Technical Disclosure Commons

Defensive Publications Series

May 31, 2019

Wireless-Connection Drop Prediction, Warning, and Protection

Jim Sun

Aaron Lee

Follow this and additional works at: https://www.tdcommons.org/dpubs_series

Recommended Citation

Sun, Jim and Lee, Aaron, "Wireless-Connection Drop Prediction, Warning, and Protection", Technical Disclosure Commons, (May 31, 2019)
https://www.tdcommons.org/dpubs_series/2233

This work is licensed under a Creative Commons Attribution 4.0 License.
This Article is brought to you for free and open access by Technical Disclosure Commons. It has been accepted for inclusion in Defensive Publications Series by an authorized administrator of Technical Disclosure Commons.

Wireless-Connection Drop Prediction, Warning, and Protection

Abstract:

This publication describes systems and techniques directed to wireless-connection drop prediction, warning, and protection. A wireless-communication device, such as a smartphone, includes a wireless-connection manager application. The wireless-communication device, having a wireless connection to an access point of a wireless network, performs operations under the direction of the wireless-connection manager application to predict, warn, and protect a user of instances where the wireless connection may drop. The operations include determining that a quality metric of a signal supporting the wireless connection to the access point does not meet a threshold, determining that another access point to the wireless network is not available, and, in response, presenting a warning to the user to protect the user and allow the user to make decisions so that the wireless-communication device maintains the wireless connection to the access point.

Keywords:

call drop, received signal strength indicator (RSSI), signal-to-noise ratio (SNR), cell handover, cell re-selection, signal strength predictor, call drop indicator, call drop prediction, call drop warning

Background:

A wireless-communication device often connects to a wireless network through an access point. For example, a smartphone may be connected to a Fourth Generation Long Term Evolution (4G LTE) or a Fifth Generation New Radio (5G NR) wireless network through a base station. The wireless-communication device may maintain connectivity with the wireless network while physically located within a service area (*e.g.*, a cell) supported by the access point.

A quality of a signal supporting a wireless connection (*e.g.*, a wireless link) of the wireless-communication device to the access point can vary for a variety of reasons, examples of which include a change in a geolocation of the wireless-communication device within the service area and wireless-communication traffic within the service area. The quality of the signal is quantifiable through a number of metrics, such as a received signal-strength indicator (RSSI) metric and a signal-to-noise ratio (SNR) metric.

Today, it is common for the wireless-communication device to measure the quality of the signal supporting the wireless connection from the wireless-communication device to the access point of the wireless network. However, the relationship between the measured quality of the signal and a threshold that corresponds to a dropped wireless connection to the access point is often not visible to a user of the wireless-communication device. And, in some instances, the user may falsely assume that other access points are available for a handover of the wireless connection if the quality of the signal falls below the threshold. In summary, the acts of measuring the quality of the signal supporting the wireless connection, as practiced today, fail to protect the user from a dropped wireless connection.

Description:

This publication describes systems and techniques directed to wireless-connection drop prediction, warning, and protection. A wireless-communication device, such as a smartphone, includes a wireless-connection manager application. The wireless-communication device, having a wireless connection to an access point of a wireless network, performs operations under the direction of the wireless-connection manager application to predict, warn, and protect a user of instances where the wireless connection may drop. The operations include determining that a quality metric of a signal supporting the wireless connection to the access point does not meet a

threshold, determining that another access point to the wireless network is not available, and, in response, presenting a warning to the user to protect the user and allow the user to make a decision so that the wireless-communication device maintains the wireless connection to the access point.

Fig. 1, below, illustrates an example wireless-communication device and elements of the wireless-communication device that support wireless-connection drop prediction, warning, and protection.

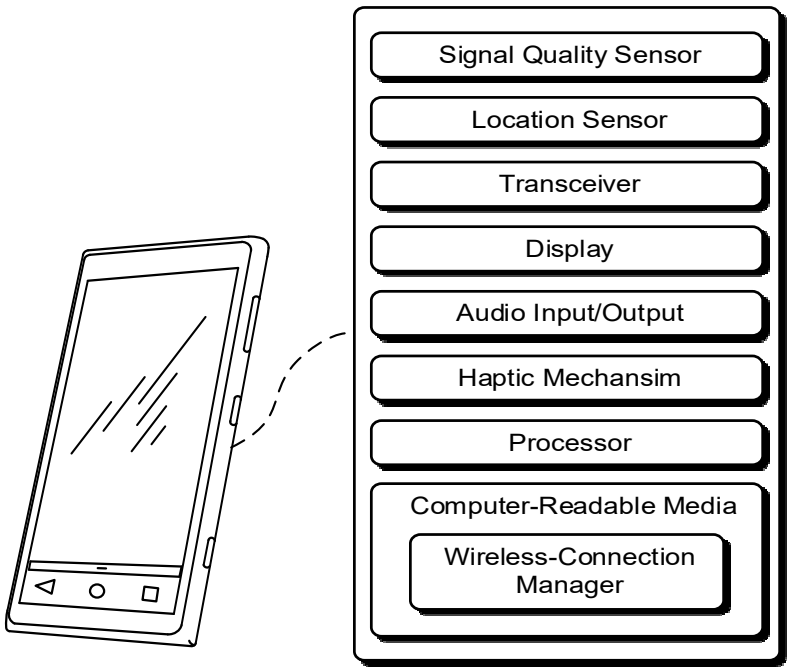

Fig. 1

As illustrated, the wireless-communication device is a smartphone. However, other wireless-communication devices (*e.g.*, a tablet, a laptop computer, a wearable device, or the like) can also support wireless-connection drop prediction, warning, and protection. The wireless-communication device includes a signal quality sensor (*e.g.*, signal strength detection circuitry), a location sensor (*e.g.*, a global positioning system (GPS) sensor), a transceiver (*e.g.*, a 4G LTE or 5G NR transceiver for communicating with the access point of the wireless network), a display

(*e.g.*, a light emitting diode (LED) display or liquid crystal display (LCD)), an audio input/output mechanism (*e.g.*, a speaker), and a haptic mechanism (*e.g.*, a vibration mechanism).

The wireless-communication device also includes a processor. The processor may be a single core processor or a multiple core processor composed of a variety of materials, such as silicon, polysilicon, high-K dielectric, copper, and so on. The wireless-communication device also includes a computer-readable medium (CRM) storing executable instructions of a wireless-connection manager application. The CRM may include any suitable memory or storage device such as random-access memory (RAM), static RAM (SRAM), dynamic RAM (DRAM), non-volatile RAM (NVRAM), read-only memory (ROM), or flash memory. The wireless-connection manager application, when executed by the processor of the wireless-communication device, causes the wireless-communication device to perform operations described within this document. In some instances, the wireless-connection manager application may be offered by a service provider and downloaded to the wireless-communication device.

Fig. 2 illustrates an example technique associated with wireless-connection drop prediction, warning, and protection. The technique may use elements of the wireless-communication device of Fig. 1.

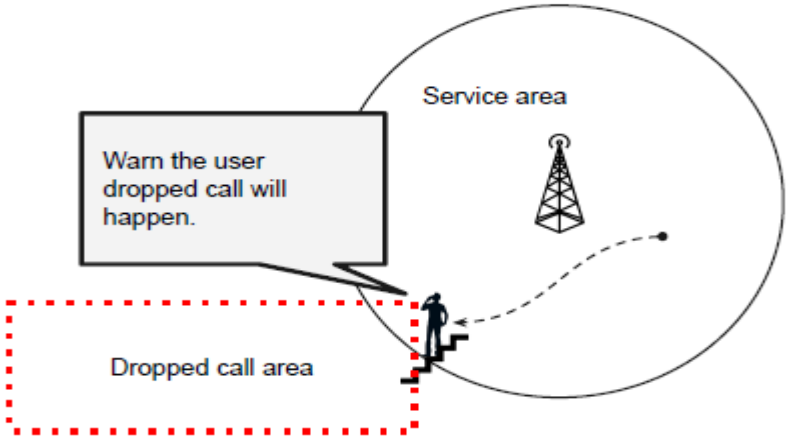

Fig. 2

In the example technique of Fig. 2, the wireless-communication device has a wireless connection to an access point (*e.g.*, a base station) of a wireless network and a user is performing a wireless call through the wireless network. The access point provides a service area (*e.g.*, a cell of the wireless network) in which the wireless connection is maintainable. While a geolocation of the wireless-communication device is located within the service area, the signal quality sensor of the wireless-communication device monitors a signal quality metric (*e.g.*, a received signal-strength indicator (RSSI) metric or a signal-to-noise ratio (SNR) metric) and provides the monitored signal quality metric to the wireless-connection manager application.

In one example instance, as the user approaches a boundary of the service area, the wireless-communication device (*e.g.*, the processor executing the instructions of the wireless-connection manager application) determines that the signal quality metric does not meet a threshold and that the user is entering an area where the wireless connection to the access point will be lost (*e.g.*, a dropped-call area). The wireless-communication device also determines that as another access point to the wireless network is not available, a handover is not possible and presents a warning to the user.

Fig. 3, below, illustrates example warnings that the wireless-communication device might present to the user.

Fig. 3

As illustrated, the warning may be a visual warning presented through the display of the wireless-communication device, an audible warning presented through the audio input/output of the wireless-communication device, or a vibration warning presented through the haptic mechanism of the wireless-communication device. The warning, in effect, protects the user and allows the user to make a decision (*e.g.*, decide to maintain his geolocation within the service area) so that the wireless-communication device maintains the wireless connection to the access point.

Fig. 4, below, illustrates operations of the technique of Fig. 2 as performed by the wireless-communication device.

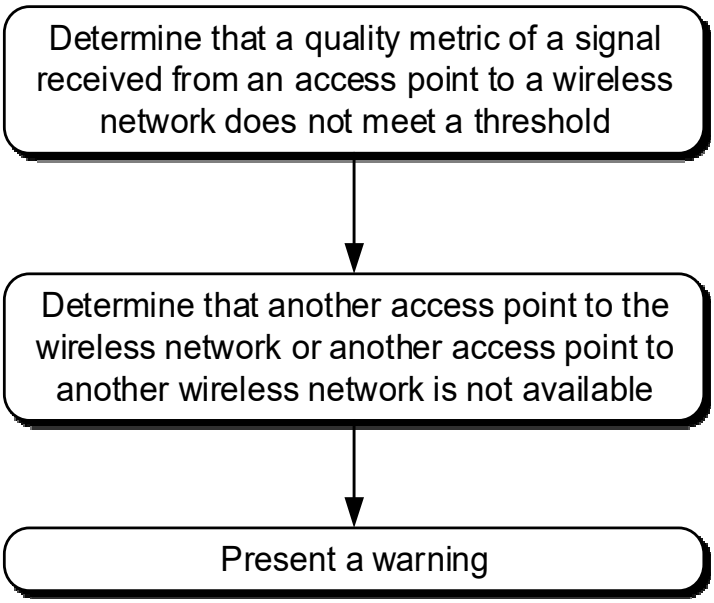

Fig. 4

Under certain conditions, the operations, or portions of the operations, as illustrated, may be reordered or performed by entities other than the wireless-communication device (*e.g.*, a provider of a cloud-based service or the wireless network may offer and execute the operations, or portions of the operations, of the wireless-connection manager).

Fig. 5. illustrates another example technique associated with wireless-connection drop prediction, warning, and protection. The technique may use elements of the wireless-communication device illustrated by Fig. 1.

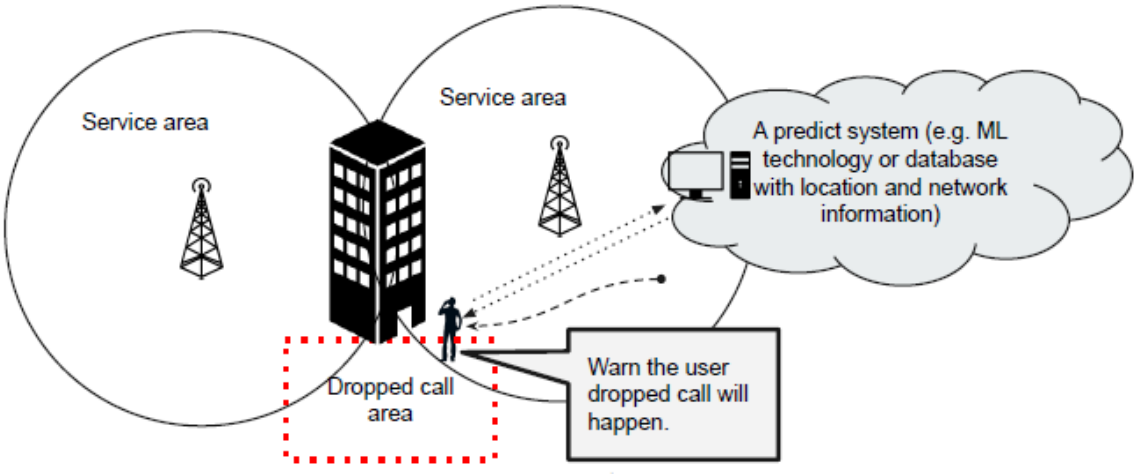

Fig. 5

In the example technique of Fig. 5, the wireless-communication device has a wireless connection to an access point (*e.g.*, a base station) of a wireless network and a user is performing a wireless call using the wireless network. As illustrated, multiple access points (*e.g.*, base stations supporting multiple service areas) are available to the wireless-communication device. In this example, the wireless-communication device receives information from the wireless network that identifies geolocations where wireless connections are dropped or not maintainable.

As illustrated by Fig. 5, the wireless-communication device, under the direction of the connection-manager application, monitors its geolocation using the location sensor (*e.g.*, the location sensor of Fig. 1) and determines that it is approaching an identified geolocation where wireless connections are dropped or not maintainable. In response, the wireless-communication device presents a warning to the user (*e.g.*, one of the warnings illustrated by Fig. 3).

It is important to note that the technique of Fig. 5 include the wireless network using a prediction system (*e.g.*, a server having a prediction application) to provide, to the wireless-

communication device, the information that identifies the geolocations where wireless connections are dropped or not maintainable. In some instances, the prediction system may collect from multiple wireless-communication devices, over a period of time, data that might be associated with dropped wireless connections. The data may include geolocations of the multiple wireless-communication devices, signal quality characteristics (*e.g.*, uplink and downlink signal quality characteristics), mobile country codes (MCC), mobile network codes (MNC), wireless network types, wireless-network congestion levels, and the like. The prediction system may then apply machine-learning techniques to a database containing the collected data to identify the geolocations where wireless connections are dropped or not maintainable.

Fig. 6, below, illustrates operations of the technique of Fig. 5 as performed by the wireless-communication device.

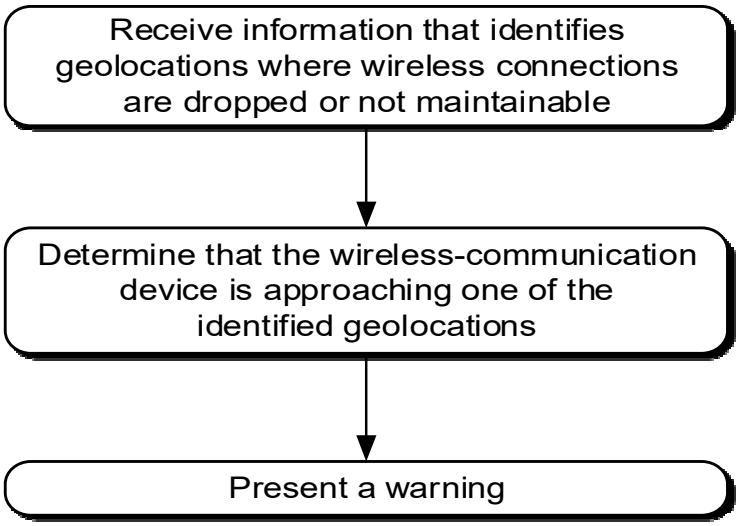

Fig. 6

Under certain conditions, the operations, or portions of the operations, as illustrated, may be reordered or performed by entities other than the wireless-communication device (*e.g.*, a

provider of a cloud-based service or the wireless network may offer and execute the operations, or portions of the operations, of the wireless-connection manager).

It is important to note that the described techniques and systems are not limited to the described examples. For instance, the described techniques and systems can apply to a wireless-communication device that is accessing a wireless local area network (WLAN) through a router and, as opposed to performing a wireless call, executing an application or exchanging data.

In conclusion, wireless-connection drop prediction, warning, and protection, using the techniques and systems as described above, offers to a user of a wireless-communication device a way to avoid dropped wireless connections. Such wireless-connection drop prediction, warning, and protection is not available today.