

**DYNAMIC SELECTION OF CHANNEL FREQUENCY
SCANNING**

FIELD OF THE INVENTION

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This invention relates to dynamically modifying channel frequency scanning of a communication device. The invention is particularly suitable for, but not limited to, dynamically selecting channel frequencies of a channel frequency scan list of roaming selective call receivers.

BACKGROUND ART

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Portable communication devices are becoming widely accepted as a form of communication. One type of communication device is known as a selective call receiver, often referred to as a pager, which receives paged information transmitted from one or more transmitters in a system. In this specification, selective call receivers will be used by way of example, however the invention is not necessarily limited to selective call receivers. Such selective call receivers are usually carried by users for receiving paged messages when they are away from their office or home telephone.

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As communication receiver users travel more, it is preferable to have a communication receiver, known as a roaming communication receiver, which can operate or roam in one or more selective call systems whilst still being able to receive relevant messages. Such systems provide transmission of selective call messages from a message originator who contacts a selective call terminal and provides the contents of the message and information identifying the intended selective call receiver user. The selective call terminal encodes the message into one of several known protocols, such as the POCSAG signalling

code or the FLEX™ high speed paging protocol. In addition, the terminal appends an address assigned to the communication receiver to the message. The address and message are then modulated onto a selective call signal and transmitted from the selective call terminal.

In systems that employ simulcast techniques as used in the FLEX™ protocol and as mentioned, for example, in US patents 469605, 469051, a selective call receiver identifies and monitors a valid channel in order to receive messages. In the remainder of this specification channel includes a message transmission frequency and/or System Identification Information (SII). When considering the FLEX™ protocol, this System Identification Information SSI includes either or both a Network Identifier (NID) or Simulcast System Identifier (SSID). However, other identifiers and other protocols may provide such System Identification Information SSI.

Roaming communication receivers generally have a frequency scan list of possible valid channel frequencies that are periodically scanned. However, depending upon protocol used, a roaming communication receiver may need to be synchronised to a valid channel. Further, such roaming communication receivers must identify that a channel frequency is associated with a valid channel (i.e. the channel is transmitting messages in one or more specific protocols usable by the receiver).

To identify a valid channel a communication receiver has a scan list of channel frequencies store in non-volatile memory (usually known as a codeplug). These frequencies are usually continuously used to determine which channels are available to the communication receiver. In this regard, the receiver is usually required to frequently scan all relevant channel frequencies in the scan list during a detection portion

("power up" portion) of a scan interval. If any channels are detected during scanning they are then usually processed to determine if they are transmitting messages in one or more specific protocols. Unfortunately, scanning and processing of channels causes power drain on the power supply of the communication receiver, which for a selective call receiver is usually a type AA or AAA battery. Accordingly, if there are numerous channels (typically between 5 to 15) this can result in a relatively long detection portion of the scan interval. As a result, these channels will be frequently scanned and processed and therefore battery life may be inadequate or even unacceptable to users.

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SUMMARY OF THE INVENTION

It is an aim of the invention to overcome or alleviate at least one of the problems associated with scanning or processing channels for a roaming communication receiver.

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According to one aspect of the invention there is provided a communication device comprising:

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receiver means for receiving coded messages transmitted on one or more channels;

processing means, in communication with said receiver means, for processing one or more of said messages;

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channel control means coupled to both said processing means and said receiver means, said channel control means being adapted to control said receiver means to thereby control reception of said channels; and

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a memory means storing a group of channel frequencies, said memory means being coupled to said processing means;

5 wherein said processing means is adapted to dynamically select one or more of said channel frequencies and in combination with said control means, control said receiver means to scan, in a single scan interval, said frequencies that have been dynamically selected.

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Suitably, said processing means may be adapted to dynamically select said channel frequencies depending upon respective baud rate detection of messages received on said channels.

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Preferably, said processing means may be adapted to dynamically select said channel frequencies depending upon respective synchronization detection of messages received on said channels.

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Preferably, said processing means may be adapted to dynamically select said channel frequencies depending upon respective counters reaching a threshold number, said counters being incremental upon synchronization
25 detection failure of respective messages received on said channels.

Suitably, said processing means may be adapted to dynamically select said channel frequencies depending
30 upon respective analysis of one or more bits of messages received respectively on said channels.

Preferably, said processing means may be adapted to dynamically select said channel frequencies, wherein
35 unselected ones of said channels can only be selected after a pre-determined time.

Preferably, said communication device may be a selective call receiver.

According to another aspect of this invention, there
5 is provided a method for dynamic selection of channel frequencies of a communication device, the method comprising the steps of:

scanning for coded messages received on one or more
10 channel frequencies, said channel frequencies being stored in memory means of said device;

processing said messages to dynamically select one or more of said channel frequencies for subsequent scanning, in a single scan interval, said frequencies
15 that have been dynamically selected.

Suitably, said method may be further characterised by said channel frequencies being dynamically selected depending upon respective baud rate detection of messages
20 received on said channels.

Preferably, said method may be further characterised by said channel frequencies being dynamically selected depending upon respective synchronization detection of
25 messages received on said channels.

Preferably, said method may be further characterised by said channel frequencies being dynamically selected depending upon respective counters reaching a threshold
30 number, said counters being incremental upon synchronization detection failure of respective messages received on said channels.

Suitably, said method may be further characterised
35 by said channel frequencies being dynamically selected depending upon respective analysis of one or more bits of messages received respectively on said channels.

Preferably, said method may be further characterised by unselected ones of said channels can only be selected after a pre-determined time.

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BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be readily understood and put into practical effect, reference will now be made to a preferred embodiment as illustrated with reference to the accompanying drawings in which:

FIG. 1 is a block diagram of a selective call receiver in accordance with an embodiment of an invention;

FIG. 2 illustrates a scan interval associated with a scan list of the selective call receiver of FIG. 1 and the relationship thereof with frames of a received message;

FIG. 3 is part of a flow diagram illustrating operation of the selective call receiver of Fig. 1; and

FIG. 4 is a further part of the flow diagram illustrating operation of the selective call receiver of Fig. 1.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

With reference to Fig. 1 there is illustrated a communication device in the form of a selective call receiver 1 commonly known as a pager. Selective call receiver 1 comprises a receiver means 2 coupled to be in communication with a processing means 3. Processing

means 3 includes a channel control means in the form of a frequency synthesizer 4 coupled to be controllable by a micro-processor 13. However, the frequency synthesizer 4 can be arranged to be external to processing means 3.

5 Further, an alert generator 17 is coupled to be controllable by micro-processor 13 and a display in the form of a Liquid crystal display (LCD) 5 and user actuatable function switches 6 are coupled to be in communication with micro-processor 13.

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In this preferred embodiment receiver means 2 includes a receiver 8 coupled to an antenna 7 by a radio frequency amplifier 9.

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The processing means 3 also includes a demodulator 10 coupled to both receiver 8 and a decoder 11. The decoder 11 is coupled to micro-processor 13 and has an associated Read Only Memory (ROM) 12 that stores data for decoding received messages. Micro-processor 13 is also
20 coupled a Random Access Memory (RAM) 14, a Read Only Memory (ROM) 15 and a non-volatile codeplug memory 20. Further, liquid crystal display 5 has an associated slave driver 16 controllable by micro-processor 13.

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As will be apparent to a person skilled in the art, alert generator 17 comprises an addressable tone generator addressable by micro-processor 13. Outputs of tone generator 17 are coupled to drive either or both a speaker and a transducer in the form of a vibrator motor
30 for vibrating a casing of selective call receiver 1.

The Read Only Memory 15 stores data for converting decoded received binary messages into characters for displaying on liquid crystal display 5. In this
35 embodiment Read Only Memory 15 also stores operating code for micro-processor 13, whereas Random Access Memory 14 is for storing received decoded paged messages and is

also used for storing temporary data such as a dynamic Active List AL of channel frequencies. Further, codeplug 20 stores channel information including channel frequencies and information concerning system identifiers such as Simulcast System Identifiers (SSID) or Network Identifiers (NID) as defined in the FlexTM protocol.

In FIG. 2 there is illustrated a Scan Interval SI associated with a scan list of the selective call receiver 1. The scan list is the Active List AL which is a dynamically variable list of frequencies to be scanned. The Scan Interval SI comprises a baud detect period, synchronization word detect period and a sleep period. As illustrated, the Scan Interval SI is less than three frames of a protocol, which in this example is the FlexTM protocol.

Referring to Figs. 3 and 4, there is a flow diagram illustrating a method of operation selective call receiver 1. The code associated with this flow diagram is stored in ROM 15 and it is assumed that frequencies of valid channels are copied from codeplug 20 to the dynamic Active List AL which is stored in RAM 14. At step 50 a baud detect operation is performed on all channel frequencies in Active List AL in which the frequency synthesizer 4 in combination with the processing means 3 controls receiver means 2 in order to scan for coded messages. The baud detect operation is performed during a sampling interval, as is known to a person skilled in the art, which for a receiver 1 expecting a FlexTM message has a duration of less than three frames which is required for receiving and processing four mandatory frames of the FlexTM roaming protocol.

After the baud detect operations have been performed at step 51, step 52 is effected in which processing means 3 flags channel frequencies in Active List AL that have

had a successful baud detect. In other words, channel frequencies that appear to have a valid baud rate for a message protocol are flagged as possible valid channels. After step 52, step 53 performs a synchronization word
5 detect operation usually on a single flagged channel frequency in which information being transmitted on the flagged channel frequency is analysed to determine if it matches a synchronization bit pattern. As will be apparent to a person skilled in the art, the number of
10 flagged channel frequencies on which the word detect operation is performed depends upon the time required to sample the synchronization word and the remainder of the time interval which is a function of the message protocol. The result(s) from step 53 are stored in RAM 14
15 and then at a test step 54 a test is effected to determine if a synchronization word detect operation has been performed on all flagged channel frequencies.

If test step 54 determines that a synchronization
20 word detect operation has not been performed on all flagged channel frequencies, then a mark and prioritise step 55 is effected. At step 55 all flagged non sampled frequencies in Active List AL are prioritised in which the first time this step is effected all flagged non
25 sampled frequencies will be of equal priority. However, when step 55 is subsequently effected the most recent flagged channel frequencies are preferably given a higher priority than other flagged channel frequencies.

30 A synchronization fail test step 56 is effected by processor means 3 upon completion of mark and prioritise step 55. Alternatively, fail test step 56 is effected if test step 54 determines that a synchronization word detect operation has been performed on all flagged
35 channel frequencies. At synchronization fail test step 56, the result(s) from step 53, stored in RAM 14, are analysed to determine if there were any synchronization

word detect failures of any flagged channel frequencies in Active List AL. If test step 56 determines that there were any failures then an increment Interfering Counter step 57 is effected. In this regard, individual
5 interfering counters associated with a respective channel frequency having a synchronization word detect failure are incremented.

A roaming test step 58 is effected by processing
10 means 3 upon completion of increment Interfering Counter step 57 or alternatively if test step 56 determines that there were no failures. Roaming test step 58 checks a Roam bit associated with each flagged channel frequency in Active List AL that has a successful synchronization
15 detect. Thus, when considering the FlexTM protocol, roaming test step 58 is effectively checking if a channel which passed synchronization detect is a roaming channel or non roaming channel as identified by the protocol's designated Roam Bit. If it is determined at step 58 that
20 the roaming bit is unset for one or more flagged channel frequencies in active list AL, then a removal step 59 is effected. The removal step 59 temporarily removes frequencies from the Active List AL in which the Roaming bit (if checked) was identified as unset. A reinstate
25 timer for each frequency removed from Active List AL is then set and each reinstate timer commences counting from a set value to zero.

After removal step 59 or if at step 58 it is
30 determined that each roaming bit is set for each flagged channel frequency in Active List AL, an interfering counter test step 60 is effected by processing means 3. This thereby determines if a respective Interfering Counter of any channel frequencies in Active List AL have
35 reached a threshold value' (typically the threshold value will be set to 5). If any Interfering Counters have

reached the threshold level then a removal step 61 is effected, otherwise a test step 62 is effected.

At removal step 61, frequencies in the Active List
5 AL that have their respective Interfering Counter equal to the threshold value are temporarily removed from the Active List AL. Further, the Interfering Counters associated with each removed frequency are reset to zero and a reinstate timer for each frequency removed from
10 Active List AL is then set and each reinstate timer commences counting from the set value to zero.

Upon completion of step 61 or directly after counter test step 60, test step 62 is effected. At test step 62
15 processing means 3 checks if a complete sample cycle has occurred. For example, in the FlexTM protocol one cycle is 128 frames (4 minutes) and each combined baud and synchronization word detect takes a minimum of 4 frames. Accordingly, a complete cycle will occur when step 62 is
20 effected x times where x is a rounded up value of 240 seconds (on FlexTM cycle) divided by the sampling interval in seconds. When a complete cycle occurs reset step 63 will result otherwise step 51 will be effected.

At reset step 63, the interfering counters
25 associated with a channel frequency that is currently in the Active List AL are reset. A test step 64 is then effected to determine if any marked channel frequencies are in Active List AL. If test step 64 determines that
30 there are no marked non sampled channel frequencies a reset step 65 is effected, otherwise it is determined that Active List AL contains frequencies that are marked non sampled and a test step 66 results.

At reset step 65 frequencies are inserted into the
35 Active List AL that have an expired reinstate timer and their respective markers are reset. At test step 66 the

reinstate counters are checked to determine if any one of them has expired. In this regard when a reinstate timer expires an associated reinstate flag is set, it is this flag which is tested by test step 66. If any reinstate
5 flag is set a step 67 inserts into Active List AL an associated channel frequency and also resets the reinstate flag. If at test step 66 no reinstate flag is set or after completion of step 67, step 51 is again effected and a baud detect operation is performed on all
10 channel frequencies in Active List AL.

Advantageously, the present invention eliminates the scanning of all possible channel frequencies during every Scan Interval SI. This is achieved by dynamically
15 selecting one or more of the channel frequencies which therefore allows for an increase in battery life before recharging or replacement is required. For instance, in the case of a FlexTM non roaming channel or a non FlexTM channel with
20 1600 or 3600 baud signalling information, the selective call receiver 1 will identify these frequencies as interfering. Accordingly, these identified interfering frequencies will not be continuously monitored for baud and synchronization detection thereby reducing battery
25 drain.

Although the invention has been described with reference to a preferred embodiment it is to be understood that the invention is not restricted to the
30 particular embodiment described herein.



WE CLAIM:

1. A communication device comprising:

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receiver means for receiving coded messages transmitted on one or more channels;

processing means, in communication with said
10 receiver means, for processing one or more of said messages;

channel control means coupled to both said processing means and said receiver means, said channel
15 control means being adapted to control said receiver means to thereby control reception of said channels; and

a memory means storing a group of channel frequencies, said memory means being coupled to said
20 processing means;

wherein said processing means is adapted to dynamically select one or more of said channel frequencies and in combination with said control means, control said receiver means to scan, in a single scan
25 interval, said frequencies that have been dynamically selected.

2. A communication device as claimed in claim 1, wherein said processing means is adapted to dynamically
30 select said channel frequencies depending upon respective baud rate detection of messages received on said channels.

3. A communication device as claimed in any preceding
35 claim, wherein said processing means is adapted to dynamically select said channel frequencies depending



upon respective synchronization detection of messages received on said channels.

4. A communication device as claimed in any preceding
5 claim, wherein said processing means is adapted to
dynamically select said channel frequencies depending
upon respective counters reaching a threshold number,
said counters being incremental upon synchronization
detection failure of respective messages received on said
10 channels.

5. A communication device as claimed in any preceding
claim, wherein said processing means is adapted to
dynamically select said channel frequencies depending
15 upon respective analysis of one or more bits of messages
received respectively on said channels.

6. A communication device as claimed in any preceding
claim, wherein said processing means is adapted to
20 dynamically select said channel frequencies, wherein
unselected ones of said channels can only be selected
after a pre-determined time.

7. A communication device as claimed in any preceding
25 claim, wherein, said communication device is a selective
call receiver.

8. A method for dynamic selection of channel
frequencies of a communication device, the method
30 comprising the steps of:

scanning for coded messages received on one or more
channel frequencies, said channel frequencies being
stored in memory means of said device;

35 processing said messages to dynamically select one
or more of said channel frequencies for subsequent



scanning, in a single scan interval, said frequencies that have been dynamically selected.

9. A method as claimed in claim 8, wherein said channel
5 frequencies are dynamically selected depending upon
respective baud rate detection of messages received on
said channels.
10. A method as claimed in claim 8 or claim 9, wherein
10 said channel frequencies are dynamically selected
depending upon respective synchronization detection of
messages received on said channels.
11. A method as claimed in any one of claims 8 to 10,
15 wherein said channel frequencies are dynamically selected
depending upon respective counters reaching a threshold
number, said counters being incremental upon
synchronization detection failure of respective messages
received on said channels.
- 20 12. A method as claimed in any one of claims 8 to 11,
wherein said channel frequencies are dynamically selected
depending upon respective analysis of one or more bits of
messages received respectively on said channels.
- 25 13. A method as claimed in any one of claims 8 to 12,
wherein unselected ones of said channels can only be
selected after a pre-determined time.
- 30 14. A communication device substantially as described
herein with reference to and as illustrated by the
accompanying drawings.
- 35 15. A method substantially as described herein with
reference to and as illustrated by the accompanying
drawings.