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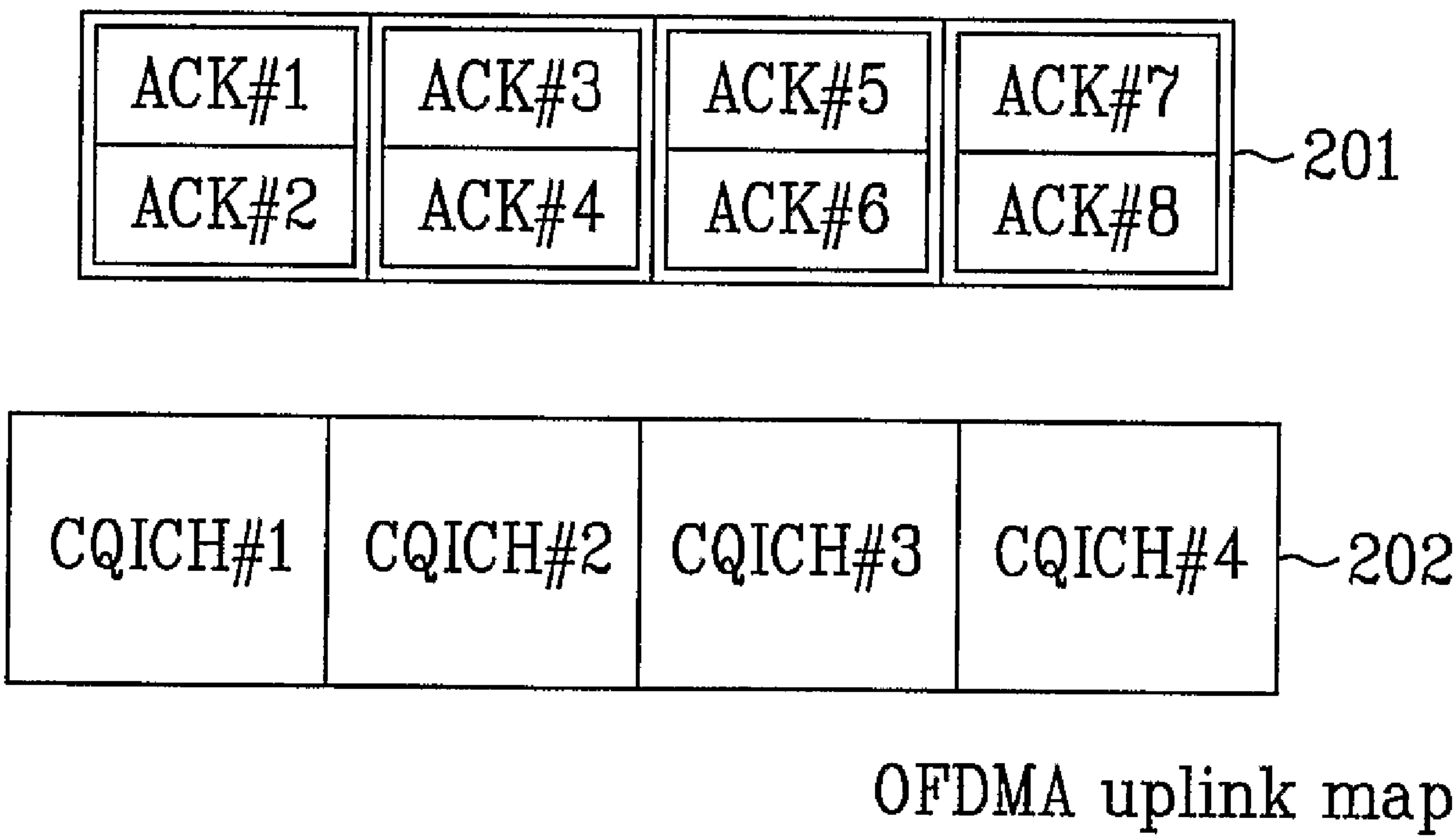
(54) Title: COMMUNICATING NON-COHERENT DETECTABLE SIGNAL IN BROADBAND WIRELESS ACCESS SYSTEM



(57) Abrégé/Abstract:
The present invention relates to allocating a radio resource in a wireless communication system utilizing orthogonal frequency division multiplexing (OFDM). Preferably, the present invention comprises receiving in a mobile station data associated with a radio resource allocation map from a base station, wherein the radio allocation map comprises control parameters for transmitting an uplink channel, wherein the uplink channel comprises at least one OFDM tile comprising a first set of subcarriers associated with representing at least part of an n-bit data payload, and a second set of subcarriers associated with representing at least part of a non-pilot m-bit data payload wherein each subcarrier carries a modulated data, and the first and the second set of subcarriers are exclusive to each other, and transmitting the uplink channel from the mobile station to the base station.

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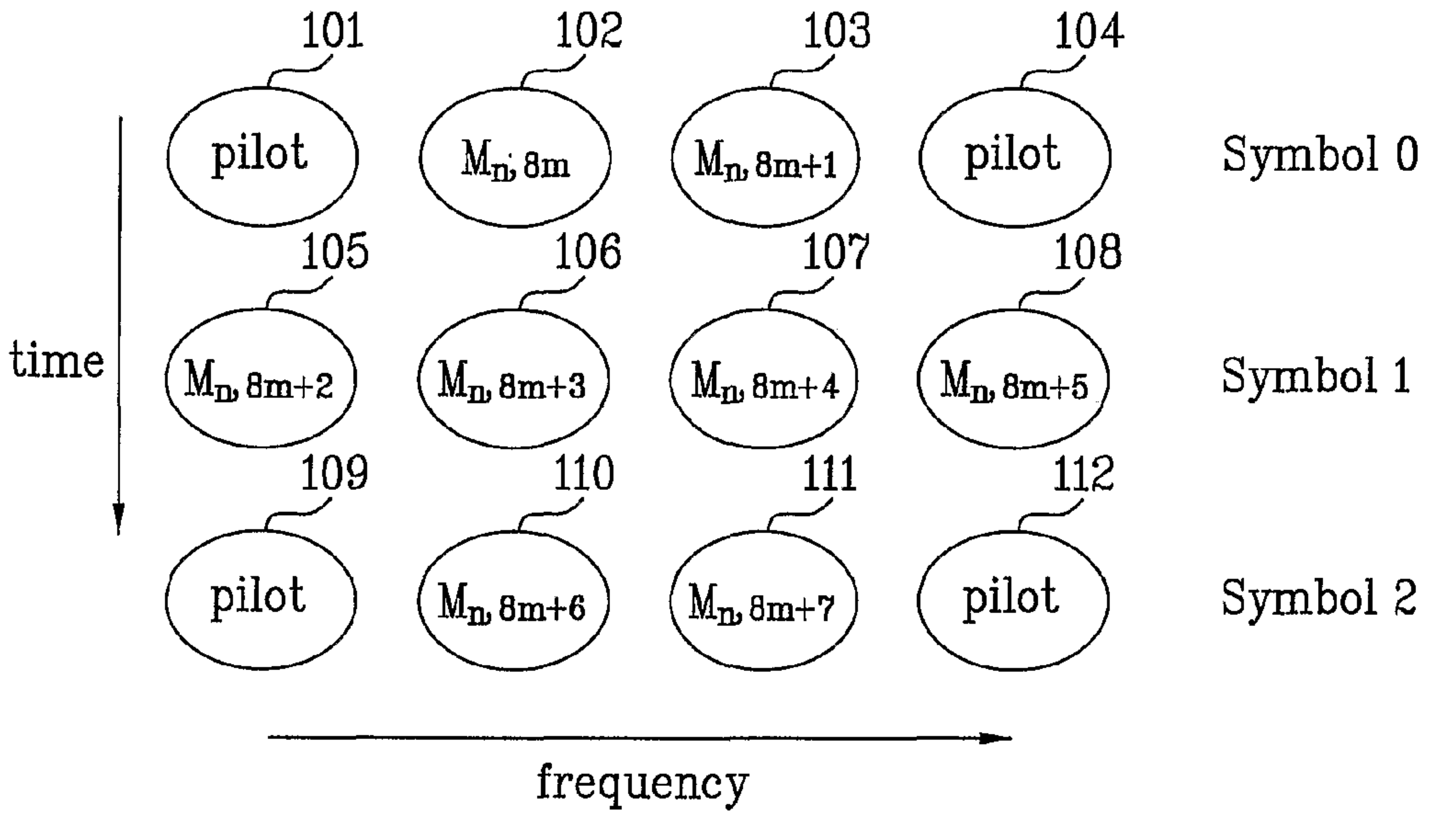
(54) Title: COMMUNICATING NON-COHERENT DETECTABLE SIGNAL IN BROADBAND WIRELESS ACCESS SYSTEM



(57) **Abstract:** The present invention relates to allocating a radio resource in a wireless communication system utilizing orthogonal frequency division multiplexing (OFDM). Preferably, the present invention comprises receiving in a mobile station data associated with a radio resource allocation map from a base station, wherein the radio allocation map comprises control parameters for transmitting an uplink channel, wherein the uplink channel comprises at least one OFDM tile comprising a first set of subcarriers associated with representing at least part of an n-bit data payload, and a second set of subcarriers associated with representing at least part of a non-pilot m-bit data payload wherein each subcarrier carries a modulated data, and the first and the second set of subcarriers are exclusive to each other, and transmitting the uplink channel from the mobile station to the base station.

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COMMUNICATING NON-COHERENT DETECTABLE SIGNAL IN BROADBAND WIRELESS ACCESS SYSTEM

TECHNICAL FIELD

The present invention relates to a broadband wireless access system, and more particularly, to communicating a non-coherent detectable signal for use in an orthogonal frequency division multiplexing (OFDM) access system.

BACKGROUND ART

In order to enable a plurality of users to simultaneously use limited radio resources, a multiplexing scheme is required. The multiplexing scheme divides a single line or transmission path into a plurality of channels capable of simultaneously transmitting/receiving individual independent signals. There are a variety of multiplexing schemes, for example, a Frequency Division Multiplexing (FDM) scheme for dividing a single line into a plurality of frequency bands and performing signal multiplexing, and a Time Division Multiplexing (TDM) scheme for dividing a single line into a plurality of very short time intervals and performing signal multiplexing.

Currently, due to the increasing demands of multimedia data in mobile communication, a multiplexing method for effectively transmitting a large amount of data is required. A representative multiplexing method is an orthogonal frequency division multiplexing (OFDM) scheme.

The OFDM scheme is indicative of a digital modulation scheme capable of improving a transfer rate per bandwidth and preventing multi-path interference from being generated. The OFDM scheme is characterized in that it acts as a multi-sub-carrier modulation scheme using a plurality of sub-carriers, wherein individual sub-carriers are orthogonal to each other. Therefore, although frequency components of individual sub-carriers overlap with each other, the OFDM scheme is problem free. The OFDM scheme can perform multiplexing of many more sub-carriers than those of a general frequency division multiplexing (FDM) scheme. Thus, high frequency use efficiency is implemented.

A mobile communication system based on the above-mentioned OFDM scheme currently uses a variety of multiple access schemes capable of allocating radio resources to a plurality of users, for example, an OFDM-FDMA (OFDMA) scheme, an OFDM-TDMA scheme, and an OFDM-CDMA scheme, etc. Specifically, the OFDMA (Orthogonal Frequency Division Multiple Access) scheme allocates some parts of all sub-carriers to individual users, such that it can accommodate a plurality of users.

FIG. 1 illustrates a method for allocating radio resources in accordance with the related art. Referring to FIG. 1, a broadband wireless access system comprises a specific configuration of FIG. 1 as a basic unit for allocating OFDMA uplink radio resources. This specific configuration shown in FIG. 1 is referred to as a tile structure. In the case of the above-mentioned tile structure, data of a Channel Quality Indication Channel (CQICH) or data of an Acknowledge Channel (ACKCH) is transmitted via a plurality of data sub-carriers 102, 103, 105, 106, 107, 108, 110, and 111. A pilot channel is transmitted via pilot sub-carriers 101, 104, 109, and 112. Each sub-carrier transmitted via the tile structure is referred to as a constituent unit of the tile structure.

DISCLOSURE OF THE INVENTION

Some embodiments of the present invention are directed to communicating a non-coherent detectable signal for use in an orthogonal frequency division multiplexing (OFDM) access system.

Additional features and advantages will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

According to one aspect of the invention, there is provided a method of transmitting uplink channel by a mobile station in an orthogonal frequency division multiplexing (OFDM) wireless communication system the method comprising: receiving information associated with a radio resource allocation map from a base station, wherein the radio resource allocation map comprises control parameters for a primary Channel Quality Indication Channel (CQICH) and a secondary CQICH; and transmitting the primary CQICH and the secondary CQICH to the base station utilizing the information, wherein the primary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	NULL	$M_{n,8m}$	$M_{n,8m+1}$	NULL
Symbol 1	$M_{n,8m+2}$	$M_{n,8m+3}$	$M_{n,8m+4}$	$M_{n,8m+5}$
Symbol 2	NULL	$M_{n,8m+6}$	$M_{n,8m+7}$	NULL

, and

wherein the primary CQICH is used for carrying p-bit payload, and orthogonally modulated with quadrature phase shift keying (QPSK) symbols, wherein $M_{n,8m+k}$ ($0 \leq k \leq 7$) is the k-th QPSK symbol of the m-th uplink tile in the n-th primary CQICH, wherein the second CQICH consists of 6 uplink tiles:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	$M_{n,4m}$	NULL	NULL	$M_{n,4m+1}$
Symbol 1	NULL	NULL	NULL	NULL
Symbol 2	$M_{n,4m+2}$	NULL	NULL	$M_{n,4m+3}$

, and

wherein the secondary CQICH is used for carrying q-bit payload, and orthogonally modulated with QPSK symbols, wherein $M_{n,4m+k}$ ($0 \leq k \leq 3$) is the k-th QPSK symbol of the m-th uplink tile in the n-th secondary CQICH.

In one aspect of the invention, information associated with the use of one of the first and the second sets of subcarriers is received in the mobile station using a normal map information element.

In another aspect of the invention, information associated with the use of one of the first and the second sets of subcarriers is received in the mobile station using a HARQ map information element.

In some embodiments, the first set of subcarriers is associated with representing at least part of a 6-bit data payload. In some embodiments, the second set of subcarriers is associated with representing at least part of a 4-bit data payload.

In a further aspect of the invention, the uplink channel is associated with transmitting one of channel quality information, antenna selection option and precoding matrix code book.

In some embodiments, the uplink channel is associated with transmitting one of fast down link measurement, MIMO mode, antenna grouping, antenna selection, reduced codebook, quantized precoding weight feedback, index to precoding matrix in codebook, channel matrix information and per stream power control.

In some embodiments, the use of the second set of subcarriers for transmitting at least part of the m-bit data payload is requested by one of the base station or the mobile station.

In some embodiments, six OFDM tiles comprise one OFDM slot for representing a 4-bit data payload, wherein the 4-bit data payload is represented as follows:

4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)	4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)
0b0000	a,a,a,b,b,b	0b1000	a,a,b,d,c,c
0b0001	b,b,b,a,a,a	0b1001	b,d,c,c,d,b
0b0010	c,c,c,d,d,d	0b1010	c,c,d,b,a,a
0b0011	d,d,d,c,c,c	0b1011	d,d,b,a,b,b
0b0100	a,b,c,d,a,b	0b1100	a,a,d,c,a,d
0b0101	b,c,d,a,b,d	0b1101	b,c,a,c,c,a
0b0110	c,d,a,b,c,d	0b1110	c,b,d,d,b,c
0b0111	d,a,b,c,d,a	0b1111	d,c,c,b,b,c

wherein

Vector Index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$
a	P0, P0, P0, P0
b	P0, P2, P0, P2
c	P0, P1, P2, P3
d	P1, P0, P3, P2

In accordance with another embodiment of the present invention, there is provided a method of receiving feedback information by a base station in an orthogonal frequency division multiplexing (OFDM) wireless communication system, the method comprising: transmitting information associated with a radio resource allocation map to a mobile station, wherein the radio resource allocation map comprises control parameters for a primary Channel Quality Indication Channel (CQICH) and a secondary CQICH; and receiving the primary CQICH and the secondary CQICH from the mobile station utilizing the information, wherein the primary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	NULL	$M_{n,8m}$	$M_{n,8m+1}$	NULL
Symbol 1	$M_{n,8m+2}$	$M_{n,8m+3}$	$M_{n,8m+4}$	$M_{n,8m+5}$
Symbol 2	NULL	$M_{n,8m+6}$	$M_{n,8m+7}$	NULL

, and

wherein the primary CQICH is used for carrying p-bit payload, and orthogonally modulated with quadrature phase shift keying (QPSK) symbols, wherein $M_{n,8m+k}$ ($0 \leq k \leq 7$) is the k-th QPSK symbol of the m-th uplink tile in the n-th primary CQICH, wherein the secondary CQICH consists of 6 uplink tiles, the m-th uplink tiles of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	$M_{n,4m}$	NULL	NULL	$M_{n,4m+1}$
Symbol 1	NULL	NULL	NULL	NULL
Symbol 2	$M_{n,4m+2}$	NULL	NULL	$M_{n,4m+3}$

, and

wherein the secondary CQICH is used for carrying q-bit payload, and orthogonally modulated with QPSK symbols, wherein $M_{n,4m+k}$ ($0 \leq k \leq 3$) is the k-th QPSK symbol of the m-th uplink tile in the n-th secondary CQICH.

In accordance with another embodiment of the present invention, there is provided a mobile station configured to transmit feedback information in an orthogonal frequency division multiplexing (OFDM) wireless communication system, the mobile station comprising: a processor; and a radio frequency (RF) module for transmitting and receiving a radio signal to and from the outside under the control of the processor, wherein the processor is configured to: receive information associated with a radio resource allocation map from a base station, wherein the radio resource allocation map comprises control parameters for a primary Channel Quality Indication Channel (CQICH) and a secondary CQICH; and transmit the primary CQICH and the secondary CQICH to the base station utilizing the information, wherein the primary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	NULL	$M_{n,8m}$	$M_{n,8m+1}$	NULL
Symbol 1	$M_{n,8m+2}$	$M_{n,8m+3}$	$M_{n,8m+4}$	$M_{n,8m+5}$
Symbol 2	NULL	$M_{n,8m+6}$	$M_{n,8m+7}$	NULL

, and

wherein the primary CQICH is used for carrying p-bit payload, and orthogonally modulated with quadrature phase shift keying (QPSK) symbols, wherein $M_{n,8m+k}$ ($0\leq k\leq 7$) is the k-th QPSK symbol of the m-th uplink tile in the n-th primary CQICH, wherein the secondary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	$M_{n,4m}$	NULL	NULL	$M_{n,4m+1}$
Symbol 1	NULL	NULL	NULL	NULL
Symbol 2	$M_{n,4m+2}$	NULL	NULL	$M_{n,4m+3}$

, and

wherein the secondary CQICH is used for carrying q-bit payload, and orthogonally modulated with QPSK symbols, wherein $M_{n,4m+k}$ ($0\leq k\leq 3$) is the k-th QPSK symbol of the m-th uplink tile in the n-th secondary CQICH.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. Features, elements, and aspects of the invention that are referenced by the same numerals in different figures represent the same, equivalent, or similar features, elements, or aspects in accordance with one or more embodiments.

FIG. 1 illustrates a method for allocating radio resources in accordance with the related art.

FIG. 2 illustrates a method for allocating a CQICH (Channel Quality Indication Channel) area and an ACKCH (Acknowledge Channel) area in an OFDM uplink in accordance with one embodiment of the present invention.

FIG. 3 illustrates a tile structure for when a new signal is transmitted using a sub-carrier having transmitted a pilot signal in accordance with one embodiment of the present invention.

FIG. 4 illustrates a method for acquiring a secondary ACKCH from a CQICH tile structure in accordance with one embodiment of the present invention.

FIG. 5 illustrates a method for acquiring a secondary ACKCH from two ACKCH tile structures in accordance with one embodiment of the present invention.

FIG. 6 illustrates a method for acquiring a secondary CQICH from two CQICH tile structures in accordance with one embodiment of the present invention.

FIG. 7 illustrates a method for acquiring a secondary CQICH from four ACKCH tile structures in accordance with one embodiment of the present invention.

FIG. 8 illustrates a tile structure for use in a method for allocating a codeword using an additional sub-carrier in accordance with one embodiment of the present invention.

FIGs. 9A and 9B illustrate a structure of a transmitter unit and receiver unit of a mobile communication device in accordance with one embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention relates to allocating a radio resource in a wireless communication system utilizing orthogonal frequency division multiplexing (OFDM).

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

Preferably, the present invention is applied to a broadband wireless access system, such as the system disclosed in IEEE 802.16e. However, it is contemplated that the present invention may be utilized in other types of wireless access systems.

Typically, channel estimation is performed on a data sub-carrier on the basis of the pilot sub-carrier, such that a coherent detection scheme is used for the data sub-carrier. However, an ACKCH or CQICH may use a non-coherent detection scheme without performing the channel estimation. In the meantime, the ACKCH or CQICH uses orthogonal codewords to implement a non-coherent detection scheme.

The following Table 1 exemplarily shows codewords for modulating ACKCH sub-carriers when ACK information of 1 bit is provided.

[Table 1]

ACK 1-bit symbol	Vector indices per tile Tile(0), Tile(1), Tile(2)

0	0, 0, 0
1	4, 7, 2

The following Table 2 exemplarily shows codewords for modulating CQICH sub-carriers when CQI information of 6 bits is provided.

[Table 2]

6-bit payload	Fast Feedback vector indices per tile Tile(0), Tile(1),..., Tile(5)
0b000000	0, 0, 0, 0, 0, 0
0b000001	1, 1, 1, 1, 1, 1
0b000010	2, 2, 2, 2, 2, 2
0b000011	3, 3, 3, 3, 3, 3
⋮	⋮

The following Table 3 exemplarily shows codewords for modulating CQICH sub-carriers when CQI information of 5 bits is provided.

[Table 3]

5-bit payload	Fast Feedback vector indices per tile Tile(0), Tile(1),..., Tile(5)
0b00000	0, 0, 0, 0, 0
0b00001	1, 1, 1, 1, 1
0b00010	2, 2, 2, 2, 2
0b00011	3, 3, 3, 3, 3
⋮	⋮

The following Table 4 exemplarily shows codewords for modulating CQICH sub-carriers when CQI information of 4 bits is provided.

[Table 4]

4-bit payload	Fast Feedback vector indices per tile Tile(0), Tile(1),..., Tile(5)

0b0000	0, 0, 0, 0, 0, 0
0b0001	1, 1, 1, 1, 1, 1
0b0010	2, 2, 2, 2, 2, 2
0b0011	3, 3, 3, 3, 3, 3
⋮	⋮

With reference to Table 4, a vector for each tile includes 8 Quadrature Phase Shift Keying (QPSK) symbols, such that a signal can be transmitted via 8 data sub-carriers.

[Table 5]

Vector Index	$M_{n,m8}$, $M_{n,8m+1}$, ... $M_{n,8m+7}$
0	P0,P1,P2,P3,P0,P1,P2,P3
1	P0,P3,P2,P1,P0,P3,P2,P1
2	P0,P0,P1,P1,P2,P2,P3,P3
3	P0,P0,P3,P3,P2,P2,P1,P1
4	P0,P0,P0,P0,P0,P0,P0,P0
5	P0,P2,P0,P2,P0,P2,P0,P2
6	P0,P2,P0,P2,P2,P0,P2,P0
7	P0,P2,P2,P0,P2,P0,P0,P2

With reference to Table 5, P0, P1, P2, and P3 are denoted by the following Equation 1:

[Equation 1]

$$P_0 = \exp\left(j\frac{\pi}{4}\right),\ P_1 = \exp\left(j\frac{3\pi}{4}\right),\ P_2 = \exp\left(-j\frac{3\pi}{4}\right),\ P_3 = \exp\left(-j\frac{\pi}{4}\right)$$

A single sub-channel includes 6 tiles. The CQICH can use a single sub-channel, and the ACKCH can use half of the sub-channel. In other words, the CQICH can use 6 tiles, and the ACKCH can use 3 tiles.

FIG. 2 illustrates a method for allocating a CQICH (Channel Quality Indication Channel) area and an ACKCH (Acknowledge Channel) area in an OFDM uplink in accordance with one embodiment of the present invention. Referring to FIG. 2, some areas of a two-dimensional map of an uplink are pre-assigned to the ACKCH dedicated area 201, and the remaining areas other than the above-mentioned areas are pre-assigned to the CQICH dedicated area 202.

Individual sub-channels are assigned to an ACKCH dedicated area 201 and a CQICH dedicated area 202, such that a specific Mobile Subscriber Station (MSS) can use the ACKCH dedicated area 201 and the CQICH dedicated area 202. Referring to FIG. 2, an MSS#1 may be assigned to an ACK#1, an MSS#2 may be assigned to an ACK#2, ..., an MSS#8 may be assigned to an ACK#8, an MSS#9 may be assigned to a CQICH#1, an MSS#10 may be assigned to a CQICH#2 and a CQICH#3, and an MSS#11 may be assigned to a CQICH#4.

If a base station uses a non-coherent detection scheme, there is no need to use pilot sub-carriers. In this case, it is not necessary to use 4 pilot sub-carriers assigned to each tile, and the uplink's radio resources and terminal's transmission power are unnecessarily consumed.

Therefore, new information is loaded on a sub-carrier assigned to a pilot channel, and is then transmitted to the CQICH and ACKCH tile structures, such that specific information based on the non-coherent detection scheme in the same manner as in the CQICH or ACKCH can be transmitted using a conventional sub-carrier equipped with a pilot signal.

FIG. 3 illustrates a tile structure for when a new signal is transmitted using a sub-carrier having transmitted a pilot signal in accordance with one embodiment of the present invention. Referring to FIG. 3, a new signal can be transmitted using sub-carriers 301, 304, 309, and 312. These sub-carriers used to transmit a pilot signal.

As stated above, if the new signal is loaded on the sub-carrier having transmitted the pilot signal in the tile structure for the CQICH and the ACKCH, the sub-carrier having transmitted each pilot signal is referred to as an additional sub-carrier. If the additional sub-carrier formed by the grouping of unit tile structures is used, a secondary CQICH and a secondary ACKCH other than a primary ACKCH and a primary CQICH can be acquired.

FIG. 4 illustrates a method for acquiring a secondary CQICH from a CQICH tile structure in accordance with one embodiment of the present invention. Referring to FIG. 4, a single CQICH includes 6 tile units (1 subchannel), wherein 4 additional sub-carriers may be acquired from each tile unit, such that a total of 24 additional sub-carriers may be acquired from each CQICH. Meanwhile, an ACKCH or a secondary CQICH may include 3 tile units (1/2 subchannel), wherein each tile unit includes 8 sub-carriers, such that a single ACKCH or a secondary CQICH may be constructed using 24 sub-carriers. Therefore, a single ACKCH (i.e., the secondary ACKCH) or a secondary CQICH may be constructed using 24 additional sub-carriers capable of being acquired from a single CQICH.

FIG. 5 illustrates a method for acquiring a secondary ACKCH from two ACKCH tile structures in accordance with one embodiment of the present invention. Referring to FIG. 5, a single ACKCH may include 3 tile units, wherein 4 additional sub-carriers may be acquired from each tile unit, such that a total of 24 additional sub-carriers can be acquired from two ACKCHs. Meanwhile, a single ACKCH may be constructed using 24 sub-carriers, such that a single ACKCH (i.e., the secondary ACKCH) can be constructed when additional sub-carriers are acquired from a group comprising 2 ACKCHs, as shown in FIG. 5.

FIG. 6 illustrates a method for acquiring a secondary CQICH from two CQICH tile structures in accordance with one embodiment of the present invention. Referring to FIG. 6, each CQICH may include 6 tile units, wherein 4 additional sub-carriers are acquired from each tile unit, such that a total of 48 additional sub-carriers may be acquired from two CQICHs. Meanwhile, a CQICH may also include 6 tile units, wherein each tile unit includes 8 sub-carriers, such that a single CQICH may be constructed using 48 sub-carriers.

Therefore, a single CQICH (i.e., the secondary CQICH) may be constructed using 48 additional sub-carriers capable of being acquired from two CQICHs.

FIG. 7 illustrates a method for acquiring a secondary CQICH from four ACKCH tile structures in accordance with one embodiment of the present invention. Referring to FIG. 7, a single ACKCH may include 3 tile units, wherein 4 additional sub-carriers may be acquired from each tile unit, such that a total of 48 additional sub-carriers may be acquired from 4 ACKCHs. Meanwhile, a CQICH may include 6 tile units, wherein each tile unit includes 8 sub-carriers, such that a single CQICH may be constructed using 48 sub-carriers. Therefore, a single CQICH (i.e., the secondary CQICH) may be constructed using 48 additional sub-carriers capable of being acquired from 4 ACKCHs.

Preferably, the following methods can be adapted to assign a codeword to a sub-carrier. According to a first preferred embodiment of the present invention, 12 tiles contained in either a single CQICH or two ACKCHs are grouped into 6 sets, each of which comprises 2 tiles, and the codeword can be assigned, as shown in the following Tables 6 - 9.

The following Table 6 exemplarily shows a method for assigning a codeword to modulate a secondary ACKCH sub-carrier when ACK information of 1 bit is provided.

[Table 6]

Additional ACKCH 1-bit symbol	Vector indices per tile (Tile(0), Tile(1)), (Tile(2), Tile(3)), (Tile(4), Tile(5))
0	0, 0, 0
1	4, 7, 2

The following Table 7 exemplarily shows a method for assigning a codeword to modulate a CQICH sub-carrier when CQI information of 6 bits is provided.

[Table 7]

6-bits payload	Fast Feedback vector indices per tile (Tile(0),Tile(1)),(Tile(2),Tile(3)),(Tile(4),Tile(5)),...(Tile(10),Tile(11))

0b000000	0, 0, 0, 0, 0, 0
0b000001	1, 1, 1, 1, 1, 1
0b000010	2, 2, 2, 2, 2, 2
0b000011	3, 3, 3, 3, 3, 3
	⋮

The following Table 8 exemplarily shows a codeword for modulating a CQICH sub-carrier when CQI information of 5 bits is provided.

[Table 8]

5-bits payload	Fast Feedback vector indices per tile (Tile(0),Tile(1)),(Tile(2),Tile(3)),(Tile(4), Tile(5)),...(Tile(10),Tile(11))
0b00000	0, 0, 0, 0, 0
0b00001	1, 1, 1, 1, 1
0b00010	2, 2, 2, 2, 2
0b00011	3, 3, 3, 3, 3
⋮	⋮

The following Table 9 exemplarily shows a codeword for modulating a CQICH sub-carrier when CQI information of 4 bits is provided.

[Table 9]

4-bits payload	Fast Feedback vector indices per tile (Tile(0),Tile(1)), (Tile(2),Tile(3)), (Tile(4),Tile(5)),...(Tile(10),Tile(11))
0b00000	0, 0, 0, 0, 0, 0
0b00001	1, 1, 1, 1, 1, 1
0b00010	2, 2, 2, 2, 2, 2
0b00011	3, 3, 3, 3, 3, 3
⋮	⋮

Meanwhile, according to a second preferred embodiment of the present invention, a codeword can be assigned to each of 12 tiles contained in either a single CQICH or two ACKCHs, as shown in the following Tables 10 - 11.

The following Table 10 exemplarily shows a method for assigning a codeword to modulate a secondary ACKCH sub-carrier when ACK information of 1 bit is provided.

[Table 10]

additional ACK 1-bit symbol	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)
0	a, a, a, a, a, a
1	b, b, b, b, b, b

[Table 11]

additional CQICH 6-bits, 5-bits and 4-bits payload	Fast Feedback vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5),...Tile(10), Tile(11)
0b000000, 0b00000, 0b0000	a, a, a, a, a, a, a, a, a, a, a, a
0b000001, 0b00001, 0b0001	b, b, b, b, b, b, b, b, b, b, b, b
0b000010, 0b00001, 0b0001	c, c, c, c, c, c, c, c, c, c, c, c
0b000011, 0b00011, 0b0011	d, d, d, d, d, d, d, d, d, d, d, d

Additional sub-carriers of the tile applied to the codeword allocation shown in Table 11 are depicted in FIG. 8.

FIG. 8 illustrates a tile structure for use in a method for allocating a codeword using an additional sub-carrier in accordance with one embodiment of the present invention.

Referring to FIG. 8 and the following Table 12, a vector assigned to each tile includes 4 modulation symbols in order to perform signal transmission via 4 additional sub-carriers.

[Table 12]

Vector Index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$

a	P0, P0, P0, P0
b	P0, P2, P0, P2
c	P0, P1, P2, P3
d	P1, P0, P3, P2

The secondary ACKCH can be constructed using 24 sub-carriers assigned to a pilot channel. A method for constructing the ACKCH using the 24 pilot sub-carriers can be implemented with additional sub-carriers in various ways other than exemplary methods shown in FIGS. 9 - 10.

The secondary ACKCH can be configured using 3 tiles. The following Table 13 exemplarily shows a codeword available for the above-mentioned case in which the secondary ACKCH includes 3 tiles.

[Table 13]

Secondary ACK 1-bit symbol	Vector indices per tile Tile(0), Tile(1), Tile(2)
0	a, a, a
1	b, b, b

The secondary CQICH can be constructed using 48 pilot sub-carriers. A method for constructing the ACKCH using the 48 pilot sub-carriers can be implemented with additional sub-carriers in various ways other than the exemplary methods shown in FIGS. 6 - 7.

The secondary CQICH can be configured using 6 tiles. The following Table 14 exemplarily shows a codeword available for the above-mentioned case in which the secondary CQICH includes 6 tiles.

[Table 14]

Secondary CQICH 4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)	Secondary CQICH 4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)

0b0000	a,a,a,b,b,b	0b1000	a,a,b,d,c,c
0b0001	b,b,b,a,a,a	0b1001	b,d,c,c,d,b
0b0010	c,c,c,d,d,d	0b1010	c,c,d,b,a,a
0b0011	d,d,d,c,c,c	0b1011	d,d,b,a,b,b
0b0100	a,b,c,d,a,b	0b1100	a,a,d,c,a,d
0b0101	b,c,d,a,b,d	0b1101	b,c,a,c,c,a
0b0110	c,d,a,b,c,d	0b1110	c,b,d,d,b,c
0b0111	d,a,b,c,d,a	0b1111	d,c,c,b,b,c

Meanwhile, a new codeword can be constructed using binary phase-shift keying (BPSK), as shown in the following Table 15.

[Table 15]

Vector Index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$
a	1, 1, 1, 1
b	1, -1, 1, -1
c	1, 1, -1, -1
d	1, -1, -1, 1

A base station can use messages shown in the following Table 16 to inform a mobile subscriber station (MSS) of information associated with the secondary ACKCH.

[Table 16]

Syntax	Size(bits)	Notes
Compact_UL_MAP_IE(){		
UL-MAP Type	3	Type=7
UL-MAP Sub-type	5	Sub-type=3
Length	4	Length of the IE bytes
Primary/Secondary H-ARQ Region Change Indication	1	0=no region change 1=region change
If(Primary/Secondary H-ARQ Region Change indication==1){		
OFDMA Symbol Offset	8	
Subchannel Offset	8	
No. OFDMA Symbols	8	
No. Subchannels	8	
}		
Reserved	3	

}		

With reference to Table 16, the "UL-MAP TYPE" field and the "Sub-Type" field are adapted to inform an MSS of message type information. In other words, the MSS can recognize content information of a corresponding message by referring to the above-mentioned "UL-MAP TYPE" and "Sub-Type" fields. Meanwhile, the "Length" field informs the MSS of size information of overall messages including the "Length" field in byte units.

The "Primary/Secondary H-ARQ Region Indication" field has a value of 1 either when a current frame has an H-ARQ region different from that of a previous frame or when another H-ARQ region is present in the same frame. The "OFDMA Symbol Offset" field informs the MSS of coordinates at which the "H-ARQ" region begins at an uplink in symbol units. The "Subchannel Offset" field informs the MSS of coordinates at which the "H-ARQ" region begins at an uplink in sub-channel units. The "No. OFDMA symbols" field informs the MSS of size information occupied by the "H-ARQ" region at an uplink in symbol units. The "No. Sub-channels" field informs the MSS of size information occupied by the "H-ARQ" region at an uplink in subchannel units.

Meanwhile, a base station may use messages shown in the following Table 17 to inform the MSS of information associated with the secondary CQICH.

[Table 17]

Syntax	Size(bits)	Notes
Compact_UL_MAP_IE(){		
UL-MAP Type	3	Type=7
UL-MAP Sub-type	5	Sub-type=3
Length	4	Length of the IE bytes
Primary/Secondary H-ARQ Region Change Indication	1	0=no region change
If(Primary/Secondary H-ARQ Region Change indication==1){		1=region change

OFDMA Symbol Offset	8	
Subchannel Offset	8	
No. OFDMA Symbols	8	
No. Subchannels	8	
}		
Reserved	3	
}		

With reference to Table 17, the "UL-MAP TYPE" field and the "Sub-Type" field are adapted to inform the MSS of message type information. In other words, the MSS can recognize message content information by referring to the above-mentioned "UL-MAP TYPE" and "Sub-Type" fields. Meanwhile, the "Length" field informs the MSS of size information of overall messages including the "Length" field in byte units.

The "Primary/Secondary CQICH Region Indication" field has a value of 1 either when a current frame has a CQICH region different from that of a previous frame or when another CQICH region is present in the same frame. The "OFDMA Symbol Offset" field informs the MSS of coordinates at which the "CQICH" region begins at an uplink in symbol units. The "Subchannel Offset" field informs the MSS of coordinates at which the "CQICH" region begins at an uplink in subchannel units. The "No. OFDMA symbols" field informs the MSS of size information occupied by the "CQICH" region at an uplink in symbol units. The "No. Sub-channels" field informs the MSS of size information occupied by the "CQICH" region at an uplink in subchannel units.

Information transmitted via the secondary CQICH according to the present invention can be used in various ways according to feedback types. For example, if information associated with a Signal-to-Noise Ratio (SNR) is transmitted to the base station, a payload of the above-mentioned information may occur as depicted in the following Equation 2:

[Equation 2]

$$4bit\ payload\ bit\ nibble = \begin{cases} 0, & S/N < -2dB \\ n, & 2n-4 < S/N < 2n-2,\ \ 0 < n < 15 \\ 15, & S/N > 26dB \end{cases}$$

Meanwhile, in the case of a Multi-Input Multi-Output (MIMO) mode, a payload depicted in the following Table 18 may occur.

[Table 18]

Value	Description
0b0000	STTD and PUSC/FUSC permutation
0b0001	STTD and adjacent-subcarrier permutation
0b0010	SM and PUSC/FUSC permutation
0b0011	SM and adjacent-subcarrier permutation
0b0100	Closed-loop SM and PUSC/FUSC permutation
0b0101	Closed-loop SM and adjacent-subcarrier permutation
0b0110	Closed-loop SM + Beamforming and adjacent-subcarrier permutation
0b0111-0b1111	Interpretation according to table 296e, 296f or 296g, depending on if antenna grouping, antenna selection or a reduced precoding matrix code book is used.

The following Table 19 exemplarily shows antenna grouping methods corresponding to individual values shown in Table 18.

[Table 19]

Value	Description
0b0111	Antenna Group A1 for rate 1 For 3-antenna BS, See 8.4.8.3.4 For 4-antenna BS, See 8.4.8.3.5
0b1000	Antenna Group A2 for rate 1
0b1001	Antenna Group A3 for rate 1
0b1010	Antenna Group B1 for rate 2 For 3-antenna BS, See 8.4.8.3.4 For 4-antenna BS, See 8.4.8.3.5
0b1011	Antenna Group B2 for rate 2
0b1100	Antenna Group B3 for rate 2

0b1101	Antenna Group B4 for rate 2 (only for 4-antenna BS)
0b1110	Antenna Group B5 for rate 2 (only for 4-antenna BS)
0b1111	Antenna Group B6 for rate 2 (only for 4-antenna BS)

The following Table 20 exemplarily shows antenna selection methods corresponding to individual values shown in Table 18.

[Table 20]

Value	Description
0b0111	Antenna selection option 0
0b1000	Antenna selection option 1
0b1001	Antenna selection option 2
0b1010	Antenna selection option 3
0b1011	Antenna selection option 4
0b1100	Antenna selection option 5
0b1101	Antenna selection option 6
0b1110	Antenna selection option 7
0b1111	Reserved

The following Table 21 exemplarily shows a method for employing reduced precoding matrix code books corresponding to individual values shown in Table 18.

[Table 21]

Value	Description
0b0111	Reduced Precoding matrix code book entry 0
0b1000	Reduced Precoding matrix code book entry 1
0b1001	Reduced Precoding matrix code book entry 2
0b1010	Reduced Precoding matrix code book entry 3
0b1011	Reduced Precoding matrix code book entry 4
0b1100	Reduced Precoding matrix code book entry 5
0b1101	Reduced Precoding matrix code book entry 6
0b1110	Reduced Precoding matrix code book entry 7
0b1111	Reserved

The base station transmits information associated with the above-mentioned feedback type information to an MSS via a "CQICH_Enhanced_Alloc_IE" field.

The following Tables 22 and 23 exemplarily show some parts of the "CQICH_Enhanced_Alloc_IE" field including the above-mentioned feedback type information.

[Table 22]

CQICH_Enhanced_Alloc_IE(){		
...	...	...
Feedback type	3 bits	0b000 = Fast DL Measurement 0b001 = MIMO Mode selection / Antenna Grouping 0b010 = MIMO Mode selection / Antenna Selection 0b011 = MIMO Mode Selection / Reduced Codebook 0b100 = Quantized Precoding Weight Feedback 0b101 = Index to Precoding Matrix in Codebook 0b110 = Channel Matrix Information 0b111 = Per Stream Power Control
...	...	...

[Table 23]

CQICH_Enhanced_Alloc_IE(){		
...	...	...
Feedback type	3 bits	0b000 = Fast DL measurement/Antenna grouping for 6bit payload = Fast DL measurement for 4bit payload 0b001 = Fast DL measurement/Antenna selection for 6bit payload = MIMO mode/Antenna grouping for 4bit payload 0b010 = Fast DL measurement/Reduced codebook for 6bit payload = Antenna selection/Reduced Codebook for 4bit payload 0b011 = Quantized precoding weight feedback 0b100 = Index to precoding matrix

		in codebook 0b101 = Channel Matrix Information 0b110 = Per stream power control 0b111 = reserved

Meanwhile, if only information associated with the SNR is transmitted to the base station, a payload of information transmitted via the secondary CQICH according to the present invention may occur as depicted in the following Equation 3:

[Equation 3]

$$4bit\ payload\ bit\ nibble = \begin{cases} 0, & S/N < -2dB \\ n, & 2n-4 < S/N < 2n-2, \quad 0 < n < 15 \\ 15, & S/N > 26dB \end{cases}$$

Information associated with feedback types capable of transmitting only SNR-associated information to the base station is transmitted to the MSS via the “CQICH_Enhanced_Alloc_IE” field.

The following Table 24 exemplarily shows some parts of the “CQICH_Enhanced_Alloc_IE” field including the above-mentioned feedback type information.

[Table 24]

CQICH_Enhanced_Alloc_IE(){		
...	...	...

Feedback type	3 bits	0b000 = Fast DL measurement/Antenna grouping for 6bit payload = Fast DL measurement for 4bit payload 0b001 = Fast DL measurement/Antenna selection for 6bit payload = Fast DL measurement for 4bit payload 0b010 = Fast DL measurement/Reduced codebook for 6bit payload = Fast DL measurement for 4bit payload 0b011 = Quantized precoding weight feedback 0b100 = Index to precoding matrix in codebook 0b101 = Channel Matrix Information 0b110 = Per stream power control 0b111 = reserved
...	...	...

Meanwhile, information transmitted via the secondary CQICH can be used in various ways according to feedback types. In other words, the above-mentioned secondary CQICH can be used only for MIMO mode selection. If the secondary CQICH is used only for the MIMO mode selection, a payload may occur as shown in the following Table 25.

[Table 25]

Value	Description
0b0000	STTD and PUSC/FUSC permutation
0b0001	STTD and adjacent-subcarrier permutation
0b0010	SM and PUSC/FUSC permutation
0b0011	SM and adjacent-subcarrier permutation
0b0100	Closed-loop SM and PUSC/FUSC permutation
0b0101	Closed-loop SM and adjacent-subcarrier permutation

0b0110	Closed-loop SM + Beamforming and adjacent-subcarrier permutation
0b0111-0b1111	Interpretation according to table 296e, 296f or 296g, depending on if antenna grouping, antenna selection or a reduced precoding matrix code book is used.

The following Table 26 exemplarily shows antenna grouping methods corresponding to individual values shown in Table 25.

[Table 26]

Value	Description
0b0111	Antenna Group A1 for rate 1 For 3-antenna BS, See 8.4.8.3.4 For 4-antenna BS, See 8.4.8.3.5
0b1000	Antenna Group A2 for rate 1
0b1001	Antenna Group A3 for rate 1
0b1010	Antenna Group B1 for rate 2 For 3-antenna BS, See 8.4.8.3.4 For 4-antenna BS, See 8.4.8.3.5
0b1011	Antenna Group B2 for rate 2
0b1100	Antenna Group B3 for rate 2
0b1101	Antenna Group B4 for rate 2 (only for 4-antenna BS)
0b1110	Antenna Group B5 for rate 2 (only for 4-antenna BS)
0b1111	Antenna Group B6 for rate 2 (only for 4-antenna BS)

The following Table 27 exemplarily shows antenna grouping methods corresponding to individual values shown in Table 25.

[Table 27]

Value	Description
0b0111	Antenna selection option 0
0b1000	Antenna selection option 1
0b1001	Antenna selection option 2
0b1010	Antenna selection option 3
0b1011	Antenna selection option 4
0b1100	Antenna selection option 5
0b1101	Antenna selection option 6
0b1110	Antenna selection option 7

0b1111	Reserved

The following Table 28 exemplarily shows a method for employing reduced precoding matrix code books corresponding to individual values shown in Table 25.

[Table 28]

Value	Description
0b0111	Reduced Precoding matrix code book entry 0
0b1000	Reduced Precoding matrix code book entry 1
0b1001	Reduced Precoding matrix code book entry 2
0b1010	Reduced Precoding matrix code book entry 3
0b1011	Reduced Precoding matrix code book entry 4
0b1100	Reduced Precoding matrix code book entry 5
0b1101	Reduced Precoding matrix code book entry 6
0b1110	Reduced Precoding matrix code book entry 7
0b1111	Reserved

The base station transmits information associated with the above-mentioned feedback type information to an MSS via the "CQICH_Enhanced_Alloc_IE" field.

The following Table 29 exemplarily shows some parts of the "CQICH_Enhanced_Alloc_IE" field including the above-mentioned feedback type information.

[Table 29]

CQICH_Enhanced_Alloc_IE(){		
...	...	...
Feedback type	3 bits	0b000 = Fast DL measurement/Antenna grouping for 6bit payload = MIMO mode/Antenna grouping for 4bit payload 0b001 = Fast DL measurement/Antenna selection for 6bit payload = MIMO mode/Antenna selection for 4bit payload 0b010 = Fast DL measurement/Reduced codebook for 6bit payload = MIMO mode/Reduced codebook for 4bit payload

		0b011 = Quantized precoding weight feedback 0b100 = Index to precoding matrix in codebook 0b101 = Channel Matrix Information 0b110 = Per stream power control 0b111 = reserved
...	...	...

Although the use of the secondary fast feedback channel is requested by the BS to the MSS, the MSS has an option to request the usage by sending a request message to the BS. As apparent from the above description, a method for receiving a non-coherent detectable signal in a broadband wireless access system according to the present invention can transmit other signal(s) instead of a pilot signal when signal detection can be performed according to the non-coherent detection scheme, resulting in the implementation of increased transmission efficiency.

Although the present invention is described in the context of mobile communication, the present invention may also be used in any wireless communication systems using mobile devices, such as PDAs and laptop computers equipped with wireless communication capabilities.

The preferred embodiments may be implemented as a method, apparatus or article of manufacture using standard programming and/or engineering techniques to produce software, firmware, hardware, or any combination thereof. The term "article of manufacture" as used herein refers to code or logic implemented in hardware logic (e.g., an integrated circuit chip, Field Programmable Gate Array (FPGA), Application Specific Integrated Circuit (ASIC), etc.) or a computer readable medium (e.g., magnetic storage medium (e.g., hard disk drives, floppy disks, tape, etc.), optical storage (CD-ROMs, optical disks, etc.), volatile and non-volatile memory devices (e.g., EEPROMs, ROMs, PROMs, RAMs, DRAMs, SRAMs, firmware, programmable logic, etc.).

Code in the computer readable medium is accessed and executed by a processor. The code in which preferred embodiments are implemented may further be accessible through a transmission media or from a file server over a network. In such cases, the article of manufacture in which the code is implemented may comprise a transmission media, such as a network transmission line, wireless transmission media, signals propagating through space, radio waves, infrared signals, etc. Of course, those skilled in the art will recognize that many modifications may be made to this configuration without departing from the scope of the present invention, and that the article of manufacture may comprise any information bearing medium known in the art.

FIGs. 9A and 9B illustrate a structure of a transmitter unit and receiver unit of a mobile communication device in accordance with one embodiment of the present invention. Referring to FIG. 9A, a transmitter unit 500 preferably comprises a processor 510 for processing a signal to be transmitted. Before transmission, data bits are channel coded in a channel coder 520, wherein redundancy bits are added to data bits. The data bits are then mapped to a signal such as QPSK or 16QAM in a symbol mapper 530. Subsequently, the signal goes through subchannel modulation in a subchannel modulator 540 wherein the signal is mapped to the OFDMA subcarriers. Afterward, an OFDM waveformed-signal is constructed by combining several subcarriers through an Inverse Fast Fourier Transform (IFFT) 550. Finally, the signal is filtered through filter 560, converted to an analog signal by a digital-to-analog converter (DAC) 570 and transmitted to a receiver by an RF module 580.

Referring to FIG. 9B, a structure of a receiver 600 of the present invention is similar to that of the transmitter 500; however, the signal goes through a reverse process. Preferably, a signal is received by an RF module 680 and subsequently converted to a digital signal by an analog-to-digital converter 670 and filtered through filter 660. Upon filtering, the signal goes through a Fast Fourier Transform (FFT) 650 for deconstructing the waveformed-signal. The signal is then subchannel demodulated in subchannel demodulator 640, symbol demapped by symbol demapper 630 and channel decoded by channel decoder 620 prior to being forwarded to a processor 610 for processing.

Preferably, when a user enters instructional information, such as a phone number, for example, into the mobile communication device by pushing buttons of a keypad or by voice activation using a microphone, the processor 510 or 610 receives and processes the instructional information to perform the appropriate function, such as to dial the telephone number. Operational data may be retrieved from a storage unit to perform the function. Furthermore, the processor 510 or 610 may display the instructional and operational information on a display for the user's reference and convenience.

The processor issues instructional information to the RF module 580 or 680, to initiate communication, for example, transmit radio signals comprising voice communication data. The RF module comprises a receiver and a transmitter to receive and transmit radio signals. An antenna facilitates the transmission and reception of radio signals. Upon receiving radio signals, the RF module may forward and convert the signals to baseband frequency for processing by the processor. The processed signals would be transformed into audible or readable information outputted via a speaker, for example.

The processor is adapted to store message history data of messages received from and messages transmitted to other users in the storage unit, receive a conditional request for message history data input by the user, process the conditional request to read message history data corresponding to the conditional request from the storage unit, and output the message history data to the display unit. The storage unit is adapted to store message history data of the received messages and the transmitted messages.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

INDERSTRIAL APPLICABILITY

The present invention can be applied to a broadband wireless access system.

CLAIMS:

1. A method of transmitting uplink channel by a mobile station in an orthogonal frequency division multiplexing (OFDM) wireless communication system the method comprising:

receiving information associated with a radio resource allocation map from a base station, wherein the radio resource allocation map comprises control parameters for a primary Channel Quality Indication Channel (CQICH) and a secondary CQICH; and

transmitting the primary CQICH and the secondary CQICH to the base station utilizing the information,

wherein the primary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	NULL	$M_{n,8m}$	$M_{n,8m+1}$	NULL
Symbol 1	$M_{n,8m+2}$	$M_{n,8m+3}$	$M_{n,8m+4}$	$M_{n,8m+5}$
Symbol 2	NULL	$M_{n,8m+6}$	$M_{n,8m+7}$	NULL

, and

wherein the primary CQICH is used for carrying p-bit payload, and orthogonally modulated with quadrature phase shift keying (QPSK) symbols,

wherein $M_{n,8m+k}$ ($0\leq k\leq 7$) is the k-th QPSK symbol of the m-th uplink tile in the n-th primary CQICH,

wherein the second CQICH consists of 6 uplink tiles:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	$M_{n,4m}$	NULL	NULL	$M_{n,4m+1}$
Symbol 1	NULL	NULL	NULL	NULL
Symbol 2	$M_{n,4m+2}$	NULL	NULL	$M_{n,4m+3}$

, and

wherein the secondary CQICH is used for carrying q-bit payload, and orthogonally modulated with QPSK symbols,

wherein $M_{n,4m+k}$ ($0 \le k \le 3$) is the k-th QPSK symbol of the m-th uplink tile in the n-th secondary CQICH.

2. The method of claim 1, wherein the p is 6.

3. The method of claim 1, wherein the q is 4.

4. The method of claim 3, wherein the 4-bit data payload for the secondary CQICH is mapped to the uplink tiles as follows:

4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)	4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)
0b0000	a,a,a,b,b,b	0b1000	a,a,b,d,c,c
0b0001	b,b,b,a,a,a	0b1001	b,d,c,c,d,b
0b0010	c,c,c,d,d,d	0b1010	c,c,d,b,a,a
0b0011	d,d,d,c,c,c	0b1011	d,d,b,a,b,b
0b0100	a,b,c,d,a,b	0b1100	a,a,d,c,a,d
0b0101	b,c,d,a,b,d	0b1101	b,c,a,c,c,a
0b0110	c,d,a,b,c,d	0b1110	c,b,d,d,b,c
0b0111	d,a,b,c,d,a	0b1111	d,c,c,b,b,c

wherein

Vector Index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$
a	P0, P0, P0, P0
b	P0, P2, P0, P2
c	P0, P1, P2, P3
d	P1, P0, P3, P2

wherein $P0=\exp\left(j\frac{\pi}{4}\right)$, $P1=\exp\left(j\frac{3\pi}{4}\right)$, $P2=\exp\left(-j\frac{3\pi}{4}\right)$ and $P3=\exp\left(-j\frac{\pi}{4}\right)$.

5. A method of receiving feedback information by a base station in an orthogonal frequency division multiplexing (OFDM) wireless communication system, the method comprising:

transmitting information associated with a radio resource allocation map to a mobile station, wherein the radio resource allocation map comprises control parameters for a primary Channel Quality Indication Channel (CQICH) and a secondary CQICH; and

receiving the primary CQICH and the secondary CQICH from the mobile station utilizing the information,

wherein the primary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	NULL	$M_{n,8m}$	$M_{n,8m+1}$	NULL
Symbol 1	$M_{n,8m+2}$	$M_{n,8m+3}$	$M_{n,8m+4}$	$M_{n,8m+5}$
Symbol 2	NULL	$M_{n,8m+6}$	$M_{n,8m+7}$	NULL

, and

wherein the primary CQICH is used for carrying p-bit payload, and orthogonally modulated with quadrature phase shift keying (QPSK) symbols,

wherein $M_{n,8m+k}$ ($0 \leq k \leq 7$) is the k-th QPSK symbol of the m-th uplink tile in the n-th primary CQICH,

wherein the secondary CQICH consists of 6 uplink tiles, the m-th uplink tiles of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	$M_{n,4m}$	NULL	NULL	$M_{n,4m+1}$
Symbol 1	NULL	NULL	NULL	NULL
Symbol 2	$M_{n,4m+2}$	NULL	NULL	$M_{n,4m+3}$

, and

wherein the secondary CQICH is used for carrying q-bit payload, and orthogonally modulated with QPSK symbols,

wherein $M_{n,4m+k}$ ($0 \leq k \leq 3$) is the k-th QPSK symbol of the m-th uplink tile in the n-th secondary CQICH.

6. The method of claim 5, wherein the p is 6.

7. The method of claim 5, wherein the q is 4.

8. The method of claim 7, wherein the 4-bit data payload for the secondary CQICH is mapped to the uplink tiles as follows:

4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)	4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)
0b0000	a,a,a,b,b,b	0b1000	a,a,b,d,c,c
0b0001	b,b,b,a,a,a	0b1001	b,d,c,c,d,b
0b0010	c,c,c,d,d,d	0b1010	c,c,d,b,a,a
0b0011	d,d,d,c,c,c	0b1011	d,d,b,a,b,b
0b0100	a,b,c,d,a,b	0b1100	a,a,d,c,a,d
0b0101	b,c,d,a,b,d	0b1101	b,c,a,c,c,a
0b0110	c,d,a,b,c,d	0b1110	c,b,d,d,b,c
0b0111	d,a,b,c,d,a	0b1111	d,c,c,b,b,c

wherein

Vector Index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$
a	P0, P0, P0, P0
b	P0, P2, P0, P2
c	P0, P1, P2, P3
d	P1, P0, P3, P2

wherein $P0=\exp\left(j\frac{\pi}{4}\right)$, $P1=\exp\left(j\frac{3\pi}{4}\right)$, $P2=\exp\left(-j\frac{3\pi}{4}\right)$ and $P3=\exp\left(-j\frac{\pi}{4}\right)$.

9. A mobile station configured to transmit feedback information in an orthogonal frequency division multiplexing (OFDM) wireless communication system, the mobile station comprising:

a processor; and

a radio frequency (RF) module for transmitting and receiving a radio signal to and from the outside under the control of the processor,

wherein the processor is configured to:

receive information associated with a radio resource allocation map from a base station, wherein the radio resource allocation map comprises control parameters for a primary Channel Quality Indication Channel (CQICH) and a secondary CQICH; and

transmit the primary CQICH and the secondary CQICH to the base station utilizing the information,

wherein the primary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	NULL	$M_{n,8m}$	$M_{n,8m+1}$	NULL
Symbol 1	$M_{n,8m+2}$	$M_{n,8m+3}$	$M_{n,8m+4}$	$M_{n,8m+5}$
Symbol 2	NULL	$M_{n,8m+6}$	$M_{n,8m+7}$	NULL

, and

wherein the primary CQICH is used for carrying p-bit payload, and orthogonally modulated with quadrature phase shift keying (QPSK) symbols,

wherein $M_{n,8m+k}$ ($0 \leq k \leq 7$) is the k-th QPSK symbol of the m-th uplink tile in the n-th primary CQICH,

wherein the secondary CQICH consists of 6 uplink tiles, the m-th uplink tile of which has a below structure:

	Subcarrier 0	Subcarrier 1	Subcarrier 2	Subcarrier 3
Symbol 0	$M_{n,4m}$	NULL	NULL	$M_{n,4m+1}$
Symbol 1	NULL	NULL	NULL	NULL
Symbol 2	$M_{n,4m+2}$	NULL	NULL	$M_{n,4m+3}$

, and

wherein the secondary CQICH is used for carrying q-bit payload, and orthogonally modulated with QPSK symbols,

wherein $M_{n,4m+k}$ $(0 \leq k \leq 3)$ is the k-th QPSK symbol of the m-th uplink tile in the n-th secondary CQICH.

10. The mobile station of claim 9, wherein the p is 6.

11. The mobile station of claim 9, wherein the q is 4.

12. The mobile station of claim 11, wherein the 4-bit data payload for the secondary CQICH is mapped to the uplink tiles as follows:

4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)	4 bit payload	Vector indices per tile Tile(0), Tile(1), Tile(2), Tile(3), Tile(4), Tile(5)
0b0000	a,a,a,b,b,b	0b1000	a,a,b,d,c,c
0b0001	b,b,b,a,a,a	0b1001	b,d,c,c,d,b
0b0010	c,c,c,d,d,d	0b1010	c,c,d,b,a,a
0b0011	d,d,d,c,c,c	0b1011	d,d,b,a,b,b
0b0100	a,b,c,d,a,b	0b1100	a,a,d,c,a,d
0b0101	b,c,d,a,b,d	0b1101	b,c,a,c,c,a
0b0110	c,d,a,b,c,d	0b1110	c,b,d,d,b,c
0b0111	d,a,b,c,d,a	0b1111	d,c,c,b,b,c

wherein

Vector Index	$M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$
a	P0, P0, P0, P0
b	P0, P2, P0, P2
c	P0, P1, P2, P3
d	P1, P0, P3, P2

wherein $P0=\exp\left(j\frac{\pi}{4}\right)$, $P1=\exp\left(j\frac{3\pi}{4}\right)$, $P2=\exp\left(-j\frac{3\pi}{4}\right)$ and $P3=\exp\left(-j\frac{\pi}{4}\right)$.

FIG. 1

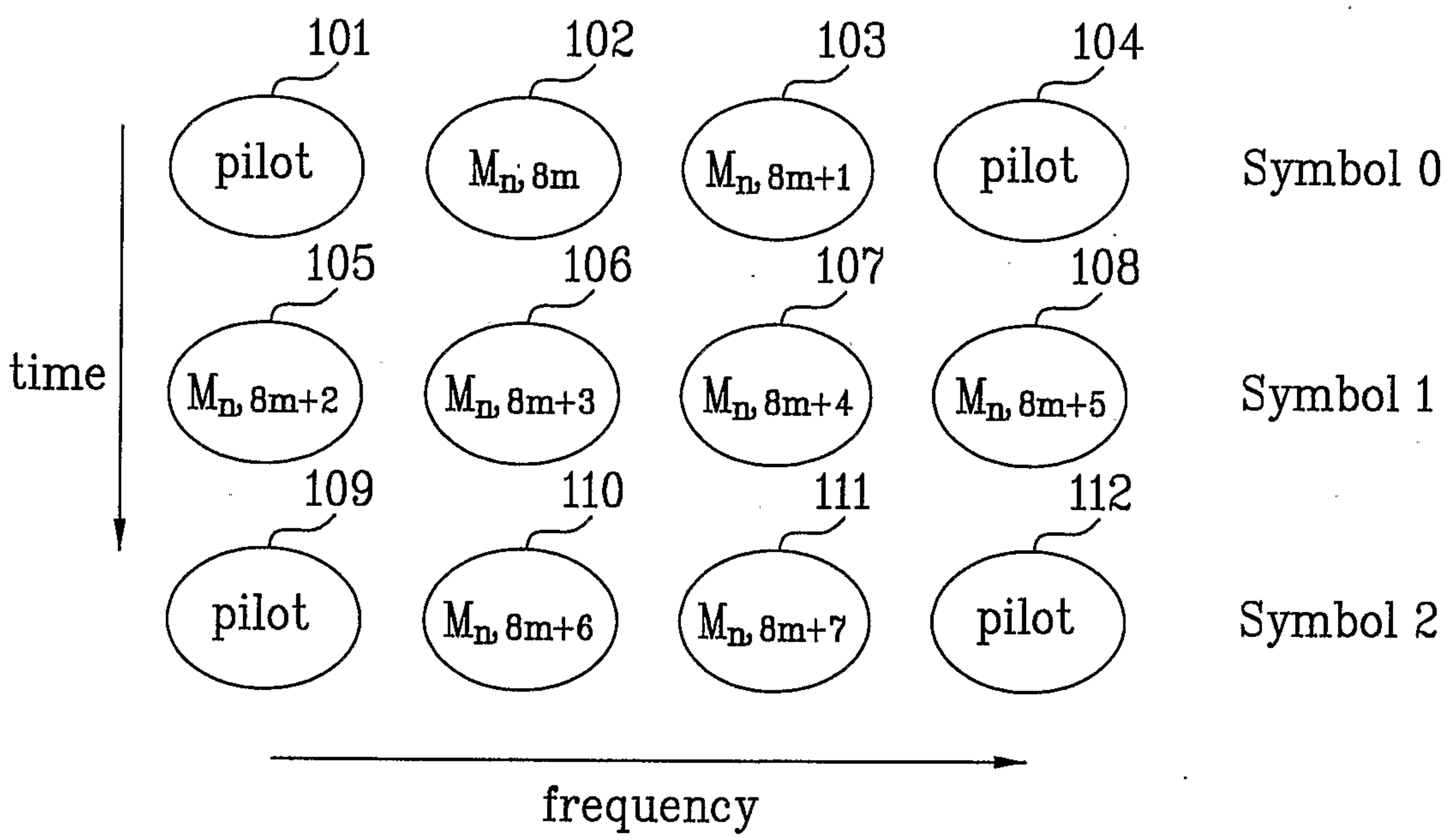

101
102
103
104
pilot
$M_{n, 8m}$
$M_{n, 8m+1}$
pilot
Symbol 0
105
106
107
108
time
$M_{n, 8m+2}$
$M_{n, 8m+3}$
$M_{n, 8m+4}$
$M_{n, 8m+5}$
Symbol 1
109
110
111
112
pilot
$M_{n, 8m+6}$
$M_{n, 8m+7}$
pilot
Symbol 2
frequency

FIG. 2

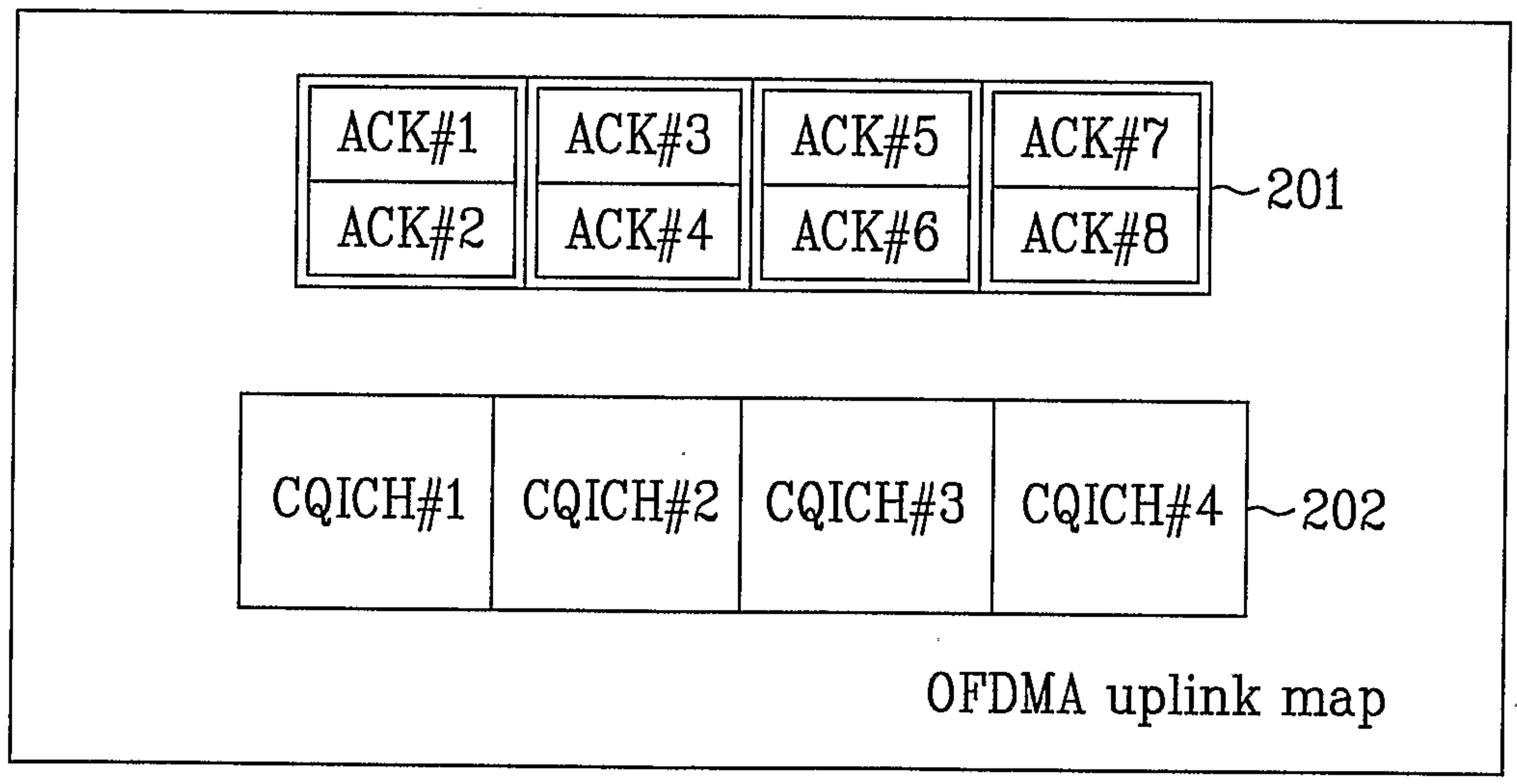

ACK#1
ACK#2
ACK#3
ACK#4
ACK#5
ACK#6
ACK#7
ACK#8
201
CQICH#1
CQICH#2
CQICH#3
CQICH#4
202
OFDMA uplink map

FIG. 3

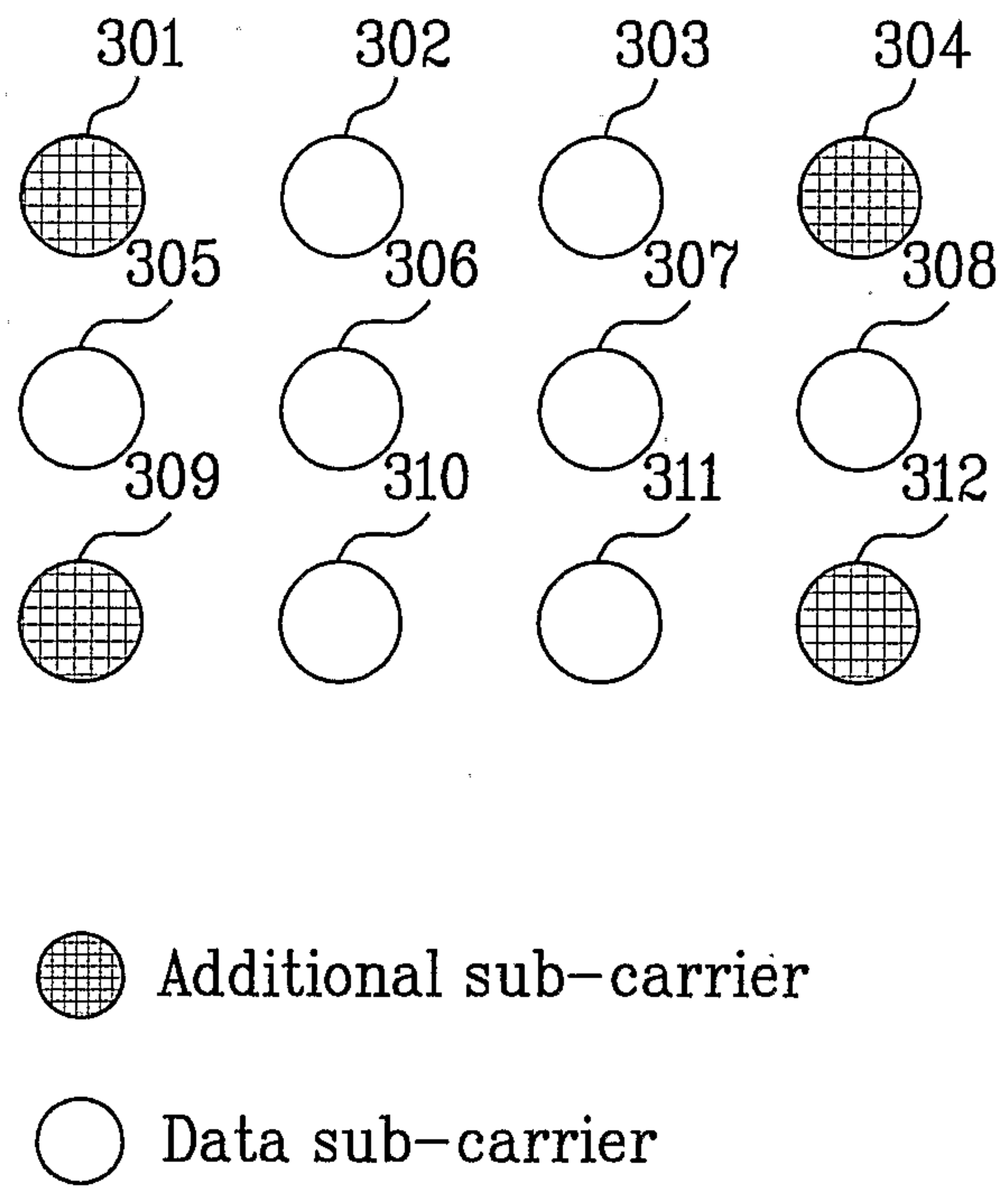

301
302
303
304
305
306
307
308
309
310
311
312
Additional sub-carrier
Data sub-carrier

FIG. 4

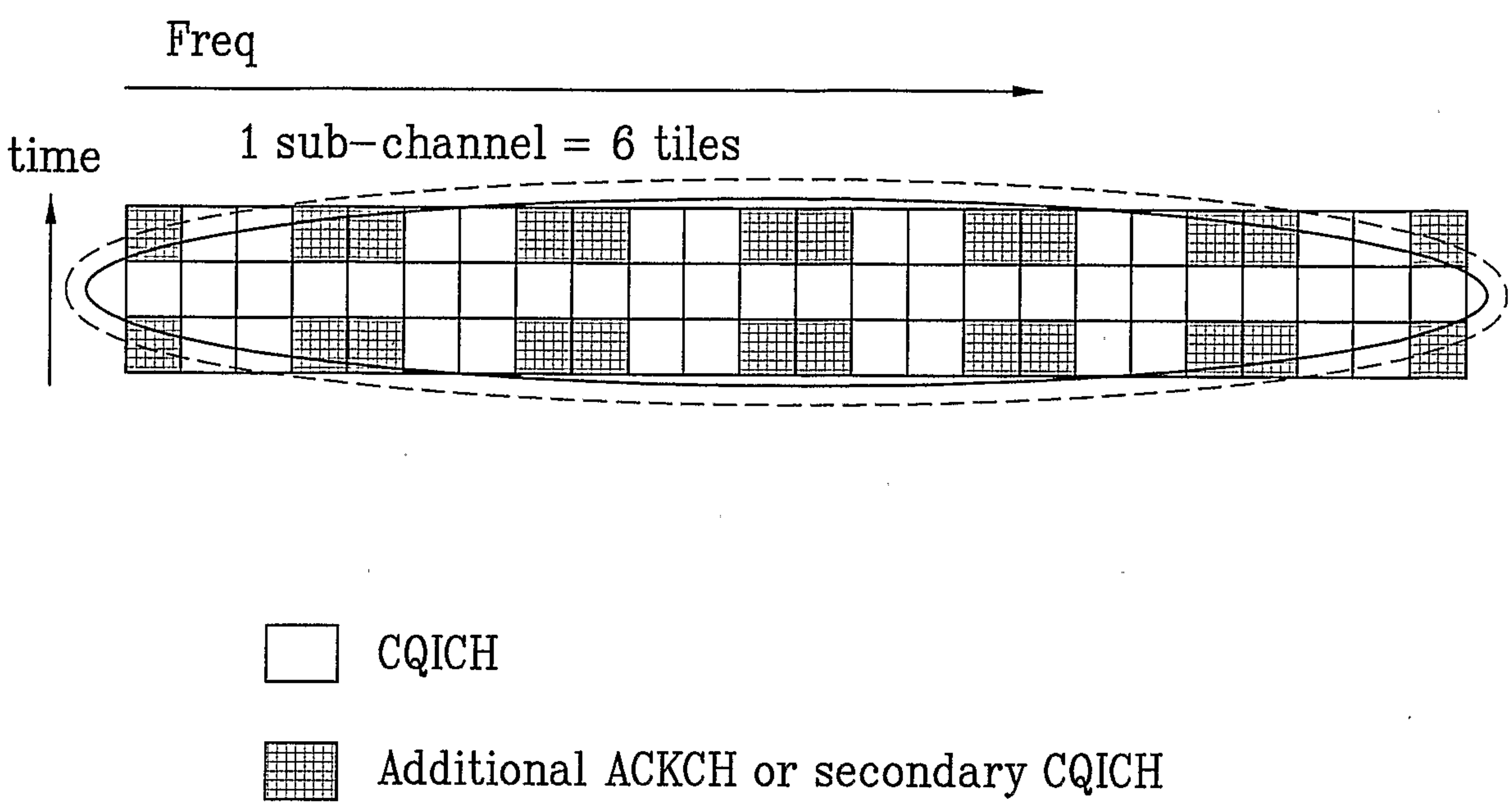

Freq
time
1 sub–channel = 6 tiles
CQICH
Additional ACKCH or secondary CQICH

FIG. 5

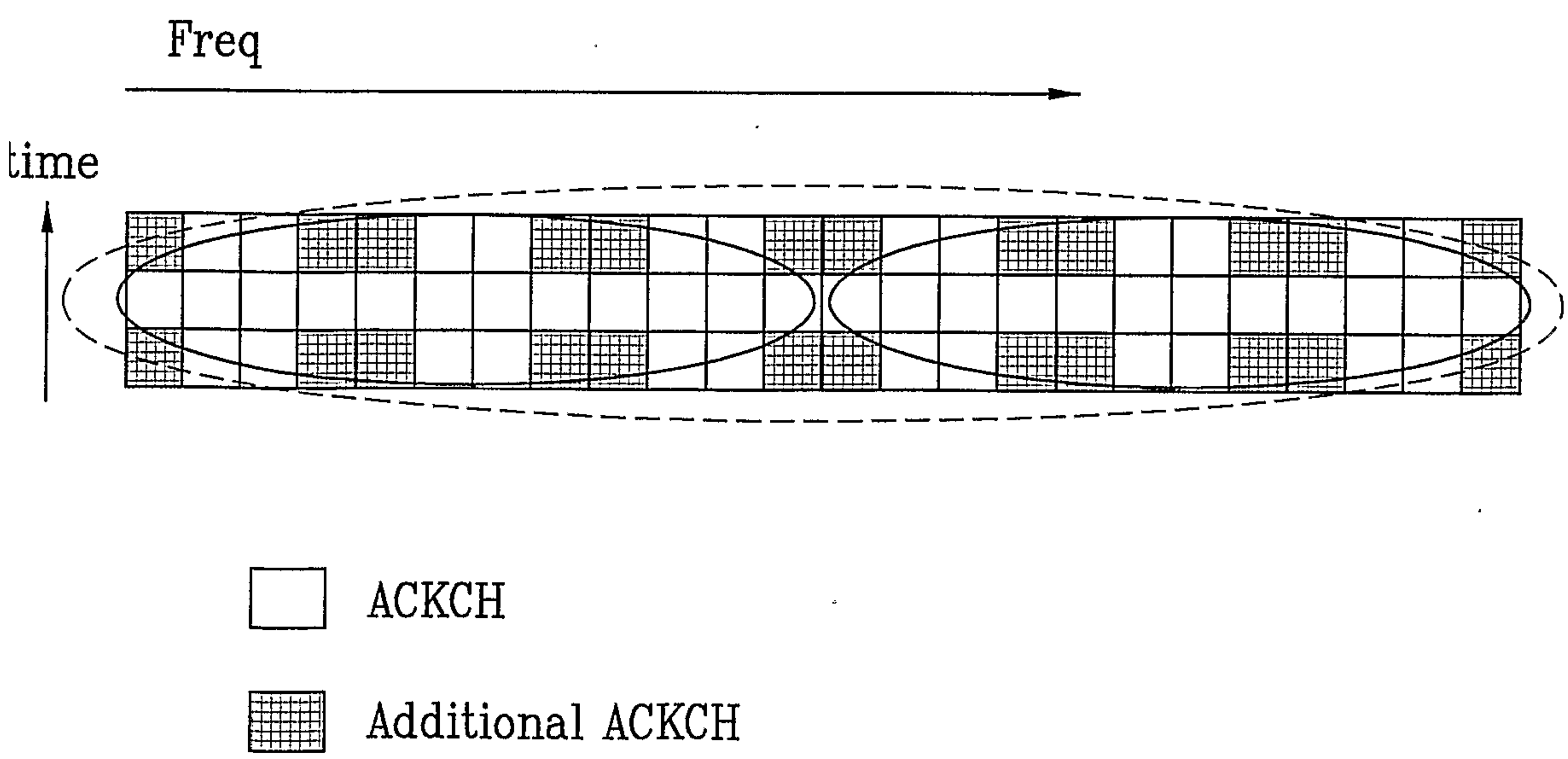

Freq
time
ACKCH
Additional ACKCH

FIG. 6

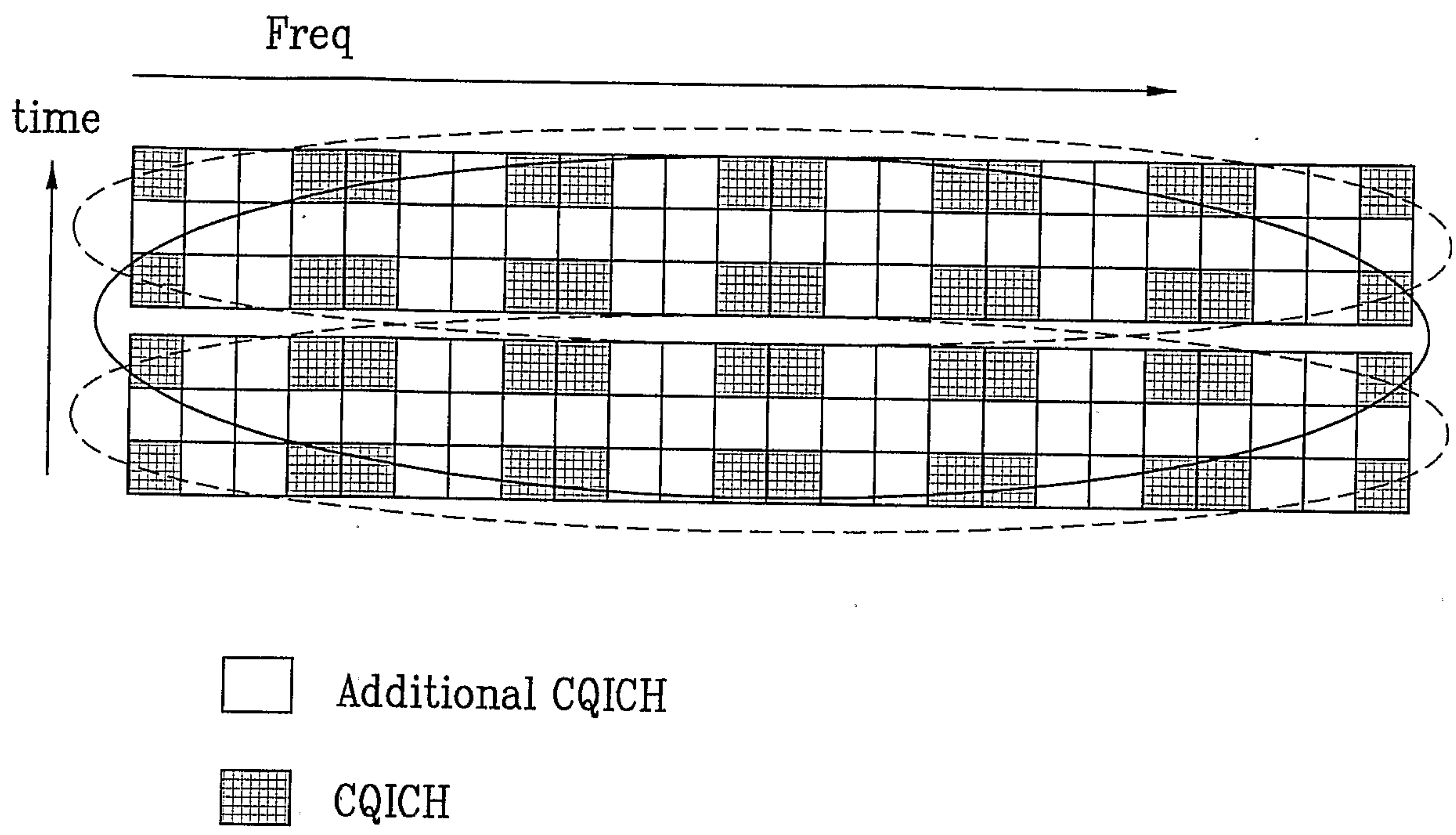

Freq
time
Additional CQICH
CQICH

FIG. 7

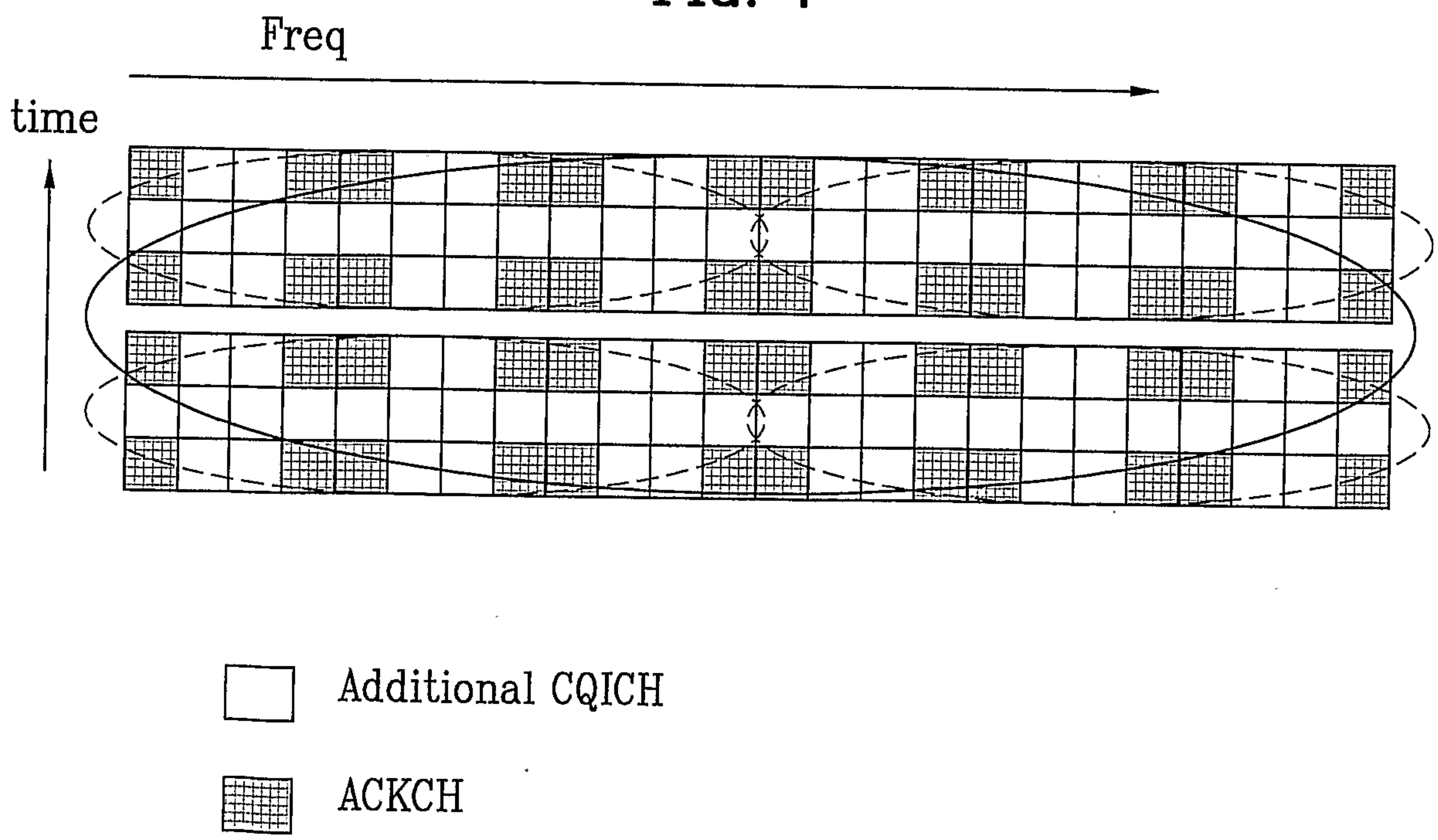

Freq
time
Additional CQICH
ACKCH

FIG. 8

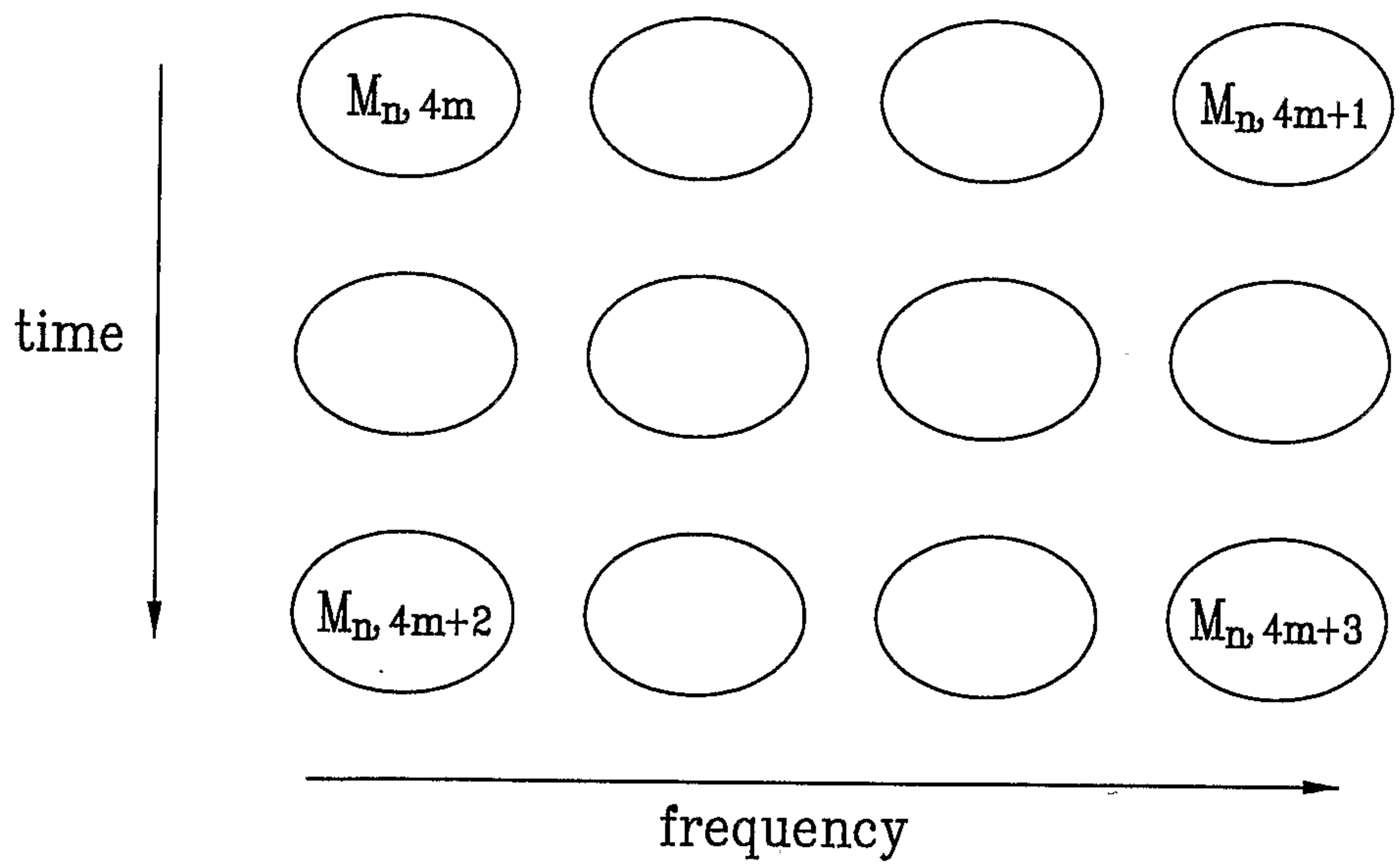


FIG. 9A

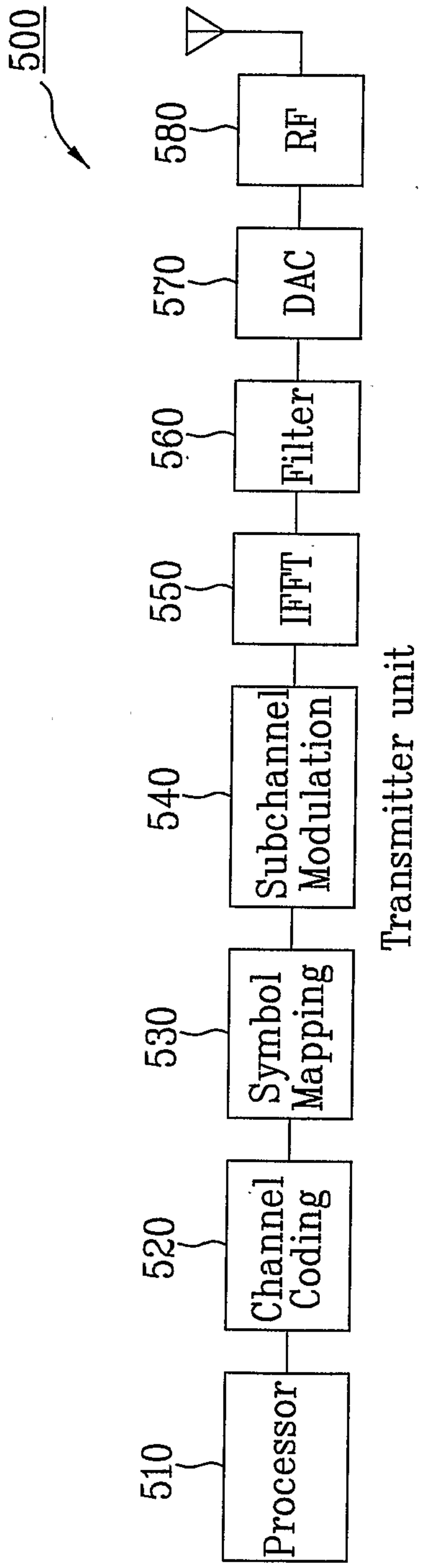
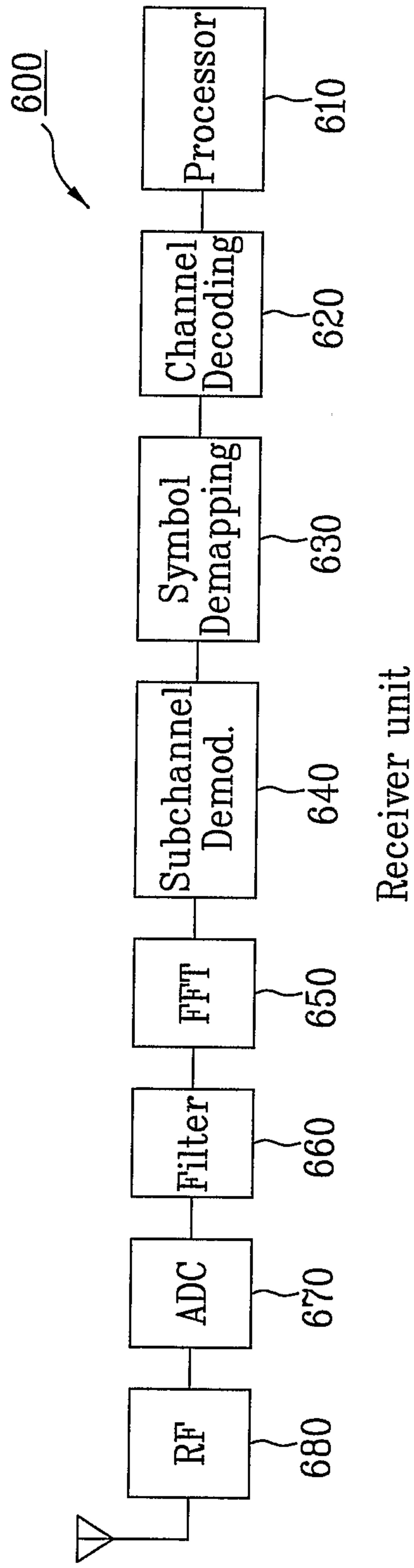
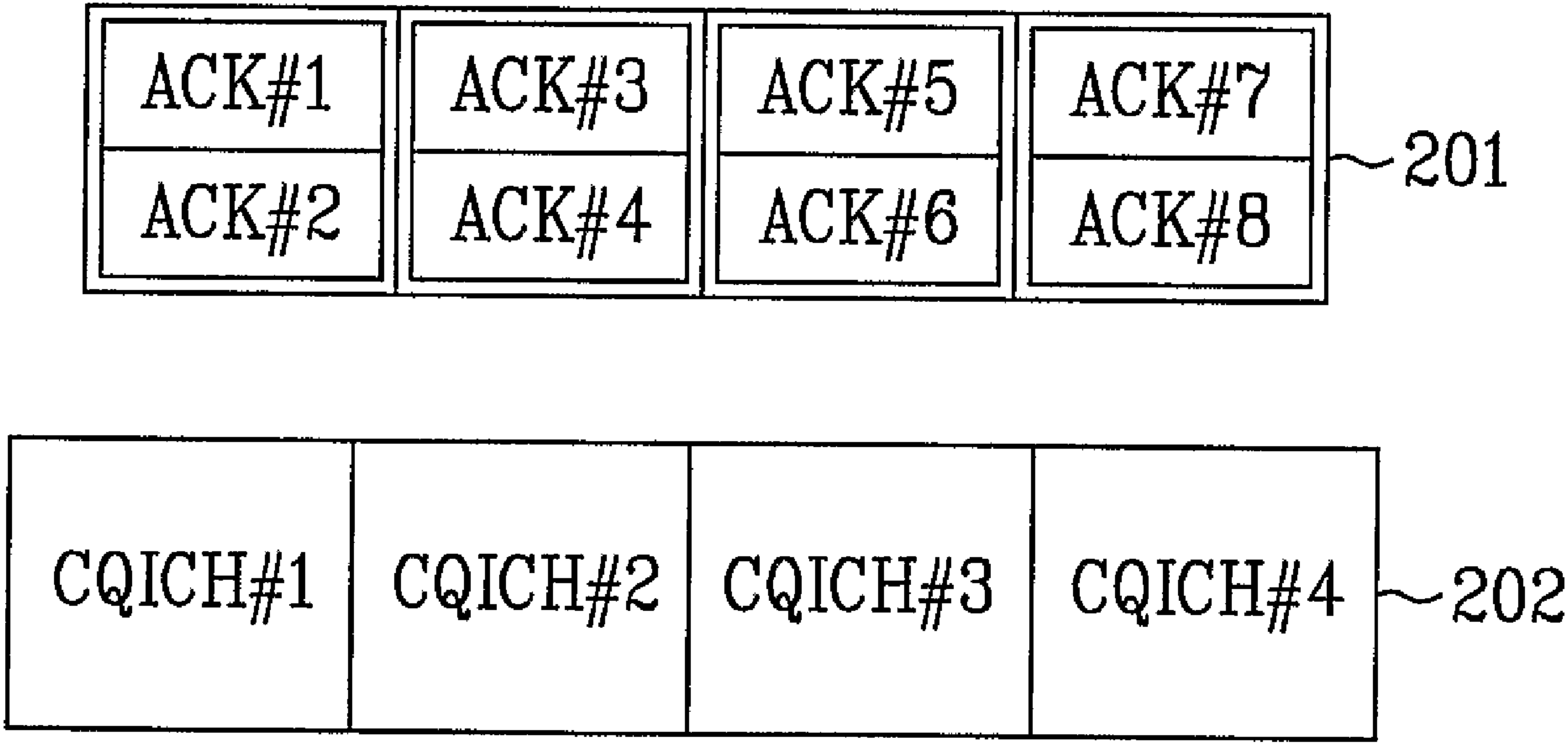

500
Processor
Channel Coding
Symbol Mapping
Subchannel Modulation
IFFT
Filter
DAC
RF
510
520
530
540
550
560
570
580
Transmitter unit

FIG. 9B


600
RF
ADC
Filter
FFT
Subchannel Demod.
Symbol Demapping
Channel Decoding
Processor
680
670
660
650
640
630
620
610
Receiver unit



OFDMA uplink map