(19) DANMARK

(10) DK/EP 2077632 T3

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *H 04 W 52/32 (2009.01)* *H 04 W 52/14 (2009.01)*

(45) Oversættelsen bekendtgjort den: **2019-01-14**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2018-09-26**

(86) Europæisk ansøgning nr.: **09150163.5**

(86) Europæisk indleveringsdag: **2009-01-07**

(87) Den europæiske ansøgnings publiceringsdag: **2009-07-08**

(30) Prioritet: **2008-01-07 US 6343 P** **2008-08-28 US 136328 P**
2008-12-05 US 314239

(84) Designerede stater: **AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR**

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(54) Benævnelse: **Fremgangsmåder og indretninger til downlink PDSCH effektindstilling**

(56) Fremdragne publikationer:
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DESCRIPTION

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to methods and apparatus for transmitting power setting information in a downlink Physical Downlink Shared Channel (PDSCH) in a communication system.

Description of the Related Art

[0002] The following documents represent the background in which the present invention was conceived.

1. [1]. "Chairman's notes", 3GPP RAN WG1#51, Nov 2007, Jeju, Korea;
2. [2]. R1-075077, "Way-forward on Data Power Setting for PDSCH across OFDM Symbols", Samsung, LGE, Nortel, Qualcomm, etc., Nov 2007, Jeju, Korea;
3. [3]. R1-080047, "Further Discussion on Data Power Setting for PDSCH", Samsung, Jan 2008, Seville, Spain;
4. [4]. R1-081600, "Draft LS on information about RANI decision regarding downlink power settings", Nokia, Shenzhen, China;
5. [5]. 3GPP TS 36.213 Standard, Version 8.3.0;
6. [6]. US Provisional Patent Application Serial No. 60/963,681, entitled "Pilot boosting and traffic-to-pilot ratio estimation in a wireless communication system", filed on 7 August 2007;
7. [7]. R1-074796, "Power Scaling and DL RS Boosting", Samsung, Nov 2007, Jeju, Korea;
8. [8]. R1-074450, "Update on Power Scaling and DL RS boosting", Samsung, Oct 2007, Shanghai, China; and
9. [9]. R1-074970, "Data Power Scaling for PDSCH across OFDM Symbols", Qualcomm Europe, Nov 2007, Jeju, Korea.

[0003] In RAN1#51 meeting in Jeju, Nov 2007 [1][2], it was agreed, in order to enable the efficient power and bandwidth utilization at the eNodeB (i.e., base station) for all Orthogonal Frequency Division Multiplexing (OFDM) symbols but at the same time to minimize the signaling or estimation efforts for the data-to-reference signal (RS) Energy Per Resource Element (EPRE) ratio, that:

- For each UE, the Physical Downlink Shared Channel (PDSCH)-to-RS EPRE ratios

among resource elements (REs) in all the OFDM symbols containing RS are equal, and are denoted by P A,

- For each UE, the PDSCH-to-RS EPRE ratios among REs in all the OFDM symbols not containing RS are equal, and are denoted by P_B,
- For each UE, P_A and P_B are potentially different due to different PDSCH EPRE,
- The ratio between P_A and P_B is known at the UE. This ratio can be derived from the signaled RS boosting value, and from other signaling that is needed to derive this ratio.

[0004] It can be noted that the power available from each antenna port for subcarriers other than the reference signals, such as data subcarriers, vary from OFDM symbol to OFDM symbol. Keeping the power level equal across antennas on these subcarriers results in inefficient use of power because power level is limited to the minimum power level available from a given antenna port even though other ports may have extra power available. Likewise, keeping the power level the same across OFDM symbols on these subcarriers also results in inefficient use of power because power level is limited to the minimum power level available in one OFDM symbol although other OFDM symbols may have extra power available. Another solution could be to puncture some data subcarriers in OFDM symbols containing pilot signals in order to keep the power level the same across the symbols. This approach, however, may result in waste of subcarrier resources thus degrading system performance and capacity.

SUMMARY OF THE INVENTION

[0005] It is therefore an object of the present invention to provide an improved method and circuit for efficiently utilizing power during wireless transmission of data among a plurality of transmission antennas.

[0006] It is another object to provide a method and circuit for transmitting power setting information in a downlink Physical Downlink Shared Channel (PDSCH).

[0007] According to one aspect of the present invention, there is provided a method of determining a downlink transmit power from a base station at a wireless terminal, the base station and the wireless terminal having a plurality of Orthogonal Frequency Division Multiplexing, OFDM, symbols available for transmission, the method comprising: receiving a signaling parameter from the base station; and determining a ratio of a first ratio to a second ratio, wherein the first ratio is a Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, ratio among Resource Elements, REs, in OFDM symbols containing RS, wherein the second ratio is a PDSCH-to-RS EPRE ratio among REs in OFDM symbols not containing RS, wherein the ratio of the first ratio to the second ratio for one cell specific antenna port is 1, 4/5, 3/5, or 2/5, respectively for the signaling parameter being 0, 1, 2, or 3, and wherein the ratio of the first ratio to the second ratio for 2 or 4 cell specific antenna ports is 5/4, 1, 3/4, or 1/2, respectively for the signaling parameter being 0, 1,

2, or 3.

[0008] According to another aspect of the preset invention, there is provided an apparatus of a wireless terminal for determining a downlink transmit power from a base station, the base station and the wireless terminal having a plurality of Orthogonal Frequency Division Multiplexing, OFDM, symbols available for transmission, the apparatus comprising: an antenna unit for receiving a signaling parameter from the base station; and a power setting unit for determining a ratio of a first ratio to a second ratio, wherein the first ratio is a Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, ratio among Resource Elements, REs, in OFDM symbols containing RS, wherein the second ratio is a PDSCH-to-RS EPRE ratio among REs in OFDM symbols not containing RS, wherein the ratio of the first ratio to the second ratio for one cell specific antenna port is 1, 4/5, 3/5, or 2/5, respectively for the signaling parameter being 0, 1, 2, or 3, and wherein the ratio of the first ratio to the second ratio for 2 or 4 cell specific antenna ports is 5/4, 1, 3/4, or 1/2, respectively for the signaling parameter being 0, 1, 2, or 3.

[0009] According to another aspect of the present invention, there is provided a method of determining a downlink transmit power for wireless terminals at a base station, the base station and the wireless terminals having a plurality of Orthogonal Frequency Division Multiplexing, OFDM, symbols available for transmission, the method comprising: transmitting a signaling parameter to wireless terminals in a cell; and transmitting traffic data by using one of a first ratio and a second ratio, wherein the first ratio is a Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, ratio among Resource Elements, REs, in OFDM symbols containing RS, wherein the second ratio is a PDSCH-to-RS EPRE ratio among REs in OFDM symbols not containing RS, wherein the ratio of the first ratio to the second ratio for one cell specific antenna port is 1, 4/5, 3/5, or 2/5, respectively for the signaling parameter being 0, 1, 2, or 3, and wherein the ratio of the first ratio to the second ratio for 2 or 4 cell specific antenna ports is 5/4, 1, 3/4, or 1/2, respectively for the signaling parameter being 0, 1, 2, or 3..

[0010] According to another aspect of the present invention, there is provided an apparatus of a base station for determining a downlink transmit power for wireless terminals, the base station and the wireless terminals having a plurality of Orthogonal Frequency Division Multiplexing, OFDM, symbols available for transmission, the apparatus comprising: an antenna unit for transmitting a signaling parameter to wireless terminals in a cell; and a transmitter for transmitting traffic data by using one of a first ratio and a second ratio, wherein the first ratio is a Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, ratio among Resource Elements, REs, in OFDM symbols containing RS, wherein the second ratio is a PDSCH-to-RS EPRE ratio among REs in OFDM symbols not containing RS, wherein the ratio of the first ratio to the second ratio for one cell specific antenna port is 1, 4/5, 3/5, or 2/5, respectively for the signaling parameter being 0, 1, 2, or 3, and wherein the ratio of the first ratio to the second ratio for 2 or 4 cell specific antenna ports is 5/4, 1, 3/4, or 1/2, respectively for the signaling parameter being 0, 1, 2, or 3.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

FIG. 1 schematically illustrates an Orthogonal Frequency Division Multiplexing (OFDM) transceiver chain suitable for the practice of the principles of the present inventions;

FIG. 2 schematically illustrates a Multiple Input Multiple Output (MIMO) transceiver chain suitable for the practice of the principles of the present inventions;

FIG. 3 schematically illustrates an example reference signals transmission over six subcarriers within a subframe via four transmission antennas (4 **T**x) suitable for the practice of the principles of the present inventions;

FIG. 4 schematically illustrates an example reference signals transmission over six subcarriers within a subframe via two transmission antennas (2 **T**x) suitable for the practice of the principles of the present inventions;

FIG. 5 schematically illustrates an example reference signals transmission over six subcarriers within a subframe via one transmission antenna (1 **T**x) suitable for the practice of the principles of the present inventions;

FIG. 6 schematically illustrates an example of mapping of downlink reference signals in OFDM symbols 1 and 2 for four transmission antenna;

FIG. 7 schematically illustrates a wireless system including the base station (eNodeB) and the user equipment as an embodiment according to the principles of the present invention;

FIG. 8 schematically illustrates a flow chart outlining a process for transmitting downlink power setting information at a base station (BS) as an embodiment constructed according to the principles of the present invention; and

FIG. 9 schematically illustrates a flow chart outlining a process for calculating power setting information at a unit of user equipment as an embodiment constructed according to the principles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0012] In this invention, we propose methods and apparatus to improve the performance and

reduce the overhead of channel quality indication feedback in a communication system.

[0013] Aspects, features, and advantages of the invention are readily apparent from the following detailed description, simply by illustrating a number of particular embodiments and implementations. The invention is also amenable to realization in other and different embodiments, and its several details can be modified in various obvious respects, all without departing from the scope of the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive. The invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings.

[0014] FIG. 1 illustrates an Orthogonal Frequency Division Multiplexing (OFDM) transceiver chain. In a communication system using OFDM technology, at transmitter chain 110, control signals or data 111 is modulated by modulator 112 and is serial-to-parallel converted by Serial/Parallel (S/P) converter 113. Inverse Fast Fourier Transform (IFFT) unit 114 is used to transfer the signal from frequency domain to time domain. Cyclic prefix (CP) or zero prefix (ZP) is added to each OFDM symbol by CP insertion unit 116 to avoid or mitigate the impact due to multipath fading. Consequently, the signal is transmitted by transmitter (Tx) front end processing unit 117 and at least one antenna (not shown), or fixed wire or cable. The signal is transmitted from one or more antennas driven by unit 117 via the atmosphere and is subjected to multipath fading to arrive at a receiver. Note that the multipath fading channel illustrated in FIG. 1 refers to a transmission media (for example, atmosphere), and the multipath fading channel is not a component connected to the receiver, nor to the transmitter. At receiver chain 120, assuming perfect time and frequency synchronization are achieved, the signal received by receiver (Rx) front end processing unit 121 is processed by CP removal unit 122. Fast Fourier Transform (FFT) unit 124 transfers the received signal from time domain to frequency domain for further processing.

[0015] The total bandwidth in an OFDM system is divided into narrowband frequency units called subcarriers. The number of subcarriers is equal to the FFT/IFFT size N used in the system. In general, the number of subcarriers used for data is less than N because some subcarriers at the edge of the frequency spectrum are reserved as guard subcarriers. In general, no information is transmitted on guard subcarriers.

[0016] The basic structure of a multi-carrier signal in the time domain is generally made up of time frames, time slots, and OFDM symbols. A frame consists of a number of time slots, whereas each time slot consists of a number of OFDM symbols. The OFDM time domain waveform is generated by applying the inverse-fast-Fourier-transform (IFFT) to the OFDM signals in the frequency domain. A copy of the last portion of the time waveform, known as the cyclic prefix (CP), is inserted in the beginning of the waveform itself to form the OFDM symbol. Using the cyclic prefix extension, the samples required for performing the FFT at the receiver can be taken anywhere over the length of the symbol. This provides multipath immunity as well as a tolerance for symbol time synchronization errors.

[0017] Multiple Input Multiple Output (MIMO) schemes use multiple transmission antennas and

multiple receive antennas to improve the capacity and reliability of a wireless communication channel. A MIMO system promises linear increase in capacity with K where K is the minimum of number of transmit (M) and receive antennas (N), i.e. K = min(M,N). A simplified example of a 4 × 4 MIMO system is shown in FIG. 2. In this example, four different data streams are transmitted separately from four transmission antennas. The transmitted signals are received at four receive antennas. Some form of spatial signal processing is performed on the received signals in order to recover the four data streams. An example of spatial signal processing is vertical Bell Laboratories Layered Space-Time (V-BLAST) which uses the successive interference cancellation principle to recover the transmitted data streams. Other variants of MIMO schemes include schemes that perform some kind of space-time coding across the transmission antennas (e.g., diagonal Bell Laboratories Layered Space-Time (D-BLAST)) and also beamforming schemes such as Spatial Division multiple Access (SDMA).

[0018] The downlink reference signals mapping for four transmission antennas in the 3GPP LTE (3rd Generation Partnership Project Long Term Evolution) system is shown in FIG. 3. The notation R_p is used to denote a resource element used for reference signal transmission on antenna port p. It can be noted that density on antenna ports 2 and 3 is half the density on antenna ports 0 and 1. This leads to weaker channel estimates on antenna ports 2 and 3 relative to channel estimates on antenna ports 0 and 1.

[0019] Similarly, FIG. 4 schematically illustrates downlink reference signals mapping for two transmission antennas in the 3GPP LTE system, and FIG. 5 schematically illustrates downlink reference signals mapping for one transmission antenna in the 3GPP LTE system.

[0020] An example of reference signals transmission over six subcarriers within the first three OFDM symbols from each of the four antenna ports is shown in FIG. 6. It can be noted that the power available from each antenna port for subcarriers other than the reference signals, e.g., data subcarriers, vary from OFDM symbol to OFDM symbol. Keeping the power level the same across antennas on these subcarriers results in inefficient use of power, because the power level is limited to the minimum power level available from a given antenna port even though other ports may have extra power available. Likewise, keeping the power level the same across OFDM symbols on these subcarriers also results in inefficient use of power, because power level is limited to the minimum power level available in one OFDM symbol although other OFDM symbols may have extra power available. Another solution could be to puncture some data subcarriers in OFDM symbols containing pilots to keep the power level the same across the symbols. This approach, however, may undesirably result in a waste of subcarrier resources thus degrading system performance and capacity.

1. Methods of calculating Traffic-to-Pilot (T2P) ratios on all OFDM symbols for 1, 2, 4 eNodeB Transmit antennas cases (1,2,4 Tx)

[0021] In a first embodiment according to the principles of the present invention, we show how

the P_A/P_B ratio is calculated from the RS boosting value, which is represented by the RS overhead as a percentage of total power in the RS OFDM symbol. Furthermore, using the P_A/P_B ratio obtained from the proposed method, we can further specify the T2P ratios on all OFDM symbols, and across different transmit antennas, for cases where we have 1, 2 or 4 transmit antennas (1, 2, or 4 Tx).

[0022] Let the total available data power on a non-RS OFDM symbol be E_B, and let the total available data power on an RS OFDM symbol be $E_A = (1-\eta_{RS})E_B$, where η_{RS} is the total RS power as a percentage of the total power on the RS OFDM symbol. For the k-th user (i.e., UE), let the pair ($P_{B,k}$ $N_{B,k}$) be the EPRE power and the number of subcarriers assigned on the non-RS OFDM symbols; and let the pair ($P_{A,k}$ $N_{A,k}$) be the EPRE power and the number of subcarriers assigned on the RS OFDM symbols.

1. 1. For two (2) Tx (2 eNode-B transmit antenna) and four (4) Tx case. We have

   $$N_{A,k} = \frac{2}{3} N_{B,k}$$

   due to the RS structure in LTE where 2 out of every 6 subcarriers are reserved for RS in RS OFDM symbols (see FIGs. 1 and 2). Furthermore, we propose the ratio between the two data EPREs as:

   $$\alpha = \frac{P_{A,k}}{P_{B,k}} = \frac{3}{2}(1-\eta_{RS}), \qquad (1)$$

   for k=1,...K, where K is the total number of UEs scheduled. Note the above ratio enables us to use maximum power in both RS and non-RS OFDM symbols at the same time. To see this, assume a power-control policy on the non-RS OFDM symbols where

   $$\sum_{k=1}^{K} P_{B,k} N_{B,k} = E_B ,$$

   i.e. max power is used in the non-RS OFDM symbols, then it is easy to verify that

   $$\sum_{k=1}^{K} P_{A,k} N_{A,k} = \sum_{k=1}^{K} \frac{3}{2}(1-\eta_{RS}) P_{B,k} \frac{2}{3} N_{B,k} = (1-\eta_{RS}) E_B = E_A , \qquad (2)$$

   which indicates the full use of power on RS OFDM symbols.
2. 2. For one (1) Tx case. We have

   $$N_{A,k} = \frac{5}{6} N_{B,k}$$

   due to the RS structure in LTE where 1 out of every six subcarriers is reserved for RS in RS OFDM symbols (see FIG. 3). Furthermore, we propose the ratio between the two data EPREs as:

   $$\alpha = \frac{P_{A,k}}{P_{B,k}} = \frac{6}{5}(1-\eta_{RS}) . (3)$$

[0023] We now organize the above proposal into tables that indicate the Traffic-to-Pilot (T2P) ratios on different antennas and different OFDM symbols. Note 'i' is the OFDM symbol index and i=1,...14, and t is the transmit antenna index.

[0024] Table 1 shows the T2P ratios on all OFDM symbols within a subframe and on all antennas for 1 Tx case. Here $i \in \{1,5,8,12\}$ is the set of OFDM symbols with RS in the normal CP situation, whereas $i \in \{2,3,4,6,7,9,10,11,13,14\}$ is the set of OFDM symbols without RS in the normal CP situation with 1Tx.

Table 1: The T2P ratio for 1Tx case.

	$i \in \{1,5,8,12\}$	$i \in \{2,3,4,6,7,9,10,11, 13,14\}$
$t \in \{0\}$	$\frac{6}{5}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$	$\frac{P_{B,k}}{P_{RS}}$

[0025] Table 2 shows the T2P ratios on all OFDM symbols within a subframe and on all antennas for 2 Tx case. Here $i \in \{1,5,8,12\}$ is the set of OFDM symbols with RS in the normal CP situation, whereas $i \in \{2,3,4,6,7,9,10,11,13,14\}$ is the set of OFDM symbols without RS in the normal CP situation with 2Tx.

Table 2: The T2P ratio for 2Tx case.

	$i \in \{1,5,8,12\}$	$i \in \{2,3,4,6,7,9,10,11, 13,14\}$
$t \in \{0,1\}$	$\frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$	$\frac{P_{B,k}}{P_{RS}}$

[0026] Table 3 shows the T2P ratios on all OFDM symbols within a subframe and on all antennas for 4 Tx case. Here $i \in \{1,2,5,8,9,12\}$ is the set of OFDM symbols with RS in the normal CP situation, whereas $i \in \{3,4,6,7,10,11,13,14\}$ is the set of OFDM symbols without RS in the normal CP situation with 4Tx.

Table 3: The T2P ratio for 4Tx case.

	$i \in \{1,2,5,8,9,12\}$	$i \in \{3,4,6,7,10,11,13,14\}$
$t \in \{0,1, 2,3\}$	$\frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$	$\frac{P_{B,k}}{P_{RS}}$

[0027] The k-th UE needs to know $P_{B,k}$ and RS overhead ratio η_{RS} to derive $P_{A,k}$. In practice, T2P ratio is more often used then the actual power, so the k-th UE needs to know $P_{B,k} / P_{RS}$ and RS overhead ratio η_{RS} to derive $P_{A,k}/P_{RS}$. Here P_{RS} is the per-subcarrier RS power.

[0028] It is important to note that while this ratio allows full use of power in both RS and non-RS OFDM symbols, this ratio does not mandate that full power being used at all time. In fact, simply removing one UE from the K UEs provides an example of not fully using the eNB power.

Examples (for 2Tx case)

[0029]

1. (1) If η_{RS} = 1/3, then we have

   $$\alpha = \frac{P_{A,k}}{P_{B,k}} = \frac{3}{2}(1-\eta_{RS}) = 1.$$

   This is the case where the percentage of total power and total bandwidth used for RS overhead is the same. We sometimes refer to this case as "non-boosted RS".
2. (2) If η_{RS} = 2/3, then we have

   $$\alpha = \frac{P_{A,k}}{P_{B,k}} = \frac{3}{2}(1-\eta_{RS}) = \frac{1}{2}.$$

   This is an example of so-called "boosted" case where more percentage of power than bandwidth is used for RS overhead. We note that the data RE powers on the RS OFDM symbols have to be reduced to make room for the RS "boosting".

2. Other alternatives for calculating T2P ratios in four (4) Tx case

[0030] For the 4Tx case, it is noteworthy that if we set T2P according to Table 3, then for the RS OFDM symbols, not all antennas are able to transmit at full power. This is due to the fact that for a given OFDM symbol, only half of the antennas will transmit RS, while the other RS will not. If we require equal T2P across all antennas in the RS OFDM symbol, then we are limited to the solution in Table 4.

[0031] In a second embodiment according to the principles of the present invention, we allow different T2P values across both antennas and OFDM symbols, and get the following table as one possible 4Tx solution.

Table 4: Further improvement for 4Tx case allowing different T2P ratio across antennas and OFDM symbols.

	$i \in \{1,5,8,12\}$	$i \in \{2,9\}$	$i \in \{3,4,6,7,10,11,13,14\}$
$t \in \{0,1\}$	$\frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$	$\frac{3}{2}\frac{P_{B,k}}{P_{RS}}$	$\frac{P_{B,k}}{P_{RS}}$
$t \in \{2,3\}$	$\frac{3}{2}\frac{P_{B,k}}{P_{RS}}$	$\frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$	$\frac{P_{B,k}}{P_{RS}}$

[0032] In a third embodiment according to the principles of the present invention, we allow the 4 Tx antennas to share the RS power overhead in the RS OFDM symbols. This can be

achieved by schemes such as using virtual antennas to share the power between different physical antennas. In this case, a virtual antenna is basically a fixed pre-coding vector applied on the existing physical antennas, and therefore can potentially use the power on all physical antennas. As a result, the T2P ratio across antennas and OFDM symbols are given by Table 5.

Table 5: Further improvement for 4Tx case allowing different T2P ratio across OFDM symbols.

	$i \in \{1,2,5,8,9,12\}$	$i \in \{3,4,6,7,10,11,13,14\}$
$t \in \{0,1,2,3\}$	$\frac{3}{4}(2-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$	$\frac{P_{B,k}}{P_{RS}}$

3. Signaling of the parameters related to DL PDSCH power setting.

[0033] We further note that the eNodeB (eNB) supports discrete levels of η_{RS}, and we can use a few bits (for example 3bits) to represent the η_{RS}, level. Furthermore, we denote R_ovhd as the eNodeB signaling indicating both the η_{RS} level and the method of computing all the T2P ratios across all antennas and OFDM symbols, according to one of the tables (Tables 1-5) as shown above.

[0034] In a fourth embodiment according to the principles of the present invention, one method of such mapping of R_ovhd to η_{RS} level and the method of computing the T2P ratios is illustrated below in Table 6. An example of 3-bit R_ovhd is shown in this example, and 4 Tx case is assumed. In this example, we observe that the methods specified in Table 3 is used for all R_ovhd entries. The number of bits used for R_ovhd can be other than 3 bits used in this example.

Table 6: Example of mapping of R_ovhd to η_{RS} level and the method of computing the T2P ratios. 3-bit R_ovhd and 4Tx assumed.

R_ovhd	η_{RS} Level	T2P calculation method
000	1/6 =16.66%	T2P ratio method specified in Table 3, for 4Tx case.
001	1/3	
010	3/6	
011	4/6	
100	5/6	
101	6/6	
110	Reserved	
111	Reserved	

[0035] Similar tables (where the same T2P calculations method is applied to all entries) can be

constructed for 1Tx case with Table 1 method, and 2Tx case with Table 2 method, and 4Tx case with Table 4 method, and finally 4Tx case with Table 5 method.

[0036] For example, a 3-bit R-ovhd design for 2Tx eNodeB transmit antenna case is shown in Table 7 below, where all R_ovhd entries will use T2P calculation method specified in Table 2.

Table 7: Example of mapping of R_ovhd to η_{RS} level and the method of computing the T2P ratios. 3-bit R_ovhd and 2Tx assumed.

R_ovhd	η_{RS} Level	T2P calculation method
000	1/6 =16.66%	T2P ratio method specified in Table 2, for 2Tx case.
001	1/3	
010	3/6	
011	4/6	
100	5/6	
101	6/6	
110	Reserved	
111	Reserved	

[0037] In a fifth embodiment according to the principles of the present invention, another method of such mapping of R_ovhd to η_{RS} level and the method of computing the T2P ratios is illustrated below in Table 8. An example of 3-bit R_ovhd is shown in this example, and 4 Tx case is assumed as an example. In this example, we observe that different methods can be used for different entries - the first 5 entries use T2P calculation method specified in Table 3, whereas the last 3 entries use T2P calculation method specified in Table 5.

Table 8: Example of mapping of R_ovhd to η_{RS} level and the method of computing the T2P ratios. 3-bit R_ovhd and 4Tx assumed.

R_ovhd	η_{RS} Level	T2P calculation method
000	1/6 =16.66%	T2P ratio method specified in Table 3, for 4Tx case.
001	1/3	
010	3/6	
011	4/6	
100	5/6	
101	1/3	T2P ratio method specified in Table 5, for 4Tx case
110	3/6	
111	4/6	

[0038] In a sixth embodiment according to the principles of the present invention, we propose to include the RS overhead signal R_ovhd in either the cell-specific broadcast message or UE-

specific radio resource control (RRC) message. Note the cell-specific broadcast message can be either included in Primary Broadcast Channel (BCH) messages, or Dynamic BCH messages (also known as SU). This can be in addition to the UE-specific signaling of $\frac{P_{B,k}}{P_{RS}}$ for k-th UE (if such a $\frac{P_{B,k}}{P_{RS}}$ signal is sent from the eNB at all), where this UE-specific signaling can be either semi-static via RRC signaling or dynamic via Physical Downlink Control Channel (PDCCH) signaling.

[0039] After receiving R_ovhd, the UE looks the mapping table of R_ovhd (examples of these tables are shown in Tables 6-8) and obtain η_{RS} level, as well the method of computing the T2P ratios across all antennas and all OFDM symbols. The UE then use both the obtained η_{RS} and $\frac{P_{B,k}}{P_{RS}}$ to calculate all other T2P ratios across different antennas and OFDM symbols, according to the method of computing the T2P ratios decoded from R_ovhd value.

[0040] FIG. 7 schematically illustrates a wireless system including the base station (eNodeB) and the user equipment as an embodiment according to the principles of the present invention. As illustrated in FIG. 7, base station 210 is constructed with a memory unit 212, a power setting unit 214, and an antenna unit 216 including at least one antenna. Memory unit 212 stores a plurality of methods for calculating traffic-to-pilot ratios (T2P) as given in Tables 1-5, and stores a mapping scheme between a plurality of overhead signals, and a plurality of reference signal (RS) overhead ratios and the plurality of T2P calculation methods as given in Table 6-8. Power setting unit 214 assigns a user-specific traffic-to-pilot ratio $P_{B,k}$ / P_{RS}, a RS overhead ratio η_{RS}, and a calculation method selected from the plurality of T2P calculation methods to user equipment 220. Antenna unit 216 transmits an overhead signal corresponding to both of the assigned RS overhead ratio η_{RS} and the assigned T2P calculation method in accordance with the mapping scheme, and the user-specific traffic-to-pilot ratio $P_{B,k}$ / P_{RS}, to user equipment 220.

[0041] Similarly, as illustrated in FIG. 7, user equipment 220 is constructed with a memory unit 224, a power setting unit 226, and an antenna unit 222 including at least one antenna. Antenna unit 222 receives an overhead signal and a user-specific traffic-to-pilot ratio $P_{B,k}$ / P_{RS} from base station 210. Memory unit 224 stores a plurality of methods for calculating traffic-to-pilot ratios (T2P) as given in Tables 1-5, and stores a mapping scheme between a plurality of overhead signals, and a plurality of reference signal (RS) overhead ratios and the plurality of T2P calculation methods as given in Table 6-8. Power setting unit 226 determines a RS overhead ratio and aT2P calculation method in dependence upon the received RS overhead signal and the mapping scheme stored in memory unit, and calculates the traffic-to-pilot ratios across different transmission antennas and different OFDM symbols in dependence upon the

received traffic-to-pilot ratio $P_{B,k}$ / P_{RS}, and the RS overhead ratio and the T2P calculation method.

[0042] FIG. 8 schematically illustrates a flow chart outlining a process for transmitting downlink power setting information at a base station (BS) as an embodiment according to the principles of the present invention. First, a plurality of methods for calculating traffic-to-pilot ratios (T2P) are established and stored at the BS via step 310. Then, a mapping scheme between a plurality of overhead signals, R_ovhd, and a plurality of reference signal (RS) overhead ratios, η_{RS}, and the plurality of T2P calculation methods is established and stored at the BS via step 312. A user-specific traffic-to-pilot ratio $P_{B,k}$ / P_{RS} for certain Orthogonal Frequency Division Multiplexing (OFDM) symbols, and a RS overhead ratio η_{RS} and a calculation method selected from the plurality of T2P calculation methods are assigned to a unit of user equipment via step 314. An overhead signal, R_ovhd, corresponding to both of the assigned RS overhead ratio η_{RS} and the assigned T2P calculation method is determined in accordance with the mapping scheme via step 316. Finally, the user-specific traffic-to-pilot ratio $P_{B,k}$ / P_{RS}, and the overhead signal, R_ovhd, are transmitted to the user equipment via step 318.

[0043] FIG. 9 schematically illustrates a flow chart outlining a process for calculating power setting information at a unit of user equipment as an embodiment according to the principles of the present invention. First, a plurality of methods for calculating traffic-to-pilot ratios (T2P) are established and stored at the UE via step 410. Then, a mapping scheme between a plurality of overhead signals, R ovhd, and a plurality of reference signal (RS) overhead ratios, η_{RS}, and the plurality of T2P calculation methods is established and stored at the UE via step 412. The UE receives a reference signal (RS) overhead signal and certain traffic-to-pilot ratio $P_{B,k}$ / P_{RS} via step 414. The UE determines both of a RS overhead ratio and a method for calculating traffic-to-pilot (T2P) ratios in dependence upon the mapping scheme via step 416. Finally, the UE calculates the traffic-to-pilot ratios across different transmission antennas and different OFDM symbols in dependence upon the received traffic-to-pilot ratio $P_{B,k}$ / P_{RS}, and the RS overhead ratio and the T2P calculation method determined via step 418.

[0044] In a seventh embodiment according to the principles of the present invention, we propose to send the either a UE-specific

$$\frac{P_{A,k}}{P_{B,k}}$$

ratio, or a UE-specific

$$\frac{P_{A,k}}{P_{RS}}$$

ratio, for the k-th UE semi-statically via RRC signaling. This is in addition to the UE-specific signaling of

$$\frac{P_{B,k}}{P_{RS}}$$

for k-th UE, where this UE-specific signaling can be either semi-static via RRC signaling or dynamic via PDCCH signaling. In this case, at the UE side, all T2P ratios are determined

directly from the signaling from the eNB.

[0045] In an eighth embodiment according to the principles of the present invention, the eNodeB determines the downlink transmit energy per resource element.

[0046] A UE may assume downlink reference symbol Energy Per Resource Element (EPRE) is constant across the downlink system bandwidth and is constant across all subframes until different RS power information is received.

[0047] For each UE, the PDSCH-to-RS EPRE ratio among PDSCH REs in all the OFDM symbols not containing RS is equal and is denoted by ρ_A. The UE may assume that for 16 QAM or 64 QAM or RI>1 spatial multiplexing, ρ_A is equal to P_A which is a UE specific semi-static parameter signaled in dB by higher layers in the range of [3, 2, 1, 0, -1, -2, -3, -6] using 3-bits.

[0048] For each UE, the PDSCH-to-RS EPRE ratio among PDSCH REs in all the OFDM symbols containing RS is equal and is denoted by ρ_B. The cell-specific ratio ρ_B / ρ_A is given by Table 9 according to cell-specific parameter P_B signaled by higher layers and the number of configured eNodeB cell specific antenna ports.

Table 9. Ratio of PDSCH-to-RS EPRE in symbols with and without reference symbols for 1, 2, or 4 cell specific antenna ports

P_B	ρ_B/ρ_A	
	One Antenna Port	Two and Four Antenna Ports
0	1	5/4
1	4/5	1
2	3/5	3/4
3	2/5	1/2

[0049] For PMCH with 16QAM or 64QAM, the UE may assume that the PMCH-to-RS EPRE ratio is equal to 0 dB.

[0050] Note in the above Table 9, we use the notion in Reference [5] (TS 36.213 version 8.3.0). Table 10 summarizes the difference in the notations used in the original DOI, Reference [1] (Chairmen's note 2007 Jeju), and Reference [5] (TS 36.213 version 8.3.0).

Table 10. Different notations used in the present invention, Reference [1] and Reference [5]

	T2P (Traffic to pilot ratio) in OFDM symbols with RS	T2P (Traffic to pilot ratio) in OFDM symbols without RS
Present invention	$\frac{P_{A,k}}{P_{RS}}$ (for user k)	$\frac{P_{B,k}}{P_{RS}}$ (for user k)

	T2P (Traffic to pilot ratio) in OFDM symbols with RS	T2P (Traffic to pilot ratio) in OFDM symbols without RS
Reference [1]	P_A	P_B
Reference [5]	ρ_B	ρ_A

[0051] Now we will observe Tables 1-3. In Tables 1-3, the second column are the T2P for OFDM symbols with RS, which is

$$\frac{P_{A,k}}{P_{RS}} = \frac{6}{5}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$$

in one antenna case, and

$$\frac{P_{A,k}}{P_{RS}} = \frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$$

in the two or four antenna case. In other words,

$$\frac{P_{A,K}}{P_{RS}} / \frac{P_{B,K}}{P_{RS}} = \frac{6}{5}(1-\eta_{RS})$$

in one antenna case, and

$$\frac{P_{A,K}}{P_{RS}} / \frac{P_{B,K}}{P_{RS}} = \frac{3}{2}(1-\eta_{RS})$$

in the two or four antenna case.

[0052] Now, if we assume η_{RS} equals to 1/6, 1/3, 3/6, 4/6, we can obtain the corresponding values for

$$\frac{P_{A,K}}{P_{RS}} / \frac{P_{B,K}}{P_{RS}}$$

summarized in Table 11.

Table 11. Different values of $\frac{P_{A,K}}{P_{RS}} / \frac{P_{B,K}}{P_{RS}}$ (ρ_B / ρ_A)

η_{RS}	P_B	ρ_B / ρ_A ($\frac{P_{A,k}}{P_{RS}} / \frac{P_{B,k}}{P_{RS}}$ in the notation of the present invention)	
		One Antenna Port	Two and Four Antenna Ports
1/6	0	1	5/4
1/3	1	4/5	1
3/6	2	3/5	3/4
4/6	3	2/5	1/2

[0053] Note that P_B in Tables 9 and 11 is a parameter signaled from the eNB (base station) to

the user equipment (UE). For example, instead of signaling a physical value of η_{RS} = 1/6, the eNB can simply signal a value of P_B = 0 to the UE. In this case, upon receiving this signal P_B = 0, the UE will read Table 11 and will figure out that ρ_B / ρ_A = 1 for the 1 Tx case, and ρ_B / ρ_A = 5/4 in the 2 or 4 Tx case

[0054] Comparing Table 9 with Tables 1-3, although the intermediate value η_{RS} does not explicitly show up in Table 9, it can be shown that any pairs of values in each row in Table 9 follows the relationship of the two equations for 1Tx

$$\frac{6}{5}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$$

(left column of Table 1), and for

$$2/4 \text{ Tx } \frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}}$$

(left column of Table 2,3). In particular, the ratios of these two values are always

$$\frac{6}{5}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}} / \frac{3}{2}(1-\eta_{RS})\frac{P_{B,k}}{P_{RS}} = 4/5,$$

as is observed by the pair of ρ_B / ρ_A values in each row of Table 9.

[0055] In should be appreciated that the functions necessary to implement the present invention may be embodied in whole or in part using hardware, software, firmware, or some combination thereof using micro-controllers, micro-processors, digital signal processors, programmable logic arrays, or any other suitable types of hardware, software, and/or firmware.

[0056] While the present invention has been shown and described in connection with the preferred embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the scope of the invention as defined by the appended claims.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US96368107P [0002]

Non-patent literature cited in the description

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- **SAMSUNGLGENORTELQUALCOMM**Way-forward on Data Power Setting for PDSCH across OFDM SymbolsR1-075077, 2007, [0002]
- **SAMSUNG**Further Discussion on Data Power Setting for PDSCHR1-080047, 2008, [0002]
- **NOKIA**Draft LS on information about RANI decision regarding downlink power settingsR1-081600, [0002]
- **SAMSUNG**Power Scaling and DL RS BoostingR1-074796, 2007, [0002]
- **SAMSUNG**Update on Power Scaling and DL RS boostingR1-074450, 2007, [0002]
- **QUALCOMM EUROPE**Data Power Scaling for PDSCH across OFDM SymbolsR1-074970, 2007, [0002]

Patentkrav

1. Fremgangsmåde til bestemmelse af downlink sendeeffekt fra en basestation (210) ved en trådløs terminal (220), hvor basestationen (210) og den trådløse terminale (220) har en flerhed af Orthogonal Frequency Division Multiplexing, OFDM, symboler til rådighed for transmission, hvilken fremgangsmåde omfatter:
- modtagelse af en signalparameter fra basestationen (210); og
- bestemmelse af et forhold af et første forhold til et andet forhold,
hvori det første forhold er et Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, forhold blandt Resource Elements, REs, i OFDM symboler indeholdende RS,
hvori det andet forhold er et PDSCH-t-RS, EPRE, forhold blandt REs i OFDM symboler, som ikke indeholder RS,
hvori forholdet af det første forhold til det andet forhold for en cellespecifik antenneport er henholdsvis 1, 4/5, 3/5 eller 2/5, for signalparameteren som værende 0, 1, 2 eller 3, og
hvori forholdet af det første forhold til det andet forhold for 2 eller 4 cellespecifikke antenneporte er henholdsvis 5/4, 1, 3/4 eller 1/2, for signalparameteren som værende 0, 1, 2 eller 3.

2. Fremgangsmåde ifølge krav 1, hvori den trådløse terminal (220) antager, at downlink referencesymbol Energy Per Resource Element, EPRE, er konstant hen over en downlink systembåndbredde og er konstant over alle delbåndkolonner, indtil der modtages en anden Reference Signal, RS, effektinformation.

3. Fremgangsmåde ifølge krav 1, hvori det første forhold eller det andet forhold er lige stort blandt trafikdata Resource Elements, REs, for hvert OFDM symbol.

4. Fremgangsmåde ifølge krav 1, hvori det andet forhold er fremskaffet på basis af en terminalspecifik parameter signaleret fra basestationen ved højere lag.

5. Indretning i en trådløs terminal (220) til bestemmelse af downlink sendeeffekt fra en basestation (210), hvor basestationen (210) og den trådløse terminal (220) har en flerhed af Orthogonal Frequency Division Multiplexing, OFDM, symboler til rådighed for transmission, hvilken indretning omfatter:
- en antenneenhed (222) til at modtage en signalparameter fra basestationen (210), og

- en effektindstillingsenhed (226) til bestemmelse af et forhold af et første forhold til et andet forhold, hvori det første forhold er et Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, forhold blandt Resource Elements, REs, i OFDM symboler indeholdende RS,
hvori det andet forhold er et PDSCH-to-RS, EPRE, forhold blandt REs i OFDM symboler, som ikke indeholder RS,
hvori forholdet af det første forhold til det andet forhold for en cellespecifik antenneport er henholdsvis 1, 4/5, 3/5 eller 2/5, for signalparameteren som værende 0, 1, 2 eller 3, og
hvori forholdet af det første forhold til det andet forhold for 2 eller 4 cellespecifikke antenneporte er henholdsvis 5/4, 1, 3/4 eller 1/2, for signalparameteren som værende 0, 1, 2 eller 3.

6. Indretning ifølge krav 5, hvori effektindstillingsenheden (226) antager, at downlink referencesymbol Energy Per Resource Element, EPRE, er konstant hen over en downlink systembåndbredde og er konstant over alle delbåndkolonner, indtil der modtages en anden Reference Signal, RS, effektinformation.

7. Indretning ifølge krav 5, hvori det første forhold eller det andet forhold er lige stort blandt trafikdata Resource Elements, REs, for hvert OFDM symbol.

8. Indretning ifølge krav 5, hvori det andet forhold er fremskaffet på basis af en terminalspecifik parameter signaleret fra basestationen (210) ved højere lag.

9. Fremgangsmåde til bestemmelse af downlink sendeeffekt for trådløse terminaler (220) ved en basestation (210), hvor basestationen (210) og de trådløse terminaler (220) har en flerhed af Orthogonal Frequency Division Multiplexing, OFDM, symboler til rådighed for transmissionen, hvilken fremgangsmåde omfatter:
- afsendelse af en signalparameter til trådløse terminaler (220) i en celle; og
- afsendelse af trafikdata ved anvendelse af et af et første forhold og et andet forhold,
hvori det første forhold er et Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, forhold blandt Resource Elements, REs, i OFDM symboler indeholdende RS,
hvori det andet forhold er et PDSCH-to-RS, EPRE, forhold blandt REs i OFDM symboler, som ikke indeholder RS,

hvori forholdet af det første forhold til det andet forhold for en cellespecifik antenneport er henholdsvis 1, 4/5, 3/5 eller 2/5, for signalparameteren som værende 0, 1, 2 eller 3, og

hvori forholdet af det første forhold til det andet forhold for 2 eller 4 cellespecifikke antenneporte er henholdsvis 5/4, 1, 3/4 eller 1/2, for signalparameteren som værende 0, 1, 2 eller 3.

10. Fremgangsmåde ifølge krav 9, hvori hver trådløs terminal (220) i cellen antager, at downlink referencesymbol Energy Per Resource Element, EPRE, er konstant hen over en downlink systembåndbredde og er konstant over alle delbåndkolonner, indtil der modtages en anden Reference Signal, RS, effektinformation.

11. Fremgangsmåde ifølge krav 9, hvori det første forhold eller det andet forhold er lige stort blandt trafikdata Resource Elements, REs, for hvert OFDM symbol.

12. Fremgangsmåde ifølge krav 9, yderligere omfattende afsendelse af en terminalspecifik parameter, som anvendes ved bestemmelse af det andet forhold, til hver trådløs terminal (220) i cellen ved højere lag.

13. Indretning i en basestation (210) til bestemmelse af downlink sendeeffekt for trådløse terminaler (220), hvor basestationen (210) og de trådløse terminaler (220) har en flerhed af Orthogonal Frequency Division Multiplexing, OFDM, symboler til rådighed for transmission, hvilken indretning omfatter:

- en antenneenhed (216) til afsendelse af en signalparameter til trådløse terminaler (220) i en celle, og
- en sender til at sende trafikdata ved anvendelse af et første forhold og et andet forhold,

hvori det første forhold er et Physical Downlink Shared Channel, PDSCH-to-Reference Signal, RS, Energy Per Resource Element, EPRE, forhold blandt Resource Elements, REs, i OFDM symboler indeholdende RS,

hvori det andet forhold er et PDSCH-to-RS, EPRE, forhold blandt REs i OFDM symboler, som ikke indeholder RS,

hvori forholdet af det første forhold til det andet forhold for en cellespecifik antenneport er henholdsvis 1, 4/5, 3/5 eller 2/5, for signalparameteren som værende 0, 1, 2 eller 3, og

hvori forholdet af det første forhold til det andet forhold for 2 eller 4 cellespecifikke antenneporte er henholdsvis 5/4, 1, 3/4 eller 1/2, for signalparameteren som værende 0, 1, 2 eller 3.

14. Indretning ifølge krav 13, hvori hver trådløs terminal (220) i cellen antager, at downlink referencesymbol Energy Per Resource Element, EPRE, er konstant hen over en downlink systembåndbredde og er konstant over alle delbåndkolonner, indtil der modtages en anden Reference Signal, RS, effektinformation.

15. Indretning ifølge krav 13, hvori det første forhold eller det andet forhold er lige stort blandt trafikdata Resource Elements, REs, for hvert OFDM symbol.

16. Indretning ifølge krav 13, hvori antenneenheden (216) sender en terminal-specifik parameter, som anvendes ved bestemmelse af det andet forhold, til hver trådløs terminal (220) i cellen ved højere lag.

DRAWINGS

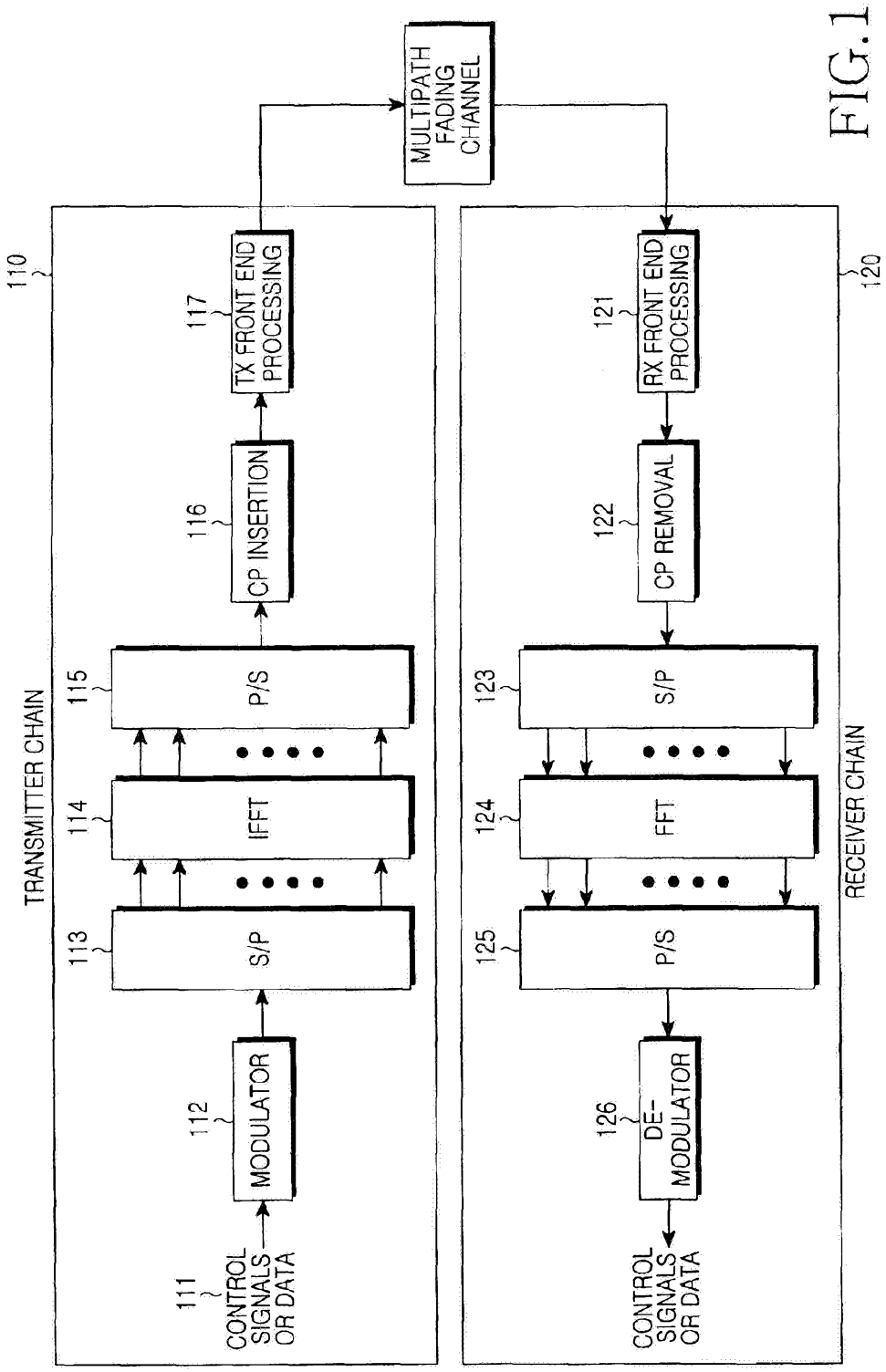


FIG.1

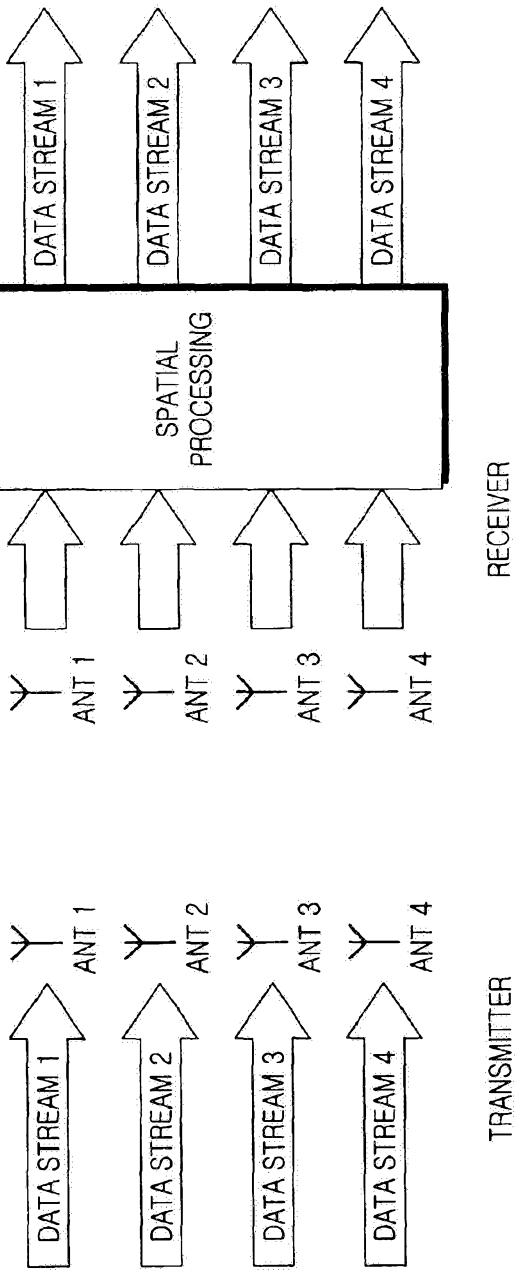

DATA STREAM 1
DATA STREAM 2
DATA STREAM 3
DATA STREAM 4
SPATIAL PROCESSING
ANT 1
ANT 2
ANT 3
ANT 4
RECEIVER
DATA STREAM 1
DATA STREAM 2
DATA STREAM 3
DATA STREAM 4
ANT 1
ANT 2
ANT 3
ANT 4
TRANSMITTER

FIG.2

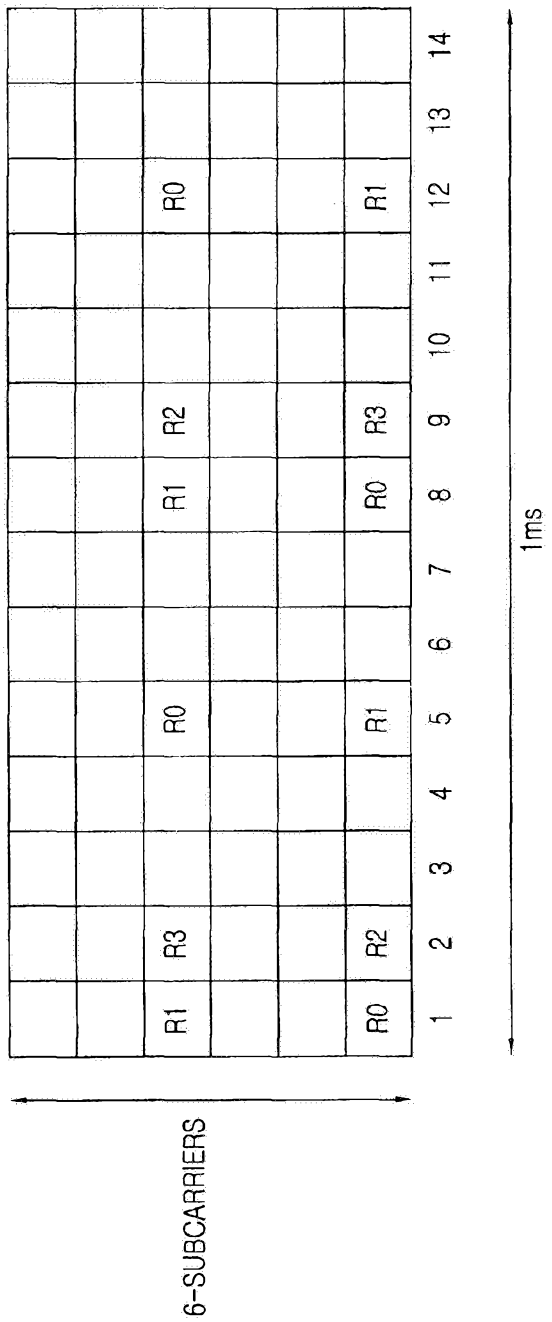

6-SUBCARRIERS
1ms
1 2 3 4 5 6 7 8 9 10 11 12 13 14
R0 R2 R1 R3 R0 R1 R0 R3 R1 R2 R0 R1

FIG.3

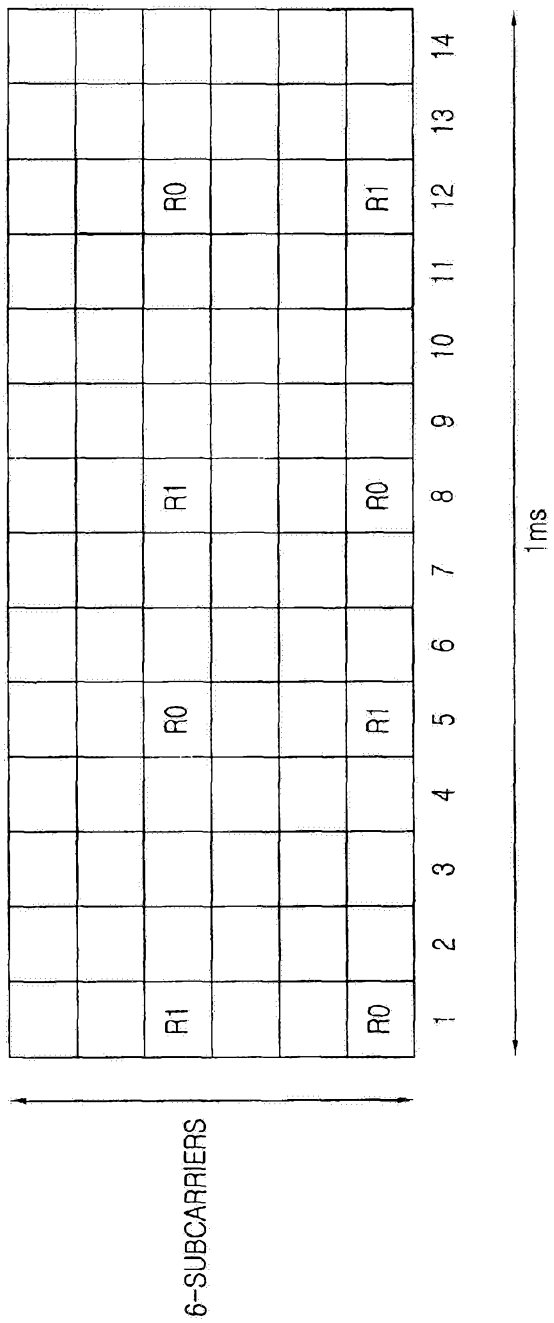

6-SUBCARRIERS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1ms
R0
R1
R0
R1
R0
R1
R0
R1
R0
R1
R0
R1

FIG.4

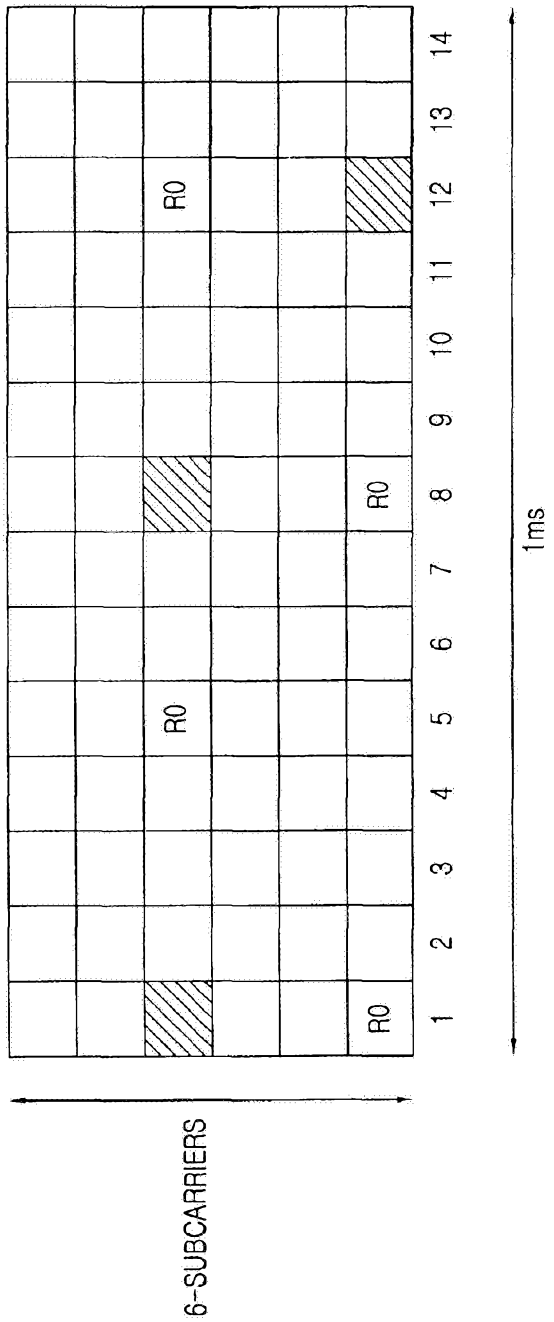


FIG.5

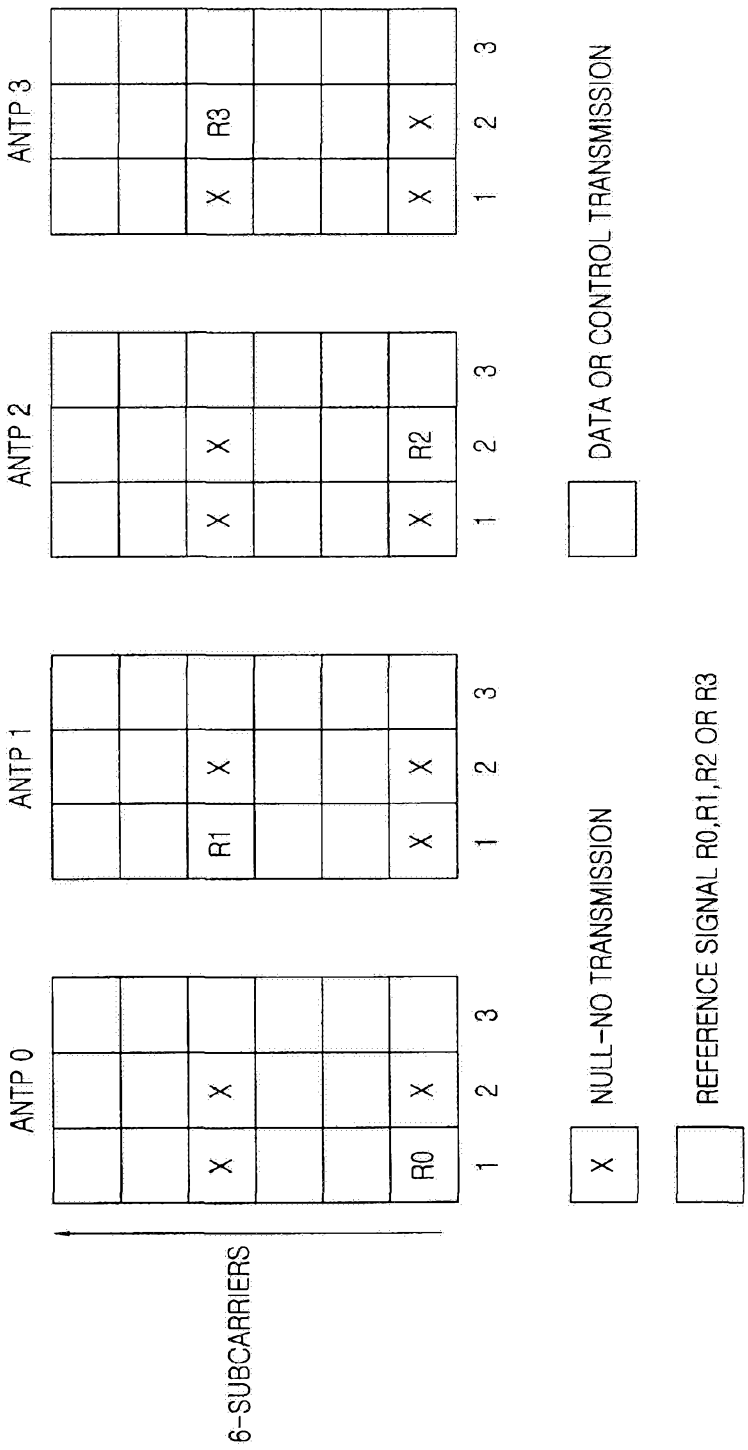

ANTP 0
ANTP 1
ANTP 2
ANTP 3
6-SUBCARRIERS
1 2 3
R0
R1
R2
R3
X
NULL-NO TRANSMISSION
REFERENCE SIGNAL R0,R1,R2 OR R3
DATA OR CONTROL TRANSMISSION

FIG.6

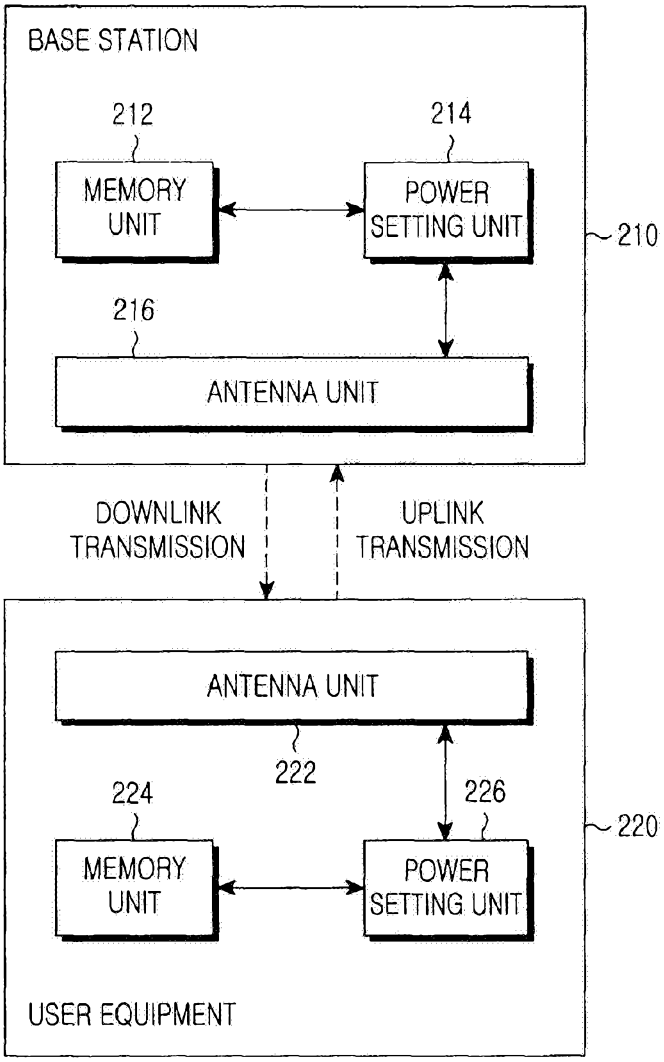

BASE STATION
212
214
MEMORY UNIT
POWER SETTING UNIT
210
216
ANTENNA UNIT
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
ANTENNA UNIT
222
224
226
220
MEMORY UNIT
POWER SETTING UNIT
USER EQUIPMENT

FIG.7

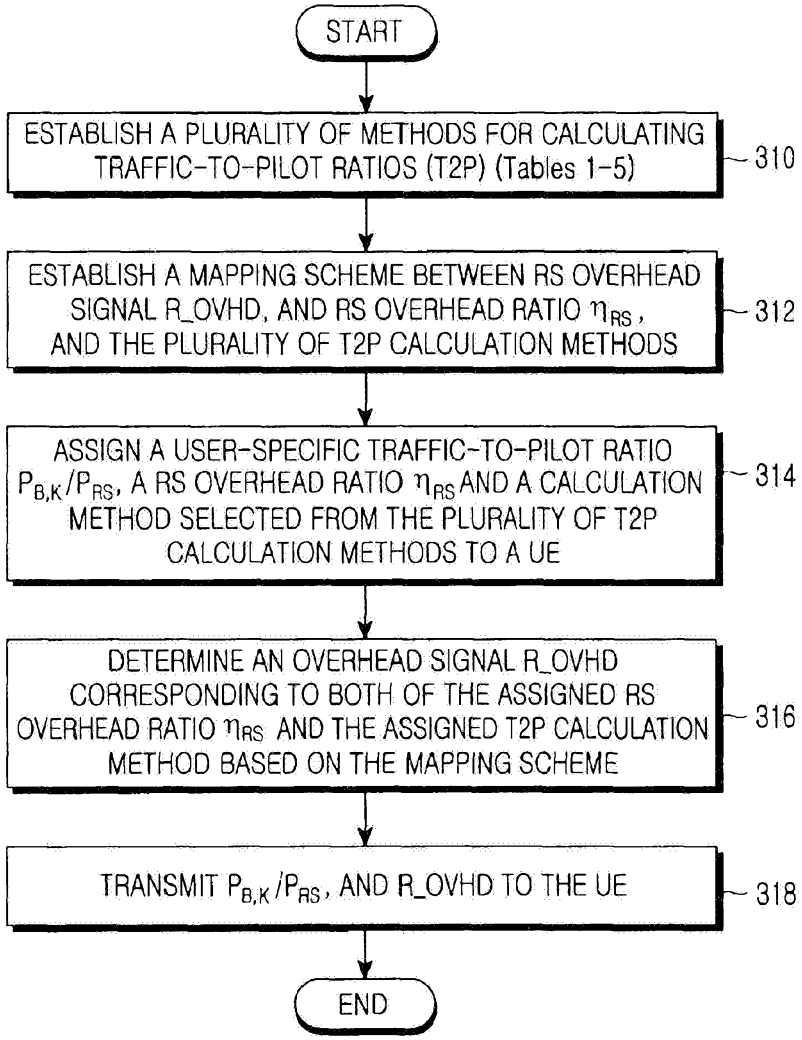

START
ESTABLISH A PLURALITY OF METHODS FOR CALCULATING TRAFFIC-TO-PILOT RATIOS (T2P) (Tables 1-5)
310
ESTABLISH A MAPPING SCHEME BETWEEN RS OVERHEAD SIGNAL R_OVHD, AND RS OVERHEAD RATIO η_{RS}, AND THE PLURALITY OF T2P CALCULATION METHODS
312
ASSIGN A USER-SPECIFIC TRAFFIC-TO-PILOT RATIO $P_{B,K}/P_{RS}$, A RS OVERHEAD RATIO η_{RS} AND A CALCULATION METHOD SELECTED FROM THE PLURALITY OF T2P CALCULATION METHODS TO A UE
314
DETERMINE AN OVERHEAD SIGNAL R_OVHD CORRESPONDING TO BOTH OF THE ASSIGNED RS OVERHEAD RATIO η_{RS} AND THE ASSIGNED T2P CALCULATION METHOD BASED ON THE MAPPING SCHEME
316
TRANSMIT $P_{B,K}/P_{RS}$, AND R_OVHD TO THE UE
318
END

FIG.8

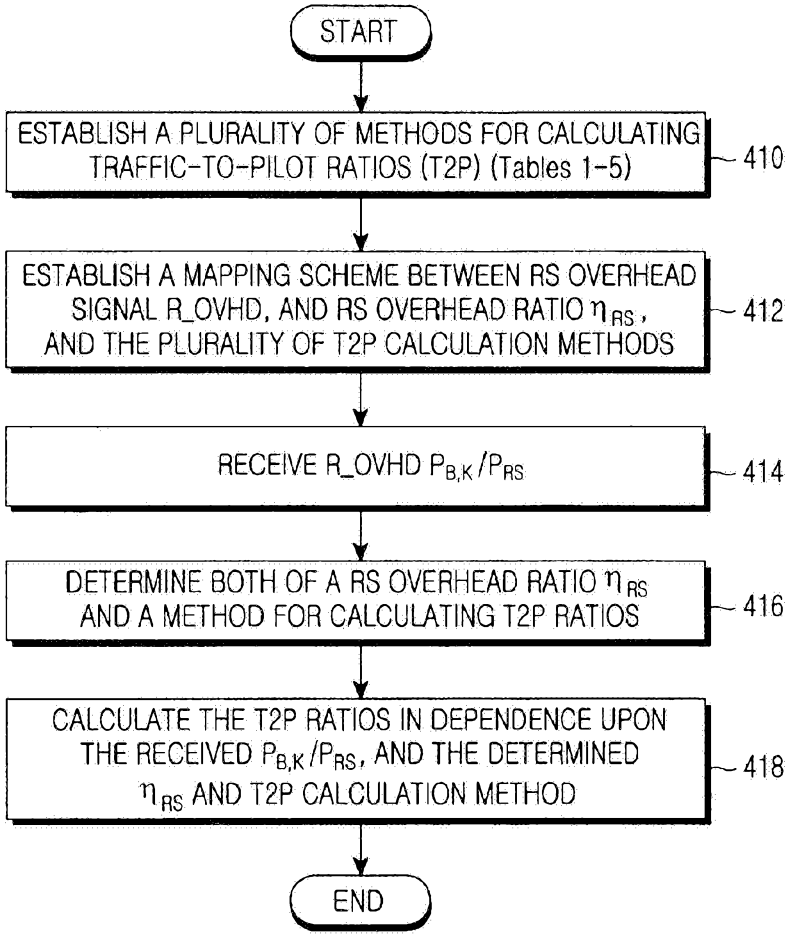

START
ESTABLISH A PLURALITY OF METHODS FOR CALCULATING TRAFFIC-TO-PILOT RATIOS (T2P) (Tables 1-5)
410
ESTABLISH A MAPPING SCHEME BETWEEN RS OVERHEAD SIGNAL R_OVHD, AND RS OVERHEAD RATIO η_{RS}, AND THE PLURALITY OF T2P CALCULATION METHODS
412
RECEIVE R_OVHD $P_{B,K}/P_{RS}$
414
DETERMINE BOTH OF A RS OVERHEAD RATIO η_{RS} AND A METHOD FOR CALCULATING T2P RATIOS
416
CALCULATE THE T2P RATIOS IN DEPENDENCE UPON THE RECEIVED $P_{B,K}/P_{RS}$, AND THE DETERMINED η_{RS} AND T2P CALCULATION METHOD
418
END

FIG.9