(54) Title: DISPLAYING CALLER ID FOR CALL WAITING IN A FIXED WIRELESS TERMINAL

(57) Abstract: A method and apparatus for displaying caller ID for call waiting during digital data and analog facsimile calls from a fixed wireless terminal (200) operating in a wireless local loop. During a digital data call, the FWT (200) may ring the telephone to indicate another call has arrived and display the calling party information on the caller ID box (222). While in a facsimile call, the FWT (200) may generate an audible or visual indicator to alert the user that a call is incoming and send the data to the caller ID box (222) when the facsimile machine is in idle.
DISPLAYING CALLER ID FOR CALL WAITING IN A FIXED WIRELESS TERMINAL

Field of the Invention

This invention is related in general to wireless communication systems and, more particularly, to an improved method and apparatus for displaying caller ID for call waiting during digital data and analog facsimile calls from a fixed wireless terminal operating in a wireless local loop.

Background of the Invention

Many cellular telephones used in a wireless telephone system include a visual interface which displays status information to the user, such as the unit’s ability to access a local cell site. Other status information about the cellular telephone itself may also be reported to the user via a visual interface and display on the cellular telephone. However, the use of an ordinary wireline telephone connected to a fixed wireless terminal (FWT) in a wireless local loop (WLL) may lack such a visual display capability, but could also benefit from the status information that is available in the wireless local loop system.

In a wireless local loop system, the fixed wireless terminal may be mounted in a building or residence in a location that is not easily accessible for obtaining status information of the FWT. Such status information may include idle or on-hook conditions, service status (e.g., no service, in service), received signal strength, battery charge, or other general faults which may affect service. This status information is important to both the user and the fixed wireless terminal installer or troubleshooter, but is not accessible with an ordinary telephone connected to the FWT. The lack of such status information can lead to wasted time and frustration due to repeated unsuccessful attempts to place a call when
unknown radio frequency (RF) or cellular system problems exist.

Moreover, during a conversation over the FWT, when the wireline telephone is off hook, the aforementioned status information, as well as other information that may be important to the user concerning hand-off or call duration, is likewise inaccessible from the wireline telephone. In addition, during digital data and facsimile calls, caller ID for call waiting is currently not available in a FWT.

In view of the foregoing it is apparent that a need exists for an improved method and apparatus for displaying caller ID for call waiting during digital data and analog facsimile calls in a fixed wireless terminal.

**Summary of the Invention**

In basic operation, a fixed wireless terminal having transceiver and call processing means establishes a wireless local loop by the connection of an ordinary wireline telephone to the FWT. A data input device such as a personal computer or hand held computer may also be connected to the FWT. This provides the user with an RF telephone link to a cellular telephone system for transmission of voice or data communications. In a preferred embodiment, a standard caller ID module, either in the telephone or in line between the fixed wireless terminal and the telephone, conveniently and inexpensively provides the means to provide status or test information to the user. Such status information may be obtained from a status processor within the fixed wireless terminal. In the preferred embodiment, the status information comprises caller ID for call waiting during digital data and analog facsimile calls. The desired status information may then be reported on the display or by tones generated in the earpiece of the telephone. A signaling generator within the telephone line interface of the fixed wireless terminal encodes the information provided by the status processor into an FSK or DTMF signal according to the generic, asynchronous caller ID protocol, or, alternatively, the
signaling generator may generate audible tones for signaling through the telephone earpiece or control signals to produce a sequence of ringing signals on the telephone ringer, or may produce a visual display.

In an alternate embodiment, a fixed wireless terminal having transceiver and call processing means, and further having status processing, signaling generator, telephone line interface means, and data line interface means, also includes the caller ID interface, decoding, and display means. This embodiment requires no other apparatus besides coupling an ordinary wireline telephone to the fixed wireless terminal via a telephone line. An ordinary data input device such as a personal computer may also be coupled to the fixed wireless terminal. The fixed wireless terminal may provide status information to be read out on the caller ID display built into the FWT. Alternatively, the status information may be provided via audible signals transmitted to the telephone.

**Brief Description of the Drawings**

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objects, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

**FIG. 1** shows a wireless local loop system communicating with the public switched telephone network via a wireless communication channel;

**FIG. 2** shows a functional block diagram of a wireless local loop system in accordance with the present invention;

**FIG. 3** shows a functional block diagram of the signaling generator portion of the fixed wireless terminal of **FIG. 2**; and

**FIG. 4** shows a functional flow diagram of a fixed wireless terminal system operating according to the present invention.
Detailed Description of the Invention

In a preferred embodiment, the present invention utilizes caller ID protocol as specified in the following Bellcore documents. GR-30-CORE Voiceband Data Transmission Interface provides the requirements for generating FSK data signals. Document numbers TR-NWT-00031 and TR-NWT-001188 provide the requirements for implementing caller ID calling number and calling name respectively. The caller ID protocol provides a generic asynchronous voice band protocol usable for displaying status and/or test or diagnostic information about a connected fixed wireless terminal on caller ID equipment both before call origination and during an active call. Note that throughout this document, status information may refer to operating conditions and parameters set within the fixed wireless terminal as well as results of tests or diagnostic procedures, which results may be considered status information resulting from the test.

FIG. 1 illustrates a wireless local loop (WLL) system communicating with the public switched telephone network (PSTN) over a wireless communication channel. WLL includes fixed wireless terminal (FWT) coupled to antenna and telephone line. Also coupled to telephone line are caller ID module and telephone. Personal computer is coupled to FWT via data line. Connections to telephone line may be made using standard connectors (not shown) such as those known by the designation RJ-11, and the like. Connections to data line may be made using standard connectors (not shown) such as those known by the designation RJ-45, and the like. Caller ID module is a typical unit available to consumers and is equipped with a display for displaying calling number and perhaps calling name information, or other similarly encoded information.
Base Telephone Station (BTS) 22, with its associated antenna 29, is shown coupled to PSTN 24 via signal path 26 to illustrate the environment in which WLL 10 operates. These units, BTS 22, antenna 29, signal path 26 and PSTN 24, are well known in the art and will not be described further herein. Similarly, other standard units in FIG. 1, such as telephone 16, personal computer 28, caller ID module 14, telephone line 18, data line 17, and antenna 19, are standard, well-known items, which will not be described further.

A data transmission path to caller ID module 14 may be established over telephone line 18 when fixed wireless terminal 12 is in an idle state prior to call origination and telephone 16 is on-hook. Useful status information may thus be displayed on caller ID module 14 before a call is originated. Similarly, WLL system 10 of FIG. 1 may be used to establish a data transmission path to caller ID module 14 during a call, while fixed wireless terminal 12 is in a conversation state, and telephone 16 is either on or off-hook. In the preferred embodiment, the conversation state of fixed wireless terminal 12 is one of an analog facsimile call, a digital data call, and a voice call. Status information may also be reported with other output indications in the form of tone or speech signals generated in fixed wireless terminal 12 and reproduced in the earpiece of telephone 16. Other output signals in the form of ringing signals may also be generated in fixed wireless terminal and coupled to telephone 16 to report status information.

FIG. 2 shows a functional block diagram of a WLL system embodying the present invention. As illustrated, fixed wireless terminal 200 is coupled to an RF communications channel (not shown) by antenna 214, and to telephone line 221 by coupling 202. Coupling 202, which may serve the dual purpose of providing a local loop interface and a status information signaling port, may illustratively be an RJ-11 connector and a local loop electrical circuit. Similarly, telephone line 221 may be coupled
to caller ID module 222 and to telephone 220 using standard telephone line cabling and connectors (connectors not shown), such as the aforementioned RJ-11 type connector. In addition, fixed wireless terminal 200 is coupled to data line 225 by coupling 227. Similarly, data line 225 may be coupled to personal computer 229 using standard cabling and connectors. Antenna 214, coupling 202, coupling 227, and the other connectors are well known in the art and will not be further described.

In fixed wireless terminal 200 shown in FIG. 2, transceiver 210 and call processor 208, coupled via path 207, are well known elements of wireless cellular telephones. The functions of call processor 208 include establishing and maintaining communication with base telephone station (BTS) 22, initiating and terminating a call, encoding and decoding voice and data, conforming to the selected multiple access protocol, and other similar functions typically performed in a subscriber unit in a cellular communications system. As there are several types of wireless telephone technologies in current use, these will not be described further because such details are well known to persons skilled in the art. By way of example, the present invention may be implemented in a CDMA (Code Division Multiple Access) fixed wireless terminal. However the invention is not limited to any particular form of multiple access or spectrum utilization technology.

As shown, call processor 208 includes status information 218. Such status information may be stored in memory or registers or other storage devices, and may include operating conditions and parameters, monitored parameters, test results, or the like.

Returning to FIG. 2, the signals conducted along path 207 may accordingly include voice or data signals, control signals, and the like. Voice path 201 illustrates the bi-directional coupling of the voice, data, and control signals between the call processor 208 and coupling 202. Similarly, path 240 illustrates the bi-directional coupling of the voice, data,
and control signals between the call processor 208 and coupling 227.

Also connected between coupling 202 and call processor 208 is dialing decoder 204 for detecting and decoding dual-tone-multi-frequency (DTMF) or pulse dialing signals received by fixed wireless terminal 200 on telephone line 221. Dialing signals are coupled to dialing decoder 204 along path 203 and decoded dialing data is coupled to call processor 208 along path 205. In some embodiments dialing decoder 204 may be implemented as part of call processor 208, especially if call processor 208 is largely implemented in software on a digital signal processor.

Call processor 208 is further coupled to telephone line 221 via data signal path 213, signaling generator 206, output signal path 209, and coupling 202. Data sent by call processor 208 or status processor 212, to be described later, are encoded for modulation in signaling generator 206 and provided as output signals for display or other reporting on telephone line 221.

Proceeding further with the description of FIG. 2, status processor 212 is shown coupling transceiver 210 to signaling generator 206 along signal path 219 and signal path 215. Status processor 212 also interacts with call processor 208 along bi-directional signal path 217.

Finally, dialing decoder 204 is also coupled to status processor 212 via signal path 211. Status processor 212 performs a number of functions under the control of call processor 208. These functions include, but are not limited to, monitoring and storing certain call processing parameters utilized during set up, reception and transmission of communication with another station. Other parameters attendant to the reliable operation of fixed wireless terminal 200 itself may be monitored during operation and stored for reporting upon request.

Diagnostic test routines may be initiated upon request during certain operating conditions or during maintenance, service, or repair. Any of such status information or test data may be retrieved and
formatted in status processor 212 for delivery to signaling generator 206. In the present invention, status processor 212 may respond to certain dialing signals input from dialing decoder 204 to produce additional status information and/or test data. This status information may be encoded by signaling generator 206 as caller ID signals for coupling to caller ID display apparatus, or as signals to produce an audible response in telephone 220. It should be understood from the above description that coupling 202, coupling 227, dialing decoder 204, signaling generator 206 and their associated signal paths together function as telephone line interface 216, shown to the left and below the dashed line within fixed wireless terminal 200 in FIG. 2.

With reference now to FIG. 3, there is depicted one implementation of signaling generator 206 as it may be used in the present invention. In general, signaling generator 206 has character or tone generation and modulation functions, depending on the particular fixed wireless terminal 200 chosen for use with the present invention. In some embodiments several character or tone generator blocks may be required. For example, in FIG. 3, signaling generator 206 includes caller ID character generator 234 and modulator 230, in addition to primary character generator 232. Signal paths 213, 215, 231, 233 and 209 are shown interconnecting the functional blocks as shown in FIG. 3. Primary character generator 232 may illustratively include an ASCII character generator, a signaling tone generator, a universal asynchronous receiver/transmitter (UART) or other device for changing the form of digital data for modulation and coupling to the telephone line 221 of FIG. 2. Primary character generator 232 may also generate ringing signals. The foregoing embodiments described for FIG. 3 are provided for illustration and should not be understood as limiting alternative implementations as will be apparent to those skilled in the art.

FIG. 4, which shows a functional flow diagram of a WLL system
operating according to the present invention, will next be described in conjunction with the apparatus illustrated in FIGs. 2 and 3. After entering the process flow at block 402, flow proceeds to decision block 404, where a determination is made whether the FWT has a call in progress. If a call is not in progress, then flow proceeds to decision block 405, where a determination is made whether caller identification information is available. If not, then flow reverts back to the start. If caller identification information is available, then flow proceeds to block 416 as discussed in greater detail below. If a call is in progress, then at decision block 406, a determination is made whether the FWT is receiving an incoming call. In the preferred embodiment, the incoming call contains calling party information comprising a Flash with Information message including caller ID. However, it will be appreciated by those skilled in the art that any proprietary message on the forward link including calling party information may be used.

If the FWT is not receiving an incoming call, then flow reverts to decision block 405. If the FWT is receiving an incoming call, then flow proceeds to decision block 408, where a determination is made whether the FWT is in a data call. If not, then flow proceeds to decision block 410, where a determination is made whether the FWT is in a voice call. If not, then flow proceeds to decision block 412, where a determination is made whether the FWT is in a fax call. If not, then flow reverts back to the start. It will be appreciated by those skilled in the art that decision blocks 408, 410, and 412 are representative of checks being made for all defined service options. If the FWT is in a data call at step 408, or in a voice call at step 410, then flow proceeds to block 416, which will be described in greater detail below. If the FWT is in a fax call at step 412, then flow proceeds to decision block 414, where a determination is made whether the fax transmission is idle, for example between pages, between blank lines, at the end of a line, etc. If the fax transmission is not idle, then flow
reverts back to decision block 412. If the fax transmission is idle, then flow proceeds to block 416, where the step of decoding the caller ID data is performed. The status information is then formatted, as shown at block 418, for reporting via coupling 202. Next, an output signal is generated at block 420 and such output signal is coupled to the telephone line, as illustrated at block 422.

In formatting process step 418, status information is parsed and then formatted for display as a caller ID signal and/or reporting via audible signals. In process step 420, caller ID character generator 234 within signaling generator 206 in FIG. 3 generates an output signal by encoding and modulating the formatted status information into character data or display data, or audible reporting signals, for transmission along telephone line 221, as shown in FIG. 2. The output signal is coupled to telephone line 221 in process step 422 (FIG. 4) by the coupling to telephone line 202 (FIG. 2).

The foregoing description of a preferred embodiment of the invention has been presented for the purpose of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications or variations are possible in light of the above teachings. The embodiment was chosen and described to provide the best illustration of the principles of the invention and its practical application, and to enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.
Claims

What is claimed is:

1. A fixed wireless terminal comprising:
   a transceiver;
   a call processor coupled to the transceiver;
   a telephone line coupling coupled to the call processor;
   a data line coupling coupled to the call processor;
   a status processor coupled to the call processor; and
   a signaling generator coupled to the status processor and the telephone line coupling.

2. The fixed wireless terminal of claim 1, wherein the signaling generator comprises an audio/visual indicator.

3. The fixed wireless terminal of claim 2, wherein the signaling generator includes one of a caller identification signaling generator, an audio signal generator, a telephone ringer signal generator, and a display.

4. The fixed wireless terminal of claim 3 wherein the audio signal generator further includes a speech synthesizer.
5. The fixed wireless terminal of claim 1, wherein the telephone line
coupling further includes an RJ-11 type connector and a local loop
electrical interface, and further wherein the data line coupling includes an
RJ-45 type connector.

6. A method for displaying caller identification for call waiting in a
fixed wireless terminal having a telephone line coupling, the method
comprising the steps of:

determining whether the fixed wireless terminal has a call in progress;

receiving an incoming call;

when the call in progress is a non-voice call, or when the call in
progress is a voice call and the incoming call is a non-voice call:

generating a caller identification output signal for display on a
caller identification unit; and

coupling the caller identification output signal to the telephone line
coupling.

7. A method as recited in claim 6, including the step of determining
whether a facsimile transmission is idle.
8. A method as recited in claim 7, wherein the step of generating a caller identification output signal further includes generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling.

9. A method as recited in claim 8, wherein the step of generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling further includes generating coded sequences of audio tones.

10. A method as recited in claim 8, wherein the step of generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling further includes generating coded sequences of ringer signals.

11. A method as recited in claim 8, wherein the step of generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling further includes generating synthesized voice signals.

12. A method as recited in claim 7, wherein the step of generating a caller identification output signal further includes generating a caller identification output signal that can be seen using a display coupled to the telephone line coupling.
13. A system for displaying caller identification for call waiting in a
fixed wireless terminal having a telephone line coupling, the system
comprising the steps of:

means for determining whether the fixed wireless terminal has a call in
progress;

means for receiving an incoming call;

when the call in progress is a non-voice call, or when the call in
progress is a voice call and the incoming call is a non-voice call:

means for generating a caller identification output signal for
display on a caller identification unit; and

means for coupling the caller identification output signal to the
telephone line coupling.

14. A system as recited in claim 13, including means for determining
whether a facsimile transmission is idle.

15. A system as recited in claim 13, wherein the means for generating a
caller identification output signal further includes means for generating a
caller identification output signal that can be heard using a telephone
coupled to the telephone line coupling.
16. A system as recited in claim 15, wherein the means for generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling further includes means for generating coded sequences of audio tones.

17. A system as recited in claim 15, wherein the means for generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling further includes means for generating coded sequences of ringer signals.

18. A system as recited in claim 15, wherein the means for generating a caller identification output signal that can be heard using a telephone coupled to the telephone line coupling further includes means for generating synthesized voice signals.

19. A system as recited in claim 13, wherein the means for generating a caller identification output signal further includes generating a caller identification output signal that can be seen using a display coupled to the telephone line coupling.
FIG. 4
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
   IPC(7) : H04Q 7/20, H04B 1/38
   US CL. : 455/425, 455/561
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
   Minimum documentation searched (classification system followed by classification symbols)
   U.S. : 455/425, 424, 561, 566, 67.7

   Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

   Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
   Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 5,819,177 A (VUCETIC et al) 06 October 1998, column 4, lines 47-column 5, lines</td>
<td>13-19</td>
</tr>
<tr>
<td>Y</td>
<td>D.S. 5,812,955 A (DENT et al) 22 September 1998, column 13, lines 39-column 14, lines</td>
<td>13-19</td>
</tr>
<tr>
<td>Y</td>
<td>US 5,663,990 A (BOLIGNO et al) 02 September 1997, Fig. 14, 16.</td>
<td>1-12</td>
</tr>
<tr>
<td>Y,P</td>
<td>US 6,124,949 A (WEST et al) 26 September 2000, Fig. 1.</td>
<td>1-12</td>
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<tr>
<td>Y,P</td>
<td>US 6,104,909 A (BALDWIN et al) 15 August 2000, Fig. 1-4.</td>
<td>1-19</td>
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</tbody>
</table>

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent published on or after the international filing date
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  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search

Date of mailing of the international search report

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Form PCT/ISA/210 (second sheet) (July 1998)
Continuation of Item 4 of the first sheet: DISPLAING CALLER ID FOR CALL WAITING IN A FIXED WIRELESS TERMINAL.

Continuation of B. FIELDS SEARCHED Item3: Fast caller ID, waiting, fixed wireless terminal, wireless local loop, processor, transceiver.