(19) EP 1 860 897 B1

(11) EP 1 860 897 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent: 30.12.2009 Bulletin 2009/53

(51) Int Cl.: H04W 88/08 (2009.01)

(21) Application number: 06254892.0

(22) Date of filing: 21.09.2006

(54) Radio base station receiver, resource allocating method and program

Funkbasisstationsempfänger, Verfahren zur Betriebsmittelzuteilung und Programm

Récepteur de station de base radio, procédé d’allocation de resources et programme

(84) Designated Contracting States: DE FR GB

(30) Priority: 26.05.2006 JP 2006147280

(43) Date of publication of application: 28.11.2007 Bulletin 2007/48

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Description

Background of the Invention

Field of the Invention

[0001] The present invention relates to a radio base station receiver that conducts reception of communication data from a plurality of users, and particularly to a method of managing process resources for processing received data of an uplink transmission (data transmitted from mobile terminals to the radio base station) in the radio base station receiver.

Description of the Related Art

[0002] Recently, a 3rd generation service started in mobile radio systems, and a CDMA (Code Division Multiple Access) method is used in the mobile radio systems of the 3rd generation. The mobile radio system of the CDMA method such as the above is disclosed in Patent Document 1 below.

[0003] Fig. 1 shows an example of a basic configuration of a radio base station receiver in a mobile radio system using the CDMA method. In the receiver shown in Fig. 1, received data of an uplink transmission is converted from data in a radio frequency band into digital data in a baseband frequency band by an RF (Radio Frequency) processing circuit 70 and an A/D (Analog/Digital) converter circuit 80 after being received by an antenna 60. A despreading process is executed by a despreading process unit 30 on the received data of the uplink transmission that has been converted into the digital data. Because the data demodulated through the despreading process was subjected to an encoding process (Viterbi encoding, Turbo encoding, or the like) by a channel coding process when being transmitted, a decoding process is executed on the demodulated data by a channel decoding process unit 40 in order to convert the data back into its original state. In the receiver, the number of resources for executing processes is limited depending on the processing capacity of the device; accordingly, the entire process amount is controlled by resource management unit 10 managing the resources.

[0004] Fig. 2 shows the despreading process unit 30, the channel decoding process unit 40, and resource management unit 10 for managing the resources of the despreading process unit 30 and channel decoding process unit 40 in a conventional example. In the conventional example, in order to simultaneously conduct reception of uplink data from a plurality of users, the resources for the despreading process by the despreading process unit 30 and the resources for the channel decoding process by the channel decoding process unit 40 are prepared such that they are of the same number, and the above resource management unit 10 conducts allocation such that the ratio of the resource for the despreading process to that for the channel decoding process is 1:1.

Next, a process flow of the above resource management unit 10 is explained by referring to Fig. 3.

[0005] Resource management unit 10 is activated by a resource allocation request from a higher layer, and checks the number of remaining resources in step S50. When the resource allocation cannot be conducted because there is no available resource, the process proceeds to step S53, and an NG response indicating that the allocation cannot be conducted is made to the higher layer in order to report resource depletion. When there are available resources, the resources are allocated to the despreading process unit 30 and the channel decoding process unit 40, the number of remaining resources is decremented by one in step S51, and a completion response of the resource allocation is made to the higher layer in step S52.

[0006] As mobile radio systems such as the above have realized higher speed and a broader band, not only conventional voice communications, but also various services utilizing packet communications have been realized. Accordingly, the percentage of communication data used in the packet data communication services to the uplink data received by the radio base station has increased.

[0007] Additionally, competition among network operators has become more intensive, and the infrastructures of the base stations and the like are increasingly required to be of a lower cost.


[0009] Voice communication such as telephone calls or the like are included in types of continuous communications because the data to be received is continuously transmitted. In contrast, in communications such as packet data communications or the like, the data to be received does not arrive continuously.

[0010] In radio base station devices, in order to secure radio links between the base station device and terminal devices (in order to secure pilot synchronization), the despreading process has to be continuously executed for demodulating pilot signals even in communication services other than continuous communication services, such as packet data communication. However, when there is no user communication data to be transmitted, the channel decoding process unit does not have to operate.

[0011] In the conventional examples, as many resources for the channel decoding processes as there are resources for the despreading processes are required because the resources for the despreading processes and the resources for the channel decoding processes are managed such that the ratio therebetween is 1:1. Thus, even when a data process is not executed, the resources for the channel decoding processes for the maximum number of users to whom the service can be
provided simultaneously are secured.

[0013] However, for packet communication, it is sufficient that the channel decoding process unit is used only when data is processed; accordingly, it is not necessary to occupy the resources for the channel decoding processes continuously.

[0014] In the conventional examples, in a device that conducts reception of data from a plurality of users such as the radio base station receiver, both of the resources for the despreading processes and the resources for the channel decoding processes are prepared such that they are of the same number as the users whose data is processed simultaneously. Accordingly, a problem is created in which the circuit scale of the radio base station receiver becomes large.

[0015] It is an object of the present invention to prevent the circuit scale of the radio base station receiver from becoming large, and to reduce the cost of the radio base station device.

[0016] WO 99/18744 discloses a base transceiver station for a mobile communications system which is divided into a plurality of functional units that enables the signal processing resources to be flexibly allocated. A flexible communications interface between the base transceiver station units allows the signal processing resources within the units to be used more efficiently. The base transceiver station hardware is dimensioned to distribute the signal processing resources statistically among the different available radio transmission services.

[0017] US 6 452 911 discloses a method of allocating vocoders during a simultaneous transfer of voice and data frames in a mobile communication system which includes allocating a separate vocoder for processing the voice frame and the data frame. When a mobile communication receives multiple requests for a simultaneous transfer of voice and data frames, the data frames are multiplexed and allocated to a single vocoder.

Summary of the Invention

[0018] The invention is defined by the independent claims. Optional features are set out in the dependent claims.

[0019] In the present invention, a resource allocation control unit may be provided between a despreading process unit and a channel decoding process unit of a radio base station receiver, and a resource for a channel decoding process is allocated only when there is actually user communication data in a communication service which is not of a continuous data communication by the resource allocation control unit.

[0020] Also, a radio base station receiver according to the present invention may have a demodulated data storage unit for putting the process to wait for a resource for a channel decoding process to become available.

[0021] According to the present invention, it is possible to reduce the number of resources required by the channel decoding process unit because the process method of the channel decoding process unit is controlled according to services. Accordingly, it is possible to reduce the scale of a circuit in the radio base station receiver. It is also possible to easily increase the number of users even when there are not so many resources for the channel decoding processes.

[0022] Therefore, according to the present invention, the resources for the channel decoding processes are used in common such that circuit efficiency is improved, and the channel decoding process unit can be used efficiently.

Brief Description of the Drawings

[0023] Fig. 1 shows an example of a basic configuration of a radio base station receiver;

Fig. 2 shows a despreading process unit and a channel decoding process unit in a conventional example;

Fig. 3 shows an example of a process flow of a resource management unit in a conventional example;

Fig. 4 is a function block diagram of embodiment 1 of the present invention;

Fig. 5 shows an example of a process flow of a resource control unit according to the present invention;

Fig. 6 shows a process flow of the entirety of a despreading process and a channel decoding process including a process of a resource allocation control unit of embodiment 1;

Fig. 7 shows a variation of the process flow of the resource allocation control unit of embodiment 1;

Fig. 8 is a function block diagram of embodiment 2 of the present invention;

Fig. 9 shows a process flow of the entirety of a despreading process and a channel decoding process including process of a resource allocation control unit of embodiment 2;

Fig. 10 shows a variation of the process flow of the resource allocation control unit of embodiment 2;

Fig. 11 shows program processes when functions of the resource allocation control unit of embodiment 1 are realized by a computer;

Figs. 12A and 12B show a counter and a table for managing resources for the despreading processes; and

Figs. 13A and 13B show a counter and a table for managing resources for the channel decoding processes.

Description of the Preferred Embodiment

[0024] First, embodiment 1 of the present invention is explained by referring to Figs. 4 through 7. It is to be noted that expressions such as "allocate a resource for a despreading process to a despreading process unit 3" and the like used hereinbelow have the meaning "allocate
a resource for a despreading process used for executing a despreading process on a received signal on which the despreading process should be executed in a despreading process unit”.

[0025] Fig. 4 is a function block diagram of embodiment 1 of the present invention. The configuration of Fig. 4 is different from the conventional example of Fig. 2 in that a resource allocation control unit 2 is provided between the despreading process unit 3 and a channel decoding process unit 4, and that the maximum number M of resources for the channel decoding processes allocated to the channel decoding process unit 4 is smaller than the maximum number N of resources for the despreading processes allocated to the despreading process unit 3. Also, resource management unit 1 is different from resource management unit 10 of the conventional example in that resource management unit 1 allocates the resources for the despreading processes and the resources for the channel decoding processes separately.

[0026] The above respective function blocks can be realized by using hardware and also by using a combination of computer hardware and software. When a computer is utilized, it is possible for the respective functions to be realized by a single computer, and also for the respective functions to be realized by a system in which the functions are distributed to a plurality of computers.

[0027] Fig. 5 shows an example of a process flow of resource management unit 1 according to the present invention.

[0028] Resource management unit 1 starts processing when it receives a resource allocation request from a higher layer (step S1) at the start of a communication, and checks the number of remaining resources for the despreading processes. When the check result identifies that there are no available resources, resource management unit 1 executes step S8 in order to make an NG response, to the higher layer, indicating that it cannot allocate the resource, and terminates the process. When it is recognized that there is an available resource, resource management unit 1 allocates the resource for the despreading process in response to the resource allocation request from the higher layer. Then, resource management unit 1 executes step S4 after decrementing the number of remaining resources for the despreading processes by one.

[0029] In step S4, resource management unit 1 checks the number of remaining resources for the channel decoding processes. When the check result identifies that there are no available resources, resource management unit 1 executes step S8, and terminates the process after making the NG response to the higher layer indicating that it cannot allocate a resource. When the check result identifies that there is an available resource, resource management unit 1 executes step S5.

[0030] In step S5, resource management unit 1 determines the type of communication service for which the resource allocation request has been made. This determination of the communication service type can be conducted based on a notification from the higher layer. When the check result identifies that the communication service is of a continuous data communication such as a voice communication, resource management unit 1 executes step S7 after allocating the resource for the channel decoding process in step S6. When it is recognized that the communication service is not of a continuous data communication, resource management unit 1 immediately executes step S7.

[0031] In step S7, resource management unit 1 returns a completion response of the resource allocation to the higher layer, and terminates the process.

[0032] As described above, resource management unit 1 allocates the resource for the channel decoding process depending on the type of service for which data is being processed. In resource management unit 1, the despreading process and the channel decoding process are always managed such that the ratio therebetween is 1:1 for the services including continuous data communication such as voice communication. However, in discontinuous data communications such as packet data communication, the resource for the channel decoding process is not allocated.

[0033] Next, a data process flow of the entirety of the despreading process and the channel decoding process including the process of the resource allocation control unit 2 of embodiment 1 is explained by referring to Fig. 6. In Fig. 6, the processes which are not enclosed by double lines are the processes of the resource allocation control unit 2. Step S10 enclosed by double lines is the process of the despreading process unit 3, and steps S30 and S31 enclosed by the double line are the processes of the channel decoding process unit 4.

[0034] When one despreading process of step S10 is completed by the despreading process unit 3, the received data demodulated as the process result is output from the despreading process unit 3 to the resource allocation control unit 2. In the resource allocation control unit 2, the type of communication service is determined first based on the data in step S21. In the case of continuous data communication, the channel decoding process is executed in step S30 by using the resource for the channel decoding process that has already been secured in step S6 by resource management unit 1 as explained in Fig. 5, and the process is terminated.

[0035] In the case of discontinuous data communication such as packet data communication, the presence/absence of user communication data is further confirmed. Although it is not shown, when there is no user communication data, the process is immediately terminated because the channel decoding process does not have to be executed.

[0036] When user communication data exists, then an attempt is made to secure a resource because the resource for the channel decoding process has not been allocated. Specifically, in step S22, the number of remaining resources is confirmed, and if there is an available resource, the resource is allocated to the channel cod-
ing process unit 4 in step S23; thereafter, the number of remaining resources is decremented by one.

[0037] Then the process proceeds to step S31, in which the channel decoding process unit 4 executes the channel decoding process. After the channel decoding process, the resource is released, and the number of the remaining resources is incremented by one in step S24 in order to terminate the process.

[0038] If there is no available resource, the received data is discarded in step S25, and the process waits for a retransmission of the data. (In typical packet communication, when reception of data is not confirmed, the data is retransmitted.)

[0039] If data of a plurality of users is output from the despreading process unit 3 at the same time and the number of available resources is insufficient for the number of resources that needs to be allocated, the resources are allocated prior to any high rate communications while taking the entire throughput into consideration.

[0040] The above confirmation of the presence/absence of packet communication data, which is one of the important factors of the process flow of the present invention, is realized based on results of the despreading process. In the case of the 3GPP (3rd Generation Partnership Project), as for a DCH (Dedicated Channel), the confirmation is realized based on the demodulation result of a TFCI (Transport Format Combination Indicator), and as for packet transfer using a RACH (Random Access Channel), the confirmation is realized based on a preamble reception result. In the above case in which the resources are allocated prior to high rate communications, rate information can be obtained based on the TFCI of a DPDCH (Dedicated Physical Data Channel), for example.

[0041] Next, by referring to Fig. 7, a variation of the data process flow of the resource allocation control unit 2 of embodiment 1 is explained. The process flow of Fig. 7 is different from that of Fig. 6 only in that the flow of Fig. 7 includes, after step S25 of the data discarding process, step S26 in which a reception NG is reported to the higher layer when discarding the data. By this configuration, earlier retransmission of the data is promoted.

[0042] Next, embodiment 2 of the present invention is explained, by referring to Figs. 8 through 10.

[0043]Fig. 8 is a function block diagram of embodiment 2 of the present invention. The function block diagram in Fig. 8 is different from that of embodiment 1 shown in Fig. 4 in that the function block diagram in Fig. 8 includes a demodulated data storage unit 5. In embodiment 2, by including the demodulated data storage unit 5, it is possible to wait until the resource for the channel decoding process becomes available while holding in the demodulated data storage unit 5 the demodulated signals as the despreading process result even when the resources for the channel decoding processes are depleted temporarily.

[0044] Accordingly, it is possible to process data when the resource for the channel decoding process becomes available in embodiment 2, while in embodiment 1, the demodulated signals have to be discarded when there is no available resource for the channel decoding process.

[0045] It is understood that operations of resource management unit 1 of embodiment 2 are the same as those of resource management unit 1 of embodiment 1.

[0046] Next, a process flow of the entirety of the despreading process and the channel decoding process including the process of the resource allocation control unit 2 of embodiment 2 is explained by referring to Fig. 9. The process flow in Fig. 9 is different from that of embodiment 1 in Fig. 6 in that in the process flow in Fig. 9 includes, with the demodulated data storage unit 5 being added, step S40 in which the despreading process result in the demodulated data storage unit 5 is temporarily accumulated, steps S42 and S43 in which the accumulation status of the demodulated data storage unit 5 is monitored, a step in which the presence/absence of the accumulated data is determined, and step S45 in which the held data from the demodulated data storage unit 5 is extracted.

[0047] Specifically, similarly to the case of embodiment 1 shown in Fig. 6, when the process result of the despreading process unit 3 in step S10 is output, the resource allocation control unit 2 determines the type of communication service first based on the data in step S21. In the case of continuous data communication, the channel decoding process unit 4 executes the channel decoding process in step S30 by using the resource for the channel decoding process that has already been secured. In the case of discontinuous data communication such as packet data communication, the presence/absence of user communication data is further confirmed. Although it is not shown, when there is no user communication data, the process is immediately terminated because the channel decoding process does not have to be executed.

[0048] When there is user communication data, the demodulated signals are stored in the demodulated data storage unit 5 in step S40 and then an attempt is made to secure the resource because the resource for the channel decoding process has not been allocated.

[0049] The resource allocation control unit 2 continuously monitors the presence/absence of the demodulated signals that are accumulated in the demodulated data storage unit 5 and the number of remaining resources, as shown in steps S42, S43, and S22 in Fig. 9, reads the demodulated signals from the demodulated data storage unit 5 during a time period that allows securement of the resources, as shown in step S45, and allocates the resource for the channel decoding process and decrements the number of remaining resources by one, as shown in step S23.

[0050] If there is no available resource, the demodulated signals are kept storing in the demodulated data storage unit 5. The demodulated signals can be read
from the demodulated data storage unit 5 in the order in which they are stored in the demodulated data storage unit 5. 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on the management table of the resources for the channel decoding processes. Also, the counter value of the available resources for the channel decoding processes is decremented by one.

[0063] Next, the process proceeds to step S240 in which the demodulated user communication data is transferred to the resource for the channel decoding process allocated in step S230.

[0064] Next, in step S300, the completion of the channel decoding process by the channel decoding process unit 4 is waited for. When it is recognized that the channel decoding process, by using the allocated resource for the channel decoding process, is completed, in step S310 the resource for the channel decoding process is released by deleting the number of the resource for the despreading processes that can be allocated to the channel decoding processes that has been completed, and the counter value of the available resources for the channel decoding processes is incremented by one. Thereafter, the process is terminated.

[0065] Although the above processes from step S100 to step S310 have been described as processes in series in the above explanation, it is obvious to those skilled in the art that a configuration is also possible in which the waiting processes of step S100 and step S300 are separated from processes of other steps, and a plurality of processes of resource allocation and resource release are executed in parallel.

[0066] Also, as is obvious from the process flow in Fig. 9, the example of program flow of embodiment 2 can be obtained by adding a process between step S210 and step S220 in which demodulated signals in the demodulated data storage unit 5 are temporarily stored and a process in which the accumulation status of the demodulated data storage unit 5 is monitored, and by further adding a process between step S220 and step S230 in which the stored data from the demodulated data storage unit 5 is monitored.

[0067] Next, the counters, the tables and the like for managing resources shown in Fig. 12A, Fig. 12B, Fig. 13A, and Fig. 13B are explained.

[0068] Fig. 12A shows the counter of available resources for the despreading processes that is for indicating the number of remaining resources for the despreading processes that can be allocated to the despreading process unit 3 and whose initial value is N, being the maximum number that can be allocated. The value of the counter of the available resource for the despreading process is managed by resource management unit 1. Resource management unit 1, receiving a resource allocation request from a higher layer in step S2 of Fig. 5, determines whether or not there is an available resource by referring to the counter value of available resources for despreading processes, and allocates the resource when there is an available resource. Thereafter, resource management unit 1 decrements the counter value of available resources for the despreading processes.

[0069] Although it is not shown, resource management unit 1, receiving a communication termination notification from the higher layer, executes a release process of the resource, and increments the value of the counter.

[0070] As described above, Fig. 12B shows the management table of the resources for the despreading processes where the number of resources for the channel decoding processes respectively associated with the numbers 1, 2, ......, N of the resources for the despreading processes and the types of communication services utilizing the corresponding resources are stored. This table is accessed and managed by both resource management unit 1 and the resource allocation control unit 2.

[0071] Fig. 13A shows the counter of available resources for the channel decoding processes; this counter is for indicating the number of remaining resources for the channel decoding processes that can be allocated to the channel decoding process unit 4 and whose initial value is M, being the maximum number that can be allocated. By making the value M smaller than the value N, the scale of the device and the cost are reduced in the present invention.

[0072] As described above, Fig. 13B shows the management table of the resources for the channel decoding processes where the numbers of the resources for the channel decoding processes respectively associated with the numbers 1, 2, ......, M of the resources for the channel decoding processes are stored.

[0073] The counter of available resources for the channel decoding processes and the management table of the resources for the channel decoding processes are respectively accessed and managed by both resource management unit 1 and the resource allocation control unit 2.

[0074] As described in detail above, according to the present invention, in services that are not of continuous data communication, such as a packet communication service, a resource for a channel decoding process is allocated only when user communication data is transmitted; accordingly, it is possible to reduce the cost of the channel decoding process unit and also of the entirety of the receiver from becoming large even when the number of users that can receive services simultaneously increases, and it is also possible to contribute to a reduction in the cost of the radio base station.

Claims

1. A radio base station receiver including a despreading process unit (3) for generating a demodulated signal by executing a despreading process on a received signal by using a resource for the despreading process, and a channel decoding process unit (4) for decoding the demodulated signal by using a resource for a channel decoding process, comprising:

   a resource allocation control unit (2) for determining, upon completion of the despreading
process, the type of communication service of the demodulated signal about which the despreading process is completed, and for allocating an available resource for a channel decoding process only when the demodulated signal includes user communication data if the communication service is not of a continuous data communication,

wherein both the resources used for channel decoding processes and the resources used for despreading processes are allocated for each user; whereby the number per user of resources used for channel decoding processes decoding the demodulated signal, is smaller than the number per user of resources used for despreading processes generating the demodulated signal by executing the despreading process on the received signal.

2. The radio base station receiver according to claim 1, wherein:

the resource allocation control unit (2) is adapted to notify a higher layer that a signal cannot be received when there is no available resource for a channel decoding process.

3. The radio base station receiver according to claim 1, comprising:

a demodulated data storage unit (5), wherein:

the resource allocation control unit (2) is adapted to temporarily accumulate the demodulated signal in the demodulated data storage unit when the communication service is not of a continuous data communication and the demodulated signal includes user communication data, is adapted to monitor the accumulation status of the demodulated signal in the demodulated data storage unit, is adapted to check the number of remaining resources for channel decoding processes if a demodulated signal is accumulated, and is adapted to allocate an available resource for a channel decoding process after reading the accumulated demodulated signal from the demodulated data storage unit (5) if there is an available resource for a channel decoding process.

4. The radio base station receiver according to claim 3, wherein:

the resource allocation control unit (2) is adapted to attach a time stamp to the demodulated signal and is adapted to accumulate the demodulated signal when temporarily accumulating the demodulated signal in the demodulated data storage unit (5), is adapted to check the time period during which the read demodulated signal has been stored in the demodulated data storage unit (5) based on the time stamp when reading, from the demodulated data storage unit (5), the demodulated signal that has been accumulated, and is adapted to allocate an available resource for a channel decoding process if the storage time period is within a prescribed time period or is adapted to discard the demodulated signal if the storage time period has exceeded the prescribed time period.

5. The radio base station receiver according to claim 1 comprising:

a resource management unit (1) for managing resources for despreading processes of a despreading process unit (3) generating a demodulated signal by executing the despreading process on a received signal, and a resource for a channel decoding process of a channel decoding process unit (4) decoding the demodulated signal, wherein:

the resource management unit (1) is adapted to allocate an available resource for the despreading process of the received signal when there is an available resource for the despreading process when receiving a resource allocation request from the higher layer for processing the received signal, is adapted to determine the type of communication service of the received signal when there is an available resource for a channel decoding process, is adapted to allocate the available resource for a channel decoding process if the communication service is of a continuous data communication, and is adapted to not to allocate the resource for a channel decoding process if the communication service is not of a continuous data communication.

6. The radio base station receiver according to claim 1, wherein:

available resources for channel decoding processes are allocated according to priority based on user communication data rate information when the available resources for the channel decoding processes are allocated.

7. The radio base station receiver according to claim 3, wherein:

available resources for channel decoding proc-
esses are allocated according to priority based on user communication data rate information when the available resources for the channel decoding processes are allocated.

8. A method of allocating a resource for a channel decoding process in a radio base station receiver that includes a despreading process unit (3) for generating a demodulated signal by executing a despreading process (S21) on a received signal by using a resource for the despreading process, and a channel decoding process unit (4) for decoding the demodulated signal by using a resource for a channel decoding process (S31), comprising:

- the determination (S21, S200) of, upon completion of the despreading process, the type of communication service of the demodulated signal about which the despreading process is completed, and allocating (S23, S230) an available resource for a channel decoding process only when the demodulated signal includes user communication data if the communication service is not of a continuous data communication,

wherein both the resources used for channel decoding processes and the resources used for despreading processes are allocated for each user; whereby the number per user of resources used for channel decoding processes decoding the demodulated signal, is smaller than the number per user of resources used for despreading processes generating the demodulated signal by executing the despreading process on the received signal.

9. The method of claim 8 further comprising:

- a communication data presence/absence determination step (S210) for determining whether or not the demodulated signal includes user communication data when the determination result of the type of communication service in the communication service determination step (S21, S200) indicates a communication service that is not of a continuous data communication;
- a step for terminating a process if the result of the determination in the communication data presence/absence determination step indicates that the demodulated signal does not include user communication data;
- a resource number check step (S220) for checking the number of remaining resources for the channel decoding processes when the result of the determination in the communication data presence/absence determination step indicates that the demodulated signal includes user communication data;
- a step (S260) for discarding the demodulated signal when the result of the check in the resource number check step indicates that there is no available resource for the channel decoding process; comprising performing the resource allocation step (S23, S230) for allocating a resource for a channel decoding process decoding the demodulated signal, when the result of the check in the resource number check step indicates that there is an available resource for the channel decoding process; and a data transmission step (S240) for transmitting the demodulated signal to the resource for the channel decoding process (S31) allocated in the resource allocation step.

10. A computer program comprising code means adapted to perform the steps of the method of claim 8 or 9 when executed on a computer.

11. A computer readable recording medium that records a program comprising code means adapted to perform the steps of the method of claim 8 or 9 when executed on a computer.

Patentansprüche

1. Funkbasisstationsempfänger, der eine Entspreizprozesseinheit (3) enthält, zum Erzeugen eines demodulierten Signals durch Ausführen eines Entspreizprozesses an einem Empfangssignal unter Verwendung einer Ressource für den Entspreizprozess, und eine Kanaldecodierprozesseinheit (4), zum Decodieren des demodulierten Signals unter Verwendung einer Ressource für einen Kanaldecodierprozess, mit:

- einer Ressourcezuordnungssteuereinheit (2), zum Bestimmen, bei Vollendung des Entspreizprozesses, des Typs des Kommunikationsdienstes des demodulierten Signals, bei dem der Entspreizprozess vollendet ist, und zum Zuordnen einer verfügbaren Ressource für einen Kanaldecodierprozess, nur wenn das demodulierte Signal Nutzerkommunikationsdaten enthält, falls der Kommunikationsdienst keine kontinuierliche Datenkommunikation ist, bei dem sowohl die Ressourcen, die für Kanaldecodierprozesse verwendet werden, als auch die Ressourcen, die für Entspreizprozesse verwendet werden, für jeden Nutzer zugeordnet werden; wodurch die Ressourcenanzahl pro Nutzer, die für Kanaldecodierprozesse verwendet wird, bei denen das demodulierte Signal decodiert wird, kleiner als die Ressourcenanzahl pro Nutzer ist, die für Entspreizprozesse verwendet wird.
denen das demodulierte Signal durch Ausführen des Entspreizprozesses an dem Empfangssignal erzeugt wird.

2. Funkbasisstationsempfänger nach Anspruch 1, bei dem:

die Ressourcenzuordnungssteuereinheit (2) dafür ausgelegt ist, um einer höheren Schicht mitzuteilen, dass ein Signal nicht empfangen werden kann, wenn für einen Kanaldecodierprozess keine verfügbare Ressource vorhanden ist.

3. Funkbasisstationsempfänger nach Anspruch 1, mit:

einer Speichereinheit für demodulierte Daten (5), bei dem:

die Ressourcenzuordnungssteuereinheit (2) dafür ausgelegt ist, um das demodulierte Signal in der Speichereinheit für demodulierte Daten temporär zu akkumulieren, wenn der Kommunikationsdienst keine kontinuierliche Datenkommunikation ist und das demodulierte Signal Nutzerkommunikationsdaten enthält, dafür ausgelegt ist, um den Akkumulationsstatus des demodulierten Signals in der Speichereinheit für demodulierte Signale zu überwachen, dafür ausgelegt ist, um die Anzahl von verbleibenden Ressourcen für Kanaldecodierprozesse zu prüfen, falls ein demoduliertes Signal akkumuliert wird, und dafür ausgelegt ist, um eine verfügbare Ressource für einen Kanaldecodierprozess nach dem Lesen des akkumulierten demodulierten Signals von der Speichereinheit für demodulierte Daten (5) zuzuordnen, falls eine verfügbare Ressource für einen Kanaldecodierprozess vorhanden ist.

4. Funkbasisstationsempfänger nach Anspruch 3, bei dem:

die Ressourcenzuordnungssteuereinheit (2) dafür ausgelegt ist, um einen Zeistempel dem demodulierten Signal beizufügen, und dafür ausgelegt ist, um das demodulierte Signal zu akkumulieren, wenn das demodulierte Signal in der Speichereinheit für demodulierte Daten (5) temporär akkumuliert wird, dafür ausgelegt ist, um die Zeitperiode, während der das gelesene demodulierte Signal in der Speichereinheit für demodulierte Signale (5) gespeichert worden ist, auf der Basis des Zeitstempels zu prüfen, wenn das demodulierte Signal, das akkumuliert worden ist, von der Speichereinheit für demoduliertes Signal (5) gelesen wird, und dafür ausgelegt ist, um eine verfügbare Ressource für einen Kanaldecodierprozess zuzuordnen, falls die Speicherzeitperiode innerhalb einer vorgeschriebenen Zeitperiode liegt, oder dafür ausgelegt ist, um das demodulierte Signal auszusondern, falls die Speicherzeitperiode die vorgeschriebene Zeitperiode überschritten hat.

5. Funkbasisstationsempfänger nach Anspruch 1, mit:

einer Ressourcenzuordnungseinheit (1), zum Verwalten von Ressourcen für Entspreizprozesse einer Entspreizprozesseinheit (3), die ein demoduliertes Signal durch Ausführen des Entspreizprozesses an einem Empfangssignal erzeugt, und einer Ressource für einen Kanaldecodierprozess einer Kanaldecodierprozesseinheit (4), die das demodulierte Signal decodiert, bei dem:

die Ressourcenzuordnungseinheit (1) dafür ausgelegt ist, um eine verfügbare Ressource für den Entspreizprozess des Empfangssignals zuzuordnen, wenn eine verfügbare Ressource für den Entspreizprozess vorhanden ist, wenn eine Ressourcenzuordnungsaufforderung von der höheren Schicht zum Verarbeiten des Empfangssignals empfangen wird, dafür ausgelegt ist, um den Typ des Kommunikationsdienstes des Empfangssignals zu bestimmen, wenn eine verfügbare Ressource für einen Kanaldecodierprozess vorhanden ist, dafür ausgelegt ist, um die verfügbare Ressource für einen Kanaldecodierprozess zuzuordnen, falls der Kommunikationsdienst eine kontinuierliche Datenkommunikation ist, und dafür ausgelegt ist, um die Ressource für einen Kanaldecodierprozess nicht zuzuordnen, falls der Kommunikationsdienst keine kontinuierliche Datenkommunikation ist.

6. Funkbasisstationsempfänger nach Anspruch 1, bei dem:

verfügbare Ressourcen für Kanaldecodierprozesse gemäß der Priorität auf der Basis von Nutzerkommunikationsdaten- Rateninformationen zugeordnet werden, wenn die verfügbaren Ressourcen für die Kanaldecodierprozesse zugeordnet werden.

7. Funkbasisstationsempfänger nach Anspruch 3, bei dem:

verfügbare Ressourcen für Kanaldecodierprozesse gemäß der Priorität auf der Basis von Nut-
zerkommunikationsdaten: Rateninformationen zugeordnet werden, wenn die verfügbaren Ressourcen für die Kanaldecodierprozesse zugeordnet werden.

8. Verfahren zum Zuordnen einer Ressource für einen Kanaldecodierprozess in einem Funkbasisstationsempfänger, der eine Entspreizprozesseinheit (3) enthält, zum Erzeugen eines demodulierten Signals durch Ausführen eines Entspreizprozesses (S21) an einem Empfangssignal unter Verwendung einer Ressource für den Entspreizprozess, und eine Kanaldecodierprozesseinheit (4), zum Decodieren des demodulierten Signals unter Verwendung einer Ressource für einen Kanaldecodierprozess (S31), mit:

dem Bestimmen (S21, S200), nach Vollendung des Entspreizprozesses, des Typs des Kommunikationsdienstes des demodulierten Signals, bei dem der Entspreizprozess vollendet ist, und Zuordnen (S23, S230) einer verfügbaren Ressource für einen Kanaldecodierprozess, nur wenn das demodulierte Signal Nutzerkommunikationsdaten enthält, falls der Kommunikationsdienst keine kontinuierliche Datenkommunikation ist, bei dem sowohl die Ressourcen, die für Kanaldecodierprozesse verwendet werden, als auch die Ressourcen, die für Entspreizprozesse verwendet werden, für jeden Nutzer zugeordnet werden; wodurch die Ressourcenanzahl pro Nutzer, die für Kanaldecodierprozesse verwendet werden, bei denen das demodulierte Signal Nutzerkommunikationsdaten enthält, kleiner als die Ressourcenanzahl pro Nutzer ist, die für Entspreizprozesse verwendet werden, bei denen das demodulierte Signal durch Ausführen des Entspreizprozesses an dem Empfangssignal erzeugt wird.

9. Verfahren nach Anspruch 8, ferner mit:

- einem Kommunikationsdatenpräsenz-/absenzenbestimmungsschritt (S210), zum Bestimmen, ob das demodulierte Signal Nutzerkommunikationsdaten enthält oder nicht, wenn das Bestimmungsergebnis des Typs des Kommunikationsdienstes bei dem Kommunikationsdienstbestimmungsschritt (S21, S200) einen Kommunikationsdienst angibt, der keine kontinuierliche Datenkommunikation ist; einem Schritt zum Beenden eines Prozesses, falls das Resultat der Bestimmung bei dem Kommunikationsdatenpräsenz-/absenzenbestimmungsschritt angibt, dass das demodulierte Signal keine Nutzerkommunikationsdaten enthält; einem Ressourcenanzahlprüfschritt (S220), zum Prüfen der Anzahl von verbleibenden Ressourcen für die Kanaldecodierprozesse, wenn das Resultat der Bestimmung bei dem Kommunikationsdatenpräsenz-/absenzenbestimmungsschritt angibt, dass das demodulierte Signal Nutzerkommunikationsdaten enthält; einem Schritt (S260) zum Aussondern des demodulierten Signals, wenn das Resultat der Prüfung bei dem Ressourcenanzahlprüfschritt angibt, dass keine verfügbare Ressource für den Kanaldecodierprozess vorhanden ist; mit dem Ausführen des Ressourcenzuordnungsschrittes (S23, S230), zum Zuordnen einer Ressource für einen Kanaldecodierprozess, bei dem das demodulierte Signal decodiert wird, wenn das Resultat der Prüfung bei dem Ressourcenanzahlprüfschritt angibt, dass eine verfügbare Ressource für den Kanaldecodierprozess vorhanden ist; und einem Datenübertragungsschritt (S240), zum Übertragen des demodulierten Signals zu der Ressource für den Kanaldecodierprozess (S31), die bei dem Ressourcenzuordnungsschritt zugeordnet wurde.

10. Computerprogramm mit einem Codemittel, das dafür ausgelegt ist, um die Schritte des Verfahrens nach Anspruch 8 oder 9 auszuführen, wenn es auf einem Computer läuft.

11. Computerlesbares Aufzeichnungsmedium, auf dem ein Programm mit einem Codemittel aufgezeichnet ist, das dafür ausgelegt ist, um die Schritte des Verfahrens nach Anspruch 8 oder 9 auszuführen, wenn es auf einem Computer läuft.

**Revendications**

1. Récepteur de station de base radio comprenant une unité de désétalement (3) destinée à générer un signal démodulé par exécution d’une opération de désétalement sur un signal reçu au moyen d’une ressource pour l’opération de désétalement, et une unité de décodage de canal (4) destinée à décoder le signal démodulé au moyen d’une ressource pour une opération de décodage de canal, comprenant :

- une unité de commande d’allocation de ressource (2) destinée à déterminer, lors de l’achèvement de l’opération de désétalement, le type de service de communication du signal démodulé pour lequel l’opération de désétalement est achevée, et à n’allouer une ressource disponible pour une opération de décodage de canal que lorsque le signal démodulé contient des données de communication utilisateur, si le service
de communication n’est pas de type communication de données continue, les ressources utilisées pour les opérations de décodage de canal ainsi que les ressources utilisées pour les opérations de désétalement étant allouées pour chaque utilisateur ; le nombre par utilisateur de ressources utilisées pour les opérations de décodage de canal décodant le signal démodulé étant inférieur au nombre par utilisateur de ressources utilisées pour les opérations de désétalement générant le signal démodulé par exécution de l’opération de désétalement sur le signal reçu.

2. Récepteur de station de base radio selon la revendication 1, dans lequel :

l’unité de commande d’allocation de ressource (2) est conçue pour notifier à une couche supérieure qu’un signal ne peut pas être reçu lorsqu’il n’y a aucune ressource disponible pour une opération de décodage de canal.

3. Récepteur de station de base radio selon la revendication 1, comprenant :
n’une unité de stockage de données démodulées (5), dans lequel :

l’unité de commande d’allocation de ressource (2) est conçue pour accumuler temporairement le signal démodulé dans l’unité de stockage de données démodulées lorsque le service de communication n’est pas de type communication de données continue et que le signal démodulé contient des données de communication utilisateur, est conçue pour surveiller l’état d’accumulation du signal démodulé dans l’unité de stockage de données démodulées, est conçue pour vérifier le nombre de ressources restantes pour les opérations de décodage de canal si un signal démodulé est accumulé, et est conçue pour allouer une ressource disponible pour une opération de décodage de canal après la lecture du signal démodulé accumulé dans l’unité de stockage de données démodulées (5) s’il y a une ressource disponible pour une opération de décodage de canal.

4. Récepteur de station de base radio selon la revendication 3, dans lequel :

l’unité de commande d’allocation de ressource (2) est conçue pour attacher une estampille temporelle au signal démodulé et est conçue pour accumuler le signal démodulé lors de l’accumu-

lation temporaire du signal démodulé dans l’unité de stockage de données démodulées (5), est conçue pour vérifier la période pendant laquelle le signal démodulé lu a été stocké dans l’unité de stockage de données démodulées (5) en fonction de l’estampille temporelle au moment de la lecture, dans l’unité de stockage de données démodulées (5), du signal démodulé qui a été accumulé, et est conçue pour allouer une ressource disponible pour une opération de décodage de canal si la période de stockage est comprise dans une période prescrite ou est conçue pour supprimer le signal démodulé si la période de stockage a dépassé la période prescrite.

5. Récepteur de station de base radio selon la revendication 1, comprenant :
n’une unité de gestion de ressources (1) destinée à gérer les ressources pour les opérations de désétalement d’une unité de désétalement (3) générant un signal démodulé par exécution de l’opération de désétalement sur un signal reçu, et une ressource pour une opération de décodage de canal d’une unité de décodage de canal (4) décodant le signal démodulé, dans lequel :

l’unité de gestion de ressources (1) est conçue pour allouer une ressource disponible pour l’opération de désétalement du signal reçu lorsqu’il y a une ressource disponible pour l’opération de désétalement au moment de la réception d’une demande d’allocation de ressource émanant de la couche supérieure pour le traitement du signal reçu, est conçue pour déterminer le type de service de communication du signal reçu lorsqu’il y a une ressource disponible pour une opération de décodage de canal, est conçue pour allouer la ressource disponible pour une opération de décodage de canal si le service de communication est de type communication de données continue, et est conçue pour ne pas allouer la ressource pour une opération de décodage de canal si le service de communication n’est pas de type communication de données continue.

6. Récepteur de station de base radio selon la revendication 1, dans lequel :

les ressources disponibles pour des opérations de décodage de canal sont allouées selon une priorité basée sur des informations de débit de données de communication utilisateur au moment où les ressources disponibles pour les opérations de décodage de canal sont allouées.
7. Récepteur de station de base radio selon la revendication 3, dans lequel :

les ressources disponibles pour des opérations de décodage de canal sont allouées selon une priorité basée sur des informations de débit de données de communication utilisateur au moment où les ressources disponibles pour les opérations de décodage de canal sont allouées.

8. Procédé d’allocation d’une ressource pour une opération de décodage de canal dans un récepteur de station de base radio qui comprend une unité de désétalement (3) destinée à générer un signal démodulé par exécution d’une opération de désétalement (S21) sur un signal reçu au moyen d’une ressource pour l’opération de désétalement, et une unité de décodage de canal (4) destinée à décoder le signal démodulé au moyen d’une ressource pour une opération de décodage de canal (S31), comprenant les étapes consisant :

à déterminer (S21, S200), lors de l’achèvement de l’opération de désétalement, le type de service de communication du signal démodulé pour lequel l’opération de désétalement est achevée, et à n’allouer (S23, S230) une ressource disponible pour une opération de décodage de canal que lorsque le signal démodulé contient des données de communication utilisateur, si le service de communication n’est pas de type communication de données continue, les ressources utilisées pour les opérations de décodage de canal ainsi que les ressources utilisées pour les opérations de désétalement étant allouées pour chaque utilisateur ; le nombre par utilisateur de ressources utilisées pour les opérations de décodage de canal décodant le signal démodulé étant inférieur au nombre par utilisateur de ressources utilisées pour les opérations de désétalement générant le signal démodulé par exécution de l’opération de désétalement sur le signal reçu.

9. Procédé selon la revendication 8 comprenant, en outre :

une étape de détermination de présence/absence de données de communication (S210) consistant à déterminer si le signal démodulé contient ou non des données de communication utilisateur lorsque le résultat de la détermination du type de service de communication à l’étape de détermination de service de communication (S21, S200) indique un service de communication qui n’est pas de type communication de données continue ;
une étape consistant à arrêter une opération si le résultat de la détermination à l’étape de détermination de présence/absence de données de communication indique que le signal démodulé ne contient pas de données de communication utilisateur ;
e une étape de vérification du nombre de ressources (S220) consistant à vérifier le nombre de ressources restantes pour les opérations de décodage de canal lorsque le résultat de la détermination à l’étape de détermination de présence/absence de données de communication indique que le signal démodulé contient des données de communication utilisateur ;
e une étape (S260) consistant à supprimer le signal démodulé lorsque le résultat de la vérification à l’étape de vérification du nombre de ressources indique qu’il n’y a pas de ressource disponible pour l’opération de décodage de canal ;
comprenant l’exécution de l’étape d’allocation de ressource (S23, S230) consistant à allouer une ressource pour une opération de décodage de canal décodant le signal démodulé lorsque le résultat de la vérification à l’étape de vérification du nombre de ressources indique qu’il y a une ressource disponible pour l’opération de décodage de canal ; et
une étape de transmission de données (S240) consistant à transmettre le signal démodulé à la ressource pour l’opération de décodage de canal (S31) allouée dans l’étape d’allocation de ressource.

10. Programme informatique comprenant des moyens de code conçus pour effectuer les étapes du procédé selon la revendication 8 ou 9 lorsque ce procédé est exécuté sur un ordinateur.

11. Support d’enregistrement lisible par ordinateur sur lequel est enregistré un programme comprenant des moyens de code conçus pour effectuer les étapes du procédé selon la revendication 8 ou 9 lorsque ce procédé est exécuté sur un ordinateur.
FIG. 1
FIG. 2
Start

THERE ARE NO AVAILABLE RESOURCES

CHECK NUMBER OF RESOURCES

THERE IS AN AVAILABLE RESOURCE

ALLOCATE RESOURCES TO DESPREADING PROCESS UNIT AND CHANNEL DECODING PROCESS UNIT (DECREMENT NUMBER OF REMAINING RESOURCES BY ONE)

MAKE RESOURCE ALLOCATION NG RESPONSE

MAKE RESOURCE ALLOCATION COMPLETION RESPONSE

End

FIG. 3
Start

S1

RECEIVE RESOURCE ALLOCATION REQUEST

S2

THERE IS NO AVAILABLE RESOURCE

S3

CHECK NUMBER OF RESOURCES FOR DESPREADING PROCESS

THERE IS AN AVAILABLE RESOURCE

ALLOCATE RESOURCE TO DESPREADING PROCESS UNIT (DECREMENT NUMBER OF REMAINING RESOURCES BY ONE)

S4

THERE ARE NO AVAILABLE RESOURCES

CHECK NUMBER OF RESOURCES FOR CHANNEL DECODING PROCESS

THERE IS AN AVAILABLE RESOURCE

S5

DETERMINE WHETHER OR NOT SERVICE IS OF CONTINUOUS DATA COMMUNICATION

OF CONTINUOUS DATA COMMUNICATION

S6

ALLOCATE RESOURCE TO CHANNEL DECODING PROCESS UNIT (DECREMENT NUMBER OF REMAINING RESOURCES BY ONE)

S8

MAKE RESOURCE ALLOCATION NG RESPONSE

S7

MAKE RESOURCE ALLOCATION COMPLETION RESPONSE

End

FIG. 5
Start

S10 DESPERADING PROCESS

S21 DETERMINE WHETHER OR NOT SERVICE IS OF CONTINUOUS DATA COMMUNICATION

S22 CHECK NUMBER OF RESOURCES FOR CHANNEL DECODING PROCESS

S23 ALLOCATE RESOURCE TO CHANNEL DECODING PROCESS UNIT (DECREMENT NUMBER OF REMAINING RESOURCES BY ONE)

S31 CHANNEL DECODING PROCESS

S24 RELEASE RESOURCE OF CHANNEL DECODING PROCESS UNIT (INCREMENT NUMBER OF REMAINING RESOURCES BY ONE)

S30 EXECUTE CHANNEL DECODING PROCESS USING RESOURCE FOR CHANNEL DECODING PROCESS ALREADY ALLOCATED

S25 EXECUTE DATA DISCARDING PROCESS

End

FIG. 6
Start

S10

DESPREADING PROCESS

S21

Determine whether or not service is of continuous data communication.

S22

There are no available resources.

S23

Allocate resource to channel decoding process unit (decrement number of remaining resources by one).

S24

Release resource of channel decoding process unit (increment number of remaining resources by one).

S25

Execute data discarding process.

S26

Execute reception NG notification process to higher layer.

S30

Execute channel decoding process using resource for channel decoding process already allocated.

End

FIG. 7
FIG. 8
Start

DESPREADING PROCESS

S10

OF CONTINUOUS DATA COMMUNICATION

Determine whether or not service is of continuous data communication

S21

TEMPORARILY ACCUMULATE DESPREADING Process RESULT IN DEMODULATED DATA STORAGE UNIT

S40

MONITOR ACCUMULATION STATUS OF DEMODULATED DATA STORAGE UNIT

S42

S43 THERE IS NO ACCUMULATED DATA

S22 THERE ARE NO AVAILABLE RESOURCES

CHECK NUMBER OF RESOURCES FOR CHANNEL DECODING PROCESS

S45

EXTRACT STORED DATA FROM DEMODULATED DATA STORAGE UNIT

S23

ALLOCATE RESOURCE TO CHANNEL DECODING Process UNIT (DECREMENT NUMBER OF REMAINING RESOURCES BY ONE)

S31

CHANNEL DECODING PROCESS

S24

RELEASE RESOURCE OF CHANNEL DECODING Process UNIT (INCREMENT NUMBER OF REMAINING RESOURCES BY ONE)

EXECUTE CHANNEL DECODING Process USING RESOURCE FOR CHANNEL DECODING Process ALREADY ALLOCATED

End

FIG. 9
Start → S10

DESPREADING PROCESS → S21

OF CONTINUOUS DATA COMMUNICATION →

DETERMINE WHETHER OR NOT SERVICE IS OF CONTINUOUS DATA COMMUNICATION

NOT OF CONTINUOUS DATA COMMUNICATION → S41

TEMPORARILY ACCUMULATE DESPREADING PROCESS RESULT IN DEMODULATED DATA STORAGE UNIT (ATTACH TIME STAMP WHEN STORING)

MONITOR ACCUMULATION STATUS OF DEMODULATED DATA STORAGE UNIT → S42

S43

THERE IS NO ACCUMULATED DATA

DETERMINE WHETHER OR NOT DATA IS ACCUMULATED IN DEMODULATED DATA STORAGE UNIT →

THERE IS ACCUMULATED DATA → S45

CHECK NUMBER OF RESOURCES FOR CHANNEL DECODING PROCESS

THERE IS AN AVAILABLE RESOURCE

EXTRACT STORED DATA FROM DEMODULATED DATA STORAGE UNIT → S46

CONFIRM STORAGE TIME PERIOD BASED ON TIME STAMP

STORAGE TIME PERIOD > T[sec] → S23

ALLOCATE RESOURCE TO CHANNEL DECODING PROCESS UNIT (DECREMENT NUMBER OF REMAINING RESOURCES BY ONE)

S31

CHANNEL DECODING PROCESS → S24

EXECUTE CHANNEL DECODING PROCESS USING RESOURCE FOR CHANNEL DECODING PROCESS ALREADY ALLOCATED → S30

RELEASE RESOURCE OF CHANNEL DECODING PROCESS UNIT (INCREMENT NUMBER OF REMAINING RESOURCES BY ONE) → S25

EXECUTE DATA DISCARDING PROCESS

End →

FIG. 10
**FIG. 12A**

Counter of available resources for despreading process

\[ 0 \leq i \leq N \]

**FIG. 12B** Management table of resources for despreading process

<table>
<thead>
<tr>
<th>Resource number for despreading process</th>
<th>Resource number for channel decoding process</th>
<th>Type of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td>*</td>
<td>*</td>
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<td>.</td>
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<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>N</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
**FIG. 13A**

COUNTER OF AVAILABLE RESOURCES FOR CHANNEL DECODING PROCESS

\[ j \quad 0 \leq j \leq M \]

**FIG. 13B** MANAGEMENT TABLE OF RESOURCES FOR CHANNEL DECODING PROCESS:

<table>
<thead>
<tr>
<th>RESOURCE NUMBER FOR CHANNEL DECODING PROCESS</th>
<th>RESOURCE NUMBER FOR DESPREADING PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td>\ldots</td>
<td>\ldots</td>
</tr>
<tr>
<td>M</td>
<td>*</td>
</tr>
</tbody>
</table>
REFERENCES CITED IN THE DESCRIPTION

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