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Seamless Wireless Connection Switching on a Mobile Device

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Abstract:

This publication describes techniques and methods to provide a seamless switch from one wireless network to another wireless network on a mobile device. The described techniques and methods include an on-device application capable of switching wireless networks (network manager) that leverages a hardware capability present in wireless chipsets allowing for a seamless switch from one wireless network to another. The hardware capability includes a chipset handling two concurrent wireless connections (*e.g.*, a first (default) network connection and a second network connection) on different networks. If the quality of the first network connection deteriorates, the device can evaluate and connect to a second network. If the network manager decides the second network is a better connection, it will make the second network the new default network. The first network can stay connected until all ongoing transfers utilizing the first network have been completed. This switch will not use the cellular network during the transition and will decrease disruption for the user.

Keywords:

smartphone, user equipment, UE, cellphone, mobile phone, portable electronic device, tablet, Wi-Fi, wireless network, connect, disconnect, application, app, service, wireless network manager, network selection, switching, dual connectivity, concurrent wireless connection

Background:

User equipment, including smartphones, tablets, laptop computers, handheld video game consoles, and other portable electronic devices, include transceivers that enable users and electronic devices to access nearby wireless networks and cellular networks. These wireless networks can include wireless local area networks (WLANs) and wireless wide area networks (WANs).

Wireless chipsets included on the user equipment may support two concurrent wireless connections to different wireless networks. In some implementations, the user equipment does not take advantage of this functionality.

When a default wireless network (NetworkA) of the user equipment begins to lose signal strength and the user equipment determines that another wireless network (NetworkB) in the area has a stronger signal, as illustrated in Figure 1, the user equipment may utilize a Break Before Make (BBM) method when switching from NetworkA to the NetworkB.

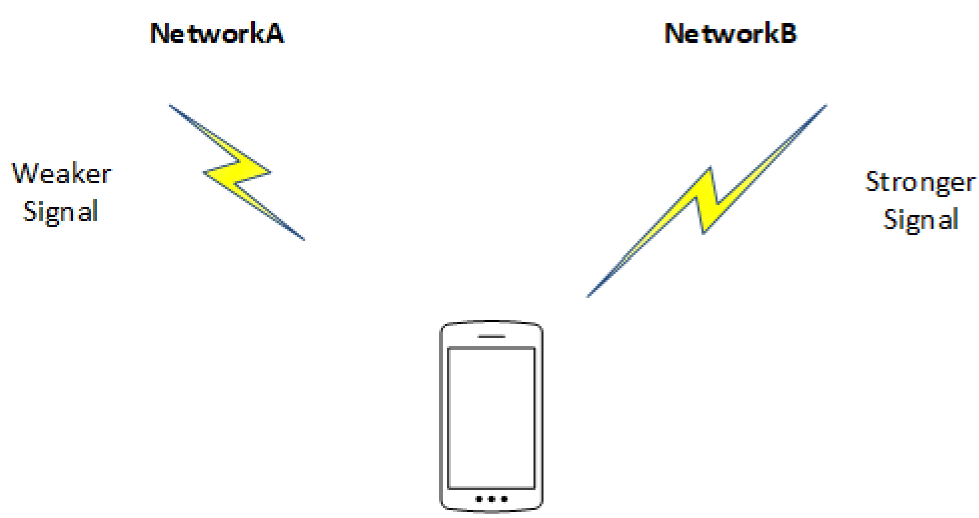

Figure 1

Once the user equipment decides to connect to NetworkB, it executes a series of steps that will briefly leave the user equipment with no active wireless network connection. During this transition from NetworkA to NetworkB, the user equipment may access a cellular network connection for applications or services (collectively “apps”) to transfer data.

One sequence of steps a BBM method might perform on a user equipment is listed below:

1. Device is connected to wireless network (NetworkA), and the wireless network is the default route on the device.
2. Connection quality of NetworkA starts to deteriorate.
3. Device detects a better wireless network (NetworkB) in the vicinity.
4. Device decides to switch to NetworkB.
5. Device disconnects from wireless NetworkA and triggers connection to wireless NetworkB.
6. Step 5 will cause all the sockets opened by various apps on the device to be closed forcefully and all ongoing traffic to be lost.
7. On mobile devices that also have a cellular connection, the default route on the device will momentarily switch to the cellular network.
8. Apps will react to the socket closure and try to open sockets on the new default network on the device (which is cellular).
9. When the device completes connection to NetworkB, which then becomes the default network on the device, apps will need to again transition their sockets (not a forced transition, so no data is lost) on the cellular network (created at step 8) to the new default network.

Description:

This publication describes techniques and methods to provide a seamless switch from one wireless network to another wireless network on a mobile device. The described techniques and methods include an on-device application capable of switching wireless networks (network manager) that directs the user equipment to perform operations that include evaluating a default connected wireless network (NetworkA) and, if connection quality of NetworkA deteriorates, to evaluate and possibly connect to a second wireless network (NetworkB) without first disconnecting from NetworkA. Once the connection to NetworkB is confirmed, NetworkB becomes the default network. NetworkA stays connected for some period of time, allowing any data transfers using NetworkA to complete. This flow, referred to as Make Before Break (MBB), allows applications on the user equipment using the wireless network (NetworkA) to finish any data transfer before the network manager drops NetworkA. Any new data transfer during this transition would be performed on NetworkB.

Figure 2, below, illustrates an example user equipment that supports two concurrent wireless connections to different wireless networks (*e.g.*, WLANs, WANs) as described herein. As illustrated in a non-limiting example, the user equipment is a smartphone. Other examples of the user equipment include tablets, laptop computers, handheld video game consoles, and other portable electronic devices. The user equipment includes one or more subscriber identity modules (SIMs) and a wireless transceiver(s) capable of supporting two concurrent wireless connections to different networks.

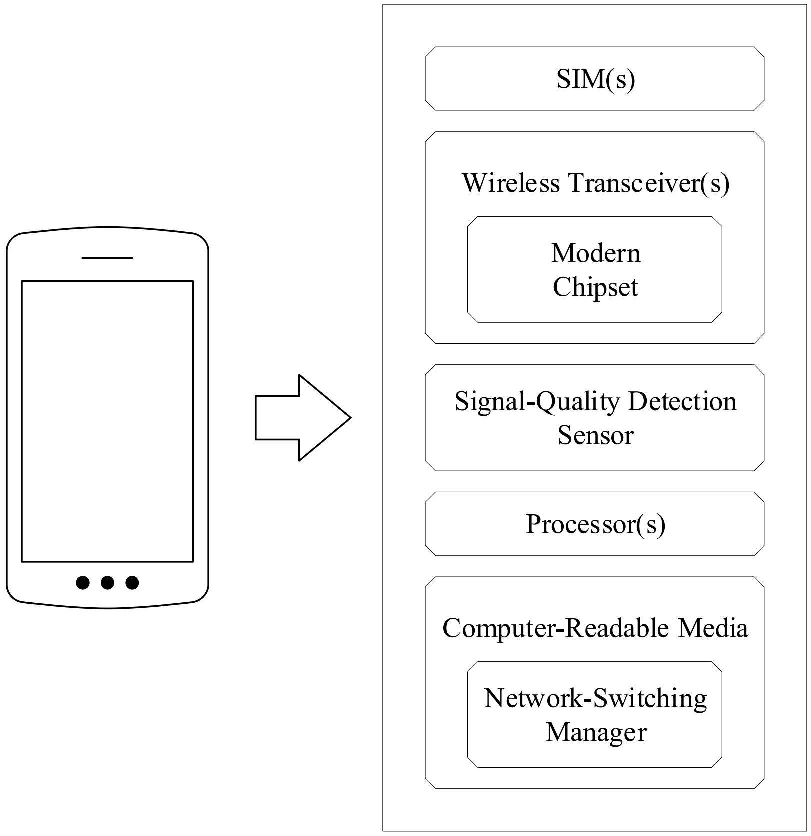

Figure 2

The user equipment includes a signal-quality detection sensor that can detect qualities of a signal received through the transceiver(s). Examples of such qualities include a received signal strength indicator (RSSI), a signal-to-noise (SNR) ratio, and a reference signal received power (RSRP) indicator.

The user equipment includes at least one processor having logic for executing instructions and a computer-readable medium (CRM). The CRM may include any suitable memory or storage device (*e.g.*, random-access memory (RAM), static RAM (SRAM), dynamic RAM (DRAM), non-volatile RAM (NVRAM), read-only memory (ROM), or Flash memory). The CRM stores a wireless-network switching application (network manager) that, when executed by the processor, performs operations described herein.

The user equipment, under the direction of the processor executing the network manager, can perform a combination of wireless connection operations, taking into account the signal quality of the networks with which the user equipment is connected or detects. Utilizing the transceiver(s) ability to concurrently connect to two wireless networks allows the network manager to compare the quality and internet connectivity of each wireless network and decide which network is best to use.

An example method of executing a seamless switch between wireless networks utilizing the network manager includes the following steps:

1. Device is connected to wireless network (NetworkA), and the wireless network is the default route on the device.
2. Connection quality of NetworkA starts to deteriorate.
3. Device detects a better wireless network (NetworkB) in the vicinity.
4. Device decides to switch to NetworkB.
5. Device triggers connection to NetworkB while remaining connected to NetworkA.
6. Device validates internet connectivity via NetworkB.
7. Once NetworkB is fully validated, make NetworkB the default route on the device without disconnecting from NetworkA.
8. Apps notice that there is a new default network on the device. The apps can, however, complete any ongoing transfers on NetworkA since it is not yet disconnected.
9. Apps can then switch their traffic to the new default route, NetworkB, on the device.
10. The connection with NetworkA is maintained for some time (*e.g.*, 30 seconds) to let all the apps on the device complete any ongoing transfers.
11. Once the time expires, the device disconnects from NetworkA.

This Make Before Break sequence by the network manager allows apps running on the user equipment to handle a network switch more seamlessly. These steps do not include any brief switch to the cellular network while NetworkB is connecting and validating. If internet connectivity is not validated on NetworkB, the switch also will not occur unless forced by the user. The user and the apps should see no disruption in network service due to switching wireless networks.

References:

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