(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 July 2001 (12.07.2001)

PCT

(10) International Publication Number
WO 01/50638 A1

(51) International Patent Classification[7]: H04B 7/26

(21) International Application Number: PCT/KR01/00007

(22) International Filing Date: 3 January 2001 (03.01.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

2000/88	3 January 2000 (03.01.2000)	KR
2000/525	6 January 2000 (06.01.2000)	KR
2000/1250	6 January 2000 (06.01.2000)	KR
2000/2273	18 January 2000 (18.01.2000)	KR

(71) Applicant: SAMSUNG ELECTRONICS CO., LTD [KR/KR]; 416, Maetan-dong, Paldal-gu, Suwon-shi, Kyungki-do 442-370 (KR).

(72) Inventor: KIM, Dae-Gyun; Kyongnam APT.#7-905, Kaepo-dong, Kangnam-gu, Seoul 135-240 (KR).

(74) Agent: LEE, Keon-Joo; Mihwa Bldg. 110-2, Myon-gryun-dong 4-ga, Chongro-gu, Seoul 110-524 (KR).

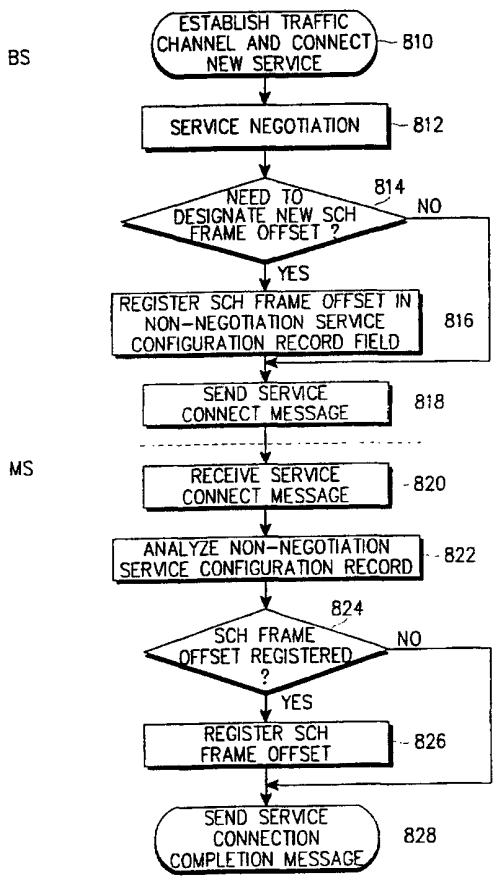
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *With international search report.*

[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR DESIGNATING FRAME OFFSET OF SUPPLEMENTAL CHANNEL IN A CDMA COMMUNICATION SYSTEM



(57) Abstract: An apparatus for receiving data transmitted over fundamental channels having a predetermined frame offset for a plurality of mobile stations and supplemental channels assigned in association with the fundamental channels. In the apparatus, a timing generator receives a frame offset of the fundamental channel, a frame offset of the supplemental channel and a system time, outputs the system time delayed by the frame offset of the fundamental channel as a fundamental channel boundary signal, and outputs the system time delayed by the frame offset of the supplemental channel as a supplemental channel boundary signal. A first symbol combiner combines multi-path symbols transmitted over the fundamental channel. A second symbol combiner combines multi-path symbols transmitted over the supplemental channel. A first deinterleaver receives the symbols and the fundamental channel boundary signal from the first symbol combiner, and deinterleaves the symbols from the first symbol combiner in a frame unit determined by the fundamental channel boundary signal. A second deinterleaver receives the symbols and the supplemental channel boundary signal from the second symbol combiner, and deinterleaves the symbols from the second symbol combiner in a frame unit determined by the supplemental channel boundary signal.

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APPARATUS AND METHOD FOR DESIGNATING FRAME OFFSET OF SUPPLEMENTAL CHANNEL IN A CDMA COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a communication apparatus and method for a CDMA mobile communication system, and in particular, to an apparatus and method for assigning a supplemental channel in a CDMA mobile communication system.

2. Description of the Related Art

In general, a CDMA (Code Division Multiple Access) mobile communication system assigns (or designates) different frame offsets to the users so as to distinguish the transmission frames to the respective users.

In the conventional CDMA mobile communication system, one 20ms frame is equally divided into 16 1.25ms segments, to which different frame offsets are assigned according to the users. A data frame is transmitted/received at a time point delayed by a frame offset assigned to the corresponding user on the basis of the system time.

In a voice call, the frame offset contributes to dispersion of a load. When many users simultaneously intend to transmit data at a boundary of the 20ms frame, there is a case where it is not possible to simultaneously process all the user frames. In this case, the frame processing time is delayed in a channel card, a base station controller and a voice codec (or vocoder). This delay is a main factor in quality deterioration of a voice service. Therefore, the 20ms frame is equally divided into 16 segments, and then, the divided segments are uniformly distributed to the users so that the load should be naturally dispersed using the reference time delayed by the corresponding frame offset between the base station and the mobile station.

Although the conventional CDMA mobile communication system has chiefly provided a voice service, a future CDMA mobile communication system will provide a high-speed data service as well as the voice service. The future CDMA mobile communication system is normally called an IMT-2000 mobile communication system. The IMT-2000 mobile communication system can provide new services such as a high-

quality voice service, a moving picture service, and an Internet search service.

In the conventional voice service, loads are uniformly generated at regular intervals. Therefore, in the voice service, the users uniformly dispersed over the frame offsets can process the voice data without delay. However, the future CDMA mobile communication system, which chiefly provides a multimedia service, generates data which has different features from the existing voice data. That is, the data having the different features may be packet data. In many cases, the packet data is generated at a burst. Therefore, the packet data has a feature that a large amount of data is generated at a short time, rather than a specific amount of data being consecutively generated.

When a traffic having this feature is generated, the system assigns a supplemental channel (SCH) in addition to a fundamental channel (FCH). The newly added supplemental channel uses the same frame offset as the previously connected fundamental channel.

When it is necessary for several users assigned the same frame offset to transmit a great amount of data at a high data rate, there may occur a state where the amount of the transmission data exceeds a traffic capacity in which the data can be transmitted at the corresponding frame offset without delay. In this case, a call is set up using only an initial fundamental channel, and each user is assigned a unique frame offset for the initial fundamental channel.

At this moment, several users may have the same frame offset. As a result, there may occur a situation where the traffic exceeds a capacity of a link between a base station and a base station controller at a specific frame offset. This will cause a delay in transmitting the data. In a service of which quality is affected by the delay, such as the voice service using the fundamental channel, the delay of the data deteriorates the service quality.

On the other hand, the supplemental channel can be used in several methods. In general, the CDMA mobile communication system assigns different supplemental channels to the respective users. In this case, the future CDMA mobile communication system can assign a supplemental channel as a new traffic is generated in a state (or a traffic state) where a basic call is connected. Here, the "traffic state" refers to a traffic channel-established state. In this case, a service delay problem and a scheduling loss problem may occur because the supplemental channels are fixedly assigned to the users. Furthermore, in the future high-speed communication system, several users may use a

limited number of the supplemental channels on a time-division basis, rather than using the supplemental channels uniquely assigned to the users. However, this may cause a scheduling loss problem because the users have the different frame offsets.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a channel assignment apparatus and method for designating a frame offset upon receipt of a data transmission request in a traffic state, in a CDMA communication system.

It is another object of the present invention to provide an apparatus and method for assigning a supplemental channel by designating a frame offset of the supplemental channel upon receipt of a data transmission request in a traffic state in a CDMA communication system.

It is further another object of the present invention to provide an apparatus and method for designating new frame offset information such that a base station can assign a supplemental channel by designating a frame offset of the supplemental channel upon receipt of a data transmission request in a traffic state, in a CDMA communication system.

It is yet another object of the present invention to provide an apparatus and method in which a mobile station designates a frame offset of a supplemental channel by receiving the frame offset information from the base station upon receipt of a data transmission request in a traffic state in a CDMA communication system.

It is still another object of the present invention to provide an apparatus and method for assigning a new frame offset for a supplemental channel in a handoff state in a CDMA communication system.

It is still another object of the present invention to provide an apparatus and method for assigning a new frame offset for a supplemental channel when it is desired to hand off a supplemental channel in a handoff state, in a CDMA communication system.

It is still another object of the present invention to provide an apparatus and method for assigning a supplemental channel by designating a new frame offset when it is desired to newly assign a supplemental channel in a handoff state, in a CDMA communication system.

It is still another object of the present invention to provide an apparatus and method for designating new frame offset information such that a base station can assign or hand off a supplemental channel by designating a frame offset of the supplemental channel in a handoff state, in a CDMA communication system.

It is still another object of the present invention to provide an apparatus and method in which a mobile station designates a frame offset of a supplemental channel by receiving the frame offset information from the base station in a handoff state in a CDMA communication system.

To achieve the above and other objects, there is provided an apparatus for receiving data transmitted over fundamental channels having a predetermined frame offset for a plurality of mobile stations and supplemental channels assigned in association with the fundamental channels. In the apparatus, a timing generator receives a frame offset of the fundamental channel, a frame offset of the supplemental channel and a system time, outputs the system time delayed by the frame offset of the fundamental channel as a fundamental channel boundary signal, and outputs the system time delayed by the frame offset of the supplemental channel as a supplemental channel boundary signal. A first symbol combiner combines multi-path symbols transmitted over the fundamental channel. A second symbol combiner combines multi-path symbols transmitted over the supplemental channel. A first deinterleaver receives the symbols and the fundamental channel boundary signal from the first symbol combiner, and deinterleaves the symbols from the first symbol combiner in a frame unit determined by the fundamental channel boundary signal. A second deinterleaver receives the symbols and the supplemental channel boundary signal from the second symbol combiner, and deinterleaves the symbols from the second symbol combiner in a frame unit determined by the supplemental channel boundary signal.

Preferably, the timing generator comprises a first delay for receiving the frame offset of the fundamental channel and the system time, and delaying the system time by the frame offset of the fundamental channel to output the fundamental channel boundary signal; and a second delay for receiving the frame offset of the supplemental channel and the system time, and delaying the system time by the frame offset of the supplemental channel to output the supplemental channel boundary signal.

Preferably, the frame offset of the fundamental channel is different from the frame offset of the supplemental channel.

Preferably, the frame offset of the supplemental channel is designated according to an amount of the transmission data for the respective frame offsets of the supplemental channels assigned in association with the fundamental channels.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a flow diagram illustrating a general procedure for assigning a supplemental channel in a CDMA communication system;

FIG. 2 is a flow chart illustrating a procedure added to designate a frame offset of a supplemental channel while assigning a supplemental channel in a CDMA communication system according to an embodiment of the present invention;

FIG. 3 is a diagram illustrating a field definition of an extended supplemental channel assignment message (ESCAM) to which the frame offset-related fields for the supplemental channel are newly added;

FIG. 4 is a block diagram illustrating a demodulator for a receiver in a CDMA communication system;

FIG. 5 is a block diagram illustrating a combiner in the demodulator in a CDMA communication system according to an embodiment of the present invention;

FIG. 6 is a block diagram illustrating a timing generator in the combiner of FIG. 5;

FIG. 7 is a flow diagram illustrating a call setup procedure in a CDMA communication system;

FIG. 8 is a flow chart illustrating a procedure added to designate a frame offset of the supplemental channel in a service negotiation process in a CDMA communication system according to an embodiment of the present invention;

FIG. 9 is a flow diagram illustrating a handoff procedure in a CDMA communication system according to an embodiment of the present invention;

FIG. 10 is a flow chart illustrating a procedure for designating a frame offset of a supplemental channel during a handoff in a CDMA communication system according to an embodiment of the present invention; and

FIG. 11 is a diagram illustrating a field definition of an extended supplemental channel assignment message or a universal handoff direction message, to which a non-negotiation service configuration record field is added according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described herein below with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail since they would obscure the invention in unnecessary detail.

The present invention is to be applied to a future CDMA mobile communication system. Therefore, although the present invention will be described herein with reference to the American CDMA-2000 system, it is also possible to apply the invention to the European UMTS system.

The present invention proposes an apparatus and method for additional assigning of a supplemental channel for data transmission, upon receipt of a high-speed data transmission request in a traffic state (or a traffic channel-established state) between the base station and the mobile station in a CDMA mobile communication system. More specifically, the apparatus and method properly designates a frame offset of the supplemental channel according to an amount of transmission/reception data for the respective frame offsets. To this end, a CDMA communication system according to an embodiment of the present invention additionally assigns a supplemental channel upon receipt of a high-speed data transmission request in the traffic state between the base station and the mobile station. At this point, a frame offset of the supplemental channel is properly established according to an amount of the transmission/reception data for the respective frame offsets presently in use. In this case, the supplemental channel can be designated (or assigned) the different frame offset from the frame offset of the presently used fundamental channel. Alternatively, the supplemental channel can be designated the same frame offset as the frame offset of the fundamental channel. When the fundamental channel and the supplemental channel are designated the different frame offsets, several users assigned the same frame offset can simultaneously transmit data at a high data rate. The base station then sends information for designating a new frame offset to the mobile station through an extended supplemental channel assignment message. Upon receipt of the frame offset information from the base station, the mobile station additionally designates a frame offset for the supplemental channel in addition to a frame offset for the fundamental channel, thereby making it possible to operate the different frame offsets in the fundamental channel and the supplemental channel.

FIG. 1 shows a general procedure for assigning a supplemental channel in a CDMA communication system. Specifically, FIG. 1 shows a message exchange

procedure between modules in the mobile station and modules in the base station.

Referring to FIG. 1, the mobile station includes a service option for driving an application service, a message processor SIG for processing a channel establishment-related control message, and a resource controller (RC) for managing and controlling base station resources. A structure of the base station is similar to the structure of the mobile station. That is, the base station also includes a service option for driving an application service, a message processor SIG for processing a channel establishment-related control message, and a resource controller (RC) for managing and controlling logical and physical resources of the mobile station.

Now, a procedure for assigning a supplemental channel will be described with reference to FIG. 1. When the mobile station has user data to transmit, the service option checks a size (or amount) of the data and determines whether it is necessary to assign a supplemental channel. If it is determined that it is necessary to assign a supplemental channel, the service option sends a supplemental channel assignment request signal Data_Tx_SCH.Req to the resource controller (RC) in step 110. The resource controller then sends a supplemental channel assignment approval signal SCH_Assign.Req to the message processor SIG in step 120. The message processor SIG sends a supplemental channel request message (SCRM) to the base station in step 130.

When the base station receives the supplemental channel request message transmitted from the mobile station, the message processor SIG in the base station inquires of the resource controller (RC) in the base station whether it is possible to assign the supplemental channel requested by the mobile station, in step 140 (SCH_Assign.Ind). If it is possible to assign the supplemental channel, the resource controller informs the service option, an application service layer of the base station, that a data transmission request has been received from the mobile station, in step 150. Upon receipt of the data transmission request, the service option, which is the application service layer, performs several data reception processes.

In step 160, the service option of the base station performs an operation in response to the data transmission request. The operation of the step 160 can be separately described for one case where the data transmission request is originated by the mobile station and another case where the data transmission request is originated by the base station. When the data transmission request is originated from the mobile station, the base station sends the resource controller a ready-to-receive signal Data_Rx_SCH.Res, in step 160. In the case where the data has previously been transmitted/received over the

fundamental channel, it is not necessary to send the ready-to-receive signal to the resource controller. On the contrary, when the data transmission request is originated by the base station, the base station sends the resource controller a forward supplemental channel assignment request signal Data_Tx_SCH.Req in step 160.

Upon receipt of the ready-to-receive signal Data_Rx_SCH.Res or the data channel assignment request signal Data_Tx_SCH.Req from the service option, the resource controller determines whether it is possible to assign a reverse or forward supplemental channel. In this process, the embodiment of the present invention adds a procedure for re-designating a requested frame offset. The added procedure includes a process for establishing a new frame offset having a lower load out of the parameters required in assigning the supplemental channel. This procedure will be described later in detail with reference to FIG. 2. Thereafter, in step 170, the resource controller sends the message processor a message SCH_Assign.Res indicating whether to approve the reverse or forward supplemental channel. If assignment of the supplemental channel for transmitting data is approved, the message processor SIG sends an extended supplemental channel assignment message (ESCAM) to the mobile station in step 180.

Upon receipt of the extended supplemental channel assignment message transmitted from the base station, the message process SIG in the mobile station sends a control signal SCH_Assign.Conf to the resource controller in step 190. At this moment, the resource controller assigns a transmission channel or a reception channel of the corresponding supplemental channel. Finally, after completing assignment of the supplemental channel, the resource controller sends to the service option, which is the application service layer of the mobile station, a data transmit/receive possibility conformation message Data_Tx_SCH.conf or Data_Rx_SCH.Conf in step 195. After performing the above procedure, the base station and the mobile station exchange a data traffic over the additionally assigned supplemental channel.

FIG. 2 shows a procedure for assigning a frame offset for a supplemental channel according to an embodiment of the present invention, performed in the supplemental channel assignment process of FIG. 1. In FIG. 2, operations of steps 210-250 correspond to the operations of steps 140-170 in FIG. 1 are performed by the base station. Further, operations of steps 260-295 correspond to the operations of steps 180-195 in FIG. 1 are performed by the mobile station. The procedure for assigning the frame offset for the supplemental channel by the base station is performed through the steps 140-180 of FIG. 1, and the procedure for assigning the frame offset for the supplemental channel by the mobile station is performed through the steps 110, 120, 130, 190 and 195 of FIG. 1.

If a supplemental channel request message (SCRM) is received from the mobile station or a supplemental channel assignment message is received from the application service layer of the base station as the application service layer has traffic data to transmit, the resource controller checks the present capacity of the base station in step 220 to determine whether the physical/logical resources are available, to thereby decide whether it is possible to assign the additional reverse or forward supplemental channel. If assignment of the supplemental channel is not permissible, the resource controller proceeds to step 230 where the resource controller transmits the data traffic over the previously connected fundamental channel (FCH) or a dedicated control channel (DCCH), or awaits a next command while delaying transmission of the data traffic.

Otherwise, if assignment of the supplemental channel is permissible in step 220 or a supplemental channel request message (SCRM) is received from the mobile station, the resource controller proceeds to step 240 where the resource controller designates a frame offset available for the supplemental channel, provides this information to the message processor, and further, provides information about the frame offset for the supplemental channel to the physical layer. The physical layer then sets this value as an exclusive frame offset for processing the supplemental channel. Here, for the frame offset of the supplemental channel established for data transmission, a proper frame offset can be designated according to the amount of the transmission/reception data for the respective frame offsets. The frame offset can be set to be different from the frame offset of the fundamental channel. Alternatively, the frame offset can be set to be identical to the frame offset of the fundamental channel. Here, the frame offset of the supplemental channel can be either previously set or generated by the base station through a separate operation. In the frame offset designation process, the resource controller should set a proper frame offset value such that the loads are properly dispersed to transmit the data without delay. Thereafter, in step 250, the resource controller generates an extended supplemental channel assignment message (ESCAM) to which the frame offset-related fields for the supplemental channel are added, and sends the generated extended supplemental channel assignment message to the mobile station.

Upon receipt of the extended supplemental channel assignment message from the base station, the message processor in the mobile station analyzes the received extended supplemental channel assignment message and provides the analyzed results to the resource controller in the mobile station, in step 260. In this process, the message processor sends to the resource controller the information about whether the frame offset for the supplemental channel is designated, and its corresponding value, together with

other supplemental channel parameters. Upon receipt of the analyzed results from the message processor, the resource controller determines in step 270 whether the frame offset of the supplemental channel is designated or not. If the frame offset of the supplemental channel is designated, the resource controller sets a frame offset for the supplemental channel according to the value in step 280. After setting the frame offset for the supplemental channel, or if the frame offset of the supplemental channel is not designated, the resource controller sends to the physical layer new frame offset information together with a supplemental channel assignment signal, in step 290. Upon receipt of the supplemental channel-related signal from the resource controller, the physical layer assigns a supplemental channel and additionally sets a frame offset for the supplemental channel so as to enable data transmission/reception. When the reverse or forward supplemental channel is established between the base station and the mobile station in the above method, the data traffic is transmitted to the application service in step 295.

In the embodiment of the present invention, the base station includes a step (a) in which the resource controller of the base station determines whether the supplemental channel is available; a step (b) in which if the supplemental channel is available, the resource controller determines a frame offset to be exclusively used for the supplemental channel; a step (c) in which the resource controller creates the extended supplemental channel assignment message shown in FIG. 3 to transmit the frame offset information to the mobile station; and a step (d) in which the resource controller designates the frame offset assigned by the physical layer to the supplemental channel. Here, in the step (d), the resource controller should set a proper value such that the loads should be properly dispersed to transmit the data without delay.

In addition, the mobile station includes a step (a) for detecting a frame offset for the supplemental channel in the process of analyzing the extended supplemental channel assignment message and providing the detected frame offset information to the resource controller; a step (b) in which the resource controller provides the set value to the physical channel; and a step (c) in which the physical layer newly sets the frame offset during assignment of the supplemental channel.

FIG. 3 shows a structure of an extended supplemental channel assignment message (ESCAM) to which the frame offset-related fields for the supplemental channel are newly added.

In the extended supplemental channel assignment message as shown in FIG. 3,

the fields for assigning the frame offset for the supplemental channel include a REV_SCH_FRAME_OFFSET_INCL field indicating whether to newly designate a frame offset during assignment of the reverse supplemental channel, and a REV_SCH_FRAME_OFFSET field for actually designating a new frame offset. The fields further include FOR_SCH_FRAME_OFFSET_INCL and FOR_SCH_FRAME_OFFSET fields indicating whether the frame offset is designated during assignment of the forward supplemental channel and the designated value, respectively. In the existing system, the supplemental channel is also assigned the same value as the frame offset designated during assignment of the fundamental channel of the dedicated control channel. However, in the embodiment of the present invention, the REV_SCH_FRAME_OFFSET and FOR_SCH_FRAME_OFFSET field values are designated such that one of 16 frame offsets should be designated within 20ms during assignment of the supplemental channel, thereby making it possible to designate the frame offsets in a unit of 1.25ms.

FIG. 4 shows a demodulator for a receiver in a CDMA communication system.

Referring to FIG. 4, reference numeral 400 indicates an antenna of the mobile station for receiving various input signals. Reference numeral 410 indicates correlators for separating the multi-path signals received through the antenna 400. Reference numeral 420 indicates a combiner for combining the separated multi-path signals into one signal. The combined signal output from the combiner 420 is applied to deinterleavers 430, and the output signals of the deinterleavers 430 provided to decoders 440. The combiner 420 provides a frame boundary indication signal to the deinterleavers 430 through a control line 450 in addition to the combined symbols.

In operation, the correlators 410 detect correlation values of the associated multi-path signals, and the combiner 420 combines the correlation values output from the correlators 410. Further, the combiner 420 generates a signal for distinguishing a frame at a frame boundary. In the embodiment of the present invention, since the frame offset value of the fundamental channel is set to be different from frame offset value of the supplemental channel, the combiner 420 generates the frame boundary signals of the fundamental channel and the supplemental channel at the different time points. The detailed description of the frame boundary signals will be made with reference to FIG. 5.

The deinterleavers 430 receive the frame boundary signals from the combiner 420 through the control line 450, and deinterleave the symbols output from the combiner 420 in a frame unit. Here, the frame boundary signals output through the control line 450

include an FCH/DCCH frame boundary signal and an SCH frame boundary signal. The decoders 440 decode the symbols output from the deinterleavers 430 to create decoded data.

FIG. 5 shows a detailed structure of the combiner 420 of FIG. 4.

Referring to FIG. 5, the combiner 420 includes a timing generator 540, a first symbol combiner 550 for combining FCH/DCCH symbols, and a second symbol combiner 555 for combining SCH symbols. The timing generator 540, receiving a system time, sets frame boundaries, generates corresponding frame boundary signals at the set frame boundaries, and provides the generated frame boundary signals to first and second deinterleavers 431 and 435. Since the embodiment of the present invention sets the frame offset of the supplemental channel at the point where the supplemental channel is assigned, the fundamental channel and the supplemental channel can use the different frame offsets. Therefore, the timing generator 540 generates a first frame boundary signal for FCH/DCCH through a control line 565 and a second frame boundary signal for SCH through a control line 560, depending on the system time, the FCH/DCCH frame offset value and the SCH frame offset value. That is, when it is intended to additionally assign a supplemental channel to transmit data, the timing generator 540 properly sets a frame offset of the supplemental channel such that the supplemental channel should have the different frame offset from the frame offset of the presently assigned fundamental channel in the traffic state. The FCH/DCCH frame offset value and the SCH frame offset value are received with the channel assignment message transmitted from the base station. The FCH/DCCH frame offset value is transmitted with a fundamental channel assignment message, and the SCH frame offset value is transmitted with a supplemental channel assignment message. The channel assignment messages are provided to a message processor 510, and the channel assignment messages processed by the message processor 510 are provided to a resource controller 520. The resource controller 520 outputs a set frame offset value for the fundamental channel (FCH/DCCH) and a set frame offset value for the supplemental channel (SCH). The frame offset values for the fundamental channel and the supplemental channel are provided to the timing generator 540.

The first symbol combiner 550 combines the multi-path symbols on the fundamental channel/dedicated control channel (FCH/DCCH), and the second symbol combiner 555 combines the multi-path symbols on the supplemental channel (SCH). The first deinterleaver 431 deinterleaves the combined symbol output from the first symbol combiner 550 in a frame unit in response to the first frame boundary signal on the control line 565, and the second deinterleaver 435 deinterleaves the combined symbol output

from the second symbol combiner 555 in a frame unit in response to the second frame boundary signal on the control line 560.

FIG. 6 shows a detailed diagram of the timing generator 540 of FIG. 5. The timing generator 540 includes two delays 620 and 630 to generate frame boundary signals using the system time 530 and the frame offsets 610 and 640. The frame offsets 610 and 640 include the frame offset 610 for the fundamental channel (FCH/DCCH) and the frame offset 640 for the supplemental channel (SCH). The frame offsets 610 and 640 are provided from the resource controller 520 shown in FIG. 5. The delay 620 delays the system time 530 by the frame offset 610 set by the resourced controller 520. That is, the delay 620 delays the system time 530 by the FCH/DCCH frame offset 610 provided from the resource controller 520 and outputs the FCH/DCCH frame boundary signal 565. The delay 630 delays the system time 530 by the frame offset 640 set by the resourced controller 520. That is, the delay 630 delays the system time 530 by the SCH frame offset 640 provided from the resource controller 520 and outputs the SCH frame boundary signal 560. As described above, in the embodiment of the present invention, the timing generator 540 includes the two additional delays 620 and 630 so that the fundamental channel and the supplemental channel have the different frame offsets. The delays 620 and 630 perform delay operations using their unique frame offsets 610 and 640, respectively. That is, the embodiment of the present invention additionally includes the delay for the supplemental channel in order to designate the frame offset assigned for the supplemental channel.

FIG. 7 shows a general call setup procedure in a CDMA communication system. Specifically, FIG. 7 shows a message exchange procedure between modules in the mobile station and modules in the base station.

Referring to FIG. 7, the mobile station includes a message processor SIG for processing a channel establishment-related control message and a resource controller (RC) for managing and controlling base station resources. A structure of the base station is similar to the structure of the mobile station. That is, the base station also includes a message processor SIG for processing a channel establishment-related control message and a resource controller (RC) for managing and controlling logical and physical resources of the mobile station.

Now, the call setup procedure will be described with reference to FIG. 7. When the mobile station has user data to transmit, the resource controller sends a call setup request signal Call_Setup.Req to the message processor SIG in step 710. The message

processor SIG then sends an origination message (or call setup request message) to the base station in step 712.

Upon receipt of the origination message transmitted from the mobile station, the message processor SIG in the base station inquires of the resource controller in the base station whether it is possible to setup the call requested by the mobile station, in step 714 (Call_Setup.Ind). If it is possible to setup the call, the resource controller sends a channel assignment approval signal Call_Setup.Res to the message processor SIG in step 716. The message processor SIG then sends an extended channel assignment message for approving assignment of the requested channel to the mobile station in step 718.

Upon receipt of the extended channel assignment message from the base station, the message process SIG in the mobile station sends a call setup confirmation signal Call_Setup.Conf to the resource controller in step 720, thereby completing establishment of the forward and reverse fundamental channel/dedicated control channel.

After completing establishment of the fundamental channel between the base station and the mobile station in the above process, the mobile station and the base station perform a service negotiation process in step 722. If the base station and the mobile station come to an agreement on a service configuration record in the service negotiation process, the message processor SIG of the base station sends the agreed record value with a service connect message to the mobile station in step 724. Further, the service connect message also includes a non-negotiation service configuration record. The non-negotiation service configuration record is registered in a non-negotiation service configuration record field assigned to the service connect message. In this process, the resource controller of the base station designates a frame offset of the supplemental channel to be used until a renegotiation is made later with the mobile station, and registers the designated frame offset value in the non-negotiation service configuration record field. In step 726, the message processor SIG of the mobile station sends to the resource controller a Call_Setup.Conf signal indicating that the frame offset of the supplemental channel has been set. In addition, the message processor of the mobile station sends a service connect completion message to the base station in step 728, thereby completing the call setup procedure.

The non-negotiation service configuration record can be transmitted with the service connect message or a universal handoff direction message, not only when a call is initially setup, but also when a new service is connected or a service configuration is changed, or when a handoff is performed. Therefore, the embodiment can newly

designate the frame offset of the supplemental channel in a state other than the call setup state.

FIG. 8 shows a detailed procedure for setting a frame offset of the supplemental channel, performed in the resource controller, shown in FIG. 7. More specifically, FIG. 8 shows a procedure for designating a frame offset for the supplemental channel during a call setup process or a new service connect process according to an embodiment of the present invention. That is, FIG. 8 shows a procedure for setting a frame offset for the supplemental channel during a call setup process or a new service connect process according to an embodiment of the present invention.

In FIG. 8, operations of steps 810-818 are performed by the base station (BS), and operations of steps 820-828 are performed by the mobile station (MS). Further, the procedure for assigning the frame offset for the supplemental channel performed by the base station in steps 810-818 corresponds to a procedure performed in the service negotiation process of step 722 of FIG. 7. Further, the procedure for assigning the frame offset for the supplemental channel performed by the mobile station in steps 820-828 corresponds to a procedure performed after the mobile station receives the service connect message from the base station in step 724.

Upon receipt of a call setup request message or a new service request message from the mobile station, the base station determines whether it is possible to assign the reverse or forward supplemental channel. When determined to perform an initial call setup, additional traffic transmission or service connection, the base station sends a channel assignment message in steps 810 and 812. Thereafter, a traffic channel is established or a new service is additionally connected between the base station and the mobile station. At this moment, the base station negotiates information for the call setup or the new service connection with the mobile station.

After completing the service negotiation in step 812, the base station determines the non-negotiation service configuration record constituting the service connect message to be transmitted to the mobile station, in step 814. That is, the base station sets the non-negotiation service configuration record to be added to the service connect message in step 814. At this point, the base station determines through the resource controller whether to newly designate a frame offset of the supplemental channel added in the present invention. If it is determined to designate a new frame offset to the supplemental channel in step 814, the base station determines a proper frame offset taking into consideration the setup call, the traffic feature of the newly connected service and the

base station resources. The frame offset of the supplemental channel can be set to be either identical to or different from the frame offset of the fundamental channel. Here, the frame offset of the supplemental channel can be either previously set or generated by the base station through a separate operation. In the frame offset designation process, the resource controller should set a proper frame offset value such that the loads are properly dispersed to transmit the data without delay. Such determined frame offset of the supplemental channel is provided to the message processor SIG and registered in the non-negotiation service configuration record field. The above operation of determining the frame offset of the supplemental channel and registering the determined frame offset of the supplemental channel in the non-negotiation service configuration record field is performed in step 816. The registered frame offset for the supplemental channel is set as a frame offset value of the supplemental channel to be assigned later. Meanwhile, in step 818, the message processor SIG of the base station sends the service connect message including the set negotiation service configuration record and non-negotiation service configuration record to the mobile station.

If the base station sends the service connect message for the call setup or the new service connection, the message processor SIG of the mobile station receives the service connect message in step 820. Upon receipt of the service connect message, the message processor SIG analyzes the received service connect message and provides the analyzed results to the resource controller of the mobile station, in step 822. That is, in step 822, the message processor SIG analyzes the non-negotiation service configuration record as well as the other service configuration record (negotiation service configuration record). Further, in step 822, the message processor SIG sends the analyzed results of the non-negotiation service configuration record, i.e., information about whether the frame offset of the supplemental channel is designated, and the set frame offset value to the resource controller.

Upon receipt of the analyzed results, the resource controller determines in step 824 whether the frame offset of the supplemental channel is registered in the non-negotiation service configuration record field. If it is determined that the frame offset of the supplemental channel is registered in the non-negotiation service configuration record field, the message processor SIG proceeds to step 826, and otherwise, proceeds to step 828. In step 826, the resource controller assigns the frame offset for the supplemental channel, provided from the message processor SIG, to the corresponding supplemental channel, or stores the provided frame offset to use it when it is necessary to assign the supplemental channel or use it in response to a supplemental channel request message (SCRM) from the mobile station. Finally, in step 828, the mobile station sends a service

connect completion message, to thereby end the frame offset setting process.

As stated above, when the base station needs to assign a supplemental channel after registering the frame offset of the supplemental channel or has received the supplemental channel request message (SCRM) from the mobile station, the base station can use the registered frame offset.

As described above, the embodiment of the present invention designates an exclusive frame offset for the supplemental channel, being different from the frame offset of the fundamental channel, to assign the supplemental channel, thereby making it possible to the scheduling loss which may caused by an excess of the link capacity.

On the other hand, a handoff may occur while data is transmitted over the supplemental channel assigned according to the embodiment of the present invention. Therefore, the handoff is possible when an exclusive frame offset for the supplemental channel is different from the frame offset of the fundamental channel, as provided in the present invention. In the context of the present invention, consideration is thus given to a case where it is not possible to support a frame offset value for the presently used supplemental channel, because a target base station uses a frame offset value for the existing supplemental channel when the handoff occurs. In this situation, it is not possible to continuously provide the service.

Therefore, in an embodiment of the present invention, when a supplemental channel is handed off or newly assigned in a handoff state between the base station and the mobile station of the CDMA communication system, a source base station measures loads of the respective frame offsets for a target base station, to designate or reset a mutually proper frame offset for the supplemental channel. To this end, in the CDMA communication system according to an embodiment of the present invention, the frame offset for the supplemental channel is designated as a frame offset value different from the frame offset of the presently used fundamental channel or different from a predetermined frame offset in a handoff state between the base station and the mobile station. The base station then sends to the mobile station new frame offset designation information with a universal handoff direction message. Upon receipt of frame offset information from the base station, the mobile station can additionally designate a frame offset for the supplemental channel in addition to the frame offset for the fundamental channel, or can operate a frame offset value different from the previously designated frame offset for the supplemental channel.

Now, a detailed description of a handoff procedure will be made with reference to the accompanying drawings, to bring a better understanding of the present invention.

FIG. 9 shows a general handoff procedure in a CDMA communication system. Specifically, FIG. 9 shows a message exchange procedure between modules of the mobile station and module of the base station.

Referring to FIG. 9, the mobile station includes a message processor SIG for processing a channel establishment-related control message and a resource controller (RC) for managing and controlling base station resources. The base station also includes a message processor SIG for processing a channel establishment-related control message and a resource controller (RC) for managing and controlling logical and physical resources of the mobile station. Here, the base station includes a source base station presently in service and a target base station to which the mobile station is to be handed off.

Now, the handoff procedure will be described with reference to FIG. 9. Upon detecting a pilot channel having a new pseudo-noise (PN) value, the resource controller of the mobile station reports measured pilot strength to the message processor SIG and commands the message processor SIG to send a new pilot strength measurement message or extended pilot strength measurement message, in step 1110. Upon receipt of this command, the message processor SIG sends a pilot strength measurement message to the base station in step 1120.

Upon receipt of the pilot strength measurement message transmitted from the mobile station, the message processor SIG in the source base station determines in step 1130 whether to add the mobile station to a new active set based on the pilot strength measurement value provided to the resource controller of the source base station from the mobile station. If it is determined to add the mobile station to the active set, the resource controller of the source base station inquires of the resource controller of the target base station whether it is possible to assign a handoff resource to the resource controller of the target base station, in step 1140 (Handoff.Req). One of the factors for determining whether it is possible to assign the resource may include supplemental channel-related contents. If the target base station can accept the handoff, the resource controller of the target base station sends a handoff acceptance response Handoff.Conf to the resource controller of the source base station, in step 1150.

Upon receipt of the handoff acceptance response Handoff.Conf from the target

base station, the source base station sends a universal handoff direction message including the new active set to the mobile station in step 1160. Here, if the target base station approves the handoff, the source base station forms a new physical channel. However, an actual part for generating the message is a message processor SIG of the source base station, and the generated message is transmitted to the mobile station using physical layers of the source and target base stations, not shown in FIG. 11. Such generated and transmitted universal handoff direction message includes supplemental channel-related information when a supplemental channel is newly assigned or handed off.

When determining in step 1140 whether it is possible to perform the handoff, the resource controller of the target base station examines whether it is possible to hand off the reverse or forward supplemental channel. In this process, the frame offset re-designation procedure is added during a handoff according to an embodiment of the present invention. The re-designation procedure is a procedure included in the Handoff.Req and Handoff.Conf messages, and a frame offset part must be added to a supplemental channel-related factor in the Handoff.Req message transmitted to the target base station. If the target base station accepts the same frame offset as the frame offset of the supplemental channel presently in service, it is possible to soft-handoff the supplemental channel without re-designation of the frame offset. However, when the service (or source) base station does not operate with the same frame offset as presently used one, the target base station negotiates an acceptable frame offset for the supplemental channel with the source base station, so that the source and target base stations newly designate the same frame offset, thereby performing a hard handoff. The added procedure is a procedure for setting a new frame offset. This procedure will be described in detail with reference to FIG. 10.

In step 1170, the message processor SIG of the mobile station sends a control signal Handoff.Req to the resource controller of the mobile station, and assigns a transmission channel or a reception channel of the corresponding fundamental channel and the supplemental channel. After completing assignment of the resource necessary for the handoff, the resource controller informs the service option which is an application service layer of the mobile station, that it is possible to transmit/receive data, in step 1180 (Handoff.Conf). Finally, in step 1190, the message generator SIG sends a handoff completion message to indicate completion of the handoff procedure. Here, the handoff completion message is processed by the message processor of the source base station. After completion of the above procedure, the base station and the mobile station exchange the data traffic with the handoff-related base station through the fundamental or supplemental channel.

FIG. 10 shows a procedure for assigning a frame offset for the supplemental channel according to an embodiment of the present invention, performed during the handoff procedure of FIG. 9. In FIG. 10, operations of steps 1210-1224 correspond to the operations of steps 1130-1150 in FIG. 9 and are performed by the source and target base stations. Further, operations of steps 1226-1236 correspond to the operations of steps 1170-1190 in FIG. 9 and are performed by the mobile station. The procedure for assigning the frame offset for the supplemental channel by the source and target base stations is performed through the steps 1140-1150 of FIG. 9, and the procedure for assigning the frame offset for the supplemental channel by the mobile station is performed through the steps 1170 and 1180 of FIG. 9.

When the mobile station sends a pilot strength measurement message (PSMM) in step 1210, the resource controller of the source base station determines in step 1212 whether to add a pilot having the newly added PN value to the active set, depending on the pilot strength. If it is determined not to add the pilot to the active set, the resource controller proceeds to step 1214 to avoid performing the handoff. However, if it is determined to add the pilot to the active set, the resource controller determines in step 1216 whether the supplemental channel and other resources are presently assigned. If the supplemental channel is not assigned, the resource controller hands off only the fundamental channel or the dedicated control channel in step 1220. Otherwise, when the supplemental channel is assigned in step 1216, the resource controller proceeds to step 1218 and determines whether it is possible to hand off the supplemental channel. At this point, it is necessary to inquire of not only the source base station but also the target base station whether it is possible to assign the handoff resource for the supplemental channel. If it is not possible to hand off the supplemental channel, the resource controller hands off only the fundamental channel or the dedicated control channel in step 1220. Otherwise, if it is possible to hand off the supplemental channel, it is necessary to search the frame offset having the lower load in both the source and target base stations.

Therefore, in step 1222, the resource controllers of the source and target base stations designate a frame offset for the supplemental channel, inform the message processor SIG of the designated frame offset, and also, inform the physical layers of the source and target base stations of the frame offset for the corresponding supplemental channel. Here, if the target base station accepts the same frame offset as the frame offset of the supplemental channel presently in service, it is not necessary to re-designate the frame offset. However, if the target base station does not operate with the same frame offset, the target base station negotiates an acceptable frame offset for the supplemental

channel with the source base station, so that the source and target base stations newly designate the same frame offset. The physical layer then sets this value as an exclusive frame offset value for the supplemental channel. Here, the frame offset of the supplemental channel established for data transmission can properly be designated according to an amount (or load) of the transmission/reception data for the respective frame offsets. The frame offset of the supplemental channel can be set to be either identical to or different from the frame offset of the fundamental channel. Here, the frame offset value is properly determined such that the loads of the service base station and the target base station, which designated the frame offset, are properly dispersed to transmit the data without delay. Thereafter, in step 1224, the resource controller of the source base station directs the universal handoff direction message (UHDM) to be created, to which frame offset-related fields for the supplemental channel are added. Upon receipt of the direction, the message controller SIG of the source base station generates the corresponding message and sends the generated message to the mobile station through the physical layers of the source base station and the target base station.

Upon receipt of the universal handoff direction message from the base station, the message processor SIG of the mobile station analyzes the received universal handoff direction message and provides the analyzed results to the source controller of the mobile station, in step 1226. After completing the analysis, the resource controller determines in step 1228 whether the supplemental channel is included, based on analyzed results. If the supplemental channel is included, the message processor SIG sends to the resource controller information about whether the frame offset for the supplemental channel is set, and the offset value, together with other supplemental channel parameters. The resource controller then receives the analyzed results by the message processor SIG and determines in step 1230 whether the frame offset of the supplemental channel is designated or not. If the frame offset of the supplemental channel is designated, the resource controller sets the corresponding frame offset value for the supplemental channel and sends to the physical layer the new frame offset value together with the supplemental channel assignment signal, in step 1232. Upon receipt of the supplemental channel-related signal from the resource controller, the physical layer assigns the supplemental channel and additionally sets a frame offset value for the supplemental channel to enable data transmission/reception. When the forward/reverse supplemental channel is established between the base station and the mobile station as stated above, the resource controller performs a handoff on the established supplemental channel in step 1234. However, if it is determined in step 1228 that the supplemental channel is not included, the resource controller performs a handoff on the fundamental channel/dedicated control channel in step 1236. Meanwhile, after completion of the handoff, the resource controller sends a

handoff completion message (HCM) in step 1238, and thereafter, the data traffic of the application service is transmitted.

In the embodiment of the present invention, the base station includes a step (a) in which the resource controller of the base station determines whether it is possible to set the supplemental channel; a step (b) in which if it is determined to set the supplemental channel, the resource controller checks a frame offset SCH_frame_offset to be exclusively used for the supplemental channel; a step (c) in which the resource controller adds the frame offset to the supplemental channel assignment message to make a message shown in FIG. 11, in order to send the frame offset to the mobile station; and a step (d) in which the resource controller designates the frame offset value designated by the physical layer to the assigned supplemental channel. Here, in the step (d), the resource controller should set a proper value such that the loads should be properly dispersed to transmit the data without delay.

In addition, the mobile station includes a step (a) for detecting a frame offset for the supplemental channel in the process of analyzing the extended supplemental channel assignment message and providing the detected frame offset information to the resource controller; a step (b) in which the resource controller provides the set value to the physical channel; and a step (c) in which the physical layer newly sets the frame offset during assignment of the supplemental channel.

FIG. 11 shows a structure of an extended supplemental channel assignment message or a universal handoff direction message, to which a non-negotiation service configuration record field is added according to an embodiment of the present invention.

In the extended supplemental channel assignment message or the universal handoff direction message as shown in FIG. 11, the non-negotiation service configuration record field includes a REV_SCH_ID field indicating an identification (ID) of a channel assigned the mobile station during assignment of the reverse supplemental channel, a REV_SCH_FRAME_OFFSET_INCL field indicating whether to newly designate a frame offset during assignment of the reverse supplemental channel, and a REV_SCH_FRAME_OFFSET field for actually designating a new frame offset. The non-negotiation service configuration record field further includes a FOR_SCH_ID field indicating an identification (ID) of a channel assigned the mobile station during assignment of the forward supplemental channel, and FOR_SCH_FRAME_OFFSET_INCL and FOR_SCH_FRAME_OFFSET fields indicating whether the frame offset is designated during assignment of the forward

supplemental channel and the designated value, respectively. In the existing system, every channel is assigned the same value as the initially assigned frame offset even in the handoff state. However, in the embodiment of the present invention, the REV_SCH_FRAME_OFFSET and FOR_SCH_FRAME_OFFSET field values are designated such that one of 16 frame offsets should be designated within 20ms during assignment of the supplemental channel, thereby making it possible to designate the frame offsets in a unit of 1.25ms. The physical layer designates the frame offset of the supplemental channel through the above message. Conventionally, the physical channel registers the frame offset value of the supplemental channel in the REV_SCH_FRAME_OFFSET, and FOR_SCH_FRAME_OFFSET fields, and this value is changed in a unit of 20ms to a REV_MULTI_FRAME_OFFSET or FOR_MULTI_FRAME_OFFSET field value according to the multi-frame size of the supplemental channel designated in the service configuration record determined during service negotiation. In the embodiment of the present invention, the record value is changed in a unit of 1.25ms in order to change the frame offset value every 1.25ms during assignment of the supplemental channel.

As described above, the present invention is applied to a case where the future CDMA communication system assigns a supplemental channel when data traffic is generated in a traffic state where a basic call is connected. By providing the novel apparatus and method for designating a new frame offset for the supplemental channel to fixedly assign the supplemental channel to the user, it is possible to reduce the transmission delay and the scheduling loss, which may be caused by traffic concentration on a specific frame offset because the traffic has the burst property in the data service.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A method for transmitting, in a base station, spread data obtained by spreading data of a plurality of users with orthogonal codes assigned to the respective users in frames on a plurality of supplemental channels, the method comprising the step of:

trasmitting the spread data of different users over the supplemental channels, in different frames having a frame offset time determined according to an amount of data on the respective supplemental channels.

2. The method as claimed in claim 1, wherein the supplemental channels are assigned in association with previously assigned fundamental channels.

3. The method as claimed in claim 1, wherein the supplemental channels are reverse supplemental channels.

4. The method as claimed in claim 1, wherein the supplemental channels are forward supplemental channels.

5. A method for assigning a supplemental channel corresponding to one of a plurality of assigned fundamental channels using the same frame offset at a request for assigning a supplemental channel corresponding to one of the fundamental channels, the method comprising the step of:

designating a frame offset of the supplemental channel to be different from frame offsets of the assigned supplemental channels according to an amount of data transmitted over supplemental channels assigned in association with the fundamental channels using the same frame offset.

6. The method as claimed in claim 5, wherein the supplemental channel assignment request is a supplemental channel request message from a mobile station in which the fundamental channel is previously assigned.

7. The method as claimed in claim 6, wherein the supplemental channels are reverse supplemental channels.

8. The method as claimed in claim 5, wherein the supplemental channel assignment request is generated depending on data to be transmitted to a mobile station in which the fundamental channel is previously assigned.

9. The method as claimed in claim 8, wherein the supplemental channels are forward supplemental channels.

10. A method for assigning a supplemental channel corresponding to a plurality of fundamental channels having a predetermined frame offset, assigned in association with a plurality of mobile stations, the method comprising the steps of:

upon receipt of a request for assigning a supplemental channel corresponding to the fundamental channels, detecting an amount of transmission data for respective frame offsets of the supplemental channels presently assigned in association with the fundamental channels; and

designating a frame offset of the assignment-requested supplemental channel according to the detected amount of the transmission data for the respective frames offsets.

11. The method as claimed in claim 10, wherein the supplemental channel assignment request is a supplemental channel request message from a mobile station in which the fundamental channel is previously assigned.

12. The method as claimed in claim 11, wherein the supplemental channels are reverse supplemental channels.

13. The method as claimed in claim 10, wherein the supplemental channel assignment request is generated depending on data to be transmitted to a mobile station in which the fundamental channel is previously assigned.

14. The method as claimed in claim 13, wherein the supplemental channels are forward supplemental channels.

15. A method for assigning a supplemental channel corresponding to a plurality of fundamental channels having a predetermined frame offset, assigned in association with a plurality of mobile stations, the method comprising the steps of:

upon receipt of a request for assigning a supplemental channel corresponding to the fundamental channels, detecting an amount of transmission data for respective frame offsets of the supplemental channels presently assigned in association with the fundamental channels, designating a frame offset of the assignment-requested supplemental channel according to the detected amount of the transmission data for the respective frames offsets, and sending the designated frame offset with an extended supplemental channel assignment message; and

upon receipt of the extended supplemental channel assignment message, assigning a supplemental channel having the designated frame offset, if the received extended supplemental channel assignment message has the designated frame offset of the supplemental channel.

16. The method as claimed in claim 15, wherein the supplemental channel assignment request is a supplemental channel request message from a mobile station in which the fundamental channel is previously assigned.

17. The method as claimed in claim 16, wherein the supplemental channels are reverse supplemental channels.

18. The method as claimed in claim 15, wherein the supplemental channel assignment request is generated depending on data to be transmitted to a mobile station in which the fundamental channel is previously assigned.

19. The method as claimed in claim 18, wherein the supplemental channels are forward supplemental channels.

20. A method for performing a handoff, from a source base station to a target base station, on a mobile station to which a plurality of fundamental channels having a predetermined frame offset and a supplemental channel corresponding to the fundamental channels are assigned, the method comprising the steps of:

upon receipt of a handoff request for the mobile station, the source base station sending to the target base station frame offset information of the fundamental channel and the supplemental channel assigned to the mobile station, to determine whether the supplemental channel is acceptable;

performing a soft handoff on the mobile station using the frame offset of the supplemental channel, if the frame offset of the supplemental channel is acceptable by the target base station; and

designating a frame offset different from the frame offset of the supplemental channel through a negotiation between the target base station and the source base station and performing a hard handoff on the mobile station using the designated frame offset of the supplemental channel, if the frame offset of the supplemental channel is not acceptable by the target base station.

21. The method as claimed in claim 20, wherein the handoff request is generated depending on a power level of a pilot signal that the source base station has

received from the mobile station.

22. The method as claimed in claim 20, wherein whether the supplemental channel is acceptable is determined on whether the target base station can transmit data using the frame offset of the supplemental channel.

23. An apparatus for receiving data transmitted over fundamental channels having a predetermined frame offset for a plurality of mobile stations and supplemental channels assigned in association with the fundamental channels, the apparatus comprising:

a timing generator for receiving a frame offset of the fundamental channel, a frame offset of the supplemental channel and a system time, outputting the system time delayed by the frame offset of the fundamental channel as a fundamental channel boundary signal, and outputting the system time delayed by the frame offset of the supplemental channel as a supplemental channel boundary signal;

a first symbol combiner for combining multi-path symbols transmitted over the fundamental channel;

a second symbol combiner for combining multi-path symbols transmitted over the supplemental channel;

a first deinterleaver for receiving the symbols and the fundamental channel boundary signal from the first symbol combiner, and deinterleaving the symbols from the first symbol combiner in a frame unit determined by the fundamental channel boundary signal; and

a second deinterleaver for receiving the symbols and the supplemental channel boundary signal from the second symbol combiner, and deinterleaving the symbols from the second symbol combiner in a frame unit determined by the supplemental channel boundary signal.

24. The apparatus as claimed in claim 23, wherein the timing generator comprises:

a first delay for receiving the frame offset of the fundamental channel and the system time, and delaying the system time by the frame offset of the fundamental channel to output the fundamental channel boundary signal; and

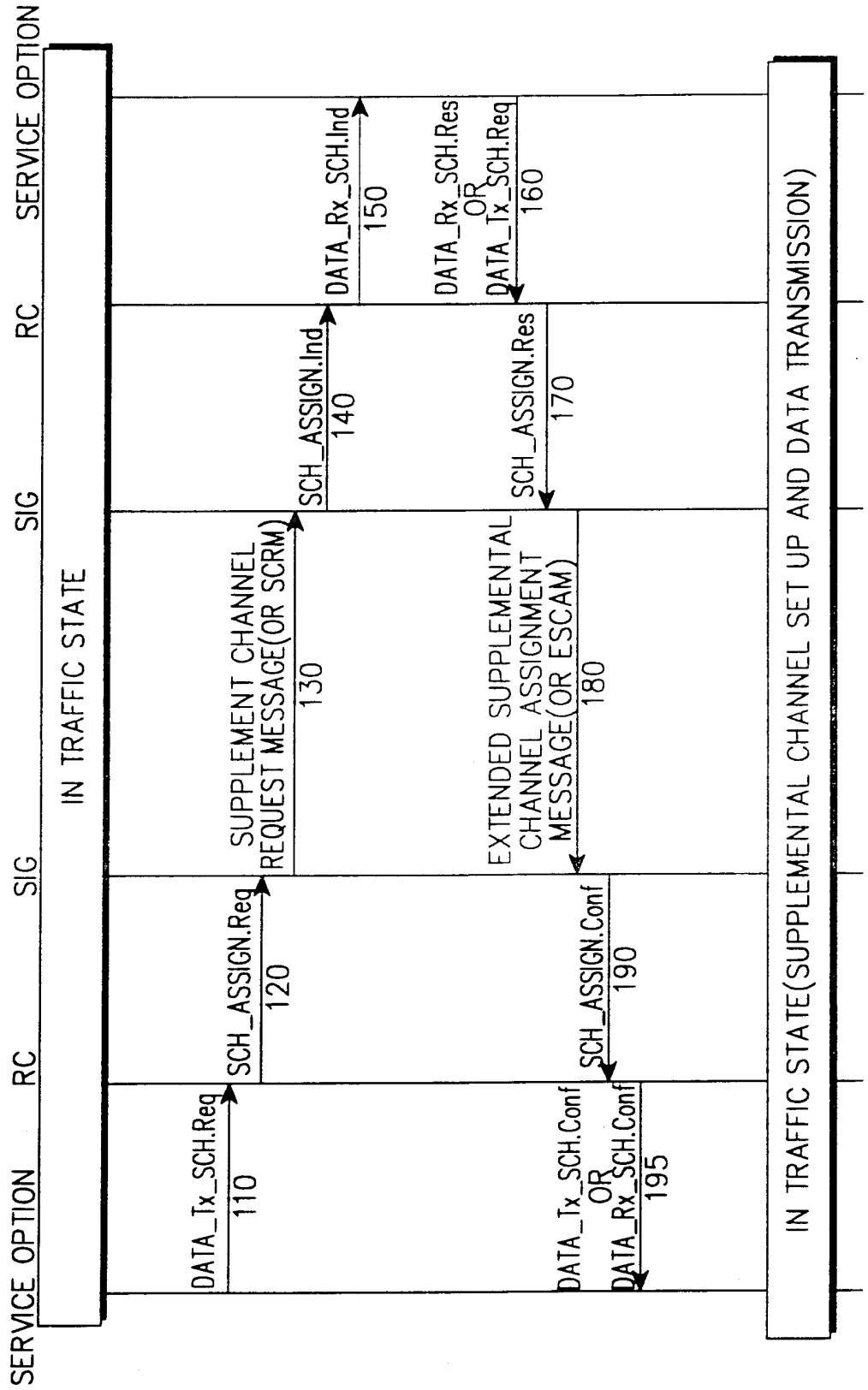
a second delay for receiving the frame offset of the supplemental channel and the system time, and delaying the system time by the frame offset of the supplemental channel to output the supplemental channel boundary signal.

25. The apparatus as claimed in claim 23, wherein the frame offset of the

fundamental channel is different from the frame offset of the supplemental channel.

26. The apparatus as claimed in claim 23, wherein the frame offset of the supplemental channel is designated according to an amount of the transmission data for the respective frame offsets of the supplemental channels assigned in association with the fundamental channels.

FIG. 1


MOBILE STATION
BASE STATION
SERVICE OPTION
RC
SIG
SIG
RC
SERVICE OPTION
IN TRAFFIC STATE
DATA_Tx_SCH.Req
110
SCH_ASSIGN.Req
120
SUPPLEMENT CHANNEL REQUEST MESSAGE(OR SCRM)
130
SCH_ASSIGN.Ind
140
DATA_Rx_SCH.Ind
150
DATA_Rx_SCH.Res OR DATA_Tx_SCH.Req
160
SCH_ASSIGN.Res
170
EXTENDED SUPPLEMENTAL CHANNEL ASSIGNMENT MESSAGE(OR ESCAM)
180
SCH_ASSIGN.Conf
190
DATA_Tx_SCH.Conf OR DATA_Rx_SCH.Conf
195
IN TRAFFIC STATE(SUPPLEMENTAL CHANNEL SET UP AND DATA TRANSMISSION)

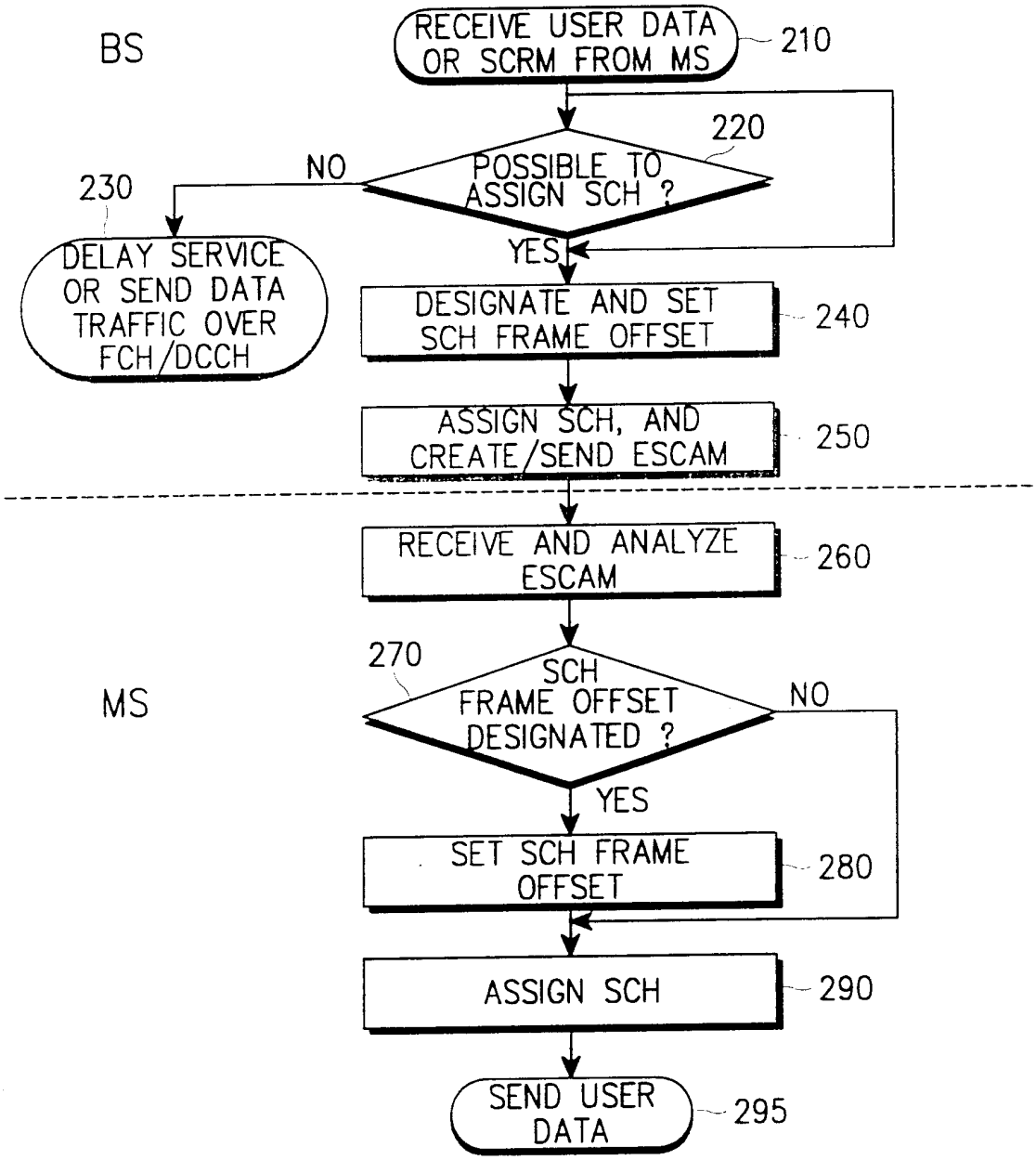

BS
RECEIVE USER DATA OR SCRM FROM MS
210
220
POSSIBLE TO ASSIGN SCH ?
NO
230
DELAY SERVICE OR SEND DATA TRAFFIC OVER FCH/DCCH
YES
DESIGNATE AND SET SCH FRAME OFFSET
240
ASSIGN SCH, AND CREATE/SEND ESCAM
250
RECEIVE AND ANALYZE ESCAM
260
MS
270
SCH FRAME OFFSET DESIGNATED ?
NO
YES
SET SCH FRAME OFFSET
280
ASSIGN SCH
290
SEND USER DATA
295

FIG. 2

FIELD	LENGTH(Bits)
START_TIME_UNIT	3
REV_SCH_DTX_DURATION	4
USE_T_ADD_ABORT	1
USE_SCRM_SEQ_NUM	1
NUM_REV_SCH	2

[.....]

REV_SCH_ID	1
REV_SCH_DURATION	4
REV_SCH_START_TIME_INCL	1
REV_SCH_START_TIME	0 OR 5
REV_SCH_NUM_BITS_IDX	4
REV_SCH_FRAME_OFFSET_INCL	1
REV_SCH_FRAME_OFFSET	0 OR 4

(CONTINUES ON NEXT PAGE)

FIELD	LENGTH(Bits)
NUM-FOR_SCH_CFG	2

[.....]

FOR-SCH_ID	1
FOR_SCH_DURATION	4
FOR-SCH-START_TIME_INCL	1
FOR_SCH_START TIME	0 OR 5
FOR_SCH_FER_REP	1
SCCL_INDEX	4
FOR_SCH_FRAME_OFFSET_INCL	1
FOR-SCH_FRAME_OFFSET	0 OR 4

FIG. 3

FIG. 4

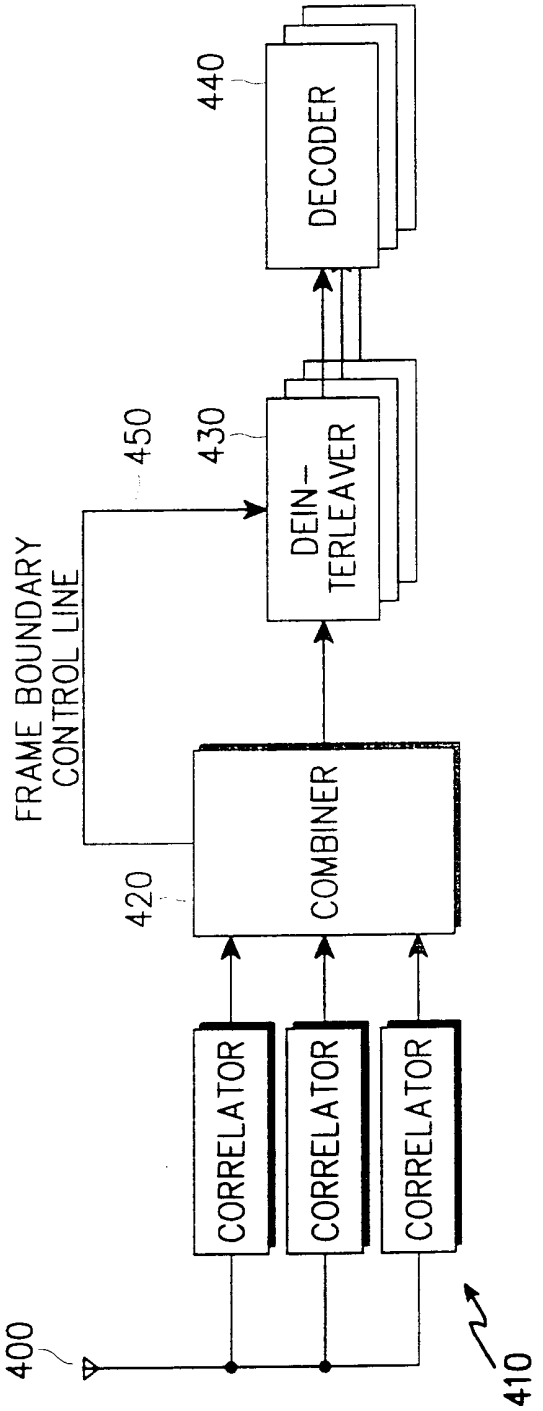

400
410
CORRELATOR
CORRELATOR
CORRELATOR
420
COMBINER
FRAME BOUNDARY CONTROL LINE
450
430
DEIN-TERLEAVER
440
DECODER

FIG. 5

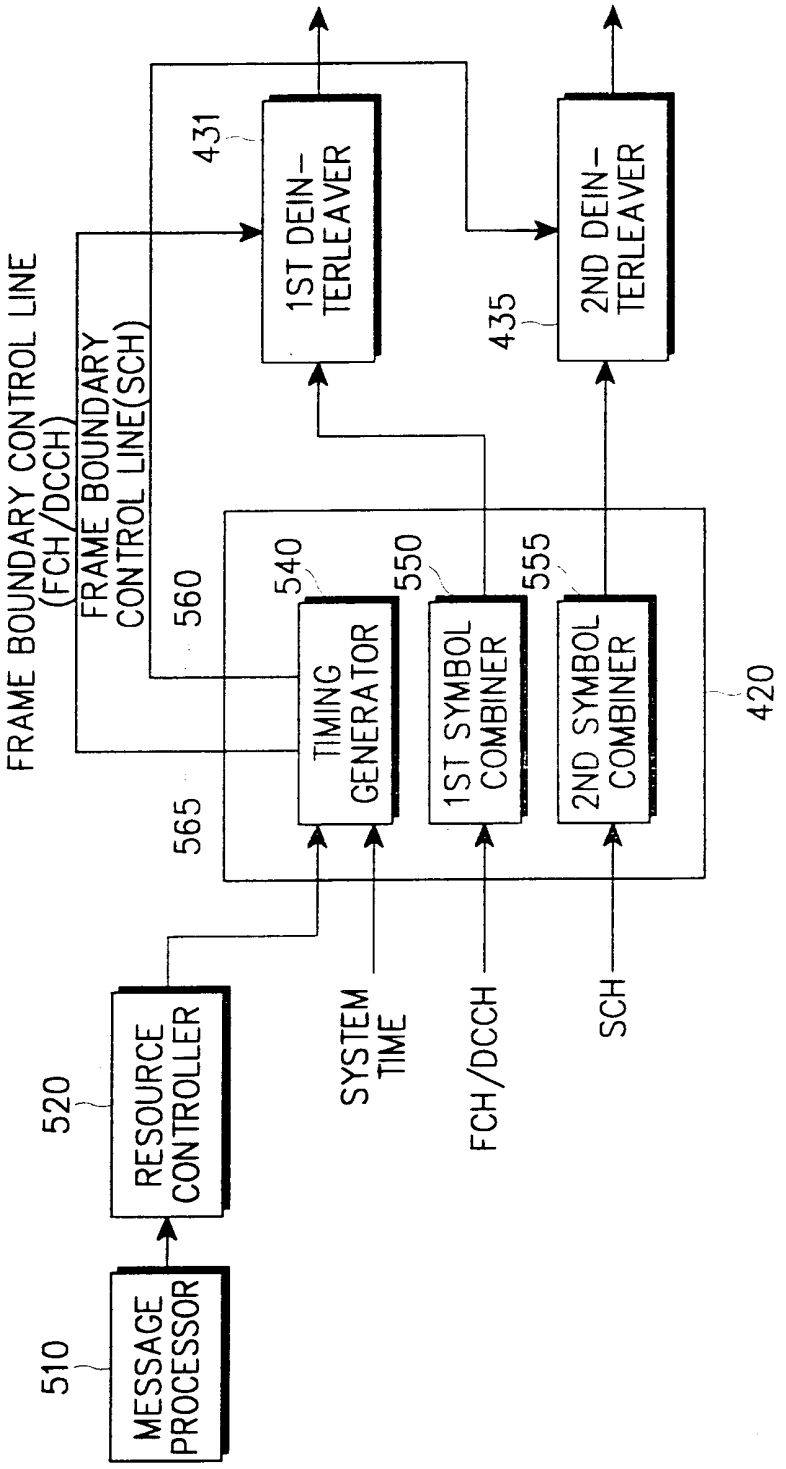

MESSAGE PROCESSOR
510
RESOURCE CONTROLLER
520
SYSTEM TIME
FCH/DCCH
SCH
TIMING GENERATOR
540
1ST SYMBOL COMBINER
550
2ND SYMBOL COMBINER
555
420
565
560
FRAME BOUNDARY CONTROL LINE (FCH/DCCH)
FRAME BOUNDARY CONTROL LINE(SCH)
1ST DEIN-TERLEAVER
431
2ND DEIN-TERLEAVER
435

FIG. 6

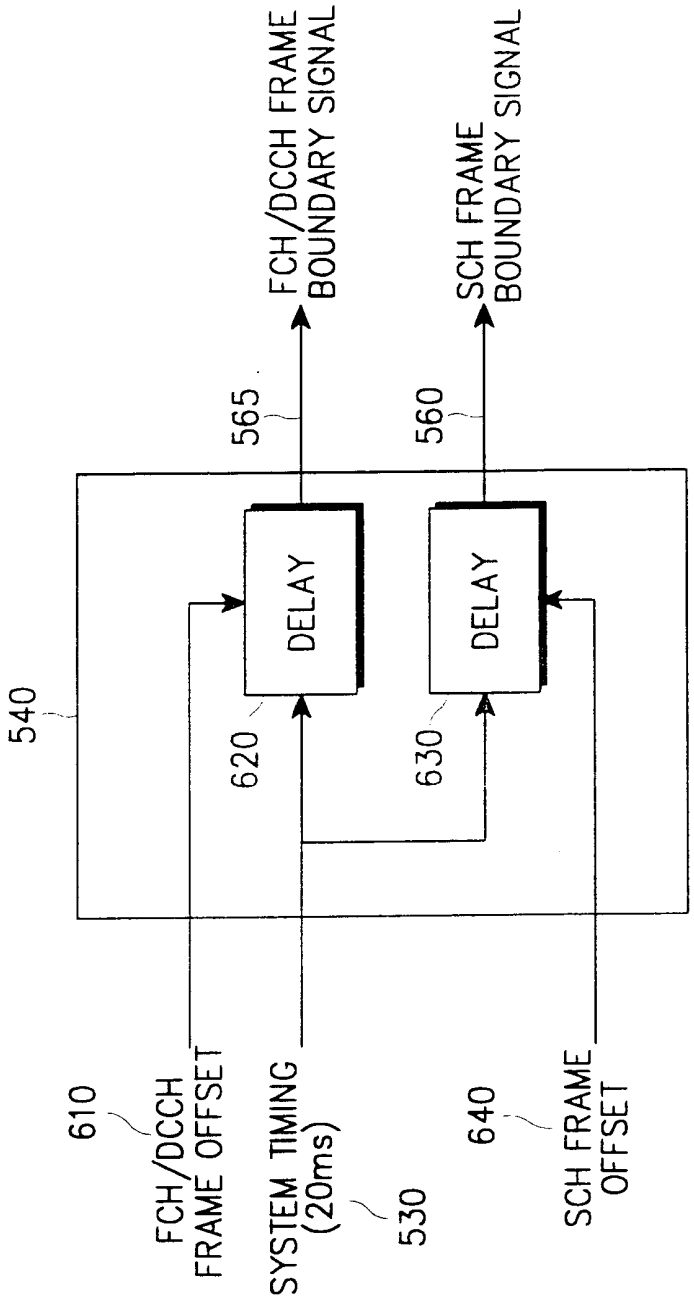
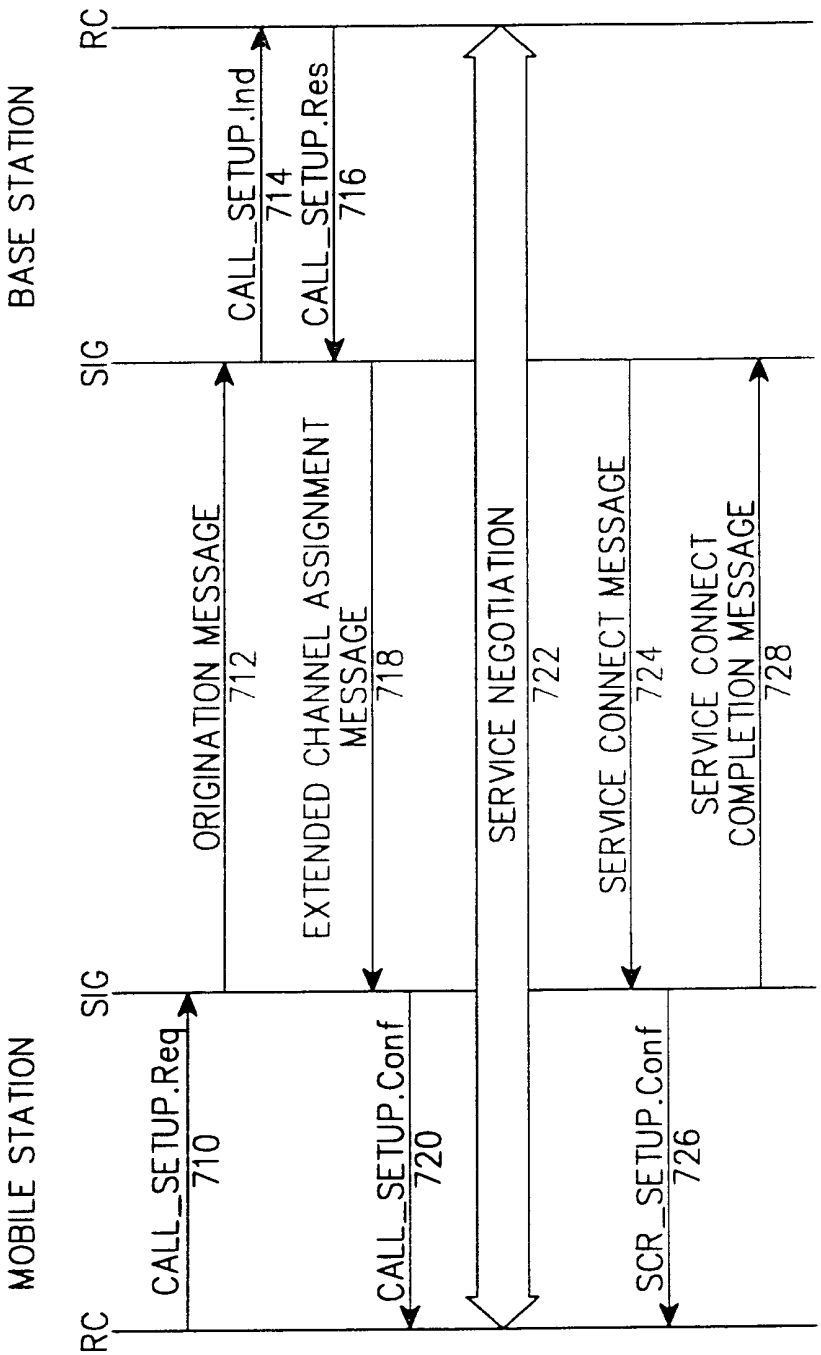

FCH/DCCH FRAME BOUNDARY SIGNAL
SCH FRAME BOUNDARY SIGNAL
565
560
DELAY
DELAY
540
620
630
610
FCH/DCCH FRAME OFFSET
SYSTEM TIMING (20ms)
530
640
SCH FRAME OFFSET

FIG. 7


MOBILE STATION
BASE STATION
RC
SIG
SIG
RC
CALL_SETUP.Req
710
ORIGINATION MESSAGE
712
CALL_SETUP.Ind
714
CALL_SETUP.Res
716
EXTENDED CHANNEL ASSIGNMENT MESSAGE
718
CALL_SETUP.Conf
720
SERVICE NEGOTIATION
722
SERVICE CONNECT MESSAGE
724
SERVICE CONNECT COMPLETION MESSAGE
728
SCR_SETUP.Conf
726

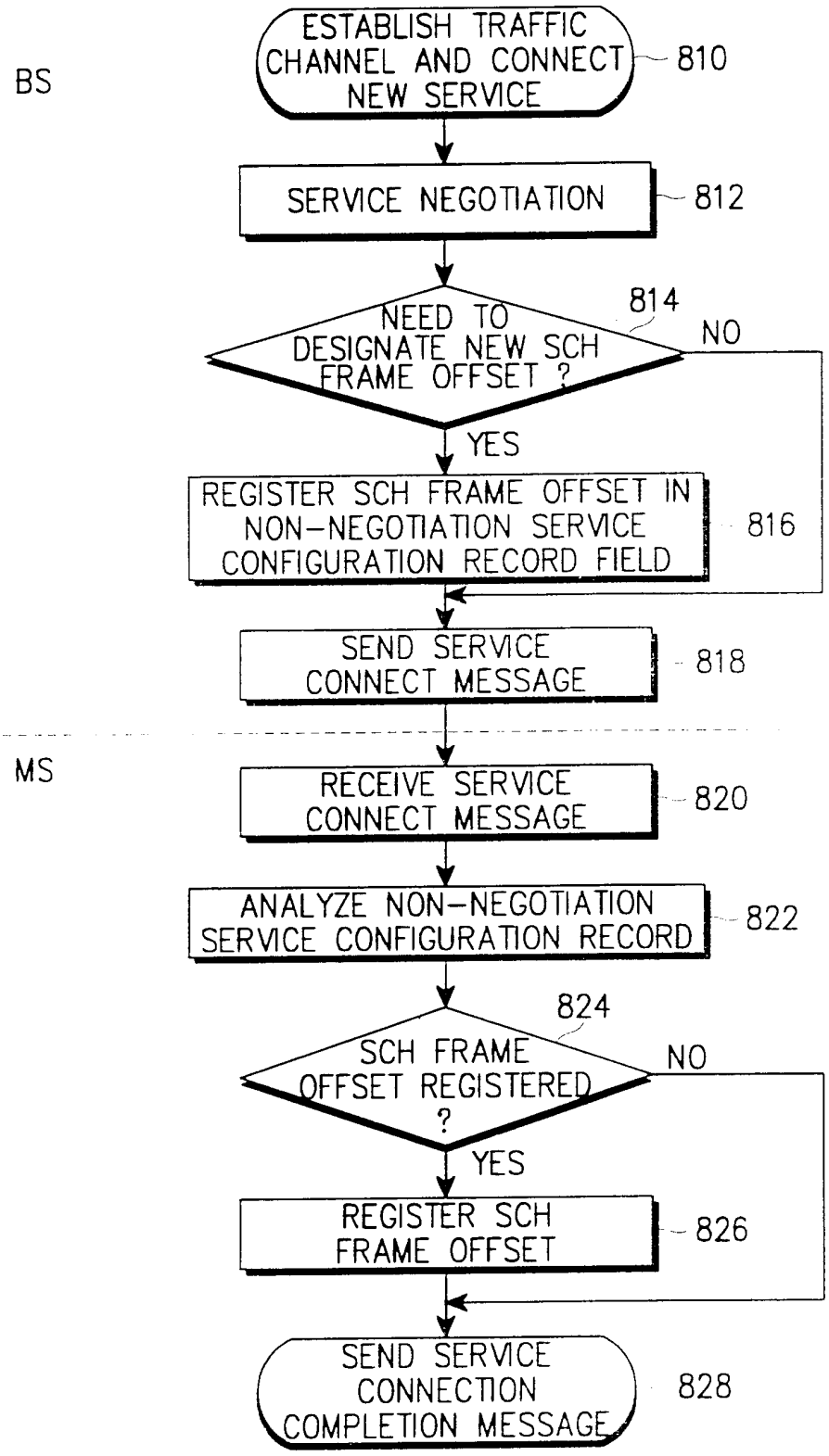
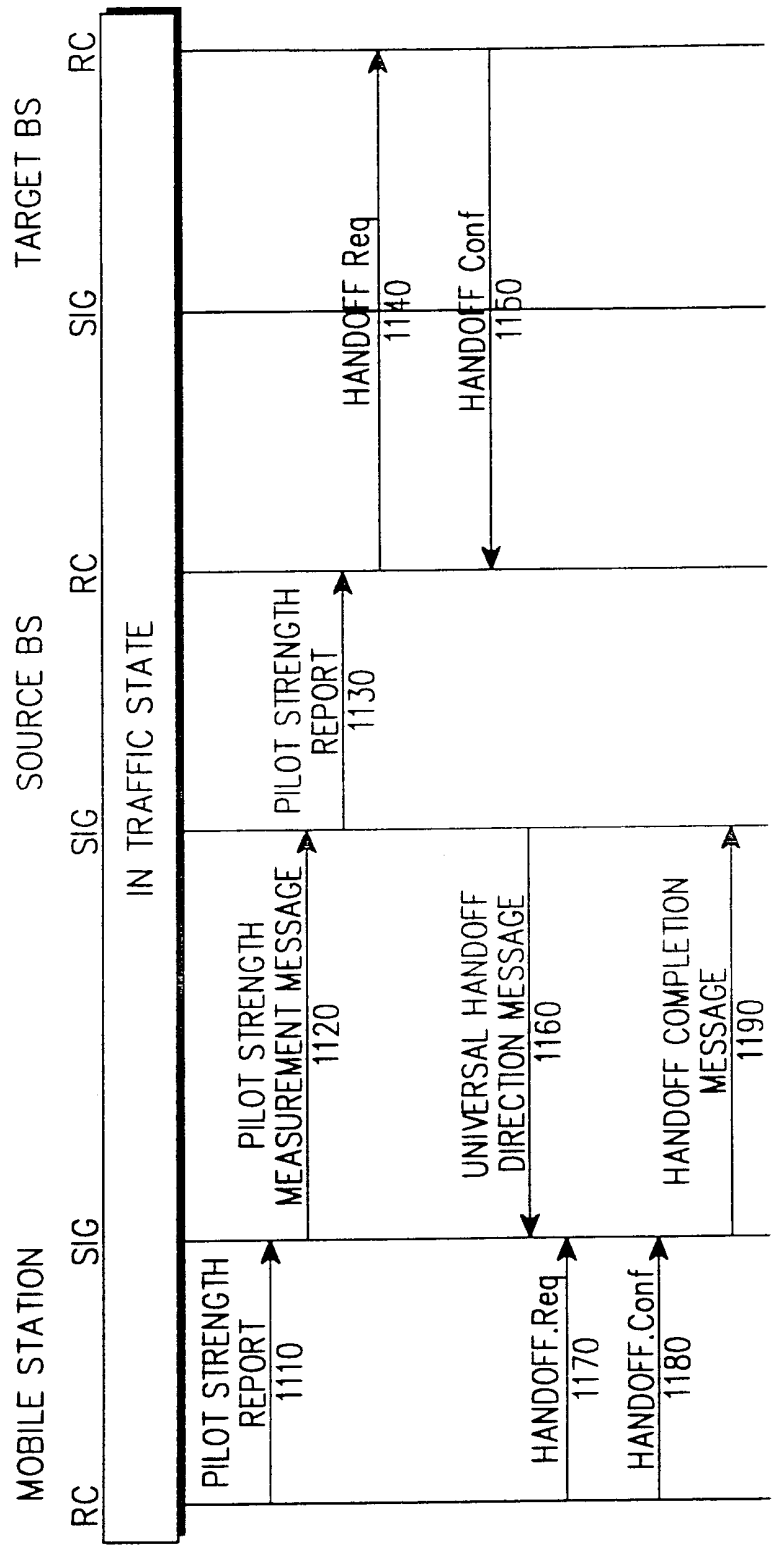

BS
ESTABLISH TRAFFIC CHANNEL AND CONNECT NEW SERVICE
810
SERVICE NEGOTIATION
812
NEED TO DESIGNATE NEW SCH FRAME OFFSET ?
814
NO
YES
REGISTER SCH FRAME OFFSET IN NON-NEGOTIATION SERVICE CONFIGURATION RECORD FIELD
816
SEND SERVICE CONNECT MESSAGE
818
MS
RECEIVE SERVICE CONNECT MESSAGE
820
ANALYZE NON-NEGOTIATION SERVICE CONFIGURATION RECORD
822
SCH FRAME OFFSET REGISTERED ?
824
NO
YES
REGISTER SCH FRAME OFFSET
826
SEND SERVICE CONNECTION COMPLETION MESSAGE
828

FIG. 8

FIG. 9


MOBILE STATION
SOURCE BS
TARGET BS
RC
SIG
RC
SIG
RC
IN TRAFFIC STATE
PILOT STRENGTH REPORT 1110
PILOT STRENGTH MEASUREMENT MESSAGE 1120
PILOT STRENGTH REPORT 1130
HANDOFF Req 1140
HANDOFF Conf 1150
UNIVERSAL HANDOFF DIRECTION MESSAGE 1160
HANDOFF.Req 1170
HANDOFF.Conf 1180
HANDOFF COMPLETION MESSAGE 1190

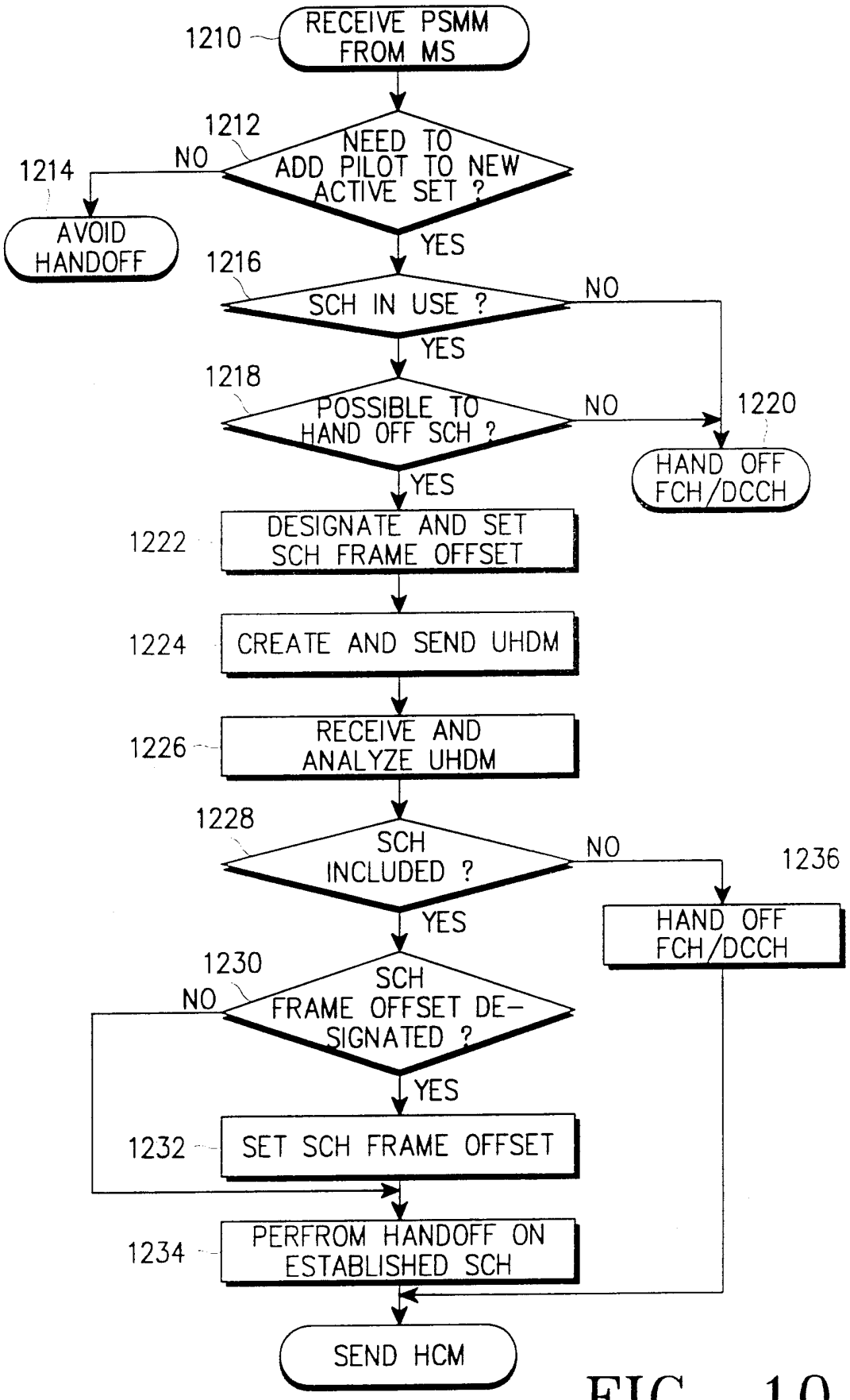

1210
RECEIVE PSMM FROM MS
1212
NEED TO ADD PILOT TO NEW ACTIVE SET ?
NO
1214
AVOID HANDOFF
YES
1216
SCH IN USE ?
NO
YES
1218
POSSIBLE TO HAND OFF SCH ?
NO
1220
HAND OFF FCH/DCCH
YES
1222
DESIGNATE AND SET SCH FRAME OFFSET
1224
CREATE AND SEND UHDM
1226
RECEIVE AND ANALYZE UHDM
1228
SCH INCLUDED ?
NO
1236
HAND OFF FCH/DCCH
YES
1230
SCH FRAME OFFSET DE-SIGNATED ?
NO
YES
1232
SET SCH FRAME OFFSET
1234
PERFROM HANDOFF ON ESTABLISHED SCH
SEND HCM

FIG. 10

FIG. 11

FIELD	LENGTH(Bits)
USE_TIME	1
ACTION_TIME	0 OR 6
[.....]	
FOR_SCH_ID	1
FOR_SCH_DURATION	4
FOR_SCH_START_TIME_INCL	0 OR 5
SCCL_INDEX	4
FOR_SCH_FRAME_OFFSET_INCL	1
FOR_SCH_FRAME_OFFSET	0 OR 4

[.....]

NUM_REV_ASSIGN	0 OR 2

THE BASE STATION SHALL INCLUDE NUM_REV_ASSIGN OCCURRENCES OF THE FOLLOWING FIELDS

REV_SCH_ID	1
REV_SCH_DURATION	4
REV_SCH-START_TIME_INCL	1
REV_SCH_START TIME	0 OR 5
REV_SCH_RATE	4
REV_SCH_FRAME_OFFSET_INCL	1
REV-SCH_FRAME_OFFSET	0 OR 4

[.....]

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/00007

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04B 7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC7 H04B 1/69, H04B 7, H04J, H04Q 7

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the internationa1 search (name of data base and, where practicable, search trerms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99/50977 A (SAMSUNG) 7 OCTOBER 1999 See the whole document	1 - 26
A	US 5956343 A (ALCATEL USA Sourcing L.P.) 21 SEPTEMBER 1999 See the abstract	1 - 26
A	US 5966374 A (NOKIA TELECOMMUNICATION OY) 12 OCTOBER 1999 See the abstract	1 - 26

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevence
"E" earlier application or patent but published on or after the international filing date
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 APRIL 2001 (18.04.2001)	18 APRIL 2001 (18.04.2001)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Taejon, Dunsan-dong, So-ku, Taejon Metropolitan City 302-701, Republic of Korea	YOON, Byoung Soo
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5709

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/00007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 99/50977 A	07. 10. 1999	KR 99-76438 A	15. 10. 1999
US 5956343 A	21. 09. 1999	WO 09933210 A	01. 07. 1999
		EP 1060585 A	20. 12. 2000
		AU 1928499 A	12. 07. 1999
US 5966374 A	12. 10. 1999	WO 9618248 A	13. 06. 1996
		EP 801853 A	22. 10. 1997