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(54) **System and method for distributing voice and data information over wireless and wireline networks**

(57) A method and device for distributing both high-speed data service, such as digital computer, video and multimedia data, and lower speed data service, such as POTS voice telephone signals, throughout a customer premises. High-speed digital data and lower speed

POTS voice signals are separated by a POTS splitter and distributed throughout the customer premises on separate distribution networks. The lower speed POTS is carried on a wireless distribution network and the high-speed data carried on the existing customer premises wiring ordinarily used for POTS.

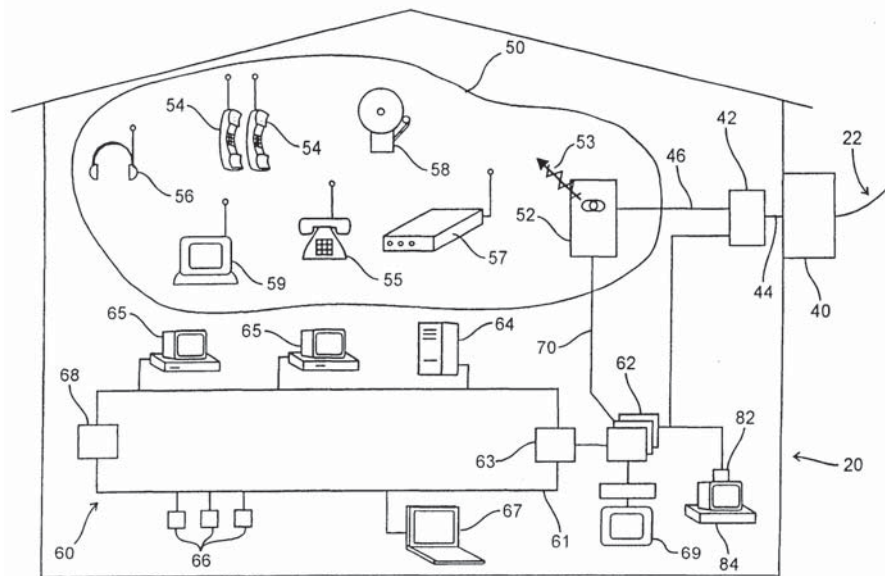


Fig. 3

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**Description**

**BACKGROUND OF THE INVENTION**

**A. Field of the Invention**

[0001] The present invention relates to a method and device for distributing high-speed digital data information and lower speed data including Plain Old Telephone Service ("POTS") voice signals throughout a customer premises.

**B. Description of the Related Art**

[0002] The Internet is a worldwide interconnection of computers that offers a vast array of multimedia audio, video, graphics, and text information accessible from a user's home computer. The available multimedia content on the Internet requires millions of bits of digital data to be transmitted or downloaded to the user's computer. Conventional voiceband data modems used to access the Internet, however, use a serial telephone line connection transmitting data at less than 56 kilobits per second. The user's ability to quickly obtain and view information using a conventional telephone line connection is thus substantially limited.

[0003] The desire to bring large amounts of multimedia digital data from the Internet into the home has increased the demand for high-speed data services such as Integrated Digital Services Network ("ISDN") and Digital Subscriber Lines ("DSL") to the home or small business office. In addition to Plain Old Telephone Service ("POTS"), telephone operating companies are now offering these high-speed data services to bring digital data from the telephone company central office to the telephone subscriber's home or office. High-speed data and POTS are often carried to the home at different frequencies on the same physical wire pair.

[0004] Once to the telephone subscriber's home, these high-speed data services must be distributed throughout the home or office to the locations where computer users are located. Existing homes typically do not have wiring facilities to distribute high-speed data. At a typical customer premises, such as the family home, the telephone company delivers conventional POTS and high-speed data services to a network interface device ("NID") located outside of the building. From the NID, a pair of conductive telephone wires delivers POTS to the rooms in the home where telephones are located. To distribute high-speed data services in addition to supplying POTS, however, additional wiring must ordinarily be installed throughout the customer premises. Installing additional wiring to each desired location throughout the premises, however, can be expensive and disruptive to those living or working there.

[0005] To avoid the cost and disruption of installing new wiring, wireless data distribution systems have been proposed to distribute high-speed digital data throughout

the customer premises location without such disruption or installation costs. Wireless distribution systems, however, typically have less bandwidth capacity than a wireline system. Wireless distribution systems may also create or be susceptible to interference with other electronic devices that are commonly found in an office environment. Thus, higher performance wireless systems that are less susceptible to interference and have higher bandwidth capacity are more complex and considerably more expensive than a wireline distribution system. Additionally, high-speed data terminals are typically placed at a fixed location, whereas voice and portable low-speed data terminals would often benefit from mobility in and near the customer premises.

[0006] In accordance with an illustrative embodiment of the present invention, the problems of distributing both high-speed data and POTS signals throughout a customer premises can be addressed without the cost and disruption of installing new wiring or cost and complexity of wireless data networks.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0007] The foregoing and other objects, features and advantages of the present invention will be more readily appreciated upon reference to the following disclosure when considered in conjunction with the accompanying drawings, in which:

Figure 1 shows a system diagram of the local loop between the customer premises and telephone service provider central office in accordance an aspect of the present invention;

Figure 2 shows a block diagram of the method according to an aspect of the present invention;

Figure 3 shows a schematic diagram of the customer premises location of the system of figure 1;

Figure 4 shows a block diagram of the POTS splitter of the system of Figure 1; and

Figure 5 shows a block diagram of the backup power feature in accordance with another aspect of the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

[0008] While the invention is described below in some detail with reference to certain illustrated embodiments, it is to be understood that it is not limited to those embodiments. On the contrary, the intent is to cover all modifications, alternatives and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

[0009] The present embodiment provides an information distribution system within a customer premises location using a wireline distribution network for distributing high-speed data and a separate wireless distribution network for distributing POTS and lower speed data. The

customer premises location receives high-speed digital data such as computer, video, multimedia data containing audio, graphics, and text, and lower speed data including POTS voice band frequencies from the public switched telephone network ("PSTN"). The PSTN includes those public switched telephone networks provided by AT&T, Regional Bell Operating Companies (e.g., Ameritech, U.S. West, Bell Atlantic, SBC, Bell South, NYNEX, and Pacific Telesis Group) and others. A POTS splitter separates the high-speed digital data from the lower speed POTS signals. Lower speed POTS signals are distributed throughout the customer premises on the wireless distribution system rather than the existing wireline distribution system. The wireless system may also have multiple channels to provide additional POTS lines and distribute lower speed data. The wireline distribution network can then be used to distribute the high-speed digital data throughout the customer premises.

**[0010]** The present embodiment provides the distribution of high-speed data and lower speed POTS signals on separate wireless and wireline network distribution facilities to avoid the cost and disruption of installing additional wiring at the customer premises. The wireless distribution system carries lower speed data and has relatively lower bandwidth requirements, reducing the complexity and cost of the wireless distribution system. The wireline distribution system also provides cordless operation allowing users to access the telephone in different areas throughout the customer premises and freely move about while speaking on the telephone. The existing telephone wiring is free from carrying POTS and can be utilized to carry high-speed data typically associated with digital computer data or multimedia information. Using the wireline distribution network, the high-speed data is available at outlets throughout the customer premises for connection to computers, computer peripherals, and video display devices.

**[0011]** The present embodiment also provides for the distribution of POTS signals and lower speed data over the existing wireline system in the event of a power failure or outage. During a loss of power, the wireless distribution network is typically out of service. Lower speed POTS is thus switched over to the wireline distribution network to provide service in the event of a power failure.

**[0012]** As shown in Figure 1, the subscriber location or customer premises 20 is in communication with the telephone service provider central office 24 using a local loop 22 carrying both POTS analog voice signals and high-speed digital data traffic between the customer premises 20 and the telephone service provider central office 24. The local loop 22 may take different forms but is typically a twisted pair of copper wires providing plain old telephone service ("POTS") or 1 measured business service to the customer location. The local loop 22 may also provide high-speed communication services such as integrated services digital network ("ISDN") or higher rate services such as Primary Rate Interface ("PRI") or 24 channel T1 service. In the present embodiment, the

local loop preferably includes a high-speed digital subscriber line 26 ("DSL" or "XDSL") such as a high-speed digital subscriber loop ("HDSL"), asymmetric digital subscriber loop ("ASDL") or rate adaptive digital subscriber line ("RADSL"). Alternatively, a digital carrier system provides digital data lines which enable subscribers 28 to transmit large amounts of digitally multiplexed data traffic over the POTS twisted pair telephone line 29. The remote terminal 27 combines a plurality of subscribers 28 onto a digital multiplexed data line 25 for transmission between the subscriber location 28 and the central office 24. For example, a 24-channel digital multiplexed T1 line is commonly used in North America for the multiplexed data line 25. T1 typically uses wire pairs using 16 to 24 gauge cable carrying data at the 1.544 Mbps DS1 line rate. In addition, fiber optic cable carrying a number of multiplexed channels of information may also be used in accordance with the present embodiment.

**[0013]** Preferably, ADSL is used to implement a subscriber loop with high-speed data capacity. ADSL implements a digital subscriber line 22 with asymmetric data rates between the customer premises and the central office, meaning the maximum available "downstream" data rate from the central office 24 to the subscriber location 20, 28 is greater than the maximum "upstream" data rate from the subscriber 20, 28 back to the central office 24. ADSL can provide data rates of up to 8 megabits-per-second ("Mbs") over 2 miles of twisted-pair wiring to provide a variety of digital data signals supporting computer, multimedia and video data, while providing POTS over the same line. A typical ADSL system provides a 1.5 Mbs rate from the central office 24 to the subscriber 20, 28 and about 640 kilobits-per-second ("Kbs") in the reverse direction from the subscriber location 20, 28 to the central office 24. ADSL may use discrete multi-tone ("DMT"), carrierless amplitude and phase ("CAP") or even quadrature amplitude modulation ("QAM") line coding. The American National Standards Institute's T1E1.4 committee has selected DMT as the ADSL standard.

**[0014]** Alternatively, the local loop may also include a wireless local loop (currently being deployed primarily in developing countries without existing communication infrastructure facilities and now available in the United States). The wireless local loop 30 provides communication from the central office 24 to the customer premises 32 without requiring new cable plant between the central office 24 and the customer premises 32. A wireless local loop 30 may use a transmitter 34 at the central office 24, transmitting microwave radio frequencies to a radio frequency receiver using an antenna 36 at the customer premises 32. The wireless local loop 30 can implement any of the ISDN, PRI, DSL, or high-capacity 24 channel T1 lines described above. In addition, fixed-satellite wireless communication systems allowing communication service to be directly received at the subscriber location from earth orbiting satellites are also available from companies such as Hughes Network Systems and Motorola

Inc. Such systems are currently being deployed in developing countries.

[0015] The local loop, in its various forms 22, 26, 30, carries POTS and high-speed data signals between the subscriber locations 20, 28, 32 and the telephone service provider central office 24. POTS signals are typically analog voice band signals within the 200 Hz to 4 KHz frequency range. In comparison, high-speed digital data is usually carried at carrier frequencies several orders of magnitude higher than the voice band frequency range. For example, lower speed POTS signals may be carried in the 0 to 10 KHz frequency range, while ADSL carries high-speed data in the frequency range from 100 KHz up to 1 MHz or at even higher. Thus, POTS signals and high-speed data are carried over the same local loop facility at different frequencies.

[0016] Figure 2, summarizes the present method of implementing the described embodiment. At step 110, combined high-speed and lower speed POTS signals from the local loop is separated onto separate facilities. Preferably, the high-speed data is separated from the lower speed POTS signals onto physically separate lines as described in connection with the description of the POTS splitter of Figure 3. At step 120, the separated lower speed POTS signals are distributed over a wireless distribution system, rather than the conventional in-house POTS telephone wiring. At step 130, high-speed data is distributed over the existing wireline ordinarily used for distributing POTS within the customer premises. The details of the present method are further described below in connection with the present embodiment.

[0017] Figure 3 shows a diagram of a telephone subscriber location or customer premises 20 such as a typical home or small business office. The local loop 22 between the customer premises 20 and the central office 24 is terminated at the network interface device ("NID") 40 connecting the customer premises 20 to the public switched telephone network ("PSTN"). Typically, the NID 40 provides a common wiring point for the customer premises and the telephone service provider to connect and interface their equipment. The NID 40 serves as a convenient place to connect the local loop 22 to the customer premises 20 and demarcates customer premises equipment from telephone service provider equipment. In the preferred embodiment, on the customer premises side of the NID 40, a POTS splitter 42 is installed to separate high-speed data signals from lower speed POTS signals. Preferably, the POTS splitter 42 separates high-speed ADSL signals from lower speed POTS signals. The POTS splitter 42 has an input/output 44 from the local loop 22. The splitter 42 separates the high-speed data and the lower speed POTS signals into two separate outputs/inputs 46, 48 for distribution within the customer premises 20. One of the outputs/inputs 48 supplies high-speed data traffic and the other output/input 46 supplies POTS voice frequency signals. From the POTS splitter 44, the POTS voice frequency signals 46 are connected to the wireless distribution system 50 while high-speed

data is connected to the wireline distribution network 60. Alternatively, the POTS splitter 42 may be provided internally within the NID 40.

[0018] Now referring to Figure 4, the operation of a POTS splitter 42 separating voice frequency signals from the data signals is described. Combined POTS and high-speed data signals carried by the local loop 22 to the customer premises are terminated at the input/output 44 of the POTS splitter 42 with an 600-800 ohm impedance. In the present embodiment, the POTS splitter 42 includes a high-pass filter 45 and a low-pass filter 43 to separate the different frequency signals. The high-pass filter 45 separates the high-speed data 48 to splitter output/input 48 and the low-pass filter 43 separates the lower speed POTS signals to output/input 46. To separate high-speed data, the high-pass filter 45 attenuates lower frequency signals and passes only higher frequency signals. The high-speed data signals are typically at higher signal frequencies, such as above 80 KHz. Thus, the high-pass filter 45 outputs only these high-speed data signals to output/input 48. To separate POTS voice signals, the low-pass filter 43 blocks high frequency signals, for example, signals above 10 KHz, passing only lower frequency voice band signals in the 200 Hz to 4 KHz range to the output/input 46. Thus, the high-pass 45 and low-pass 43 filters have separate outputs with the low-pass filter outputting POTS signals 46 and the high-pass filter outputting high-speed data traffic 48. It is to be understood that the POTS splitter 42 also operates in the reverse "upstream" direction to combine high-speed data 48 and lower speed signals 46 from the customer premises for transmission to the telephone service provider's central office 24. High-speed data destined for the central office 24 is input to the splitter 42 at output/input 48 and the lower speed data is input to the splitter at output/input 46. The high-speed data and the lower speed POTS signals are combined at input/output 44 for transmission to the central office 24. POTS splitters are available from suppliers of DSL telephone equipment such as NetSpeed of Austin, Texas.

[0019] The described embodiment of the POTS splitter is representative, and there are numerous other embodiments in accordance with the present invention. The described embodiment of the POTS splitter may be suitable for any of the local loop systems described in connection with Figure 1 which combine high-speed and lower speed signals on the same local loop at different frequencies. The POTS splitter may also be implemented according to the requirements of the local loop. For example, a local loop that carries high-speed data and lower speed voice band frequencies on separate lines to the customer premises may eliminate the need for the POTS splitter altogether. Because the high-speed and lower speed signals are already carried on separate lines, there is no need for a POTS splitter to separate the signals onto separate lines. The high-speed data line can be directly fed to the wireline distribution network 60 and the lower speed signals can be directly fed to the wireless distri-



bution system 50.

**[0020]** Referring again to Figure 3, a diagram of the wireless distribution system 50 carrying POTS and lower speed data within the customer premises 20 is represented schematically. To provide access to the wireless distribution system 50, the low-pass output/input 46 of the POTS splitter 42 is connected to a wireless controller 52. The wireless controller 52 transmits the lower speed signal output of the POTS splitter 42 to the various remote receivers 54, 55, 56, 57, 58, 59 in the range of wireless distribution network 50. Preferably, the wireless controller 52 is located near the POTS splitter 42 to receive the lower speed data or POTS voice signals from the low-pass output/input 46 of the splitter. The wireless system 50 preferably carries voice telephone signals associated with POTS, but may also carry lower speed data such as that associated with a modem or other relatively low baud rate data systems. For example, an output 80 of the ADSL modem 62 may be supplied to the wireless controller 52 of the wireless distribution system 50. The wireless controller 52 may have a low-speed data input 51 that can receive a connection 80 from the wireline distribution system 60 using a conventional RJ-11 telephone jack. The wireless distribution system 50 can thus distribute a lower speed data channel from the wireline distribution system over one of its wireless channels. For example, the wireless controller 52 may provide a multiple number of 64 Kbs to 128 Kbs data channels. The wireless channels may carry a number of POTS lines but may also be used to carry a lower speed data channel from the ADSL modem 62. Thus, lower speed data from the ADSL modem 62 is also available for use by devices on the wireless distribution system 50.

**[0021]** The wireless controller 52 has a radio frequency ("RF") interface to communicate with the various remote receivers using a small antenna 53. The antenna 53 may be driven by a low power transmitter broadcasting with less than an 0.1 watt of power to provide wireless service with a range from a few feet to a few hundred feet of the wireless controller 52. Of course, higher power wireless distribution systems may transmit with greater power to provide greater usable range. The wireless controller 52 may use the household alternating current ("AC") electrical wiring (not shown) as a transmitting antenna. Such systems may use a capacitor to block the AC line current while passing a frequency modulated carrier with a center frequency ranging from 1.6 to 1.8 MHz through its AC power cord to the household electrical wiring. Smaller whip antennas (less than one meter in length) can also be used in accordance with this exemplary embodiment. The various remote receivers 54, 55, 56, 57, 58, 59 in the wireless distribution network 50 may also use similar whip antennas to transmit with low power.

**[0022]** The wireless distribution system 50 can take many different forms and have different RF interfaces as compatible with regulatory agencies as the Federal Communications Committee ("FCC") and applicable industry standard protocols. For example, a simple consumer

cordless telephone system that provides a base unit transmitting and receiving at the 45 to 50 MHz frequency range to receivers such as a cordless, battery-powered telephone handset 54 can be used. Such cordless telephone systems provide full-duplex operation between the base station 45 and the handset 54 by transmitting at one frequency and receiving at second frequency. A typical cordless telephone system transmits signals at about a 46 MHz frequency and receives signals at around 49 MHz. Half-duplex wireless systems transmitting over a single frequency are less desirable for voice operation. In these wireless systems, the signals are typically analog signals modulated using amplitude modulation or frequency modulation techniques. Often a number of different channels at different frequencies in the 45 to 50 MHz range are made available for multiple channel capability for operation under noisy electrical conditions.

**[0023]** Most preferably, the wireless distribution system operates in the higher 800 to 900 MHz frequency band now being used in a variety of consumer wireless applications such as the latest generation of wireless telephones, pagers, and the like. The preferred system is a digital communication system having multiple channel capacity to provide a plurality of POTS lines and lower speed data channel(s). Multi-channel digital wireless systems using time-division multiple access ("TDMA"), frequency-division multiple access ("FDMA") and spread spectrum techniques such as code division multiple access ("CDMA") feature provide greater bandwidth capacity and may be less prone to interference in electrically noisy environments such as the typical business office. The remote receiver may be a wireless handset or a fixed-wireless telephone station 55, similar to a conventional style telephone, except using an antenna and transceiver rather than a wireline to receive signals. The fixed-wireless telephone station may use battery or AC power and provide the telephony functions of receiving, transmitting, DTMF generation/detection, on and off-hook detection and voice coding. Of course, all the features of conventional telephones such as wireless paging, intercom, speakerphone, security codes, volume controls, and the like may be incorporated. The wireless system may also have wireless headsets 56, wireless modems 57, or other home devices that are connected to receive lower data rate information, such as an alarm system 58.

**[0024]** In another example, a kitchen counter display device 59 with a liquid crystal display may use a channel of the wireless distribution system 50 to access a recipe page on the Internet via a modem connection. To find a recipe, a user may use the kitchen display device 59 to connect to a host computer containing recipes, such as a web page on the Internet, using a lower speed data connection over the wireless distribution system 50. Preferably, the wireless distribution system 50 provides a lower speed data connection that uses a lower speed data connection from the ADSL modem 62. A data connection on the ADSL modem 62 has the advantage over a conventional telephone modem in that the ADSL modem 62

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