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Allocating Power to Multiple Devices from Universal Serial Bus (USB) Type-C Adapter

Chao Fei

Honggang Sheng

Doug Osterhout

George Hwang

Srikanth Lakshmikanthan

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Abstract: A power adapter with multiple Universal Serial Bus (USB) Type-C ports can intelligently allocate power to multiple computing devices based on the needs of the computing devices. The adapter can allocate power to the computing devices based on respective priorities of the computing devices and/or based on charge levels of batteries in the computing devices.

A power adapter with multiple Universal Serial Bus (USB) Type-C ports can intelligently allocate and/or provide power to multiple computing devices. To minimize the size and cost of the power adapter, the power adapter can receive and provide a total power equal to the power typically used to power a single computing device (e.g., 60 Watts (W)). When more than one computing device requests power from the power adapter, the power adapter can allocate the total power based on priorities of the computing devices, such as by prioritizing a smartphone over a laptop computer, or based on charge levels of batteries, which can be considered a status of charge (SOC), in the computing devices, such as by prioritizing a device with a lower charge level. For example, if the total power supplied by the power adapter is 60 W, the power adapter can, for example, provide 45 W to a device with a higher priority and 15 W to a device with a lower priority. 45 W and 15 W are merely examples of how the shared total power could be allocated, and other combinations of power allocations could be applied. The intelligent power sharing reduces the size and cost of the power adapter compared to an adapter that can provide full power to all of the computing devices, which would require the power adapter to be able to supply the full power needed by each computing device times the number of ports (such as 60W x 2 ports = 120W). The intelligent power sharing also allows the adapter to supply the full power needed to a single computing device when only one computing device is connected to the power adapter.

FIG. 1 is a diagram of a power adapter 106 receiving power from an electrical outlet 104 in a wall 102 and providing power to two different devices 112, 114. The power adapter 106 can

receive power from the electrical outlet 104. The electrical outlet 104 can provide alternating current (AC) power to the power adapter 106 via a cable 105. The cable 105 can be a component of, and/or attached to, the adapter 106. The power adapter 106 can rectify the AC power received from the electrical outlet 104. The electrical outlet 104 can provide AC power to the power adapter 106 in a specified electrical quantity, such as 120 volts. The power adapter 106 can rectify the specified electrical quantity into a specified amount of power to provide to the computing devices 112, 114, such 60W.

The power adapter 106 can include multiple ports 108, 110 for providing power to multiple computing devices 112, 114. The ports 108, 110 can include cables extending from the power adapter 106, and/or cables can extend from the ports 108, 110. The computing devices 112, 114 can include devices with rechargeable batteries, such as a smartphone computing device 112 and/or a laptop computing device 114. While two ports 108, 110 and computing devices 112, 114 are shown in FIG. 1, the adapter 106 can include any number of ports to charge any number of computing devices.

The adapter 106 can provide a fixed total amount of power to the multiple computing devices 112, 114. The fixed total amount of power that the power adapter 106 can provide to the multiple computing devices 112, 114 can be the amount of power that the power adapter 106 would typically provide to a single computing device 112, 114.

The fixed total amount of power that the power adapter 106 can provide to the multiple computing devices 112, 114 can be insufficient to provide the sum total power typically received by all of the multiple computing devices 112, 114. A controller included in the power adapter 106 can determine how to allocate the limited, fixed total amount of power to the multiple computing devices 112, 114. In some examples, the power adapter 106 can allocate the power

based on priorities of the multiple computing devices 112, 114, such as providing more power to a smartphone computing device 112 than to a laptop computing device 114. In some examples, the power adapter 106 can allocate the power level based on charge levels of batteries included in the computing devices 112, 114, such as by providing more power to the computing device 112, 114 whose battery with a lower charge level. In some examples, the adapter 106 can allocate the priorities based on a combination of the priorities of the multiple computing devices 112, 114 and the charge levels of the batteries included in the computing devices 112, 114. In some examples, the computing devices 112, 114 can transmit their identities and/or device types, based on which the adapter 106 can determine the respective priorities of the computing devices 112, 114, and/or the charge levels of their respective batteries, via a communication channel included in the ports 108, 110 and/or cables.

FIG. 2 is a flowchart showing operations performed by the power adapter 106. The power adapter 106 can connect a first port 108, such as Port A (202), to a computing device 112, such as a smartphone. After connecting the port 108 (202) to the computing device 112, the power adapter 106 can determine whether the power adapter 106 is receiving power (204), such as whether the power adapter 106 is receiving power from an electrical outlet 104. If the power adapter 106 is not receiving power, then the power adapter 106 is not able to provide power to any other devices, and can continue determining whether the power adapter 106 is receiving power (204).

If the power adapter 106 determines that the power adapter 106 is receiving power, then the power adapter 106 can determine whether the port 108, such as Port A, is the first port connected to a computing device (206). If the port 108 is the first port of the power adapter 106 that connected to a computing device, then the port 108 must be the only port of the power

adapter 106 connected to a computing device. If the port 108 is the only port of the power adapter 106 connected to a computing device, then the power adapter 106 is connected to only one computing device 112, and the power adapter 106 can provide and/or send full power (208) to the one computing device 112 connected to the power adapter.

If the power adapter 106 determines that the port 108 is not the first port of the power adapter 106 that is connected to a computing device, then the power adapter 106 must be connected to multiple computing devices 112, 114. When the power adapter 106 is connected to multiple computing devices 112, 114, the power adapter 106 will determine how to allocate the limited amount of available power to the multiple computing devices 112, 114.

The power adapter 106 can request priorities from the ports (210). The power adapter 106 can request priorities via, for example communication channels included in the USB cables connecting the ports 108, 110 to the computing devices 112, 114. The computing devices 112, 114 can respond to the requests by providing their respective priorities to the power adapter 106 via, for example, the communication channels. The priorities can include, for example, types of computing devices 112, 114 (such as smartphones, laptop computers, netbooks, or tablet computers), and/or charge levels of batteries included in the computing devices 112, 114.

The power adapter 106 can compare the received priorities (212) of the computing devices 112, 114. The comparison (212) can include determining which computing device(s) 112, 114 has higher priority. In some examples, certain types of computing devices, such as smartphones, can have higher priority than other types of computing devices, such as laptop computers. In some examples, computing devices with batteries that have lower charge levels can have higher priority than computing devices that have higher charge levels. The power adapter 106 can allocate power between the computing devices 112, 114 based on the

determined priorities. For example, the power adapter 106 can allocate forty-five watts (45W) of power to a computing device with a higher priority, and allocate fifteen watts (15W) of power to a computing device with a lower priority.

After comparing priorities (212) of the ports 108, 110 and/or computing devices 112, 114, and/or allocating power between the computing devices 112, 114 connected to the power adapter 106, the power adapter 106 can inform the computing devices 112, 114 connected to the respective ports of the power adapter's 106 capability to provide power to the respective computing devices 112, 114. The power adapter 106 can update the capability of the power adapter 106 to provide power to the first port, such as Port B (214). The update can be a reduction in power supplied to the Port B based on the need to also supply power to Port A. The power adapter 106 can send a message to the computing device 114 receiving power via Port B, such as via a communication channel, informing the computing device 114 of the new amount of power that the power adapter 106 will be supplying to the computing device 114. The power adapter 106 can also send the power capability to the newly connected port 108, Port A (216). The power adapter 106 can send a message to the computing device 112 via Port A, such as via a communication channel, informing the new computing device 112 of the amount of power that the power adapter 106 will be supplying to the computing device 112. The power adapter 106 can thereafter provide the power to the computing devices 112, 114 that the power adapter 106 informed the computing devices 112, 114 that the power adapter 106 would provide.

In some examples, the request by the power adapter 106 (210), receipt of priorities from the computing devices 112, 114, and updating and/or sending of power capabilities (214, 216) can be part of a handshake protocol. In some examples, the handshake protocol can be defined by the USB Type-C specification. In some examples, the power adapter 106 and computing

devices 112, 114 can iteratively negotiate the power capability, with the power adapter 106 iteratively increasing or decreasing the power capability sent to each computing device 112, 114, and the computing devices 112, 114 iteratively decreasing their requested powers. In some examples, the power adapter 106 and computing devices 112, 114 can renegotiate and/or change the power allocations after a period of time has elapsed. The power needs of the computing devices 112, 114 may have changed after this time period. For example, the charge level(s) of at least one of the computing devices 112, 114 may have increased after the time period, which may change the respective priorities of, and power allocations to, the computing devices 112, 114.

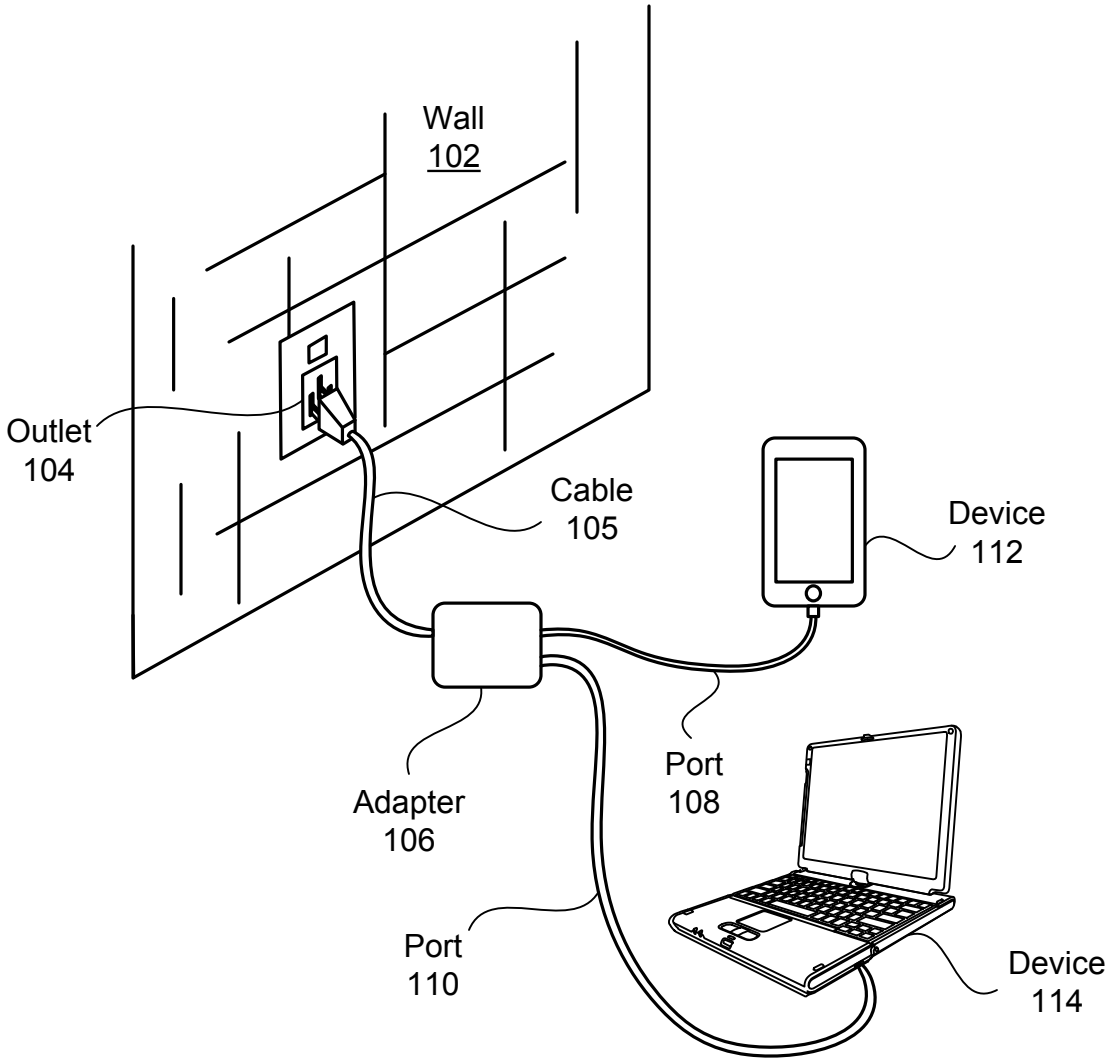
Wall
102
Outlet
104
Cable
105
Device
112
Adapter
106
Port
108
Port
110
Device
114

FIG. 1

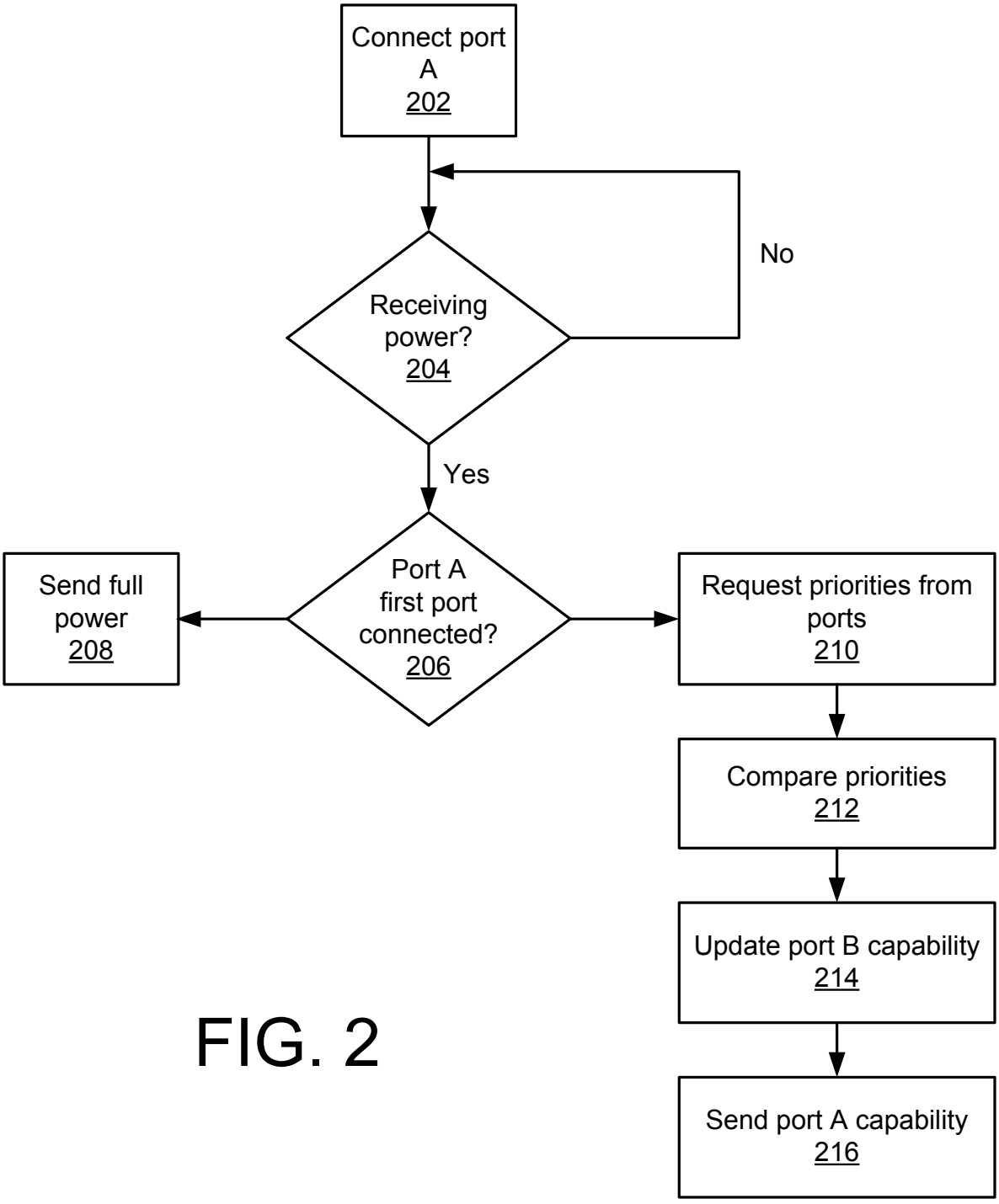
Connect port A
202
Receiving power?
204
No
Yes
Port A first port connected?
206
Send full power
208
Request priorities from ports
210
Compare priorities
212
Update port B capability
214
Send port A capability
216

FIG. 2