(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 179 819 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.02.2002 Bulletin 2002/07

(51) Int Cl.[7]: **G10L 19/00**

(21) Application number: **01301443.6**

(22) Date of filing: **19.02.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **11.08.2000 US 635739**

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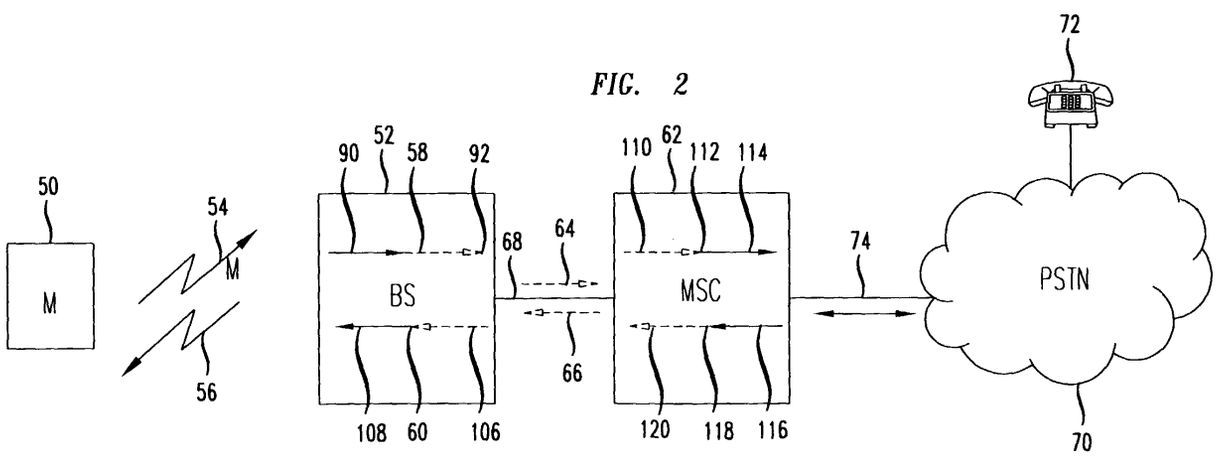
(54) Efficient comfort noise transmission

(57) During periods of silence, communication links between elements of a communication system are used more efficiently by sending messages instructing an element to generate comfort noise rather than sending messages containing comfort noise. A message instructing an element to generate comfort noise is smaller than a message containing comfort noise. As a result, the bandwidth of links between communication system elements is used more efficiently by sending messages or commands to generate comfort noise rather than a message containing comfort noise.

FIG. 2



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Description

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to communications; more specifically, wireless communications.

2. Description of the Related Art

[0002] FIG. 1 illustrates a prior art communication system. Mobile communication system element 10 communicates over an air link to base station communication system element 12. Base station communication system element 12 then communicates over communication link 14 to mobile switching center (MSC) communication system element 16. Communications from MSC 16 are then passed over a communication link such as link 18 to public switched telephone network (PSTN) communication system element 20 or, for example, another MSC. Communications from mobile 10 to PSTN 20 and destination communication system element 22 follow a communication path comprising upward air link 30, communication path 32 of base station 12, communication path 34 of link 14, communication path 36 of MSC 16, and then communication path 38 of link 18. Communications to mobile 10 from destination communication system element 22 pass from PSTN 20 over communication path 38 of link 18, over communication path 40 of MSC 16, over communication path 42 of link 14, and then over communication path 44 of base station 12 and finally over downward air link 46 to mobile 10.

[0003] During a typical communication session there are periods of silence, near silence or no voice either coming to mobile 10 or leaving mobile 10. During these periods of silence, a user at either end of the communication link may feel uncomfortable and falsely believe that the communication path has been disrupted. In order to make users at both ends of the communication path feel more comfortable, comfort noise is injected into the communication link when periods of silence, near silence or no voice are detected. Comfort noise is simply a static-like sound that allows a user to hear something indicating that the communication link is still active during periods of silence in a conversation. When a user at mobile 10 is not speaking, mobile 10 generates comfort noise which is passed over communication paths 30, 32, 34, 36 and 38 and via PSTN 20 to destination 22. Similarly, when a user at destination 22 does not speak, the silence or no voice condition is detected at MSC 16. MSC 16 injects comfort noise into communication path 40 which passes the comfort noise over communication paths 42, 44 and 46 to mobile 10.

[0004] Link 14 between base station 12 and MSC 16 is typically leased by a wireless communication service provider and is a significant portion of the cost of operating a wireless communication system.

Summary of the Invention

[0005] Wasting bandwidth of a communication link by sending comfort noise is an inefficient use of an expensive resource. The present invention provides a more efficient use of communication links between elements of a communication system. The links are used more efficiently by sending messages instructing an element to generate comfort noise rather than sending messages containing comfort noise. A message instructing an element to generate comfort noise is smaller than a message containing comfort noise. As a result, the bandwidth of links between communication system elements is used more efficiently by sending messages or commands to generate comfort noise rather than a message containing comfort noise.

Brief Description of the Drawings

[0006]

FIG. 1 illustrates a prior art communication system;
FIG. 2 illustrates a communication system using comfort noise generation messages;
FIG. 3 illustrates a message format;
FIG. 4 illustrates a simplified block diagram of a base station; and
FIG. 5 illustrates a simplified block diagram of a mobile switching center.

Detailed Description

[0007] FIG. 2 illustrates a communication system embodying the present invention. Mobile communication system element 50 communicates with base station communication system element 52 using an air link comprising upward path 54 and downward path 56. Communications from mobile 50 pass through base station 52 over paths 58 and 60, and are passed to and from MSC communication system element 62 over communication paths 64 and 66 of link 68. Communications to and from mobile 50 then pass from MSC 62 to public switched telephone network communication system element 70 and destination communication system element 72 through communication link 74.

[0008] When a user of mobile 50 is not speaking or there is near silence, mobile 50 generates a message containing comfort noise which is transmitted over upward path 54 to base station 52. Base station 52 detects the comfort noise in communication path 58 and replaces the message containing comfort noise with a message instructing the next communication system element, which in this case is MSC 62, to generate comfort noise. This is illustrated in FIG. 2 where communication path 58 consists of inward section 90 which carries messages containing comfort noise and outward section 92

which carries comfort noise generation messages instructing MSC 92 to generate a message containing comfort noise. The comfort noise generation message is passed over communication path 64 of link 68 to MSC 62. Inward section 110 of communication path 112 of MSC 62 carries the comfort noise generation messages. In response to receiving the comfort noise generation message, MSC 62 generates a comfort noise message containing comfort noise and passes it along section 114 of communication path 112 and then across link 74 and eventually to destination 72 via PSTN 70.

[0009] In a similar fashion, when a user at destination 72 does not speak, a period of silence is detected by MSC 62 by examining the data in a message or packet received along inward section 116 of communication path 118. In response to detecting a period of silence or near silence, MSC 62 creates a comfort noise generation message that instructs a receiving communication system element, which in this case is base station 52, to generate a comfort noise message containing comfort noise. MSC 62 sends the comfort noise generation message along outward section 120 of communication path 118 and over communication path 66 of link 68 to base station 52. Base station 52 then receives the comfort noise generation message on inward section 106 of communication path 60. In response to receiving the message, base station 52 generates a comfort noise message containing comfort noise which is sent along outward section 108 of communication path 60 and then over downward path 56 to mobile 50.

[0010] As a result of sending messages that instruct a communication system element to generate comfort noise rather than sending messages containing comfort noise, communication paths 64 and 66 of link 68 are used more efficiently. FIG. 3 illustrates a typical format for messages passed over communication paths 64 and 66 of link 68. Message 90 comprises header section 92 and body 94. Depending on the type of message being sent, body section 94 varies in size. In the case of messages containing comfort noise, body section 94 is equal in size to header section 92. As a result, 50% of the message space is used to convey comfort noise. The message can be shortened by removing the comfort noise and sending a command or indication to produce comfort noise. For example, 50% of the message can be eliminated by dropping message body 94 and sending header 92 without a body section. A communication element receiving a header without a body will then respond to a message in that format as a command to generate a message containing comfort noise. It is also possible to send a message 90 without body 94 with a specific bit pattern set within header 92 to indicate that comfort noise should be generated. Other types of messages may be used, but in order to obtain improved efficiency, the overall message should be shorter than a full message containing comfort noise.

[0011] FIG. 4 illustrates a simplified block diagram of base station 52. Base station 52 sends and receives signals on antenna 121. Signals to and from antenna 121 are passed through modulator/demodulator 122 and then through multiplexer/demultiplexer 124 which supplies signals to and receives signals from processors 126 and 128. Typically, a processor is provided for each communication channel handled by the base station. To simplify the figure, only two processors are shown. A processor, such as processor 126, receives messages that were transmitted by mobile 50 and received via modulator/demodulator 122 and multiplexer/demultiplexer 124. Processor 126 performs functions such as encryption and decryption, encoding and error correction. In addition to these functions, processor 126 determines whether message body 94 contains comfort noise. This can be detected, for example, by a relatively low amplitude associated with the data in message body 94. In response to receiving a message containing comfort noise, processor 126 outputs a comfort noise generation message instructing a receiving communication system element to generate a comfort noise message containing comfort noise. In this example, processor 126 outputs header 92 without body 94, and passes it to multiplexer/demultiplexer 130. Multiplexer/demultiplexer 130 then passes the message through communication link 68 to MSC communication system element 62.

[0012] FIG. 5 illustrates a simplified block diagram of MSC 62. A comfort noise generation message is received over link 68 by multiplexer/demultiplexer 150. Multiplexer/demultiplexer 150 then provides an output to vocoders or processors 152 through 154. A vocoder/processor is typically assigned to each communication channel or mobile user being serviced by MSC 62. Vocoder/ processors 152 through 154 are typically used to encode and decode speech to minimize the amount of data required to represent the speech. In order to simplify the diagram, only two vocoder/processors are shown. When vocoder/processor 152 receives a comfort noise generation message commanding the generation of a message containing comfort noise, vocoder/processor 152 sends a comfort noise message or packet containing comfort noise to switch 160. Switch 160 then passes the message or packet containing comfort noise to PSTN 70 for eventual delivery to destination communication system element 72.

[0013] When a period of silence or near silence is detected on a message or packet coming from PSTN 70 to vocoder/processor 152 via switch 160, vocoder/processor 152 generates a comfort noise generation message instructing a receiving communication element to generate a message containing comfort noise. Vocoder/processor 152 detects periods of silence or near silence, for example, by detecting a message or packet with data representing voice or sound where the amplitude associated with that voice or sound is below a threshold. The threshold may be, for example, 5% of the maximum available amplitude associated with the data representing the voice or sound. The comfort noise generation

message is then passed through multiplexer/demultiplexer 150 and over link 68 to multiplexer/demultiplexer 130 of base station 52. The comfort noise generation message is then received by vocoder/processor 126 which in response to the comfort noise generation message generates a comfort noise message containing comfort noise. The message containing comfort noise is then passed through multiplexer/demultiplexer 124 and modulator/demodulator 122 for transmission over antenna 121 to mobile 50.

Claims

1. A method, **characterized by** the steps of:

receiving a comfort noise generation message at a first communication system element;
generating a comfort noise message containing comfort noise in response to the comfort noise generation message; and
sending the comfort noise message to a second communication system element.

2. The method of claim 1, **characterized in that** the first communication system element is a base station.

3. The method of claim 2, **characterized in that** the second communication system element is a mobile station.

4. The method of claim 1, **characterized in that** the first communication system element is a mobile switching center.

5. The method of claim 4, **characterized in that** the second communication system element is a public switched telephone network.

6. The method of claim 1, **characterized in that** the comfort noise generation message is a message header.

7. The method of claim 6, **characterized in that** the message header comprises a bit pattern defining an instruction to generate the comfort noise message.

8. A method, **characterized by** the steps of:

receiving a message indicating low sound information at a first communication system element;
generating a comfort noise generation message instructing a second communication system element to generate a comfort noise message containing comfort noise; and
sending the comfort noise generation message to the second communication system element.

9. The method of claim 8, **characterized in that** the first communication system element is a base station.

10. The method of claim 9, **characterized in that** the second communication system element is a mobile switching center.

11. The method of claim 8, **characterized in that** the first communication system element is a mobile switching center.

12. The method of claim 11, **characterized in that** the second communication system element is a base station.

13. The method of claim 8, **characterized in that** the comfort noise generation message is a message header.

14. The method of claim 13, **characterized in that** the message header comprises a bit pattern defining an instruction to generate the comfort noise message.

15. The method of claim 8, **characterized in that** the step of receiving a message indicating low sound information comprises detecting a message containing comfort noise.

16. The method of claim 8, **characterized in that** the step of receiving a message indicating low sound information comprises detecting a message containing sound information associated with an amplitude below a threshold.

17. A method, **characterized by** the steps of:

receiving a first comfort noise generation message at a first communication system element;
generating a first comfort noise message containing comfort noise in response to the first comfort noise generation message;
sending the first comfort noise message to a second communication system element;
receiving a message indicating low sound information at the first communication system element;
generating a second comfort noise generation message instructing a third communication system element to generate a second comfort noise message containing comfort noise; and
sending the second comfort noise generation message to the third communication system element.

18. The method of claim 17, **characterized in that** the first communication system element is a base station, the second communication system element is a mobile station and the third communication system element is a mobile switching center.

19. The method of claim 17, **characterized in that** the first communication system element is a mobile switching center, the second communication system element is a public switched telephone network and the third communication system element is a base station.

20. The method of claim 17, **characterized in that** the step of receiving a message indicating low sound information comprises detecting a message containing sound information associated with an amplitude below a threshold.

21. The method of claim 17, **characterized in that** the step of receiving a message indicating low sound information comprises detecting a message containing comfort noise.

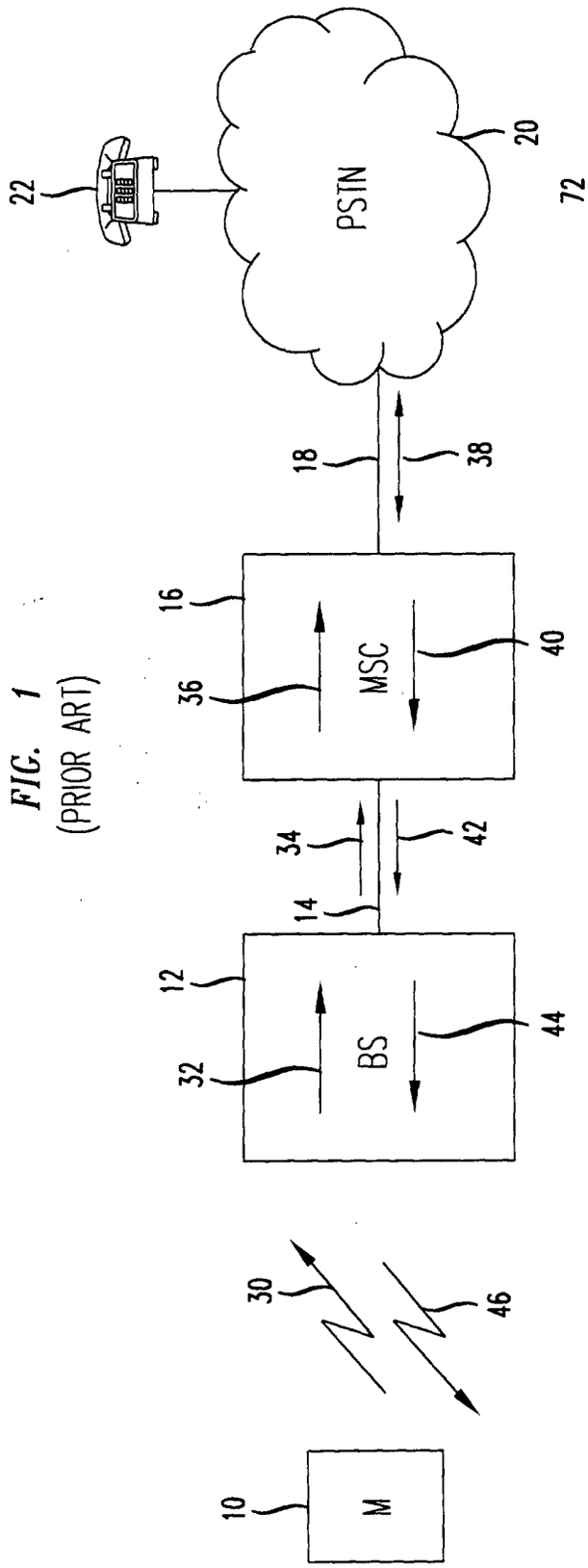


FIG. 1
(PRIOR ART)

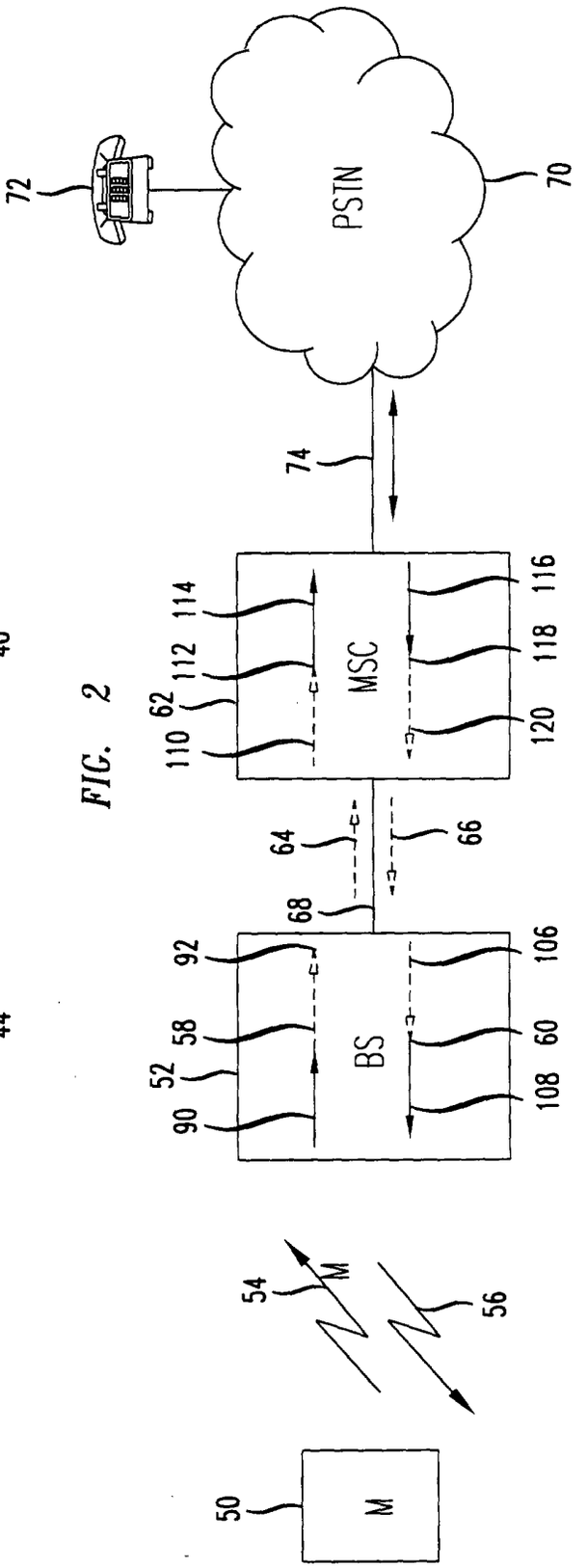


FIG. 2

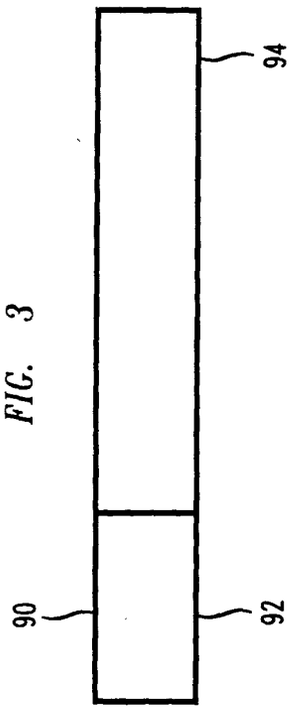

90
92
94

FIG. 3

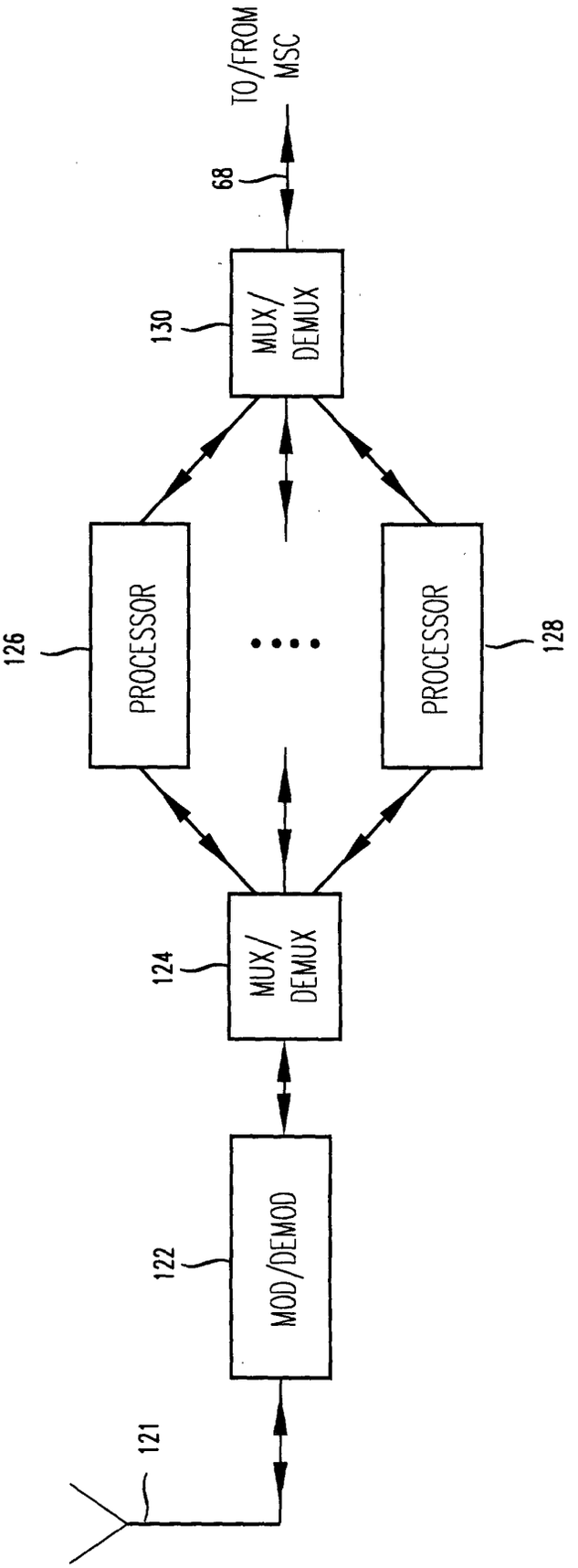
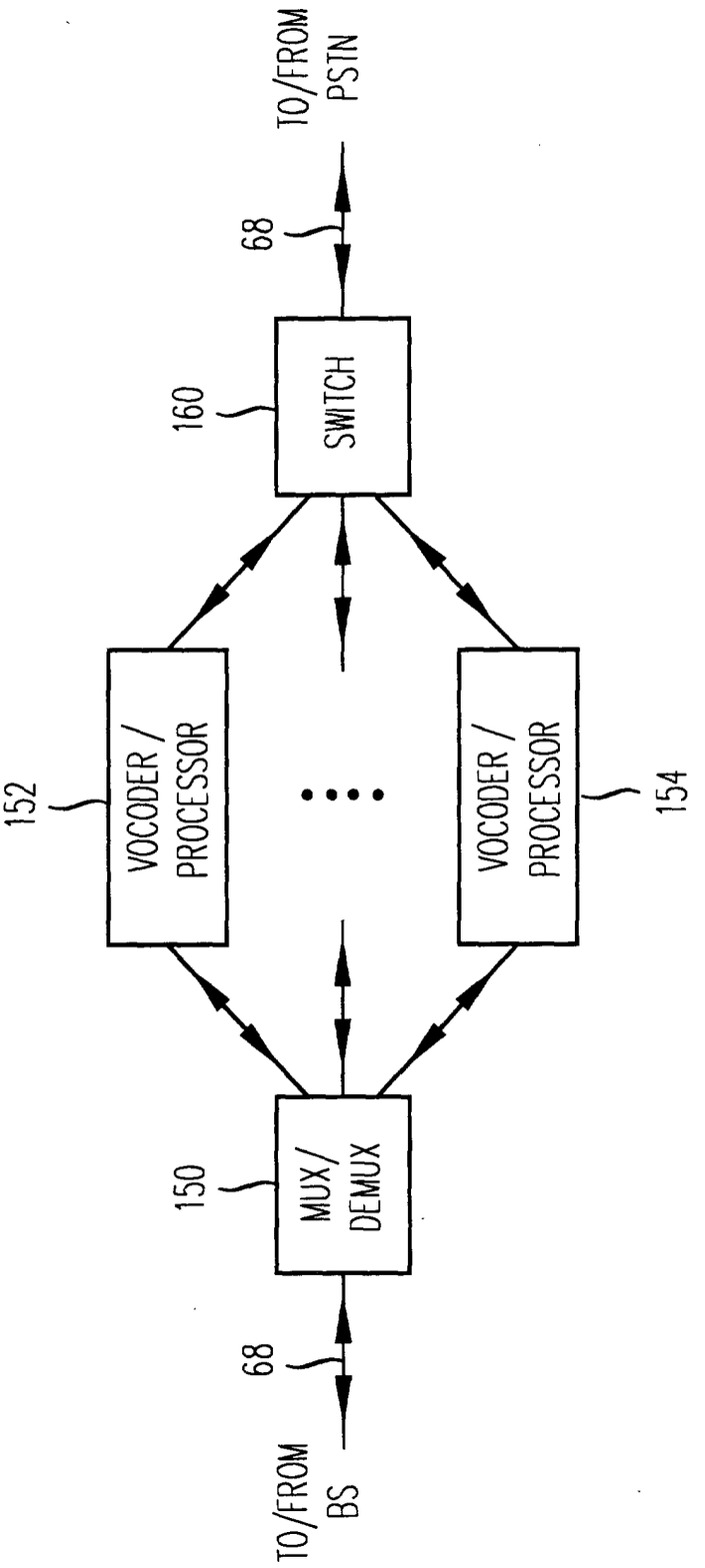

TO/FROM MSC
68
130
MUX/ DEMUX
126
PROCESSOR
128
PROCESSOR
124
MUX/ DEMUX
122
MOD/DEMOD
121

FIG. 4

FIG. 5


TO/FROM PSTN
68
160
SWITCH
152
VOCODER / PROCESSOR
VOCODER / PROCESSOR
154
150
MUX/ DEMUX
68
TO/FROM BS

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EUROPEAN SEARCH REPORT

Application Number
EP 01 30 1443

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	24 April 2001	Kreppel, J

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 1443

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