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Automatic wireless activation in the presence of saved networks

Alex Zheng

Christian Sonntag

Evan Charlton

Tyler Williams

Joseph LaPenna

See next page for additional authors

Inventor(s)
Alex Zheng, Christian Sonntag, Evan Charlton, Tyler Williams, Joseph LaPenna, and Amin Shaikh

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ABSTRACT

Mobile devices such as smartphones, tablets, laptop computers, wearables, head mounted displays, etc. have the capability to access a wireless local area network as well as a cellular data network. Users often turn off the wireless local network access capability, e.g., by turning Wi-Fi off. Turning off such Wi-Fi capability has benefits such as avoiding automatic connections to slow, unreliable or potentially malicious networks, conserving battery, etc. In some instances, users do not remember to turn Wi-Fi back on, which leads to the device utilizing the cellular data network and potentially higher bills, because of charges for cellular data usage. This disclosure describes techniques that help prevent unintentional overuse of cellular data by automatically re-enabling Wi-Fi in the presence of saved networks.

KEYWORDS

- Mobile devices
- Wireless activation
- Wi-Fi
- Data savings

BACKGROUND

Currently, user devices that have Wi-Fi capability enabled automatically connect to known Wi-Fi networks. Such automatic connection is performed even when the network is a low-quality network or a network without Internet connection. Users often turn off device Wi-Fi capability when they leave familiar locations, e.g., home, work, etc. For example, by turning off Wi-Fi capability, the user device avoids automatic connection to slow, unreliable, or potentially malicious networks. Further, users perceive that turning off Wi-Fi on a user device conserves battery. Often, users forget to reactivate device Wi-Fi capability upon return to the familiar locations. Forgetting to reactivate device Wi-Fi capability results in unintended usage of cellular networks. Data usage over a cellular network is often billed at a higher rate than data usage over an available Wi-Fi network.

Devices that have Wi-Fi disabled can consume more power, e.g., to maintain the Internet connection with a cellular network. Typically, a device consumes more power to connect to a cellular network than a Wi-Fi network. When user devices are configured with Wi-Fi turned off, the device ends up utilizing a cellular network more often, e.g., several times within a cellular carrier billing cycle. Such increased utilization of a cellular network leads to increased data usage charges from the cellular carrier.

DESCRIPTION

This disclosure describes techniques that automatically activate the Wi-Fi capability of user devices in the presence of known Wi-Fi networks. The techniques are implemented specifically upon user permission for such automatic activation, and are otherwise not implemented. Further, the techniques utilize user data only upon specific user permission.

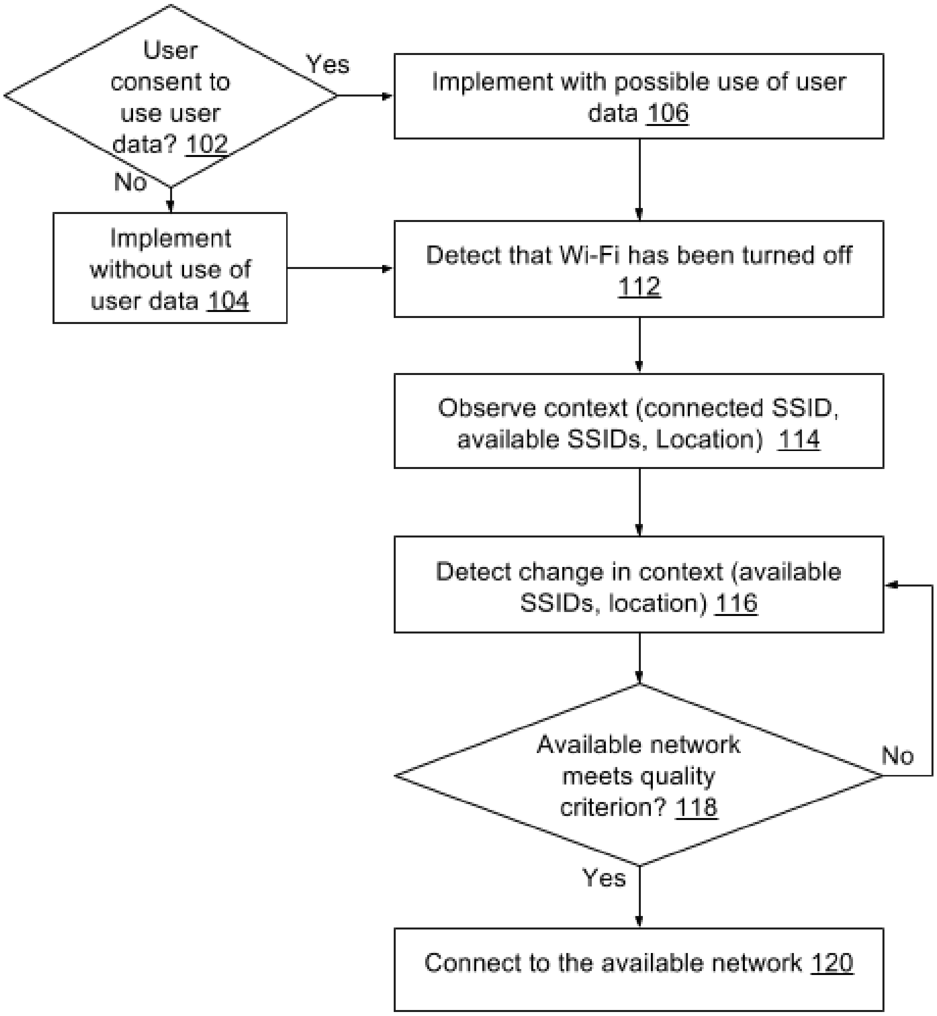
User consent to use user data? 102
Yes
No
Implement with possible use of user data 106
Implement without use of user data 104
Detect that Wi-Fi has been turned off 112
Observe context (connected SSID, available SSIDs, Location) 114
Detect change in context (available SSIDs, location) 116
Available network meets quality criterion? 118
No
Yes
Connect to the available network 120

Fig. 1: Context-based automatic Wi-Fi activation

Fig. 1 illustrates an example process to switch on device Wi-Fi capability based on device context. It is determined whether the user has provided for use of user data (102), such as contextual information. For example, user consent is verified to access location data, and to perform background scans of wireless networks. If the user declines consent, the technique is not implemented, or implemented to the extent possible without use of user data (104). If the user provides consent, the technique is implemented with possible use of user data (106).

First, when the user has provided permission to access device settings, it is detected that the device Wi-Fi capability is turned off (112). If the Wi-Fi capability is turned off, device context is determined (114), based on user data permitted for use. For example, device context includes an SSID of the last Wi-Fi network a device connected to and its last location. Available Wi-Fi network SSIDs are observed. When users provide consent to access location data, the device location is determined. Next, a change in context is detected (116) based on user data for which access has been granted by the user. For example, a context change can include changes in available SSIDs within range of the device, a change in device location, user activity indicators such as whether the user device is in motion, etc. Upon detecting one or more available Wi-Fi networks that are part of a user's saved networks list, it is determined whether the network meets quality criterion (118). If the available network meets the quality criterion, Wi-Fi capability of the device is reactivated (120) and the device connects to the available Wi-Fi network. If the available Wi-Fi network does not meet the quality criterion, Wi-Fi is not reactivated. The process is repeated periodically.

The techniques include prevention of automatic connection to networks. For example, when user provides permission to access the SSID of the last Wi-Fi network connected to at a time of user deactivation of device Wi-Fi capability, the SSID is used to prevent triggering automatic Wi-Fi connection to the same network or other networks at the same location, e.g., immediately after the user has deactivated device Wi-Fi capability. In this manner, the automatic activation of Wi-Fi is not triggered upon detection of user intent to turn Wi-Fi off. Further, when the user consents to use of device location, automatic activation of Wi-Fi is disabled if the device has not changed locations since the user last deactivated Wi-Fi. However, if the detected location is a certain type of location (e.g., home, work, etc.) automatic Wi-Fi activation can be performed even when the device location hasn't changed. The activation may be performed more often, or frequently in response to a detected change in location.

The techniques further include testing the quality of available Wi-Fi networks to determine whether to automatically connect to an available network. Such testing is performed specifically upon user consent. For example, if an available Wi-Fi network is slower or more unreliable than an available cellular connection, automatic activation and connection is not performed.

Examples of use

Example 1: User A has provided consent for use of the automatic Wi-Fi activation techniques. User A turns off Wi-Fi on their mobile phone when she leaves home. Later, when the user reaches a known work location, Wi-Fi capability on the mobile phone is automatically turned on.

Example 2: User B has provided consent for use of the automatic Wi-Fi activation techniques. It is determined that user B has a tablet device that has Wi-Fi turned off. User B visits a shopping mall. The tablet device detects several Wi-Fi networks in the vicinity. However, it is determined that the networks do not meet quality criterion. Wi-Fi is not automatically turned on. Later, user B enters a coffee shop. The tablet device detects a Wi-Fi network that is part of the user's saved networks and meets quality criteria. In response, Wi-Fi capability is automatically turned on.

Example 3: User C has provided consent for use of the automatic Wi-Fi activation techniques. User C turns off Wi-Fi on their mobile phone when she leaves home in the morning. During the day, a mobile phone periodically conducts the process described in Fig. 1 to selectively activate Wi-Fi and connect to available Wi-Fi networks.

The techniques described herein are enabled upon specific user permissions, and access only such user data as permitted by the user. Further, a user is provided options to override (e.g., disable) automatic Wi-Fi activation at any time. Users are also provided with options to specifically enable automatic activation in the presence of certain networks, and disable automatic activation otherwise. Further, automatic reactivation is disabled under certain conditions, such as when a user device is in a battery conservation mode, in an airplane mode, etc.

In situations in which certain implementations discussed herein may collect or use personal information about users (e.g., user data, e.g., regarding saved networks, information about a user's social, user's location and time at the location, results from a Wi-Fi scan, user's biometric information, user's activities and demographic information), users are provided with one or more opportunities to control whether information is collected, whether the personal information is stored, whether the personal information is used, and how the information is collected about the user, stored and used. That is, the systems and methods discussed herein collect, store and/or use user personal information specifically upon receiving explicit authorization from the relevant users to do so. For example, a user is provided with control over whether programs or features collect user information about that particular user or other users relevant to the program or feature. Each user for which personal information is to be collected is presented with one or more options to allow control over the information collection relevant to that user, to provide permission or authorization as to whether the information is collected and as to which portions of the information are to be collected. For example, users can be provided with one or more such control options over a communication network. Further, users are provided with the ability to turn off background Wi-Fi scans associated with location services. In addition, certain data may be treated in one or more ways before it is stored or used so that personally identifiable information is removed. As one example, a user's identity may be treated so that no personally identifiable information can be determined. As another example, a user's geographic location may be generalized to a larger region so that the user's particular location cannot be determined.

CONCLUSION

This disclosure describes techniques to automatically activate wireless capability (e.g., Wi-Fi) on a device that has such capability switched off. Such reactivation is performed based on contextual information such as identifiers of available networks, device location, list of saved networks, etc. when users permit use of such information. Automatic reactivation enables a device to connect to Wi-Fi networks that are known to meet quality thresholds, e.g., speed, reliability, etc. even when the user forgets to activate Wi-Fi capability, thereby conserving battery and reducing consumption of cellular data.