) The method according to claim 1, wherein the second USB signal from the ~~second~~ USB device to the embedded USB host ~~is transmitted to the first USB host via~~ bypasses the USB bridge ~~and the USB hub~~.

5. (Currently amended) A method, comprising the steps of:

providing a first USB port for communication with a USB host;

providing a second USB port for communicating with a consumer USB device;

providing a signal detection circuit for receiving USB signals from the consumer USB device via said second USB port;

determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB host mode and if so, routing said USB signals via a USB bridge to said first USB port while bypassing the USB hub;

determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB device mode and if so, routing said USB signals via the USB hub to said first USB port while bypassing the USB bridge.

6. (Currently amended) A USB communication management method for interconnecting sources of USB signals, said method comprising the steps of:

receiving first USB host signals from a first USB host;

receiving second USB signals from a second USB signal source;

determining whether the second USB signals emanate from a second USB host;

routing the second USB signals emanating from the second USB host via a USB bridge to said first USB host; and

routing the second USB signals not determined to emanate from a USB host via a USB hub to said first USB host, wherein the second USB signal bypass the USB bridge.

7. (Currently amended) The method according to claim [[8]] 6, further comprising the steps of:

determining whether the second USB signals emanate from a USB device; and

routing the second USB signals determined to emanate from the USB device via a USB hub to said first USB host.

8. (Currently amended) A USB communication management method for interconnecting sources of USB signals, said method comprising the steps of:

receiving a first USB host signal from a first USB host;

receiving a second USB signal from a second USB signal source;

determining whether the second USB signal emanates from a second USB host;

establishing a first communication path via a USB bridge between said first USB host and said second USB signal source which bypasses a USB hub if said second signal emanates from the second USB host; and

establishing a second communication path via a USB hub between said first USB host and said second USB signal source which bypasses the USB bridge if said second USB signal is determined not to emanate from the second USB host.

9. (Original) The method according to claim 8, further comprising the steps of:

determining whether the second USB signal emanates from a USB device; and

establishing the second communication path via a USB hub between said first USB host and said second USB signal source if said second USB signal is determined to emanate from the USB device.

10. (Original) The method according to claim 8, wherein the first communication path does not include a USB hub and wherein the second communication path does not include a USB bridge.

11. (Cancelled)

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/660,083	Filing Date 10/22/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	05/17/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 9	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 5	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/VENESSA JONES/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/660,083	Filing Date 10/22/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	05/25/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 7	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 5	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/LAVINIA D JOHNSON/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Robert M. Voto, et al.	Examiner:	Ernest Unelus
Application No.:	16/660,083	Group Art Unit:	2181
Filed:	October 22, 2019	Docket No.:	7021.145US4
		Confirmation No:	1000
Title:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS		

This paper is being filed electronically with the U.S. Patent Office

SUPPLEMENTAL AMENDMENT AND RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Supplement to the amendment and response submitted on May 17, 2021 in connection with the above-identified application and the Non-Final Office Action mailed on February 18, 2021:

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Remarks begin on page 5 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (Currently amended) A method for providing efficient communications among USB components of a data communication system that includes ~~multiple USB hosts and multiple USB devices~~ a first input port, a second input port, a USB hub, a USB bridge connected to the USB hub, an embedded USB host connected to the USB hub, a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, and USB multiplexing switches connected to the USB port, the USB hub, and the USB bridge, said method comprising the steps of:

~~providing a first input port for~~ receiving a first USB signal from ~~a first USB host~~ the USB device via the USB port while the USB device is operating in the USB host mode;

~~providing a second input port for~~ routing the first USB signal via the USB multiplexing switches from the USB device to the embedded USB host through the USB bridge and the USB hub;

receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode; and

~~routing the second USB signal from a second USB host via a USB bridge to said first USB host, and~~

routing the second USB signal USB multiplexing switches from [[a]] the USB device ~~via a~~ through USB hub to ~~said first~~ the embedded USB host, wherein the second USB signal from the USB device to the embedded USB host bypasses the USB bridge.

2.-4. (Cancelled).

5. (Currently amended) A method, comprising the steps of:

providing a first USB port for communication with a USB host;

providing a second USB port for communicating with a consumer USB device;

providing a signal detection circuit for receiving USB signals from the consumer USB device via said second USB port;

determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB host mode and if so, routing said USB signals via a USB bridge and USB hub to said first USB port; and

determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB device mode and if so, routing said USB signals via a USB hub to said first USB port while bypassing the USB bridge.

6. (Currently amended) A USB communication management method for interconnecting sources of USB signals, said method comprising the steps of:

receiving first USB host signals from a first USB host;

receiving second USB signals from a second USB signal source;

determining whether the second USB signals emanate from a second USB host;

routing the second USB signals emanating from the second USB host via a USB bridge and USB hub to said first USB host; and

routing the second USB signals not determined to emanate from a USB host via a USB hub to said first USB host, wherein the second USB signal bypass the USB bridge.

7. (Currently amended) The method according to claim [[8]] 6, further comprising the steps of:

determining whether the second USB signals emanate from a USB device; and

routing the second USB signals determined to emanate from the USB device via a USB hub to said first USB host.

8. (Currently amended) A USB communication management method for interconnecting sources of USB signals, said method comprising the steps of:

receiving a first USB host signal from a first USB host;

receiving a second USB signal from a second USB signal source;

determining whether the second USB signal emanates from a second USB host;

establishing a first communication path via a USB bridge and a USB hub between said first USB host and said second USB signal source if said second signal emanates from the second USB host; and

establishing a second communication path via a USB hub between said first USB host and said second USB signal source which bypasses the USB bridge if said second USB signal is determined not to emanate from the second USB host.

9. (Original) The method according to claim 8, further comprising the steps of:

determining whether the second USB signal emanates from a USB device; and

establishing the second communication path via a USB hub between said first USB host and said second USB signal source if said second USB signal is determined to emanate from the USB device.

10. (Currently amended) The method according to claim 8, wherein the ~~first communication path does not include a USB hub and wherein the~~ second communication path does not include a USB bridge.

11. (Cancelled)

REMARKS

This supplemental amendment is responsive to the Non-Final Office Action of February 18, 2021 and adopts suggestions made by Examiner Unelus in a telephone call with Applicant's representative Robert Myers on May 20, 2021. Claims 1, 5-8, and 10 have been amended and claims 2-4 and 11 have been cancelled. Following entry of the preceding amendments, claims 1 and 5-10 are pending.

All amendments presented herein are made to the claims as filed. The amendments and remarks in this supplemental response replace and supersede those presented in the Office Action response submitted on May 17, 2021.

Election/Restrictions

Applicant hereby confirms the election of Species I (claims 1-10) made by Applicant's representative Robert Myers during a telephone call with Examiner Ernest Unelus on February 10, 2021. This election of Species I is made without traverse and Species II (claim 11) is cancelled.

Claim Objections

Claims 1 and 7 were objected to as being indefinite for failing to particularly point out and distinctly claim the subject matter in which is regarded as the invention.

Applicant respectfully submits that the objection to claim 1 is obviated by the amendment of claim 1 to recite "receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode" and "receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode".

Applicant further submits that the objection to claim 7 is obviated by the amendment of claim 7 to be dependent upon claim 6. Accordingly, Applicant respectfully requests that the objections to claims 1 and 7 be reconsidered and withdrawn.

Claim Rejections – 35 U.S.C. §102

Claims 1 and 5-10 were rejected as being anticipated by Wright (US Pat. No. 7,502,878).

For an invention to be anticipated, it must be demonstrated that *each and every element* of the claimed invention is present in the "four corners" of a single prior art, either expressly described

therein or under the principle of inherency. *Lewmar Marine Inc. v Barient Inc.*, 3 USPQ2d 1766, 1767-1768 (Fed. Cir. 1987) (emphasis added). The absence from a prior art reference of any claimed element negates anticipation. *Kloster Speedsteel AB v. Crucible, Inc.*, 230 USPQ 81, 84 (Fed. Cir. 1986).

Amended claim 1 recites: "[a] method for providing efficient communications among USB components of a data communication system that includes a first input port, a second input port, a USB hub, a USB bridge connected to the USB hub, an embedded USB host connected to the USB hub, a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, and USB multiplexing switches connected to the USB port, the USB hub, and the USB bridge, said method comprising the steps of: receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode; routing the first USB signal via the USB multiplexing switches from the USB device to the embedded USB host through the USB bridge and the USB hub; receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode; and routing the second USB signal USB multiplexing switches from the USB device through USB hub to the embedded USB host, wherein the second USB signal from the USB device to the embedded USB host bypasses the USB bridge".

The Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the claimed USB hub. As shown in Fig. 5 of Wright, the first signal from the USB host 31B to the USB host 31A passes only through the multiplexer 36 and does not pass though the hub logic 38 while a second USB signal from the USB device 42 to the USB host 31A passes through both the hub logic 36 and the multiplexer 36. Therefore, Wright does not show that the first USB signal is routed via the multiplexer 36 (USB bridge) and the hub logic 38 (USB hub) and that the second USB signal is routed via the hub logic 38 (USB hub) while bypassing the multiplexer 36 (USB bridge). Since Wright does not show each and every element of amended claim 1, it is not anticipated.

Amended claim 5 recites, in part, "determining, via the signal detection circuit, whether the USB signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB host mode and if so, routing said USB signals via a USB bridge and USB hub to said first USB port; and determining, via the signal detection circuit, whether the USB

signals emanating from the consumer USB device indicate that the consumer USB device is operating in a USB device mode and if so, routing said USB signals via a USB hub to said first USB port while bypassing the USB bridge".

Again, the Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, the USB signals are routed from the USB host 31B to the USB host 31A only through the multiplexer 36 while the USB signals are routed from the USB device 42 to the USB host 31A through both the hub logic 36 *and* the multiplexer 36. Wright does not show routing the USB signals via the hub logic 38 (USB hub) to the first USB port 40E connected to the USB device 42 while bypassing the multiplexer 36 (USB bridge). Since Wright does not show each and every element of amended claim 5, it is not anticipated.

Amended claim 6 recites, in part, "routing the second USB signals emanating from the second USB host via a USB bridge and USB hub to said first USB host; and routing the second USB signals not determined to emanate from a USB host via a USB hub to said first USB host, wherein the second USB signal bypass the USB bridge".

Once more, the Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, a first USB signal from the USB host 31B to the USB host 31A passes only through the multiplexer 36 while a second USB signal from the USB device 42 to the USB host 31A passes through both the hub logic 36 *and* the multiplexer 36. Wright does not show routing the USB signals via hub logic 38 (USB hub) to the USB device 42 connected to the first port 40E while bypassing the multiplexer 36 (USB bridge). Since Wright does not show each and every element of amended claim 6, it is not anticipated. Claim 7 depends upon claim 6 and is allowable therewith.

Amended claim 8 recites, in part, "establishing a first communication path via a USB bridge and a USB hub between said first USB host and said second USB signal source if said second signal emanates from the second USB host; and establishing a second communication path via a USB hub between said first USB host and said second USB signal source which bypasses the USB bridge if said second USB signal is determined not to emanate from the second USB host".

Yet again, the Office Action points to the multiplexer 36 of Wright to show the claimed USB bridge and the hub logic 38 to show the USB hub. As shown in Fig. 5 of Wright, a first communication path from the USB host 31B to the USB host 31A that passes only through the multiplexer 36 while a second communication path from the USB device 42 to the USB host 31A passes through both the hub logic 36 *and* the multiplexer 36. Wright does not show establishing a second communication path from the USB device 42 to the USB host 31A which bypasses the multiplexer 36 (USB bridge) when the second USB signal is determined not to emanate from the USB host 31B. Claims 9 and 10 depend upon claim 8 and are allowable therewith.

For at least the reasons presented above, Applicant respectfully requests that the rejection of claims 1 and 5-10 under 35 U.S.C. §102(a)(1) be reconsidered and withdrawn and that these claims be allowed.

Claim Rejections – Nonstatutory Obviousness-Type Double Patenting

The Office has concluded that claims 1 and 5-10 are unpatentable over claims 1-17 of U.S. Patent No. 9,460,037, claims 1-20 of U.S. Patent No. 9,619,420, and claims 1-6 of U.S. Patent No. 10,545,899. Therefore, the Office has provisionally rejected these claims on the ground of nonstatutory obviousness-type double patenting.

Applicant acknowledges these rejections and their provisional nature as the current claims are not under an indication of allowance. At such time when the claims are allowed, Applicant will address the nonstatutory obviousness-type double patenting rejections.

CONCLUSION

Applicant notes that there are other arguments that may be presented to overcome the objections and rejections made in this Office Action, but those additional arguments have not been presented here in the interest of brevity. Applicant reserves the right to present any of these additional arguments in a later filed response or brief.

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at (952) 697.2641 to facilitate prosecution of this application.

Please charge any additional fees or credit any overpayment to Deposit Account No. 50-3141.

Respectfully submitted,

Billion & Armitage
7401 Metro Blvd., Suite 425
Minneapolis, MN 55439
(952) 697.2630 – main phone
(952) 697.2631 – facsimile

Dated: May 20, 2021

By /Robert J. Myers/
Robert J. Myers
Reg. No. 69,783

RJM/cas

Electronic Acknowledgement Receipt

EFS ID:	42811901
Application Number:	16660083
International Application Number:	
Confirmation Number:	1000
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Customer Number:	171991
Filer:	Robert James Myers/LaTasha Hill
Filer Authorized By:	Robert James Myers
Attorney Docket Number:	7021.145US4
Receipt Date:	25-MAY-2021
Filing Date:	22-OCT-2019
Time Stamp:	12:09:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		7021145US4_SUPP-AMEND.pdf	59893 c1b5c0d4a240408a11b102b696b58c3127e6f0e6f	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	9
Warnings:			
Information:			
	Total Files Size (in bytes):	59893	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	16660083
Filing Date	22-Oct-2019
First Named Inventor	Robert Voto
Attorney Docket Number	7021.145US4
Title of Invention	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
Aptiv Technologies Limited	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

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9619420

10545899

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

○ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request. ◉ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number 69783 ○ A sole inventor ○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ○ A joint inventor; all of whom are signing this request	
Signature	/Robert Myers/
Name	Robert Myers

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16660083

Filing Date: 22-Oct-2019

Applicant/Patent under Reexamination: Voto

Electronic Terminal Disclaimer filed on August 6, 2021

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	43443505
Application Number:	16660083
International Application Number:	
Confirmation Number:	1000
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Customer Number:	171991
Filer:	Robert James Myers/Wendy Skelly
Filer Authorized By:	Robert James Myers
Attorney Docket Number:	7021.145US4
Receipt Date:	06-AUG-2021
Filing Date:	22-OCT-2019
Time Stamp:	10:15:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	40211 f82eb1fccc588d85bfbabe5cef8b5a91e921fb1b	no	2

Warnings:

Information:	
Total Files Size (in bytes):	40211

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

171991 7590 08/12/2021

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

EXAMINER
UNELUS, ERNEST

ART UNIT	PAPER NUMBER
2181	

DATE MAILED: 08/12/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/660,083	10/22/2019	Robert M. Voto	7021.145US4	1000

TITLE OF INVENTION: FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/12/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

Microchip Ex. 1010, p. 367
Microchip v. Aptiv
IPR2024-00495

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

171991 7590 08/12/2021

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/660,083	10/22/2019	Robert M. Voto	7021.145US4	1000

TITLE OF INVENTION: FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/12/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
UNELUS, ERNEST	2181	710-313000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Microchip Ex. 1010, p. 368
Microchip v. Aptiv
IPR2024-00495

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UNITED STATES DEPARTMENT OF COMMERCE
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Address: COMMISSIONER FOR PATENTS
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/660,083	10/22/2019	Robert M. Voto	7021.145US4	1000

171991 7590 08/12/2021

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

EXAMINER	
UNELUS, ERNEST	
ART UNIT	PAPER NUMBER
2181	

DATE MAILED: 08/12/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

Microchip Ex. 1010, p. 369
Microchip v. Aptiv
IPR2024-00495

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/660,083	Applicant(s) Voto et al.	
	Examiner ERNEST UNELUS	Art Unit 2181	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Examiner's amendment.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 03/05/2021.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. 20210806.
5. ☑ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ERNEST UNELUS/
Primary Examiner, Art Unit 2181

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DETAILED ACTION

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Robert Myers (Reg. No. 69,783) on August 6, 2021. The examiner proposed amendments to better place the application in condition for allowance, particularly adding the limitation that prior arts fail to teach. Mr. Myers agreed.

The application has been amended as follows:

Listing of Claims:

1. (Currently amended) A method ~~for~~, comprising:

providing efficient communications among USB components of a data communication system that includes a first input port, a second input port, a USB hub, a USB bridge connected to the USB hub, an embedded USB host connected to the USB hub, a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, and USB multiplexing switches connected to the USB port, the USB hub, and the USB bridge~~, said method comprising the steps of:~~;

receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode;

routing the first USB signal via the USB multiplexing switches from the USB device to the embedded USB host through the USB bridge and the USB hub;

receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode; and

routing the second USB signal via the USB multiplexing switches from the USB device ~~through USB hub~~ to the embedded USB host through the USB hub, wherein the second USB signal from the USB device to the embedded USB host bypasses the USB bridge.

2.-11. (Cancelled)

ALLOWABLE SUBJECT MATTER

The primary reason for allowance of claim 1 in the instant application is that prior arts fail to disclose a USB hub module that includes a first input port, a second input port, a USB hub, a USB bridge connected to the USB hub, an embedded USB host connected to the USB hub, a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, and USB multiplexing switches connected to the USB port, the USB hub, and the USB bridge; wherein the USB hub module is: receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode; routing the first USB signal via the USB multiplexing switches from the USB device to the embedded USB host through the USB bridge and the USB hub; receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode; and routing the second USB signal

via the USB multiplexing switches from the USB device to the embedded USB host through the USB hub, wherein the second USB signal from the USB device to the embedded USB host bypasses the USB bridge.

Hence, the examiner has allowed claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

CLOSING COMMENTS

Conclusion

a. STATUS OF CLAIMS IN THE APPLICATION

The following is a summary of the treatment and status of all claims in the application as recommended by **M.P.E.P. 707.07(i)**:

a(1) CLAIMS ALOWED IN THE APPLICATION

Per the instant office action, claim 1 has been allowed.

b. DIRECTION OF FUTURE CORRESPONDENCES

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ernest Unelus whose telephone number is (571) 272-8596. The examiner can normally be reached on Monday to Friday 9:00 AM to 5:00 PM.

IMPORTANT NOTE

If attempts to reach the above noted Examiner by telephone are unsuccessful, the Examiner's supervisor, Mr. Idriss Alrobaye, can be reached at the following telephone number: Area Code (571) 270-1023.

The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PMR system, see her//pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217- 91 97 (toll-free).

/Ernest Unelus/
Primary Examiner
Art Unit 2181

Examiner-Initiated Interview Summary	**Application No.** 16/660,083	**Applicant(s)** Voto et al.		
	Examiner ERNEST UNELUS	**Art Unit** 2181	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
ERNEST UNELUS	Primary Examiner	Telephonic
Robert Myers (Reg. No. 69,783)	Attorney of Record	

Date of Interview: 06 August 2021

Issues Discussed:

Proposed Amendment(s)

The primary reason for allowance of claim 1 in the instant application is that prior arts fail to disclose a USB hub module that includes a first input port, a second input port, a USB hub, a USB bridge connected to the USB hub, an embedded USB host connected to the USB hub, a USB port connected to a USB device capable of operating in a USB Host mode and a USB device mode, and USB multiplexing switches connected to the USB port, the USB hub, and the USB bridge; wherein the USB hub module is: receiving a first USB signal from the USB device via the USB port while the USB device is operating in the USB host mode; routing the first USB signal via the USB multiplexing switches from the USB device to the embedded USB host through the USB bridge and the USB hub; receiving a second USB signal from the USB device via the USB port while the USB device is operating in the USB device mode; and routing the second USB signal via the USB multiplexing switches from the USB device to the embedded USB host through the USB hub, wherein the second USB signal from the USB device to the embedded USB host bypasses the USB bridge.

/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

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Microchip v. Aptiv
IPR2024-00495

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	**Art Unit**
	ERNEST UNELUS	2181

CPC						
Symbol					**Type**	**Version**
G06F	/	13	/	385	F	2013-01-01
G06F	/	13	/	4022	I	2013-01-01
G06F	/	13	/	4045	I	2013-01-01
G06F	/	13	/	4282	I	2013-01-01
G06F	/	2213	/	4004	A	2013-01-01
G06F	/	2213	/	0042	A	2013-01-01
G06F	/	2213	/	3812	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	1	
/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	06 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

U.S. Patent and Trademark Office — Part of Paper No.: 20210806

Microchip Ex. 1010, p. 377
Microchip v. Aptiv
IPR2024-00495

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	**Art Unit**
	ERNEST UNELUS	2181

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06F	/	13	/	38

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	1	
/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	06 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

U.S. Patent and Trademark Office — Part of Paper No.: 20210806

Microchip Ex. 1010, p. 378
Microchip v. Aptiv
IPR2024-00495

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	**Art Unit**
	ERNEST UNELUS	2181

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		10												
	2		11												
	3														
	4														
	5														
	6														
	7														
	8														
	9														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	1	
/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	06 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

U.S. Patent and Trademark Office — Part of Paper No.: 20210806

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Microchip v. Aptiv
IPR2024-00495

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	Art Unit
	ERNEST UNELUS	2181

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/12/2021	08/06/2021							
1	1	✓	=							
	2	✓	-							
	3	✓	-							
	4	✓	-							
	5	✓	-							
	6	✓	-							
	7	✓	-							
	8	✓	-							
	9	✓	-							
	10	✓	-							
	11	N	-							

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Microchip v. Aptiv
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	Art Unit
	ERNEST UNELUS	2181

CPC - Searched*		
Symbol	Date	Examiner
G06F 13/4022, 385, 4045, 4282; G06F 2213/4004, 3812 and G06F 11/3051	02/12/2021	E.U.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
EAST search: US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	02/12/2021	E.U.
Inventor search utilizing PE2E and EAST	02/12/2021	E.U.
CPC search of G06F 13/4022, 385, 4045, 4282; G06F 2213/4004, 3812 and G06F 11/3051	02/12/2021	E.U.
EAST search: US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	08/06/2021	E.U.
Inventor search utilizing PE2E and EAST	08/06/2021	E.U.
CPC search of G06F 13/4022, 385, 4045, 4282; G06F 2213/4004, 3812 and G06F 11/3051	08/06/2021	E.U.

/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	

Microchip Ex. 1010, p. 381
Microchip v. Aptiv
IPR2024-00495

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/660,083	Voto et al.
	Examiner	Art Unit
	ERNEST UNELUS	2181

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
G06F	13/385	08/06/2021	E.U.

/ERNEST UNELUS/ Primary Examiner, Art Unit 2181	

Microchip Ex. 1010, p. 382
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S174	3,035	usb with (downstream or upstream) with (port or plug or interface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 11:28
S175	36	S174 and bypass$4 with (host or master or initiat$3 or slave or peripheral or device or port or plug or interface) with mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 11:29
S176	1,471	usb with (downstream or upstream) with (port or plug or interface) with hub	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 11:58
S177	66	S176 and (host or master or initiat$3 or slave or peripheral or device or port or plug or interface) with mode with usb and (mode with (host or master or initiat$3 or slave or peripheral or device) with usb).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 12:02
S178	2,655	usb with (downstream or upstream or switch$3 or mux or multiplex$3) with (port or plug or interface) with hub	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 14:32
S179	136	S178 and (host or master or initiat$3 or slave or peripheral or device or port or plug or interface) with mode with usb and (mode with (host or master or initiat$3 or slave or peripheral or device or dual or switch$3 or mux or multiplex$3) with usb).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 14:34

S180	70	S179 not S177	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/04 14:37
S181	228	mode with usb with (downstream or upstream or switch$3 or mux or multiplex$3) with (port or plug or interface) with hub	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 13:14
S182	108	G06F13/385,4022,4045,387.cpc. and mode with usb with (downstream or upstream or switch$3 or mux or multiplex$3) with (port or plug or interface) with hub	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 13:16
S183	84	G06F13/385,4022,4045,387.cpc. and mode with usb with (downstream or upstream or switch$3 or mux or multiplex$3) with (port or plug or interface) with hub and hub with (switch$3 or mux or multiplex$3) with mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 13:18
S184	79	G06F13/385,4022,4045,387.cpc. and mode with usb with (downstream or upstream or switch$3 or mux or multiplex$3) with (port or plug or interface) with hub and hub with (switch$3 or mux or multiplex$3) with mode with usb	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 13:22
S185	55	Shyambabu Yeda.in. or Robert Voto.in. or Craig Petku.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	NEAR	ON	2021/08/06 14:32
S186	2	S185 and usb with (downstream or upstream or plurality or multiple or second or another) with (port or plug interface) with (hub or adapt$3) and bypass$4 with (host or master or initiat$3 or slave) with (peripheral or device or port or plug interface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 14:32

S187	18,032	G06F13/4022.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 14:32
S188	24,549	G06F13/385.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 14:32
S189	24	G06F2213/4004,3812.cpc. and mode with usb with (downstream or upstream or switch$3 or mux or multiplex$3) with (port or plug or interface) with hub and hub with (switch$3 or mux or multiplex$3) with mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 14:33
S190	5,634	G06F11/3051.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/08/06 14:33

8/6/2021 4:41:15 PM
C:\Users\eunelus\Documents\EAST\Workspaces\14487947.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16660083
Filing Date	2019-10-22
First Named Inventor	Voto
Art Unit	2181
Examiner Name	Unelus Ernest
Attorney Docket Number	7021.145US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/E.U/	1	20070255885	A1	2007-11-01	Bohm et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/E.U/	1	2473123	GB	A	2011-03-02	Lydon, et al.		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

Microchip Ex. 1010, p. 386
Microchip v. Aptiv
IPR2024-00495

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16660083
	Filing Date	2019-10-22
	First Named Inventor	Voto
	Art Unit	2181
	Examiner Name	Unelus Ernest
	Attorney Docket Number	7021.145US4

/E.U/	1	Examination Report for IN Application No. 201647014322, dated December 17, 2020, 5 pages	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/ERNEST UNELUS/	Date Considered	08/06/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Microchip Ex. 1010, p. 387
Microchip v. Aptiv
IPR2024-00495

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16660083
	Filing Date	2019-10-22
	First Named Inventor	Voto
	Art Unit	2181
	Examiner Name	Unelus Ernest
	Attorney Docket Number	7021.145US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert Myers/	Date (YYYY-MM-DD)	2021-03-05
Name/Print	Robert Myers	Registration Number	69783

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Microchip Ex. 1010, p. 388
Microchip v. Aptiv
IPR2024-00495

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Microchip Ex. 1010, p. 389
Microchip v. Aptiv
IPR2024-00495

Bibliographic Data

Application No: 16/660,083

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /ERNEST UNELUS/ (Examiner's Signature) | E.U. (Initials)

Title: FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/22/2019	710	2181	7021.145US4
RULE			

APPLICANTS

Aptiv Technologies Limited, St. Michael, BARBADOS

INVENTORS

Robert M. Voto, Clarkston, MI, UNITED STATES

Shyambabu Yeda, Rochester Hills, MI, UNITED STATES

Craig Petku, Clarkston, MI, UNITED STATES

CONTINUING DATA

This application is a CON of 15441775 02/24/2017 PAT 10545899

15441775 is a CON of 15268728 09/19/2016 PAT 9619420

15268728 is a CON of 14487947 09/16/2014 PAT 9460037

14487947 has PRO of 61882915 09/26/2013

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

11/07/2019

STATE OR COUNTRY

UNITED STATES

ADDRESS

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439
UNITED STATES

FILING FEE RECEIVED

$1,720

Doc Code: MFEE.C.AD
Document Description: Maintenance Fee Address Change

PTO/AIA/47 (12-20)
Approved for use through 09/30/2021. OMB 0651-0016
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is required to respond to a collection of information unless it displays a valid OMB control number.

"FEE ADDRESS" INDICATION FORM

Address to:
Mail Stop Maintenance Fee
Director of the United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

-OR-

Fax to:
571-273-6500

INSTRUCTIONS: The issue fee must have been paid for the application(s) listed on this form. In addition, only an address represented by a Customer Number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application.

When to check the first box below: If you have a Customer Number to represent the fee address.

When to check the second box below: If you have no Customer Number representing the desired fee address, in which case a completed Request for Customer Number (PTO/SB/125) must be attached to this form. For more information on Customer Numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

For the following listed application(s), please recognize as the "Fee Address" under the provisions of 37 CFR 1.363 the address associated with:

☑ Customer Number: 22851

OR

☐ The attached Request for Customer Number form (PTO/SB/125)

PATENT NUMBER (if known)	APPLICATION NUMBER
	16/660,083

Completed by (check one):

☐ Applicant/Inventor

☑ Attorney or Agent of record 69783 (Reg. No.)

☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(c) (Form PTO/AIA/96) is enclosed or was filed on _____ (Date)

/Robert Myers/
Signature

Robert Myers
Typed or printed name

_____
Requester's telephone number

October 11, 2021
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. If the assignee is a juristic entity, this form must be signed by a patent practitioner (attorney or agent) of record. Submit multiple forms if more than one signature is required, see below*.

☑ *Total of 1 forms are submitted

This collection of information is required by 37 CFR 1.363. The information is required to obtain or retain a benefit by the public, which is to indicate (and for the USPTO to process) a fee address. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 5 minutes to complete, including gathering, preparing, and submitting the completed form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND COMPLETED FORMS TO THE PREVIOUS ADDRESS. **SEND COMPLETED FORMS TO: Mail Stop Maintenance Fee, Director of the United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Robert M. Voto, et al.	Examiner:	Ernest Unelus
Application No.:	16/660,083	Group Art Unit:	2181
Filed:	October 22, 2019	Docket No.:	7021.145US4
		Confirmation No:	1000
Title:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS		

This paper is being filed electronically with the U.S. Patent Office

REPLY TO NOTICE OF ALLOWANCE

Enclosed is a completed Part B – Fee(s) Transmittal in response to the Notice of Allowance for the above referenced application. The issue fee is being paid with this reply via the Electronic Filing System (EFS-Web). Please apply those fees and any other necessary charges or credits to Deposit Account No. 50-3141, referencing the attorney docket number listed above.

COMMENTS ON EXAMINER'S REASONS FOR ALLOWANCE

It is recognized that, in accordance with M.P.E.P. § 1302.14, the Examiner's reasons for allowance need not set forth all of the details as to why the claims are allowed. In the above referenced application, it is not conceded that the Examiner's stated reasons are the only reasons for which the claims are allowable. The Examiner's reasons for allowance indicate that particular claim elements are not disclosed or suggested by the prior art of record, yet the claim may be patentable for other reasons as well, including the inventive combination of all of the recited claim elements. It is not conceded that the specific limitations identified by the Examiner are necessary to distinguish the claim over the art of record or to satisfy the requirements of 35 U.S.C. § 112. Moreover, the Examiner does not assert, nor would it be conceded, that the Examiner's reasons have any bearing on the patentability of claims in any other application directed to the disclosed subject matter.

In addition, each dependent claim stands on its own and may be allowable on its own merits. In particular, each dependent claim may be allowable on the basis of a combination of some of the features recited in the dependent claim and its base claim(s), which combination of features may not include all of the limitations identified in the Examiner's reasons for allowance.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-3141 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

Billion & Armitage
7401 Metro Blvd., Suite 425
Minneapolis, MN 55439
(952) 697.2630 – main phone
(952) 697.2631 – facsimile

Dated: October 11, 2021

By /Robert J. Myers/
Robert J. Myers
Reg. No. 69,783

RJM/lrh

Microchip Ex. 1010, p. 394
Microchip v. Aptiv
IPR2024-00495

Electronic Patent Application Fee Transmittal

Application Number:	16660083
Filing Date:	22-Oct-2019
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Filer:	Michael Allen Collins/LaTasha Hill
Attorney Docket Number:	7021.145US4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
UTILITY APPL ISSUE FEE	1501	1	1200	1200
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt

EFS ID:	43997619
Application Number:	16660083
International Application Number:	
Confirmation Number:	1000
Title of Invention:	FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS
First Named Inventor/Applicant Name:	Robert M. Voto
Customer Number:	171991
Filer:	Michael Allen Collins/LaTasha Hill
Filer Authorized By:	Michael Allen Collins
Attorney Docket Number:	7021.145US4
Receipt Date:	11-OCT-2021
Filing Date:	22-OCT-2019
Time Stamp:	15:30:07
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20210AF30423029
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	7021145US4_ISSUE-FEE.pdf	178886 eccb609f6f507a227047d3ae636f18d7e172ad14	no	1
Warnings:					
Information:					
2	Maintenance Fee Address Change	7021145US4_FEE-ADDRESS.pdf	231192 76e83c349aece547bb14f7695fd8b1c453e89eb6	no	2
Warnings:					
Information:					
3	Miscellaneous Incoming Letter	7021145US4_NOA-REPLY.pdf	22488 a8011b3883192e32e746eaccf86d9f53bd41c22d	no	2
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	40305 9f6edcb6805cbf352bc23a16e88c67b5cbbe6293	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	472871		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Best Available Copy

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

171991 7590 08/12/2021

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

LaTasha Hill	(Typed or printed name)
/LaTasha Hill/	(Signature)
October 19, 2021	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/660,083	10/22/2019	Robert M. Voto	7021.145US4	1000

TITLE OF INVENTION: FLEXIBLE MOBILE DEVICE CONNECTIVITY TO AUTOMOTIVE SYSTEMS WITH USB HUBS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/12/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
UNELUS, ERNEST	2181	710-313000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☒ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Billion & Armitage
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
APTIV TECHNOLOGIES LIMITED	Barbados

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 50-3141

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Robert Myers/ Date 2021-10-19

Typed or printed name Robert Myers Registration No. 69783

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Microchip Ex. 1010, p. 400
Microchip v. Aptiv
IPR2024-00495

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/660,083	11/16/2021	11176072	7021.145US4	1000

171991 7590 10/27/2021

Billion & Armitage - Aptiv
7401 Metro Blvd.
Suite 425
Minneapolis, MN 55439

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 50 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

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