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GB 2250665 A **GB 2229065 A** **EP 0530165 A2**
EP 0468569 A2

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ONLINE DATABASES : WPI

(54) Channel selection in a CDMA cellular mobile radio system

(57) Each mobile unit in a CDMA cellular mobile radio system includes means e.g. envelope detector 6 for monitoring each channel (0 → L - 1) and measuring the interference level. The measured level is compared 10 with unit 12 which stores the lowest interference level. Channels may be monitored on at a time (Fig. 2), each time returning to the current channel n. A new channel may be selected as soon as one is found with a lower interference level.

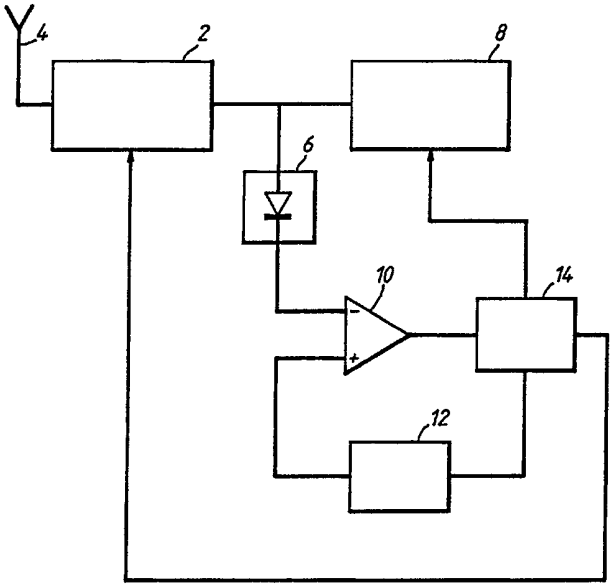

Fig.1

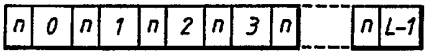

Fig.2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

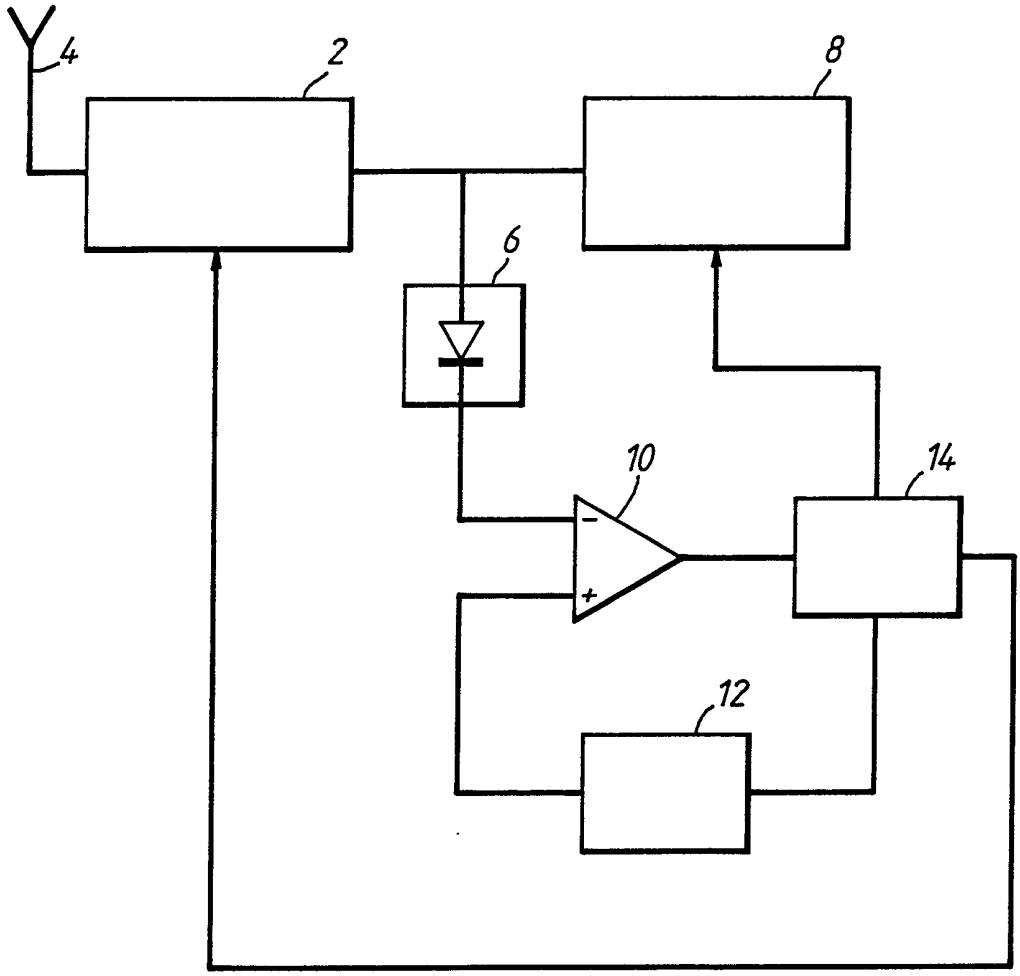

Fig.1

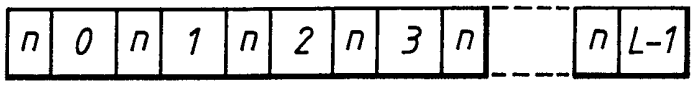

Fig.2

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CDMA CELLULAR MOBILE RADIO SYSTEMS

The present invention relates to CDMA cellular mobile radio systems and in particular is related to the issue of interferer diversity.

Interferer diversity confers an advantage upon the system in terms of spectral efficiency because each radio link suffers interference which is the sum of interference from a number of interferers at different locations and therefore the spectral efficiency is determined by the average interference rather than the worst case interference, and leads to higher spectral efficiencies. This effect is generally referred to as interferer diversity and the order of interferer diversity would be the number of interferers that a single link was receiving interference from during a particular call. In particular, a figure of merit for a system would be the order of interferer diversity and would be that which would apply when the system was fully loaded or near to fully loaded.

The design bandwidth of a spread spectrum CDMA system is constrained by practical issues and the wider the bandwidth of a spread spectrum carrier the greater the number of users it can support and therefore the greater the order of interferer diversity, however, issues of complexity would tend to argue for a relatively modest spread spectrum bandwidth.

The aim of the present invention is to allow the order of interferer diversity of a system to approach the number of users operating over a set of spread spectrum CDMA carriers. Thus, for

example, if there were 100 users operating on a 5 MHz carrier and therefore 10 x 5 MHz carriers then the order of interferer diversity would be 1,000 rather than 100, in other words the relationship between the interference on the different carriers is interlinked by the operation of a protocol.

The optimum operation of a CDMA cellular mobile radio system occurs when the mobile units are uniformly distributed over the cells so that there is no clustering or bunching of the locations of the interferers. It is easy to imagine a worst case situation in which all of the mobile units served by one base station were clustered in a corner of the cell and if this were the case they would all be subject to a higher level of interference from the surrounding base stations than they would on average if they were spread uniformly across the cell. As the number of mobile units increases, the probability of this happening to a certain proportion of that number falls. In order to obtain the best performance when there is a number of carriers in operation it would be useful if the mobile units in any given region within a cell were uniformly distributed over the carriers available to the system so that the probability of this clustering or bunching effect is significantly reduced.

In order to do this, it might appear to be necessary to locate those mobile units within the cell. One approach that could be used to do this would be to have each mobile unit measure the level of interference from the surrounding base stations and report this to its own base station or its strongest base station and allow the base station to make a recommendation/choice as to the

carrier that the mobile unit should use on the basis of its location within the cell and also on the basis of the base stations knowledge of the loading of itself on the various carriers and the loading of the surrounding base stations on the various carriers.

The present invention uses more conventional techniques in a novel way and achieves the same results in a optimal fashion.

According to the present invention there is provided a CDMA cellular mobile radio system comprising at least one base station and at least one mobile unit capable of communicating with the base station, said mobile unit including monitoring means for monitoring each channel, measuring means for measuring the interference level on each channel, and means for selecting a preferred channel to act as a carrier for the reception of information.

According to the aspect of the present invention, the mobile unit, during inactive periods, is arranged to scan the carrier channels one at a time, and, after each scan returns to its own carrier channel unless it has selected a different carrier channel.

An embodiment of the present invention will now be described with reference to the accompanying drawings, wherein:

FIGURE 1 shows a block diagram of part of a receiver in a mobile unit, and

FIGURE 2 shows the channel format.

Referring to the drawings, part of a mobile unit is shown in Figure 1. It comprises a receiver/transmitter 2, having an antenna 4. The receiver/transmitter has an output connected to an envelope detector 6, and processing means 8. An output from

the envelope detector 6 is connected to a negative input of a comparator 10, a positive input of the comparator 10 is connected to an output of a circuit 12 for determining the current lowest power level. A controller 14 receives an output signal from the comparator 10, and is arranged to control the processing means 8, the circuit 12 and the receiver/transmitter 2.

Figure 2 shows the channel format. The channels designated n each represent a normal channel which may be in use at the current time when setting up a call or the channel being listened to for call reception. The channels designated 0 to L - 1 have their amplitude scanned to ascertain when the interference level is less than that of the n channel currently in use.

Under normal scanning conditions the channel, sync and extraction parameters are saved when not on channel n, and they are updated when channel n is returned to. When the values of the interference on the current channel (any channel from 0 to L - 1) is less than the interference of the current channel then the channel m is selected. This ensures that the carrier does not spend too much time searching, because it needs to be ready to receive a call at short notice and the probability that the mobile unit is not synchronised for a carrier at a given time is minimised.

In practise, mobile units that are not currently supporting a call are generally synchronised to their preferred carrier frequency, then in turn they hold the synchronisation parameters for that carrier and visit each of the other carriers one at a time and examine the total power on those carriers, that is to say power as measured by a rudimentary power or envelope detector.

If the power on the searched carrier is lower than the power on the currently preferred carrier then the mobile unit will re-tune to that carrier and repeat the process, thus the mobile unit will remain locked and awaiting calls, and able to initiate calls on the carrier which currently has the lowest level of interference. This procedure is known in the prior art as dynamic channel assignment and confers different advantages to those experienced here. The point about this is that the interference environment that the mobile unit experiences locates that mobile unit in a real sense in relation to the other mobile units and all the mobile units in that locality will make consistent choices about which carriers to choose and the effect will be to keep the level of interference uniform across the deployment area. Thus, in a system where the level of traffic was gradually increasing the first mobile unit would make an arbitrary choice of carrier to affiliate to in a particular area in the cell. Once that mobile unit had chosen that carrier, the base station would transmit power to it increasing the total level of interference on that carrier so that the next mobile unit would choose a different carrier, thus it can be seen that in any location within any region within a cell, the mobile units would tend to distribute themselves across the range of carriers available for communication and this distribution procedure will take place in a way specific to the location within a cell. The overall effect of this will be that not only will there be a uniform distribution of load across the carriers in any given region, but also a uniform distribution of load across the carriers in totality. This means that the surrounding base stations will be fairly

uniformly loaded in terms of the interference environment that they generate and thus the mobile units decisions will tend to be dominated although not completely so by the allocations within their own cell, thus the system can be seen to lead to a state of equilibrium which is advantageous from the view point of the capacity of the overall system.

Although this dynamic channel assignment produces a good distribution, to some extent that distribution will be broken up as the mobile units move around, however, the most mobile of mobile units will be those in vehicles travelling on roads and their movements are constrained by the positions of the roads and so the clustering will tend to continue and distributions still tend to remain advantageous.

CLAIMS

1. A CDMA cellular mobile radio system comprising at least one base station and at least one mobile unit capable of communicating with the base station, said mobile unit including monitoring means for monitoring each channel, measuring means for measuring the interference level on each channel, and means for selecting a preferred channel to act as a carrier for the reception of information.

2. A system as claimed in Claim 1, wherein the monitoring means includes an envelope detector, and the measuring means includes means for determining the current lowest power detected and comparison means for comparing said lowest power with an output generated from said envelope detector, to provide a signal used for controlling the channel selection.

3. A system as claimed in any preceding claim, wherein the mobile unit, during inactive periods, is arranged to scan the carrier channels one at a time, and, after each scan returns to its own carrier channel unless it has selected a different carrier channel.

4. A system substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The rch report)

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Relevant Technical Fields

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(ii) Int Cl (Ed.5) H04B 7/26; H04Q 7/04

Search Examiner
MR JOHN CAGE

Date of completion of Search
16 JUNE 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASE: WPI

Documents considered relevant following a search in respect of Claims :-
1-4

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2250665 A	(NORTHERN TELECOM) See Figure 3b and page 10 lines 4-15	1
X	GB 2229065 A	(NEC) See Figures 1, 3 and page 4 line 27 - page 5 line 19	1
X	EP 0530165 A2	(ERICSSON) See column 8 lines 12-34	1
X	EP 0468569 A2	(PHILIPS) See column 3 lines 26-41, column 8 lines 19-23, lines 35-38	1, 3

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).