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(54) Title: DEVICE AT DECT-SYSTEM

(57) Abstract

In a DECT-system is included a central base station and a number of virtual base stations. An existing distribution network, for instance cable- or communal antenna network, is utilized by the DECT-system, and this operates with synchronization function for synchronization of respective virtual base station with the central base station, which synchronization function is referable to the amplifiers of the virtual base stations, at which the carrier of the DECT-system is used as norm for achieving the synchronization.
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APPLICANT: TELIA AB

TITLE OF THE INVENTION: DEVICE AT DECT-SYSTEM

5 TECHNICAL FIELD

The present invention relates to a device at DECT-system showing a central base and a number of virtual bases and where an existing network, for instance a cable- or communal antenna network, is included in the distribution function within the system. The DECT-system operates with synchronization function for synchronization of respective virtual base to the central base. The synchronization function can be related to the amplifiers of the virtual bases.

PRIOR ART

20 Larger surface coverage for a wireless telephone system in the form of DECT (Digital European Cordless Telecommunications) by means of existing distribution network, for instance a cable-TV network or communal antenna network, is in principle previously known for wireless telephone systems in general. Accordingly, it is for instance by the patent application WO 93/06669 previously known to combine cable-TV systems and a wireless digital telephone system. In the system the cable-TV network is utilized to distribute telephone signals between a centrally connected base unit and the cable TV outlets in concerned dwellings belonging to the mentioned cable-TV network. In this system active elements are used as amplifiers in the dwellings to obtain right signal level in the system. The mentioned patent document also describes a system showing the
mentioned qualities and where mainly fibre optical distribution of telephone- and TV-signals is used.

By EP 421 602 it is previously known to use a hybride network which can offer a number of different services. Mentioned services include TV-transmission and distribution of wireless telephony. According to the document the base unit can be placed at a node in order to communicate with a number of wireless telephones in a number of dwellings. Distribution from the node to the dwellings is made by coaxial cable. In the document is suggested that the operating frequency for the wireless telephony is transformed to a frequency which is better suited for transmission on the coaxial cable considering for instance attenuation and frequency space. The system is intended to utilize wireless telephony according to the standard CT2.

By the American patent document US 5 124 980 it is known to establish communication over an existing cable-TV network. According to the document both coaxial cable- and fibre optical systems can be utilized. This document relates to telephony by wire.

DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

There exists a general need for utilizing the in the introduction indicated principles in connection with DECT-system in multi-family districts where lacking radio coverage can be a problem. There are a number of different kinds and types of obstacles for the radio wave propagation, at which can be mentioned walls, buildings, vegetation etc. DECT is a low power system
with peak power of maximally 250 mW ERP with a bandwidth of 2 MHz, so and therefore it can be difficult to reach all dwellings within a multi-family district. With a "multi-family district" is in this context referred to block of flats and continuous district of private houses. This normally requires a concentration of base stations, or repeaters, which technically complicates the system and also makes new establishments more expensive. The invention intends to solve among other things this problem.

At the use of virtual DECT base stations it is important to have possibility to synchronize the virtual base stations with the communal base station, which normally consists of a real base station. The present invention is based on the use of simple, bidirectional amplifiers at each coaxial cable outlet. Since DECT is a TDMA/TDD-system, the synchronization of the following amplifiers, which constitute the virtual DECT base stations, is of great importance. Poor synchronization will reduce the quality considerably and can for instance reduce the radio range dramatically. The frame length which can consist of the time of 12+12 time slots is 10 ms, which for instance implies that user data become 32 kbit/s (ADPCM). Referring to this fact it is important that the synchronization which is necessarily required by the amplifiers which constitute the main part of the virtual DECT base stations is arranged to function well. These amplifiers must be synchronized with the frame structure of the DECT-system in a way that the down link passes and is amplified in one direction during the first 5 ms, and corresponding for the up link during the following 5 ms of a frame. The problem consequently is in the synchronization of respective virtual base station with the central station, above all there exist problems with suggesting how the necessary synchronization information
shall be transferred to the virtual base stations. The idea of using virtual base stations is aimed at the use of more simple equipment than complete DECT equipment, for instance repeaters, implying that also the synchronization function must be technically simple and economically advantageous and yet operate reliably. The invention also intends to solve this complex of problems.

THE SOLUTION

The new device according to the present invention is regarded to be characterized in that the carrier of the DECT-system is utilized as norm for achieving synchronization.

In one embodiment of the present invention the deviation of the synchronization is as most of the size ± 0.01 ms or ± 0.1 Hz/0.1 % in the case half of the synchronization frequency is used. In another embodiment the slots 0 and 12 are sacrificed in both down link and up link from capacity point of wiev in the DECT-system. This will have as a result that it will be possible with deviations in the synchronization pulse with ± 0.2 ms/± 2 Hz if up to half a timeslot is sacrificed for the synchronization. This will result in a demand for accuracy of the synchronization function of between 0.1 % and about 2 %.

ADVANTAGES

According to what has been indicated above the DECT-system also can be arranged to cooperate with distribution networks in the form of cable-TV networks or communal antenna networks. At this the DECT-system
can be connected to a central point or node in a cable-TV network or communal antenna network to obtain wide coverage in a multi-family district where blocks of flats, private houses etc, are included. The antenna outlets in each flat/private house will in this way act as a virtual base in the DECT-system by an antenna being connected to the coaxial cable in the flat. By utilizing the distribution network in question it will be technically easier and economically more advantageous to utilize such a distribution network compared with procedures to concentrate the base stations or install repeaters. No reduction of importance of the total capacity will arise in the system, which inevitably would be the result in the case where repeaters would be used. The invention will be especially applicable when DECT-equipment is used in connection with coaxial cable networks.

DESCRIPTION OF FIGURES

One at present suggested embodiment of a device which shows the for the invention significant characteristics shall be described below while referring to enclosed drawings, where

Figure 1 in vertical section shows installation in a block of flats

Figure 2 shows the construction of the frame structure in the DECT-system, and

Figure 3 in the form of a principal diagram shows a known DECT-system.
DETAILED EMBODIMENT

The invention is based on existing cable- or communal antenna network being used as distribution network, together with necessary equipment to amplify and transmit the DECT-signalling. Two solutions are presented for this; one "central" solution and one distributed solution.

Communal antenna networks (this term is here also used for cable-TV-networks) are often arranged as star networks, with a number of connections on each arm. The networks are used for transmission of TV-signals, in most cases within the frequency range 50-1000 MHz. As medium is predominantly used coaxial cable, which can very well be used for transmission of 2 GHz (the operating frequency of DECT), if yet with some higher attenuation than at the TV-frequencies.

The communal antenna outlets, see Figure 1, in the dwellings contain in most cases some form of high pass filters for that part of the signal which is above the radio broadcasting band (88-108 MHz), and some form of attenuator/direction coupler to prevent influence on the network from individual TV-sets. These filters, attenuators and direction couplers can be by-passed the equipment which shall transmit DECT-signalling.

In a district with blocks of flats and private houses a DECT-station can be placed in a node for the communal antenna network; such nodes in most cases exist one in each block of flats or one in each district of private houses. The DECT-base station can be equipped with that number of radio units which are needed to give sufficiently high capacity within the district. A DECT-base station can be extended to a maximal capacity of
120 Erlang (this requires 10 radio units). The dynamic channel allocation, described in the DECT-standard, takes care of and distributes channels to each user. One in this way established system will still offer the concentrator effect which is usually obtained via ether carried radio. The present embodiment consequently does not lead to any restrictions of this kind.

The very high capacity of DECT (10 000 Erlang/km²/flat) makes possible the arrangement which is described here, without any capacity problems arising.

This arrangement can be said to create a virtual DECT-base station at each communal antenna outlet, thereby making accessible for a user all the (technical) facilities and services which the DECT-standard contains, and share the capacity of the base station with other users as if all users were in the immediate vicinity of the real base station.

By this arrangement a number of pseudo cells are created (1-2 in each flat/private house), and by the functionality of DECT is obtained without any problems handover between these pseudo cells (in the reality intracell handover).

In both cases an antenna for DECT is required which is connected to the communal antenna outlet in the flat/private house.

The two embodiments complete each other; which is selected if an installation is made depends on the architecture and quality of the cable-TV network.
Formally there are no base stations in the DECT-standard, there are instead "portable parts" and "fixed parts".

According to the DECT-standard the output power must not be higher than 250 mW, which is measured at the "antenna outlet" of the DECT-equipment.

At central arrangement the DECT-signals need to be somewhat amplified to compensate for the losses which originate from the communal antenna network. In this suggestion this is made by a centrally located unit (amplifier) directly connected to the DECT base station (as a booster), which is connected to N in the figure.

The amplifier must be bidirectional (both up- and down link). In order not to cause unwanted resonance the amplifier is equipped with signalling to the DECT base station making the units synchronized.

In the case the TV-network is not balanced, implying that the arms of the network do not all have the same attenuation (depending on different lengths or different numbers of connected outlets) separate amplifiers can be used. One possibility is to distribute the frequency bands of DECT on the different arms (B) by restricting the amplifiers to one or a few of DECT's carrier frequencies. In other case the amplifier shall have the full bandwidth of DECT (1880-1900 MHz).

The advantages with this arrangement are: Easy to amplify all DECT-channels, easy to control the output level, even per time frame, and cheap, since only one amplifier (per radio or carrier) is needed.
At decentralized arrangement two simple bidirectional amplifiers are connected to the communal antenna outlets U in the flats/private houses, and to the node N a conventional DECT base station is connected. Control information regarding shift between up- and down link can be transmitted on the coaxial cable on low frequency; the amplifiers can obtain operating voltage via the coaxial cable as well.

The advantages with this embodiment is that the level for each amplifier can be individually adjusted, and that received signals (down link) are amplified as early as they cannot drown in the noise.

These units then become DECT-stations, which can be passed as type according to the DECT-standard, and by that no problems regarding regulations need arise.

Figure 2 shows the in itself known construction of the TDMA/TDD-structure of the DECT-system. Since the structure is known it will not be described in details here. See however the discussion under "Technical problems" above.

In Figure 3 is shown a central base station in a known DECT-system 1 and virtual bases 2, 2", 2". The synchronization unit according to the above is shown with 1a. The connection with controlling station in the DECT-system is symbolized with 4.

In the present invention the DECT-carrier is utilized as norm. The deviation of the synchronization should be max. $\pm 0.01$ ms, or $\pm 0.1$ Hz (0.1%) if a bit less than half of the synchronization frequency is allowed to be used (see Figure 2). As a matter of fact it should be possible to have a considerably more generous measure
since slot 0 and slot 12 (down link respective up link according to figure 2) quite simply can be sacrificed which would reduce the capacity with only about 10%. According to this reasoning the deviation of the synchronization pulse may be up to ± 0.2 ms or ± 2 Hz, if up to about half a timeslot is sacrificed for synchronization. By that the demands for accuracy on the synchronization pulse can be said to be between 0.1% and 2%. (The upper limit with some reservation since such an arrangement for instance may demand extra equipment).

The operating frequency of DECT is 1880-2000 Mhz, which can be expressed as 1900 Mhz ± 0.5%. It is by that possible to use the carrier frequency of DECT as generator for the synchronization in VB.

The invention is not restricted to the in the above as example shown embodiment byt can be subject to modifications within the frame of the following patent claims and idea of invention.

In figure 2:

A = 4 bits which may me used to detect packet collisions.
PATENT CLAIMS

1. Device at DECT-system showing a central base station (1) and a number of virtual base stations (2, 2', 2'') and
where an existing network, for instance a cable - or
communal antenna network, is included in the
distribution function within the system and where the
system operates with synchronization function for
synchronization of respective virtual base station with
the central base station, which synchronization function
is referrable to the amplifiers of the virtual base
stations, characterized in that for
achieving the synchronization the carrier of the DECT-
-system is used as norm.

2. Device according to patent claim 1,
characterized in that deviations of the
synchronization is at most of the size ± 0.01 ms or ± 0.1
Hz (0.1 %) in the case half of the synchronization
frequency is used.

3. Device according to patent claim 1,
characterized in that the slots 0 and 12 in
both down link and up link are sacrificed from capacity
point of wiev in the system, making it possible with
deviations of the synchronization pulse up to ± 0.2 ms/±
2 Hz, if up to about half a time slot is sacrificed for
the synchronization, which gives a demand of accuracy on
the synchronization function of between 0.1 % and about
2 %.

4. Device according to any of the previous patent
claims, characterized in that mentioned
amplifiers obtain synchronization by the frame structure
of the DECT-system in a way that the down link passes
and is amplified in one direction during the first 5 ms,
and corresponding occurs for up link during the following 5 ms of a frame.

5. Device according to any of the previous patent claims, characterized in that respective virtual base station is connected to a central point/node in the distribution network.
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC6:** H04Q 7/24
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

**IPC6:** H04Q, H04B, H04M

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

SE, DK, FI, NO classes as above

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

## WPI, CLAIMS, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

- **T**: later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- **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
- **&**: document member of the same patent family

**Date of the actual completion of the international search:** 27 June 1996

**Date of mailing of the international search report:** 28 -06- 1996

Name and mailing address of the ISA/Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Faxfacimile No. + 46 8 666 02 86

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