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## Voice Service Availability Indication for Data Centric Networks on a Mixed-Use Wireless Device

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## **Voice Service Availability Indication for Data Centric Networks on a Mixed-Use Wireless Device**

### **Abstract:**

A wireless device, such as a smartphone, includes voice and data capabilities for a user. However, a user interface (UI) on the wireless device shows the signal quality of only the voice service signal. The user does not have information about the signal quality of data service which may be available to the user, creating a frustrating user experience. To improve the user wireless device experience, the availability of data service and the availability of voice service can be displayed in the UI.

### **Keywords:**

User Interface, UI, icon, symbol, indicator, signal bar, status bar, Signal Strength Indicator, SSI, Received Signal Strength Indicator, RSSI, Reference Signal Received Power, RSRP, Reference Signal Received Quality, RSRQ, signal quality, signal strength, service operator, service provider, Citizens Broadband Radio Service, CBRS, data, voice

### **Background:**

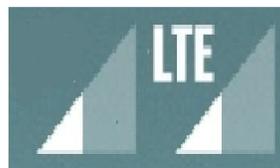
Wireless devices that traditionally were relied upon for cellular voice service have become increasingly data-centric. Traditionally, if data service was not available, the lack of service was displayed on a UI of a wireless device as an 'x' in a signal bar, for instance in a status bar. However in many cases, wireless devices incorrectly rejected data-centric networks that could provide data service without any voice service. The user may be able to utilize data access to perform needed operations when voice service is not available, or voice service is of poor quality. For example,

the user may be able access voice services through the data services such as via IP Multimedia Subsystem (IMS) or Voice over Internet Protocol (VoIP). In this example of accessing voice services through data service, the signal bar of a cellular voice service such as Reference Signals Received Power/Reference Signal Received Quality (RSRP/RSRQ) does not accurately represent the quality of voice service available. In another example, the wireless device may be connected to two networks; one providing only voice service and another only data service. Each network has its own corresponding signal. There is a need to provide information in the UI about the signal quality of data service which may be available to the user.

**Description:**

A display associated with a wireless device displays a user interface for indicating the availability of voice services and data services.

Consider a first implementation of the user interface, illustrated in Figure 1. In this implementation, the user interface uses a dual signal bar to indicate voice signal quality and data signal quality. The data signal bar (on the right) is distinguished from the voice signal bar (on the left) for a user by the “LTE” (Long Term Evolution) label. The voice signal bar and the data signal bar become less shaded as their respective network signal quality improves.



**Figure 1**

An example of a data-centric network includes Citizens Broadband Radio Service (CBRS) which is a relatively new spectrum available for data service transmission. In a wireless device that is CBRS network-enabled, the data signal bar indicates the quality of the CBRS network that

provides the data service. The voice signal bar indicates the signal quality of the network that provides the voice service. A user would be able to monitor the status of each type of service in the user interface. Additionally, if the wireless device was not connected anymore to the CBRS network, the data signal bar may indicate the signal quality of the network that now provides the data service which may be the same network that provides the voice service.

A second example of a data-centric network includes a 5G network that does not support Voice over 5G (Vo5G). The wireless device can display a data signal bar that indicates the quality (*e.g.*, signal strength) of the 5G network that provides the data service. The wireless device may be connected to a different network, such as a 4G network, to provide the voice service and the voice signal bar indicates the signal strength of the available 4G fallback cell. A user would be able to monitor the status of each type of service in the user interface.

The dual signal bar may indicate to a user with a blank voice signal bar when no voice service is available. For example, a New Radio 5G (NR5G) network may not have a 4G network that supports Voice over LTE (VoLTE) available as an LTE fallback network to provide voice service. There may not be a circuit switched (CS) network (such as a 3G network) available as a CS fallback to provide the voice service. In this example, the user may see a blank voice signal bar, with a cross or other indicia, to indicate no voice service availability.

The UI may display reduced signal quality of one or more signal bars if the wireless device experiences network congestion (*i.e.*, significantly reduced data rate) that impacts the quality of voice and/or data transmission. The wireless device may have multiple networks available and select a network to provide data and/or voice services based on comparisons of each network's signal quality and network congestion. For example, if a 4G network has significant congestion, the device may utilize a 3G network to provide a voice service.

The dual signal bar with a dedicated data signal bar is useful for various cases including wireless devices with Opportunistic Citizens Broadband Radio Service (CBRS) Dual SIM Dual Standby (DSDS) enabled and wireless devices connected to standalone 5G networks without Voice over 5G (Vo5G) that require an alternative network for voice capabilities.

Consider a second implementation of the user interface, illustrated in Figure 2. In this implementation, the user interface uses a single signal bar to indicate the data signal quality. Additionally, there is an embedded phone icon for indicating voice service availability. The data signal bar is distinguished for a user by the “LTE” label. The data signal bar becomes less shaded as the data network signal quality improves.



**Figure 2**

A single signal bar may be used in a wireless device with a single stack implementation where cellular service provider has its own data-only deployment. For example, wireless devices with Single Radio LTE (SRLTE)/Single Radio 5G (SR5G) deployments that rely on a 1X network (*i.e.*, 2G Code Division Multiple Access (CDMA) 1X network) to access voice service. Alternatively, the network the wireless device is connected to for the data service could be the same network that provides the voice service. In this example, the data signal bar also indicates the voice signal quality. In another example, the data service and voice service may be available on two different networks. In a single signal bar implementation, preference may be given to display the strength of the voice signal quality.

If no voice service is available, the UI displays a cross or other indicia over the phone icon, as illustrated in Figure 3. For example, a wireless device may be connected to an LTE network

without Voice over LTE (VoLTE) enabled on the wireless device. If there is not a 1X network available to provide voice service, the wireless device has data service available but no voice service.



**Figure 3**

In a third implementation, based on a dynamic evaluation of user activity performed by the wireless device, the UI shows either a data signal bar that indicates the signal quality of the network that provides the data service, a voice signal bar indicates the signal quality of the network that provides the voice service, or a hybrid of both in the text part of the signal bar. The UI may determine a user's intention based on a user mood or a state of the device. As a first example, the UI indicates data signal quality in the signal bar when a user is actively using data with no voice call activity, as illustrated in Figure 4. The UI indicates voice signal quality in the signal bar when a user enters a phone application on the wireless device or receives a call, as illustrated in Figure 5. The UI may display the best technology currently acquired in the text part of the signal bar.



**Figure 4**



**Figure 5**

Wireless devices are relied upon for both voice and data usage but a UI on a wireless device shows the signal quality of only the voice service. The user does not have information about the signal quality of data service which may be available to the user. To improve the user wireless

device experience, the availability of data service and the availability of voice service can be displayed in the UI.