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Strawczynski et al.

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[54] **CELLULAR COMMUNICATION NETWORK WITH VOCODER SHARING FEATURE**

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[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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[51] **Int. Cl.**[7] **H04Q 7/20**; H04B 1/38; H04M 1/00; G01R 31/08

[52] **U.S. Cl.** **455/445**; 455/422; 455/560; 370/238

[58] **Field of Search** 455/445, 422, 455/436, 67.4, 11.1, 561, 560; 375/242; 370/238

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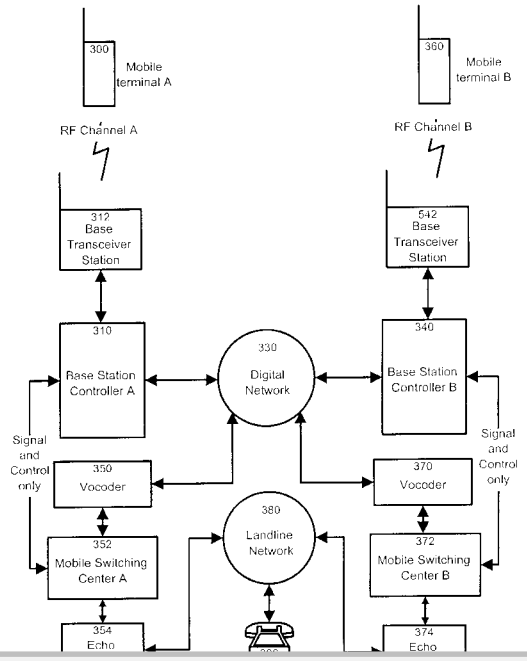
Primary Examiner—Dwayne D. Bost
Assistant Examiner—Raymond B. Persino

[57] **ABSTRACT**

The present invention provides a novel system and a method for improving the voice quality of wireless-to-wireless calls or wireless-to-fixed terminal calls, while permitting a more efficient utilization of network resources. In a first aspect, the invention provides a communication system including a plurality of base stations connected to one another through a digital network (such as TDM, frame relay or ATM). Also, a plurality of vocoder channels, separate from the individual base stations, provide a data flow path from the base stations to wireline terminals first through the digital network via a Mobile Switching Center and finally through a landline network. In a wireless-to-wireless call, the compressed audio signal travels from one base station to another without undergoing any de-compression/compression. This avoids undesirable vocoder tandeming known to degrade voice quality. If the call is identified as being of a wireless-to-wireline terminal nature, the data is directed to a vocoder channel for decompression into PCM samples. The samples are then transmitted to the fixed terminal through the landline network. The main advantage of this network architecture is that fewer vocoders are required by comparison to prior art systems, therefore fewer costs are incurred. In addition, voice quality is improved.

17 Claims, 3 Drawing Sheets



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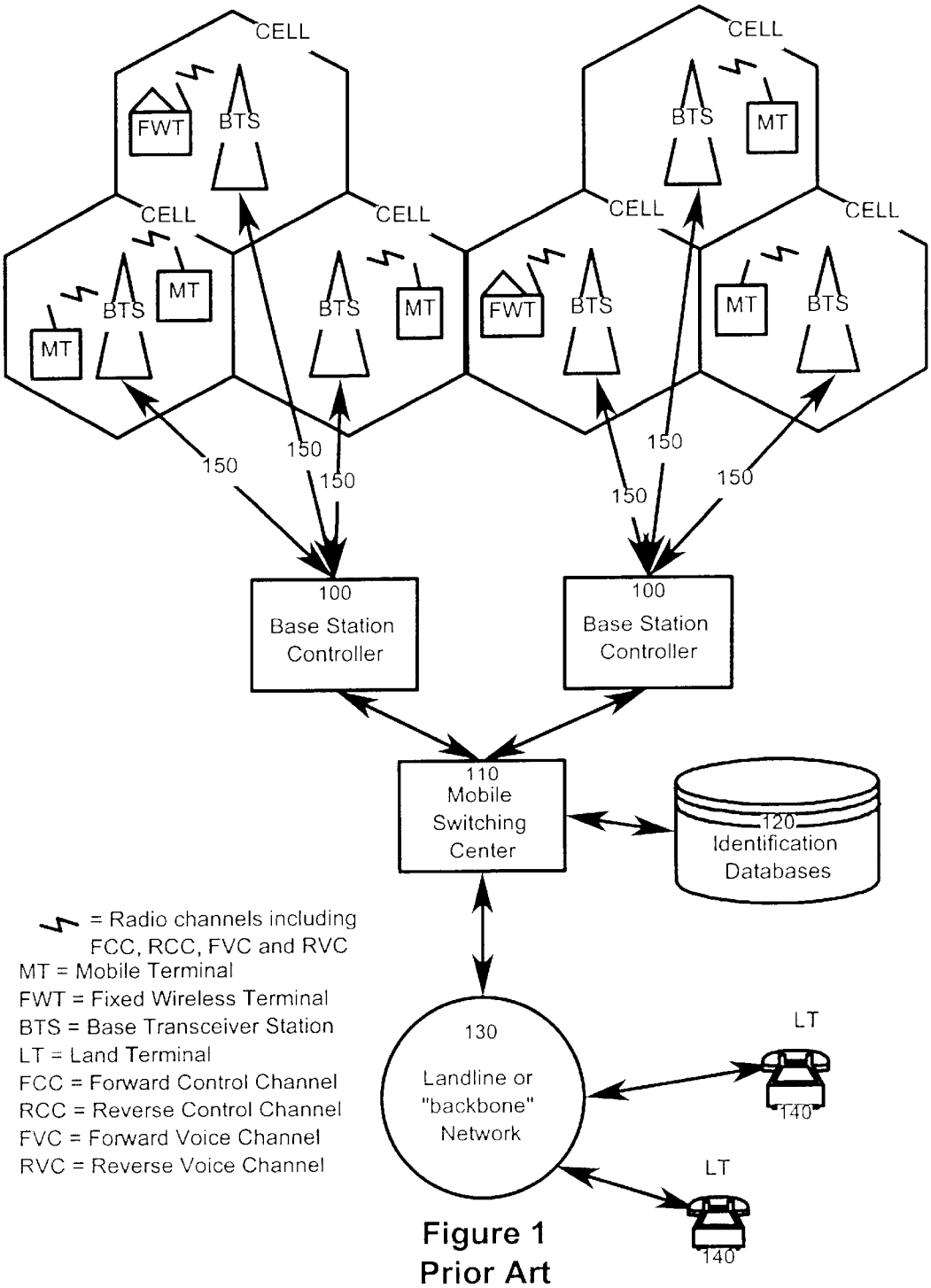

Figure 1
Prior Art

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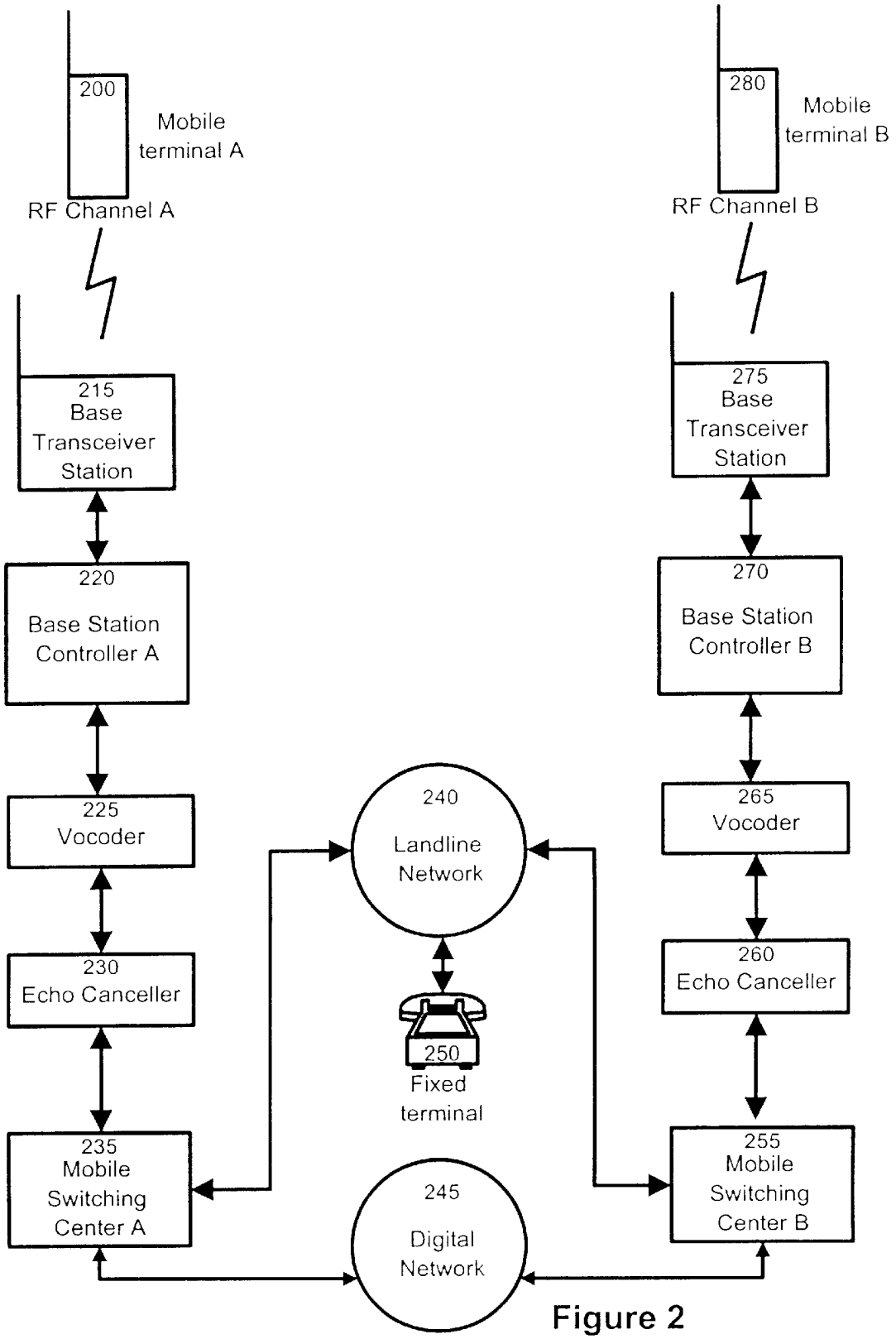

Figure 2
Prior Art

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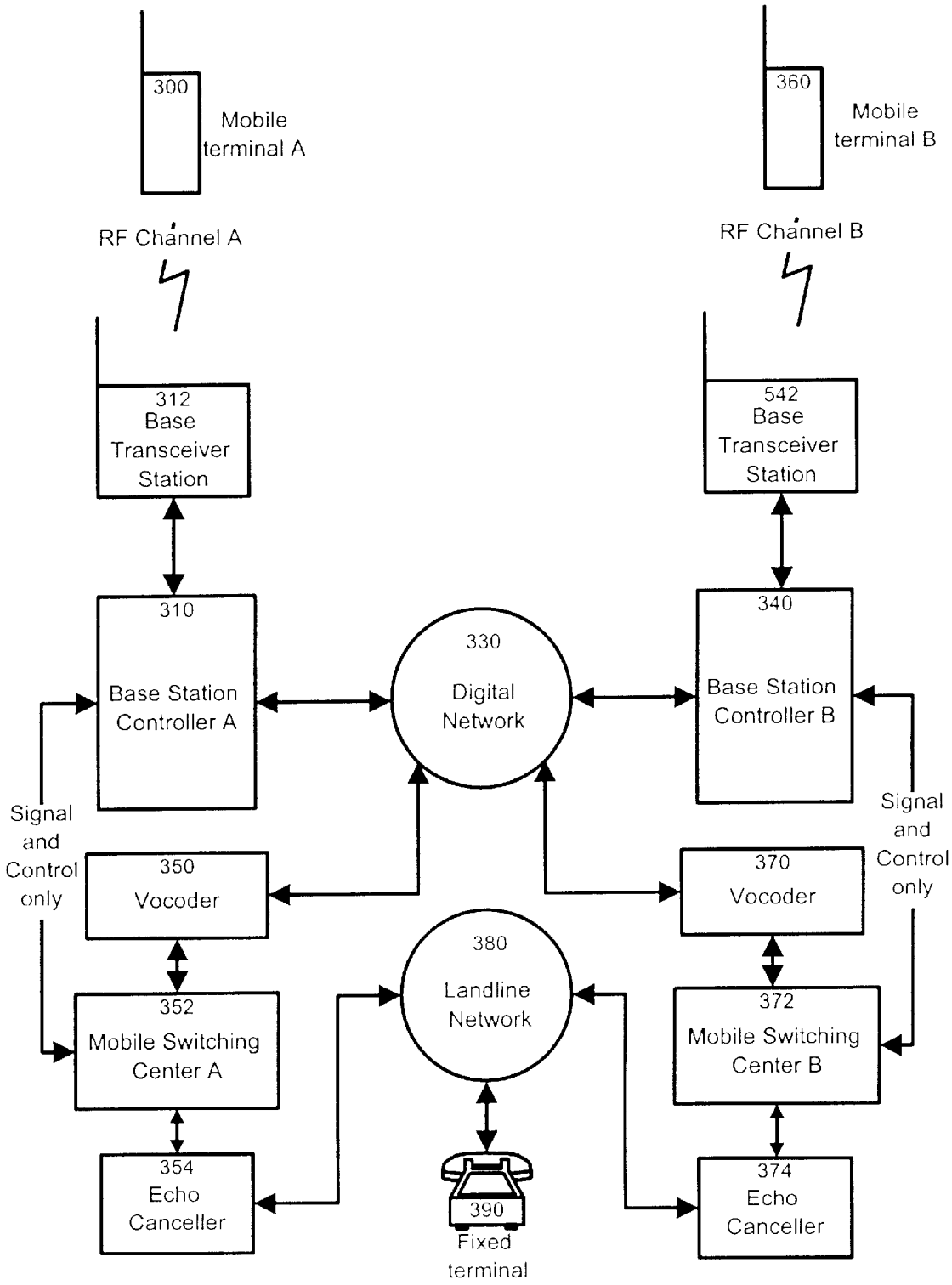

Figure 3

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CELLULAR COMMUNICATION NETWORK WITH VOCODER SHARING FEATURE

FIELD OF THE INVENTION

The invention relates to digital signal processing in a digital cellular network and more particularly to a communication system featuring one or more vocoder channels functionally separate from the base stations. The vocoder channel is bypassed in the case of wireless-to-wireless calls, thus avoiding vocoder tandeming that can degrade the voice quality of the connection. In the case of a wireless-to-fixed terminal call the data flow is directed through the vocoder channel for de-compression and transported to the fixed terminal through a landline network, such as a PSTN, ISDN or Internet network.

BACKGROUND OF THE INVENTION

In recent years, the telecommunications industry has witnessed the proliferation of a variety of digital vocoders in order to meet bandwidth demands of different wireline and wireless communication systems. The name <<vocoder>> stems from the fact that its applications are specific to the encoding and decoding of voice signals primarily. A vocoder therefore is comprised of an encoder stage and a decoder stage. Vocoders are usually integrated in mobile telephones and the base stations of the communication network. They provide compression of a digitized voice signal as well as the reverse transformation. Typically, a voice signal is digitized through one of many quantization techniques. Examples of these techniques are Pulse Code Modulation (PCM) and Delta Modulation. For the purposes of this description we will refer to PCM as the input format for the vocoder. Thus a vocoder includes an encoder stage that will accept as input a digitized voice signal and output a compressed signal, the typically compression ratio being in the order of 8:1 to 12:1. As for the reverse transformation the vocoder is provided with a decoder stage that will accept the compressed speech signal and output a digitized signal, such as PCM samples.

The main advantage of compressing speech is that it uses less of the limited channel bandwidth for transmission. The main disadvantage is loss of speech quality.

The rapid growth in the diversity of networks and the number of users of such networks is increasing the number of instances where two vocoders are placed in tandem to serve a single connection. Tandem connections of low bit-rate codecs are known to cause additional distortions and reduce the quality of the speech signal. One example of such a scenario in a wireless context is a wireless-to-wireless link.

In such a case, a first encoder is used to compress the speech of the first wireless user. The compressed speech is transmitted to a base station serving the local wireless terminal and it is then decompressed (converted to PCM format samples) by a vocoder. The resulting PCM samples arrive at the base station serving the second wireless terminal, over the digital trunk of the telephone network, after being compressed by a second encoder. The speech signal is then ready for transmission to the second wireless terminal. A speech decoder at the speech wireless terminal decompresses the received compressed speech data to synthesize the original speech signal from the first wireless terminal.

In an attempt to eliminated the condition of vocoder tandeming, a method called <<bypass>> has been proposed

and a bypass mechanism that is invoked when the incoming signal is in a format compatible with the vocoder. In use, the digital signal processor associated with the first base station that receives the RF signal from a first wireless terminal determines, through signaling and control that a compatible digital signal processor exists at the second base station associated with the wireless terminal at which the call is directed. The digital signal processor associated with the first base station, rather than converting the compressed speech signals into PCM samples, invokes the bypass mechanism and outputs the compressed speech to the transport network. The compressed speech signal, when arriving at the digital signal processor associated with the second base station, is routed such as to bypass the local vocoder. Decompression of the signal occurs only at the second wireless terminal. The "bypass" approach is described in the international application serial number PCT/CA95/00704 dated Dec. 13, 1995. The contents of this disclosure are incorporated herein by reference.

Although this solution is effective in reducing vocoder tandeming, it still requires a dedicated vocoder per base station. This vocoder deployment strategy is not particularly effective because the vocoder units are not utilized in the most efficient manner. More specifically, when a call is made, the system determines whether the vocoder should be enabled or the bypass mechanism should be invoked. This is not an optimal utilization of network resources since the vocoder functionality, or the bypass functionality of the base station, are alternative elements and if one is invoked during a given call, the other remains idle.

OBJECTS AND STATEMENT OF THE INVENTION

An object of the invention is to provide a cellular communication network configured to reduce the likelihood of vocoder tandeming in the course of a call.

Another object of the invention is to provide a method for call routing in a cellular communication network to reduce the likelihood of vocoder tandeming in the course of a wireless-to-wireless call.

As embodied and broadly described herein, the invention provides a communication network, comprising:

a) a group of base stations, each base station being capable to establish an RF communication with a wireless terminal over an air interface, each base station being capable of exchanging with a respective wireless terminal data packets of compressed audio information, each data packet including a coefficients segment and a excitation segment;

b) a digital network interconnecting said base stations to one another, said digital network establishing a pathway to allow a given base station to exchange data packets of compressed audio information with another base station of said group;

c) a branch connected to said digital network to establish a pathway from said digital network toward a landline network, said branch including a decoder capable of decoding a data packet of compressed audio information directed through said branch;

d) a control system to control routing of a data packet of compressed audio information received at one of said base stations from an associated wireless terminal, said control system capable of selectively directing the data packet of compressed audio information toward either

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