

MOBILE TELEPHONE NETWORK FOR COMMUNICATING BETWEEN TWO COMMUNICATION SETS

The invention concerns a local communications network between a first mobile station such as a mobile telephone and a second fixed station, especially a fixed-line telephone, by means of a relay antenna and a data transmission link.

In known systems of this type coaxial cables are used as the data transmission link. The use of coaxial cables has the major problem that construction of the installation is subject to strict constraints which entail in general the deployment of a group of receivers for the placement of the coaxial cables and the operation test. In addition the testing a fixed station antenna necessitates the use of highly expensive materials which are difficult to transport. These known systems are furthermore subject to other kinds of constraints having to do with the physical installation of a fixed set with respect to the antenna which must be within a 30-meter perimeter and which depends on the power source as well as the presence of carriers in the area where the system is installed. As a result, known systems, especially owing to the use of coaxial cables, are difficult to put into operation and costly.

The purpose of the invention is to propose a system of the type defined above which allows the problems of known systems, just described, to be eliminated.

In order to attain this objective, the local communications system according to the invention is characterized in that the data transmission link between the antenna and the fixed radio frequency station is a wireless link.

The invention will be better understood and other purposes, characteristics, details, and advantages of it will be seen more clearly from the following explanatory description in combination with the appended schematic drawings which are submitted exclusively by way of illustrating one mode of realization of the invention and in which:

Figure 1 shows a general schematic for a communications system between a mobile telephone and a fixed-line telephone by means of a mobile telephone network according to the invention.

Figure 2 is a functional schematic which illustrates the structure of the link device indicated by 6 on Figure 1 of the mobile telephone network according to the invention.

Figure 3 is a flow chart of the communications function between the antenna and the mobile telephone network station according to the invention.

Figure 4 is a flow chart of the communications function between the station and the mobile telephone network antenna according to the invention.

Figure 5 is a flow chart of the multiplexing function between the various telephone network operating frequencies.

Figure 6 is an elevation of a building on which a network according to the invention has been installed.

Figure 7 is an elevation showing a part of Figure 6 on a larger scale.

Figure 8 is a schematic drawing of a mobile telephone network consisting of three relay antennas capable of functioning in three different transmission bands.

The invention shall be described below as applied to a communications system between a mobile telephone 1 and a fixed-line telephone 2 by means of a mobile telephony network usually called GSM (Global System Mobile) 3 and the fixed network 4.

Inside the GSM mobile telephony network 3, communication goes from a relay antenna 5 for communicating with the mobile telephone 1 by means of a data transmission link 6 to a fixed assembly consisting of a radiocommunication station 7, which is a base transmission system usually referred to as BSC (Base Station Controller) and a communications center 9 called MSC (Mobile Switching Center). Of course, if the communication goes from the fixed-line telephone 2 to the mobile telephone 1, the signals flow in the opposite direction.

The relay antenna 5 may be of the multiband type, for example single band, dual-band, or tri-band and receive and transmit frequency bands or channels of 900, 1800, or 2200 MHz. The antenna is supported by a mast 11 built for example on the roof of a building as shown in Figures 6 and 7.

In conformity with the invention, the link between the antenna 5 and the radiocommunication station 7 is realized in the form of a radio frequency link. The wireless transmission takes place between an electronic device built at the base of the antenna mast 11, enclosed in a housing 12 and an electronic equipment device enclosed in a housing 13 linked to the communications station 7. If the antenna is a multiband type, a housing 12 is built for each band. One station is provided for each antenna 5 frequency band. The antenna housing 12 and station housing 13 are equipped with means of transmitting and receiving the signals to be transmitted. The specific transmission route of wireless signals is indicated by 14.

Referring to Figure 2, it may be seen that, on the antenna 5 side, enclosed in the antenna housing 12, the radio frequency link 6 includes in succession, starting from the antenna, a high frequency demodulation module 16, an encoding module 17, an analog/digital converter 18, a modulation and broadcast module 20, which broadcasts or receives the wireless signals on the transmission channel 14.

The modules just mentioned allow the operations indicated on the Figure 3 flowchart. The multiplexing and demodulation module 16 has the purpose of ensuring the frequency multiplexing for a station 21 to identify the operation frequency, that is, the frequency band in which the signals arrive at the antenna or are broadcast by it. To that end, the multiplexing module is equipped with a reference frequency source, as may be seen in Figure 5, which furnishes the frequencies

corresponding to the antenna transmission bands. The multiplexing module identifies the frequency by comparing input signal frequency and the appropriate reference frequencies. If the GSM antenna 5 uses three frequency channel bands of 900 MHz, 1800 MHz, and 2200 MHz, the input signal will be compared first to the 900 MHz reference signal, then to that of 1800 MHz, and finally to the 2200 MHz signal. This multiplexing is done before any signal manipulation.

In conformity with Figure 3, after multiplexing, in a stage 22, a test of the presence of a corresponding station is carried out. Its purpose is to ensure that the GSM network has a station 7 which can function at the frequency of the signals received. More precisely, at operation 22, a response test to this frequency is carried out on the radio station 7 side, consisting for example of a broadcast followed by listening at that frequency. In the absence of a response, it searches the next frequency, returning to step 21 to thus establish the conditions for another communication on another frequency channel.

If there is a positive reaction indicating the presence of a communicating station 7 at the frequency identified, the communication between the antenna and the station is established. The high-frequency analog signal received from the antenna is then demodulated at step 23 to a low-frequency level. The signal is demodulated to eliminate the modulation signal or carrier, which is the high-frequency component of the signal.

At the following decoding operation 24, the signal is sampled. In order to avoid undesirable phenomena resulting from the conventional Varicap type diode on which the modulation is superimposed, causing a frequency gap of $-F_m$ or $+F_m$ for logic "0" or "1," respectively, with the risk that the locked loop has the tendency to catch up with the modulation gap, in the case of the invention these levels are advantageously separated into a well defined "0" or "1" alternation so that the mean value of the modulating signal is null. In this way, whatever the content of the modulation, the carrier frequency does not vary.

Then comes the analog-digital conversion at operation 25. During the conversion, the low-frequency component, which presents the useful signal and is the result of the demodulation operation, is converted to digital. The analog-digital conversion is clocked for sampling frequency which is equal to or higher than twice the useful signal frequency.

In the subsequent signal compression operation, the binary stream received is separated into packets in conformity with the GSM network standards. These packets are compressed before being sent to the station 7. Data compression ensures a reduction of packet size, which allows the broadcast/receiving rate imposed by the GSM standard to be respected. At operation 27 the packets are transmitted by the wireless broadcast module 20 on an appropriate frequency band which could consist of a range of frequencies, for example from 400 MHz to 18 GHz. This relatively wide range allows an advantageous wireless transmission channel to be chosen, for economic or technical

reasons. For example, by transmitting on an 869 MHz frequency band, there is the advantage of using a frequency band which is public in France and whose use is free of charge.

The signal thus transmitted by the modulation and transmission module 20 is received by a demodulation/receiver module 28 which is part of the radio-frequency station 7 housing 13. Then the signal received passes successively through the decompression modules 29, the digital/analog converter 30, a decoding module 31, and an optional high-frequency modulation module 32, finally reaching the station 7.

The description of the invention was made taking as an example the establishment of communication in the antenna-station direction. Of course, the process of establishing communication in the opposite direction, that is in the station-antenna direction, corresponds to that which has just been described and is illustrated in Figure 4, and indicates a succession of operations beginning at the station 7, that is, the operations of signal demodulation 33, signal coding 34, analog/digital conversion 33, signal compression 34, and signal transmission to the antenna, carried out respectively by the modulation 32, decoding 31, conversion 30, decompression 29, and demodulation 28 modules.

Figures 6 and 7, which are elevations of a building in which the roof carries three relay antennas 5 such as those shown in Figure 1 and the appropriate electronic equipment, illustrate the advantage of wireless links over the coaxial cables hitherto used. These figures illustrate not only the savings that the suppression of cables allows, but also that, owing to the fact that the space between antennas and stations can be greater, the invention allows placement of station boxes in advantageous locations. In the case of the invention, the installation conditions do not dictate the placement of the boxes, rather the locations may be chosen freely as a function of other aspects, for example those determined by the architecture of the building. In the case of the invention, the distance between the GSM antennas and the radio stations may be 10 to 500 m according to the placement of the station vis-a-vis the antennas. The assured range is a function of the frequency band used and the power allowed. For example, for an 869 MHz band, the range of the system is on the order of 400 m. By comparison, in known coaxial cable systems, the station must be located within 30 m of the antenna.

In addition, another advantage of the invention is that the wireless link electronic equipment allows integration of certain radio station functions, such as signal amplification or attenuation, which offers the possibility of lightening the internal structure of the radio stations and thus reducing their weight, currently on the order of 500 kg, which represents a strong constraint on their placement on site during installation.

Figure 8 illustrates in particular the advantage that the invention brings. In fact, the system represented has three multifrequency antennas, for example of 900 MHz, 1800 MHz, and 2200 MHz, designed to cooperate with three radio frequency stations 7 capable of functioning

respectively at 900 MHz, 1800 MHz, and 2200 MHz. It may be ascertained that the use of wireless connections between the antennas and the stations allows each antenna to be made to cooperate easily with each of the stations, which implies the possible presence of nine links. These links can be realized easily in the form of wireless links, but would be problematic if one had to realize them according to the current technique of coaxial cables.

Claims

1. Local communications network between a first mobile station, such as a mobile telephone, and a second station, such as a fixed-line telephone, through a relay antenna and a data transmission link which links the antenna to a fixed radio frequency station, characterized in that the transmission link is a wireless radio frequency transmission link (6).

2. Communications network in accordance with Claim 1, characterized in that the wireless link (6) includes means for transmitting and receiving signals at a frequency between 400 MHz and 18 GHz, the frequency being chosen within this frequency range.

3. Network in accordance with Claim 2, characterized in that wireless connection (6) is equipped with an electronic device (12) associated with antenna (5) and an electronic device (13) associated with the station (7) and a wireless transmission channel (14) between these two devices.

4. Network in accordance with Claim 3, characterized in that the antenna electronic device (12) includes means for analog/digital conversion (18) and station electronic device (13) includes means for digital/analog conversion (30).

5. Network in accordance with either of Claims 3 or 4, characterized in that the antenna and station electronic devices (13) include means for compressing or decompressing the signal to be transmitted.

6. Network in accordance with any of Claims 1-5, characterized in that, in the case of a multiband antenna (5), antenna electronic device (12) includes means for identifying the channel on which the signals to be transmitted are received by the antenna.

7. Network in accordance with any of Claims 1-6, characterized in that the antenna electronic device (12) includes means to verify the presence of a station (7) capable of functioning at the frequency at which the signals to be transmitted are received by the antenna (5).

8. Network in accordance with any of Claims 1-7, characterized in that it includes several stations (7), each of which is capable of functioning at a predetermined frequency, these stations being capable of communicating with an appropriate multi-band antenna.