

MULTICHANNEL SELECTIVE CALL RECEIVER

Field of the Invention

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This invention relates to selective call receivers, such as pagers, for operating in the communication environment of frame based synchronous selective call systems. In particular, this invention relates to, but is not necessarily limited by, a multichannel selective call receiver and a method for channel monitoring therein.

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Background of the Invention

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Selective call receivers, such as pagers, operating in the communication environment of synchronous selective call systems are known. Within the communication environment, selective call signals are received and decoded by the selective call receivers to obtain information for users. Conventionally, information is encoded onto radio frequency (rf) carriers or channels to form selective call signals in accordance with a messaging protocol of a synchronous selective call system.

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Information can be received on different channels by a multichannel selective call receiver. Such channels are prioritized for the multichannel selective call receiver to monitor for selective call signals. Typically, a multichannel selective call receiver simultaneously scans for higher priority channels to monitor when monitoring a lower priority channel.

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Application of a messaging protocol enables multichannel selective call receivers to efficiently receive and decode information when synchronized to selective call signals. As is known in the art, synchronizing to synchronization codewords of a selective call signal provides a preliminary indication that information is being received correctly. In addition, error checks are also made for a more reliable indication that the information received is correct.

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In many situations within the communication environment, synchronization and error checks on received information works well. However, in some situations, problems can arise when a multichannel selective call receiver is synchronized to synchronization codewords but

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the information is not received correctly. This can occur because, as is known in the art, part of the synchronization codewords used for synchronizing can be transmitted at a lower baud rate than subsequent information encoded in a selective call signal. Also, a change of channel
5 may not occur in these situations because the channel being monitored is of the highest priority and, therefore, the multichannel selective call receiver does not need to scan another equal or lower priority channel. Hence, such a selective call receiver is ineffectively monitoring a highest priority channel without scanning for any other available channels to
10 monitor.

Summary of the Invention

15 It is an object of this invention to provide a multichannel selective call receiver and a method for channel monitoring therein.

According to one aspect of the invention, there is provided a multichannel selective call receiver for operating within a frame based
20 synchronous selective call system, said multichannel selective call receiver comprising:

a receiver for receiving a selective call signal on a current channel when said receiver is synchronized to said signal;
25 signal processing means for processing selected frames of said signal;
and
a controller coupled to said receiver and said signal processing means,
30 wherein said controller is adapted to determine whether to control said receiver to continue monitoring said current channel or to scan other channels to receive other selective call signals in response to a comparison of at least one ratio with at least one control parameter, said ratio being derived from synchronization codewords detected in
35 said selected frames.

Preferably, said controller can be further adapted to derive a first ratio and compare said first ratio with a first control parameter and, when said first ratio is greater than or equal to said first control parameter, said controller is further adapted to derive a second ratio to compare with a
5 second control parameter.

Suitably, said controller can be further adapted to control said receiver to continue monitoring said current channel when said second ratio is greater than or equal to said second control parameter.
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Preferably, said controller can be further adapted to control said receiver to scan for said other channels, said other channels being of higher priority relative to said current channel.

15 Suitably, said controller can be further adapted to control said receiver to stop scanning for said other channels, said other channels being of lower or equal priority relative to said current channel.

20 Preferably, said controller can be further adapted to control said receiver to scan for said other channels when said first ratio is less than said first control parameter or when said second ratio is less than said second control parameter, said other channels being of lower or equal priority relative to said current channel.

25 Suitably, said controller can be further adapted to check that said selected frames are sufficient to derive said first ratio, said first ratio being derived from number of said synchronization codewords detected and number of said selected frames.

30 Preferably, said controller can be further adapted to check that said synchronization codewords detected are sufficient to derive said second ratio, said second ratio being derived from number of block information words detected and number of said synchronization codewords detected.

35 Suitably, said controller can be further adapted to check whether a new channel has been found from scanning said other channels.

Preferably, said controller can be further adapted to control said receiver to stop monitoring said current channel and to start monitoring said new channel when found.

5 Suitably, said signal processing means can include a demodulator.

Preferably, said signal processing means can include a decoder.

10 Suitably, said multichannel selective call receiver can further comprise a memory to store said control parameter.

Preferably, said memory can further store said ratio.

15 According to another aspect of the invention, there is provided a method for channel monitoring by a multichannel selective call receiver operating within a frame based synchronous selective call system, said method comprising the steps of:

20 receiving a selective call signal on a current channel when said receiver is synchronized to said signal;
 processing selected frames of said signal;
 and
 determining whether to control said receiver to continue
25 monitoring said current channel or to scan other channels to receive other selective call signals in response to a comparison of at least one ratio with at least one control parameter, said ratio being derived from synchronization codewords detected in said selected frames.

30 Preferably, said step of determining can comprise the steps of:

 deriving a first ratio;
 comparing said first ratio with a first control parameter;
 deriving a second ratio when said first ratio is greater than or
35 equal to said first control parameter;
 comparing said second ratio with a second control parameter;
 and

controlling said receiver to continue monitoring said current channel when said second ratio is greater than or equal to said second control parameter.

5 Suitably, said step of determining can further comprise the step of controlling said receiver to scan for said other channels when said first ratio is less than said first control parameter or when said second ratio is less than said second control parameter, said other channels being of lower or equal priority relative to said current channel.

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Preferably, said step of controlling can comprise the step of controlling said receiver to scan for said other channels, said other channels being of higher priority relative to said current channel.

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Suitably, said step of controlling can comprise the step of controlling said receiver to stop scanning for said other channels, said other channels being of lower or equal priority relative to said current channel.

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Preferably, said step of deriving said first ratio can comprise the step of checking whether said selected frames are sufficient, said first ratio being derived from number of said synchronization codewords detected and number of said selected frames.

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Suitably, said step of checking can comprise the step of returning to said step of processing when said selected frames are insufficient.

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Preferably, said step of deriving said second ratio can comprise the step of checking whether said synchronization codewords detected are sufficient, said second ratio being derived from number of block information words detected and number of said synchronization codewords detected.

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Suitably, said step of checking can comprise the step of returning to said step of processing when said synchronization codewords detected are insufficient.

Preferably, said method can further comprise the step of checking whether a new channel has been found from scanning said other channels.

5 Suitably, said method can further comprise the step of controlling said receiver to stop monitoring said current channel and to start monitoring said new channel when found.

10 Preferably, said method can further comprise the step of resetting a memory for storing information about said selected frames.

Suitably, said method can further comprise the step of returning to said step of processing when said new channel is not found.

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Brief Description of the Drawings

20 In order to describe the invention and to put it into practical effect, reference will now be made to a preferred embodiment as illustrated with reference to the accompanying drawings in which:

FIG. 1 shows basic structure of a FLEX™ cycle.

25 FIG. 2 is a block diagram of a FLEX™ pager in accordance with a preferred embodiment of the invention; and

FIGs. 3a and 3b is a flow diagram of a method for channel monitoring in the FLEX™ pager of FIG. 2.

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Detailed Description of the Invention

35 One example of a frame based synchronous selective call system that supports multichannel selective call receivers is Motorola's FLEX™ roaming system. The FLEX™ roaming system will be used as an example to illustrate this invention. Conventionally, a FLEX™ selective call signal or FLEX™ signal provides a plurality of FLEX™ cycles transmitted on a

channel. A FLEX™ multichannel selective call receiver or pager has to synchronize to this FLEX™ signal to selectively process frames within some of the FLEX™ cycles to obtain information.

5 FIG. 1 shows basic structure of a FLEX™ cycle 10. The structure of cycle 10 is defined in accordance with the FLEX™ messaging protocol. cycle 10 is cyclically transmitted on a channel and has one hundred and twenty-eight frames that are transmitted within a predetermined time of four minutes. A frame 11 is indicated in FIG. 1 and is partially exploded to show
10 a synchronization codeword 12 and a plurality of data blocks 13. Synchronization codeword 12 contains three portions, namely, Sync_1 15, a frame information word 16 and Sync_2 17.

 A data block 13 includes an initial portion (not shown) that is referred to as a block information word (BIW) and which specifies information
15 contained in the remaining portion of the data block 13. The FLEX™ messaging protocol permits data blocks 13 to be transmitted at a baud rate equal to or higher than Sync_1 15 of synchronization codeword 12.

 Selected frames within cycle 10 of a FLEX™ signal provide information to a FLEX™ pager. Such frames are specified by channel
20 parameters such as collapse cycles and addresses. To continue monitoring for information, the FLEX™ pager conventionally checks Sync_1 15 and the BIW. Presently, checking Sync_1 15 and the BIW requires a substantial period of time before it can be determined that the FLEX™ signal is weak and that, therefore, another channel should be
25 monitored for other FLEX™ signals. Furthermore, as Sync_1 15 can be transmitted more reliably at a lower baud rate compared with data blocks 13, the FLEX™ pager can mistakenly pass the test on Sync_1 15 while receiving subsequent information poorly. Hence, the FLEX™ pager can continue monitoring a channel without receiving any of the subsequent
30 information.

 A block diagram of a FLEX™ pager 20 in accordance with a preferred embodiment of the invention is shown in FIG. 2. Pager 20 is operable
35 within the communication environment of a FLEX™ roaming system to receive FLEX™ signals. These FLEX™ signals are cyclically transmitted on different radio frequency (rf) carriers or channels within the communication environment. Pager 20 can selectively monitor the different channels to

receive one of the FLEX™ signals. A FLEX™ signal 21 is illustrated as an example in FIG. 2.

As shown in FIG.2, pager 20 comprises a receiver 22 coupled to an antenna 23, signal processing means 24 for processing selected frames from FLEX™ signal 21 on a current channel, a controller 25 and memory 26 for storing channel parameters and at least one control parameter. Memory 26 also stores information about the selected frames of a channel when pager 20 is monitoring such a channel. In this preferred embodiment, signal processing means 24 includes a demodulator 27 and a FLEX™ decoder 28. Controller 25 couples to receiver 22, memory 26 and FLEX™ decoder 28 to process the selected frames and provide information to a user of pager 20.

When receiver 22 is synchronized to FLEX™ signal 21 on the current channel, controller 25 makes a comparison of at least one ratio with at least one control parameter. In response to this comparison, controller 25 is adapted to determine whether to control receiver 22 to continue monitoring the current channel or to scan other channels to receive other FLEX™ signals (not shown). The at least one ratio is derived from synchronization codewords detected in the selected frames.

Control parameters are predetermined and stored within memory 26. Such control parameters can be varied depending on the communication environment in which pager 20 is intended to operate. For this invention, a control parameter is a numerical variable with which to compare with the at least one ratio.

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Reference will now be made to FIGs. 3a and 3b which shows a flow diagram of a method 30 for channel monitoring in FLEX™ pager 20. Starting from step 31, receiver 21 is receiving FLEX™ signal 21 at step 32. Selected frames from FLEX™ cycles within FLEX™ signal 21 are processed by signal processing means 24 at step 33. At decision step 34, controller 25 checks whether the selected frames are sufficient for deriving a first ratio. When there are insufficient selected frames, method 30 returns to step 33 for processing more selected frames. Otherwise, method 30 continues to step 35 to derive the first ratio.

In this preferred embodiment, the first ratio is a synchronization ratio. This synchronization ratio (Sync_Ratio) is derived from the synchronization codewords detected in the selected frames. Conventionally, detection of

Sync_1 15 corresponds to detection of a synchronization codeword. The Sync_Ratio is derived as follows:

$$\text{Sync_Ratio} = \frac{\text{Number of synchronization codewords detected}}{\text{Number of selected frames}}$$

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Following the derivation of the first ratio at step 35, method 30 proceeds to decision step 36 in which controller 25 compares the Sync_Ratio with a first control parameter. At decision step 36, controller 25 determines whether the Sync_Ratio is greater than or equal to the first control parameter. With a "No" from decision step 36, method continues to step 40 in which controller 25 controls receiver 22 to scan for the other channels. These other channels will be of lower or equal priority relative to the current channel. With a "Yes" from decision step 36, method 30 continues to decision step 37 in which controller 25 checks whether the synchronization codewords detected are sufficient.

Method 30 returns to step 33 with a "No" from decision step 37 or, with a "Yes", proceeds to step 38 in which controller 25 derives a second ratio. In this preferred embodiment, the second ratio is a block information word ratio (BIW_Ratio). This BIW_Ratio is derived from number of block information words (BIWs) detected and number of the synchronization codewords detected in the selected frames. Conventionally, detection of a BIW is known and such detection conventionally requires, among other things, detection of frame information word 16 and Sync_2 17 subject to a tolerable degree of error. The BIW_Ratio is derived as follows:

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$$\text{BIW_Ratio} = \frac{\text{Number of BIWs detected}}{\text{Number of synchronization codewords detected}}$$

Following the derivation of the BIW_Ratio, method 30 proceeds to decision step 39 in which controller 25 compares the BIW_Ratio with the second control parameter. At decision step 39, controller 25 determines whether the BIW_Ratio is greater than or equal to the second control parameter. With a "No" from decision step 39, method 30 continues to step 40 in which controller 25 controls receiver 22 to scan for the other channels. These other channels will be of lower or equal priority relative to the current channel. With a "Yes" from decision step 39, method 30

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continues to step 41 in which controller 25 controls receiver 22 to continue monitoring the current channel and also to scan for other channels which are of higher priority relative to the current channel. At step 41, controller 25 also controls receiver 22 to stop scanning for other channels that are of
5 lower or equal priority relative to the current channel. This scanning of lower or equal priority channels by receiver 22 may occur just prior to step 41 because method 30 can return to step 41 following an earlier step 40.

Method 30 continues to decision step 42 from either step 40 or 41. At
10 decision step 42, controller 25 checks whether a new channel has been found from scanning of the other channels. When a new channel has been found, controller 25 controls receiver 22 to stop monitoring the current channel and to start monitoring this new channel at step 43. Otherwise, when a new channel is not found, method 30 returns to step 33.

15 Proceeding from step 43, memory 26 is reset at step 44 to store information about the selected frames of the new channel. As described above, such information is used to derive the Sync_Ratio and the BIW_Ratio.

20 Advantageously, method 30 is an improvement over conventional channel monitoring in frame based synchronous selective call systems. By applying method 30, pager 20 can reliably monitor other FLEX™ signals in the communication environment regardless of the priority of such FLEX™ signals. Hence, situations in which a higher priority channel is
25 inappropriately monitored when a lower priority channel can more reliably provide information are avoided. Such situations can occur, for example, within overlapping coverage areas of a synchronous selective call system where more than one channel is available to provide information.

30 Although the invention has been described with reference to a preferred embodiment using the FLEX™ roaming system as an example, it is to be understood that the invention is not restricted to the preferred embodiment described herein.



Claims

What is claimed is:

- 5 1. A multichannel selective call receiver for operating within a frame based synchronous selective call system, said multichannel selective call receiver comprising:
- 10 a receiver for receiving a selective call signal on a current channel when said receiver is synchronized to said signal;
- signal processing means for processing selected frames of said signal;
- 15 and
- a controller coupled to said receiver and said signal processing means,
- 20 wherein said controller is adapted to determine whether to control said receiver to continue monitoring said current channel or to scan other channels to receive other selective call signals in response to a comparison of at least one ratio with at least one control parameter, said ratio being derived from synchronization
- 25 codewords detected in said selected frames.
- 30 2. The multichannel selective call receiver as claimed in Claim 1 wherein said controller is further adapted to derive a first ratio and compare said first ratio with a first control parameter and, when said first ratio is greater than or equal to said first control parameter, said controller is further adapted to derive a second ratio to compare with a second control parameter.
- 35 3. The multichannel selective call receiver as claimed in Claim 2 wherein said controller is further adapted to control said receiver to continue monitoring said current channel when said second ratio is greater than or equal to said second control parameter.



4. The multichannel selective call receiver as claimed in Claim 3
wherein said controller is further adapted to control said receiver
to scan for said other channels, said other channels being of
higher priority relative to said current channel.
5. The multichannel selective call receiver as claimed in Claim 3
wherein said controller is further adapted to control said receiver
to stop scanning for said other channels, said other channels
being of lower or equal priority relative to said current channel.
6. The multichannel selective call receiver as claimed in Claim 2
wherein said controller is further adapted to control said receiver
to scan for said other channels when said first ratio is less than
said first control parameter or when said second ratio is less than
said second control parameter, said other channels being of lower
or equal priority relative to said current channel.
7. The multichannel selective call receiver as claimed in Claim 2
wherein said controller is further adapted to check that said
selected frames are sufficient to derive said first ratio, said first
ratio being derived from number of said synchronization
codewords detected and number of said selected frames.
8. The multichannel selective call receiver as claimed in Claim 2
wherein said controller is further adapted to check that said
synchronization codewords detected are sufficient to derive said
second ratio, said second ratio being derived from number of
block information words detected and number of said
synchronization codewords detected.
9. The multichannel selective call receiver as claimed in Claim 1
wherein said controller is further adapted to check whether a new
channel has been found from scanning said other channels.



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10. The multichannel selective call receiver as claimed in Claim 9 wherein said controller is further adapted to control said receiver to stop monitoring said current channel and to start monitoring said new channel when found.
11. The multichannel selective call receiver as claimed in Claim 1 wherein said signal processing means includes a demodulator.
- 10 12. The multichannel selective call receiver as claimed in Claim 1 wherein said signal processing means includes a decoder.
- 15 13. The multichannel selective call receiver as claimed in Claim 1 wherein said multichannel selective call receiver further comprises a memory to store said control parameter.
14. The multichannel selective call receiver as claimed in Claim 13 wherein said memory further stores said ratio.
- 20 15. A method for channel monitoring by a multichannel selective call receiver operating within a frame based synchronous selective call system, said method comprising the steps of:
- 25 receiving a selective call signal on a current channel when said receiver is synchronized to said signal;
- processing selected frames of said signal;
- and
- 30 determining whether to control said receiver to continue monitoring said current channel or to scan other channels to receive other selective call signals in response to a comparison of at least one ratio with at least one control parameter, said ratio being derived from synchronization codewords detected in said
- 35 selected frames.



16. The method of Claim 15 wherein said step of determining comprises the steps of:

deriving a first ratio;

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comparing said first ratio with a first control parameter;

deriving a second ratio when said first ratio is greater than or equal to said first control parameter;

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comparing said second ratio with a second control parameter;

and

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controlling said receiver to continue monitoring said current channel when said second ratio is greater than or equal to said second control parameter.

17. The method of Claim 16 wherein said step of determining further comprises the step of controlling said receiver to scan for said other channels when said first ratio is less than said first control parameter or when said second ratio is less than said second control parameter, said other channels being of lower or equal priority relative to said current channel.

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18. The method of Claim 16 wherein said step of controlling comprises the step of controlling said receiver to scan for said other channels, said other channels being of higher priority relative to said current channel.

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19. The method of Claim 16 wherein said step of controlling comprises the step of controlling said receiver to stop scanning for said other channels, said other channels being of lower or equal priority relative to said current channel.

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- 5 20. The method of Claim 16 wherein said step of deriving said first ratio comprises the step of checking whether said selected frames are sufficient, said first ratio being derived from number of said synchronization codewords detected and number of said selected frames.
- 10 21. The method of Claim 20 wherein said step of checking comprises the step of returning to said step of processing when said selected frames are insufficient.
- 15 22. The method of Claim 16 wherein said step of deriving said second ratio comprises the step of checking whether said synchronization codewords detected are sufficient, said second ratio being derived from number of block information words detected and number of said synchronization codewords detected.
- 20 23. The method of Claim 22 wherein said step of checking comprises the step of returning to said step of processing when said synchronization codewords detected are insufficient.
- 25 24. The method of Claim 1 and further comprising the step of checking whether a new channel has been found from scanning said other channels.
- 30 25. The method of Claim 24 and further comprising the step of controlling said receiver to stop monitoring said current channel and to start monitoring said new channel when found.
- 35 26. The method of Claim 25 and further comprising the step of resetting a memory for storing information about said selected frames.
27. The method of Claim 24 and further comprising the step of returning to said step of processing when said new channel is not found.



28. A multichannel selective call receiver comprising a receiver, signal processing means and a controller substantially as described herein with reference to and as illustrated by the accompanying drawings.

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29. A method for channel monitoring by a multichannel selective call receiver operating within a frame based synchronous selective call system substantially as described herein with reference to and as illustrated by the accompanying drawings.

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