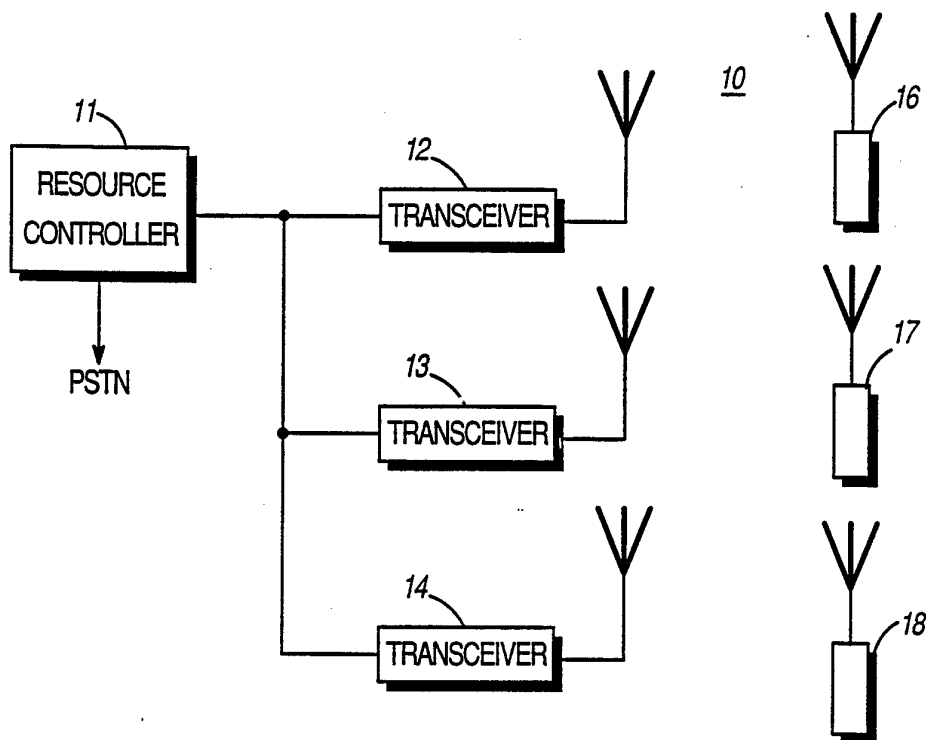




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(54) Title: METHOD OF ALLOCATING CHANNELS IN MULTIRATE CHANNEL ENVIRONMENT



(57) Abstract

A method is provided of allocating channels in a trunked radio frequency communication system (10) having a plurality of channels, each with a channel rate. The method includes the steps of transmitting channel characteristics on idle channels of the plurality of channels by a base site (12, 13, 14). Idle channels are then scanned for channel characteristics by a communication unit (16, 17, 18). The method also includes the step of seizing an idle channel, by the communication unit, based, at least in part, upon the channel characteristics.

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METHOD OF ALLOCATING CHANNELS IN MULTI-RATE CHANNEL ENVIRONMENT

Field of the Invention

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The invention relates to communication systems and in specific to trunked communication systems.

Background of the Invention

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Cellular communication systems are known. Such systems are typically comprised of a number of base sites, each having a service coverage area, distributed throughout a geographic area. The service coverage areas of the base sites are arranged in such a manner as to provide substantially continuous service to communication units passing through such a geographic area.

Communication services within such a system are typically provided on a radio frequency (rf) channel temporarily allocated by the base site to a communication unit for use in exchanging a communicated signal between base site and communication unit. Such rf channel is typically one of many channels (f_1 - f_n) available through the base site.

Allocation of the rf channel within a cellular system is typically based upon perception of a need for communication services. Such perception of a need may be based upon an access request transmitted by the communication unit or an acknowledgment of a page transmitted by the communication unit.

Access requests and paging responses within a communication system are typically transmitted on inbound frequencies of a control channel unique to a particular base site. Pages are typically transmitted on an outbound frequency of the control channel.

Following receipt of the access request or paging response by the base site, the base site and communication unit proceed through the process of channel set-up either on the control channel or on an auxiliary control channel designated by the base site.

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-2-

During channel set-up the base site determines the characteristics of the communication channel needed by the communication unit. During channel set-up the communication unit may request a full rate, a half rate, or a quarter rate channel. Following channel set-up the base site assigns the communication unit to a traffic channel having the characteristics requested by the communication unit. The communication unit moves to the traffic channel and begins exchanging a communicated signal on the assigned channel.

Personal communication networks (PCNs) are also known. PCNs are short-range cellular communication devices constructed for use within shopping malls, sports stadiums, or other limited coverage areas. Base sites for PCNs tend to be low power units that may, or may not, provide handoff among base sites. Service offered under PCN may be characterized as basic, while allowing a user to make and receive calls within prescribed areas.

While cellular systems and system controls have worked well in the past in cellular environments, the control algorithm used between base and communication unit is not well suited for PCNs. PCNs are constructed for pedestrian traffic and do not need the sophistication of control necessary for vehicular traffic. A need exists for a method of PCN channel allocation that is simple to use in the PCN environment and consistent with service levels of PCNs.

30 Summary of the Invention

A method is provided of allocating channels in a trunked radio frequency communication system having a plurality of channels, each with a channel rate. The method includes the steps of transmitting channel characteristics on idle channels of the plurality of channels by a base site. Idle channels are then scanned for channel characteristics by a communication unit. The method also includes the step of seizing an idle channel, by the communication unit, based, at least in part, upon the channel characteristics.

Brief Description of the Drawings

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FIG. 1 comprises a block diagram of a base site in accordance with one embodiment of the invention.

Detailed Description of the Preferred Embodiment

10

The solution to the problem of channel allocation in personal communication networks lies, conceptually, in the transmission, by base sites, of channel characteristics on idle channels. Mobile communication units, within such systems and in advance of seeking access to the system, scan idle channels for suitable characteristics. Upon identifying a suitable channel the communication unit seizes the channel for its own use.

Base sites in such a system transmit variables such as channel capacity at maximum values. Transmitting maximum values beneficially assures that a channel will be used to its greatest potential by causing communication units not seeking a high capacity channel to continue scanning for a channel of a lesser capacity thereby matching needs or requirements of the communication unit to availability. Such scanning and identification reduces the control requirements of base sites and avoids fragmentation of high capacity channels.

A communication unit within such a system may receive service from the system at a variety of service levels. Such service levels may be a reflection of service quality or voice processing efficiency. Communication units with lower levels of efficiency or requiring a higher quality of service may obtain system access at a higher level of service on a higher capacity channel. Communication units that process speech information more efficiently or who do not require such a high service quality level may request system access at a lower level of service.

40

Higher levels of service may require a full rate traffic channel. Lower levels of service may involve

- 4 -

half-rate, quarter-rate, or even one-eighth rate traffic channels at reduced service rates. Handoff between base sites may be an option available at any service level.

5 Upon seeking access, communication units scan for
channel characteristics upon which the scanning
communication unit can most efficiently operate
consistent with a pre-established service level. The
10 communication unit identifies such a channel by
attempting to match its own operating characteristics
with channel characteristics transmitted by the base
sites on idle channels. If upon completing a first scan a
match is not found, then the communication unit selects
15 a next higher capacity channel and transmits an access
request. The base site upon receiving such a request
may grant the request, transmit an identifier of a more
appropriate channel, or transmit a system busy
response.

20 FIG. 1 is a block diagram of a base site, generally,
(10) of a communication system, in accordance with the
invention. Included at the base site (10) is a resource
controller (11), and transceivers (12-14). Also shown in
FIG. 1 are communication units (16-18).

25 Signaling protocols within the system may be
based as under any of a number of prior art techniques
(e.g., Global System for Mobile Communications (GSM), as
specified in GSM recommendations available from the
European Telecommunications Standards Institute
(ETSI)). Control and traffic channels may also be
30 arranged under a time division multiplex (TDM) format
(e.g., GSM) with slot 0 designated as a broadcast control
channel. transmitted (inter alai) on the outbound
channel (base site to communication unit) is a system
identifier, locations of traffic channels (slots and
35 alternate frequencies), and access options.

 Communications units (16-18), upon activation,
scan for the control channel (slot 0) of a nearby base site
and monitor for paging messages. Upon detecting a
paging message or upon desiring to make a call, the
40 communication unit (16-18) uses system information
received in slot 0 to identify and scan traffic channels

- 5 -

for a channel having the desired characteristics (e.g., channel rate) needed by the communication unit (16-18).

5 Upon locating such a channel (e.g., slot 2) the communication unit (16-18) may request access on the following frame or continue to monitor the channel for additional frames before transmitting an access request. Delaying the access request in certain implementations may ensure that the channel is, in fact, idle.

10 Following the receipt of the three frames indicating that the channel is idle, the communication unit (16-18) transmits an access request on the identified channel including a requested channel rate and an identifier of the requesting communication unit (16-18). The base
15 site (10), upon receipt of such a request and upon verification that the communication unit (16-18) is registered within the system at the service rate of the channel requested, verifies that the channel is capable of the requested rate. Upon making such a determination
20 the base site (10) makes a further determination based upon the identity of the type of communication unit (16-18) as to the most efficient rate (from the system point of view) at which the communication unit (16-18) will be allowed to operate. (If the system is heavily loaded
25 and the communication unit (16-18) requests a full rate channel but is capable of operation on a half-rate channel, then the base site (10) may determine that the most efficient rate is a half-rate channel.)

30 Upon determination of the most efficient rate from the system point of view, the base site (10) responds to the requesting communication unit (16-18) with an instruction indicating a suggested rate to the requesting communication unit (16-18). The suggested rate may be
35 on the originally requested channel or another channel identified to the communication unit (16-18) by the base site (10). The communication unit (16-18) may either accept or reject such rate. If the communication unit (16-18) rejects such rate, then a call reject instruction is returned by the base site (10) and the call is ended.

40 If the communication unit (16-18) returns an acceptance of the suggested rate the base site returns an

- 6 -

access grant. The base site indicates such grant by transmitting a channel acceptance message to the requesting communication unit.

5 If, upon receipt of the channel request, the base site (10) does not recognize the communication unit (16-18), or the communication unit (16-18) is not eligible for the service rate of the channel requested, then the base site (10) transmits a call reject instruction to the
10 requesting communication unit (16-18). The communication unit (16-18) must then re-scan for an appropriate channel before re-requesting access.

If upon scanning idle channels the communication unit (16-18) does not find an appropriate channel, then the communication unit (16-18) transmits an access
15 request on an identified channel of the next higher rate. The base site (10), upon receipt of such a request, may grant access on the identified channel or transmit the identify of another channel of the same or lesser capacity than the identified channel. As above the
20 communication unit (16-18) may either accept or reject. If the communication unit (16-18) accepts then call set-up proceeds on the accepted channel as in the prior art.

- 7 -

Claims

- 5 1. A method of allocating channels in a trunked radio
frequency communication system having a plurality of
channels, each with a channel rate, such method
comprising the steps of: transmitting channel
characteristics on idle channels of the plurality of
10 channels by a base site; scanning idle channels for
channel characteristics by a communication unit; and,
seizing an idle channel, by the communication unit,
based, at least in part, upon the channel characteristics.
- 15 2. The method of claim 1 further including the step of
selecting a channel for seizure by substantially matching
channel characteristics of idle channels with
communication unit operating characteristics.
- 20 3. The method of claim 2 further including the step of
scanning for a higher rate channel upon failing to match
characteristics.
4. The method of claim 1 further including the step of
25 transmitting an access request, by the communication
unit to the base site, on the seized channel.
5. A method of allocating channels in a trunked radio
frequency communication system having a plurality of
30 channels, each with a channel rate, such method
comprising the steps of: transmitting a maximum
channel rate code, by a base site, on each idle channel of
the plurality of channels assigned to the base site;
scanning channels, by a communication unit, for a
35 channel with a maximum channel rate that can be
efficiently used by the communication unit and, seizing
an idle channel, by the communication unit based, at
least in part, upon the maximum channel rate code of
the seized idle channel.
- 40

- 8 -

6. The method of claim 5 further including the step of selecting a channel for seizure by substantially matching rate codes of idle channels with a communication unit channel rate.
- 5
7. The method of claim 6 further including the step of scanning for a higher rate channel upon failing to match characteristics.
- 10
8. The method of claim 5 further including the step of transmitting an access request, by the communication unit to the base site, on the seized channel.
- 15
9. A method of allocating channels in a trunked radio frequency communication system having a plurality of channels including a first idle channel having a first channel rate and an at least second idle channel having a second channel rate, such method including the steps of:
- 20
- transmitting, by a base site, a channel rate code on the first channel and at least second channel; receiving and decoding the channel rate codes by a communication unit; and, seizing the channel of the first and at least second channel, having the channel rate needed by the communication unit.
- 25
10. The method of claim 9 further including the step of selecting a channel for seizure by substantially matching rate codes of idle channels with a communication unit channel rate.
- 30

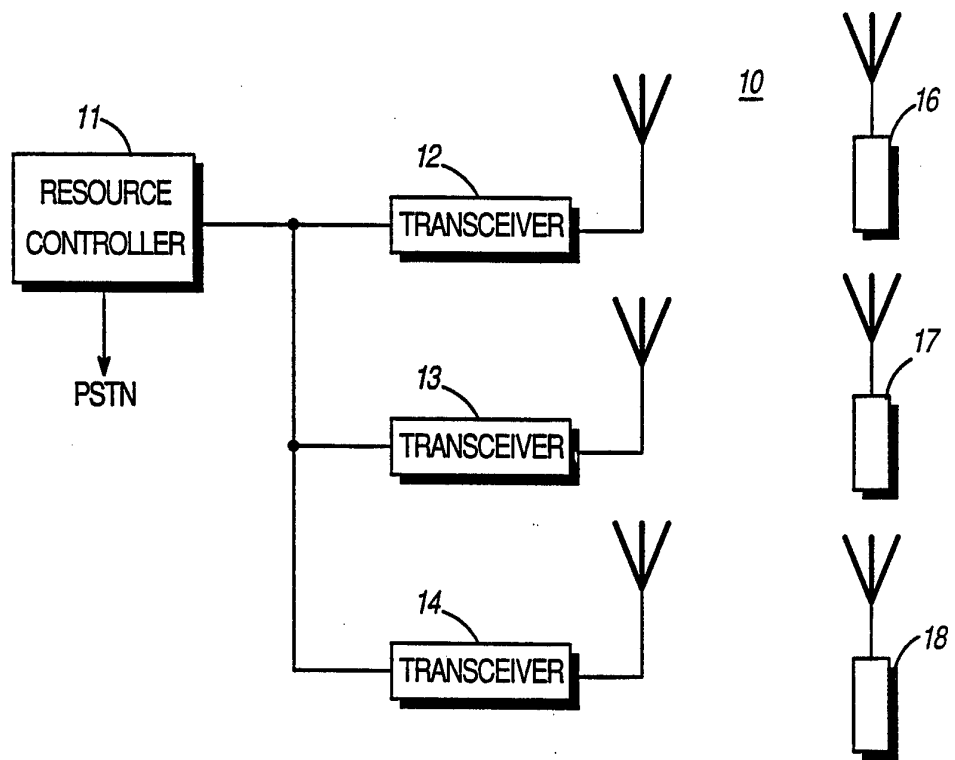


FIG.1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/07941

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(5) :HO4Q 7/00 US CL : 455/34.1, 34.2, 54.1, 62; 370/84, 85.7 According to International Patent Classification (IPC) or to both national classification and IPC</p>																				
<p>B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 455/34.1, 34.2, 54.1, 62; 370/84, 85.7; 375/121</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>																				
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>US, A, 4,763,322 (Eizenhofer)09 August 1988 see figures 1-4 and column 2, lines 9-69.</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>US, A, 5,070,536 (Mahany et al)03 December 1991 see figures 6 and 12.</td> <td>1-10</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	US, A, 4,763,322 (Eizenhofer)09 August 1988 see figures 1-4 and column 2, lines 9-69.	1-10	A	US, A, 5,070,536 (Mahany et al)03 December 1991 see figures 6 and 12.	1-10									
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Date of the actual completion of the international search 04 November 1993		Date of mailing of the international search report 09 DEC 1993																		
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE		Authorized officer <i>Andrew Faile</i> Andrew Faile Telephone No. (703) 305-4380																		