

CLAIMS

1. A method for feeding back channel state information, wherein the method comprises:

5 receiving a reference signal sent by a base station;

selecting a precoding matrix W from a ~~codebook~~ matrix set based on the reference signal, wherein a column vector of the precoding matrix W is expressed as $\alpha \begin{bmatrix} \mathbf{v} & e^{j\phi} \mathbf{v} \end{bmatrix}^T$, $\mathbf{v} = \begin{bmatrix} 1 & e^{j\theta} \end{bmatrix}$, wherein α is a constant, θ and ϕ are phases, and $[\]^T$ indicates transposing of a matrix or vector; and

10 sending a precoding matrix indicator PMI to the base station, wherein the PMI is corresponding to the selected precoding matrix W ;

wherein the matrix set is one of:

$$\left\{ \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\};$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or}$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

15 wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and

$\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

2. The method according to claim 1, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \begin{bmatrix} 1 & 1 \\ 1 & e^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 2 & j \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 2 & -1 \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 2 & -j \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater

5 than $i_2/4$, $i_1 = 0, \dots, 15$, and $i_2 = 0, \dots, 15$.

3. The method according to claim 1, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \begin{bmatrix} 1 & 1 & 1 \\ \sqrt{8} & 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 & 1 & 1 \\ \sqrt{8} & j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or}$$

$$\left\{ \begin{bmatrix} 1 & 1 & 1 \\ \sqrt{8} & 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \begin{bmatrix} 1 & 1 & 1 \\ \sqrt{8} & j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

10 wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

4. The method according to claim 1, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \begin{bmatrix} 1 & 1 & 1 \\ \frac{1}{\sqrt{12}} & e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 & 1 & 1 \\ \frac{1}{\sqrt{12}} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \right. \\ \left. \begin{bmatrix} 1 & 1 & 1 \\ \frac{1}{\sqrt{12}} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ 1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 & 1 & 1 \\ \frac{1}{\sqrt{12}} & -e^{j\theta} & e^{j\theta} & e^{j\theta} \\ 1 & 1 & -1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/4 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 15$, and $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

5. The method according to claim 1, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} 1 & 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix} \end{array} , \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} j & j & -j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \end{array} \right\}$$

or

$$\left\{ \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} 1 & -1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix} \end{array} , \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} j & -j & j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \end{array} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/2 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 7$, and $\lfloor i_2/2 \rfloor$ indicates the greatest integer not greater than $i_2/2$.

62. The method according to any one of claims 2 to 5 claim 1, wherein the sending a precoding matrix indicator PMI to the base station comprises:

sending a first precoding matrix indicator PMI₁ and a second precoding matrix indicator PMI₂ to the base station, wherein the first precoding matrix indicator PMI₁ and the second precoding matrix indicator PMI₂ are respectively used to indicate

indexes i_1 and i_2 corresponding to the selected precoding matrix W.

73. A method for feeding back channel state information, wherein the method comprises:

sending a reference signal to a user equipment UE;

receiving a precoding matrix indicator PMI sent by the UE, wherein the PMI is corresponding to a precoding matrix W that is selected by the UE from a matrix set codebook based on the reference signal, and a column vector of the precoding

matrix W is expressed as $\alpha \begin{bmatrix} \mathbf{v} & e^{j\phi} \mathbf{v} \end{bmatrix}^T$, $\mathbf{v} = \begin{bmatrix} 1 & e^{j\theta} \end{bmatrix}$, wherein α is a constant, θ

and ϕ are phases, and $\begin{bmatrix} \end{bmatrix}^T$ indicates transposing of a matrix or vector;

wherein the matrix set is one of:

$$\left\{ \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\},$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or}$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and

5 $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

8. The method according to claim 7, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\}$$

10 wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$, $i_1 = 0, \dots, 15$, and $i_2 = 0, \dots, 15$.

9. The method according to claim 7, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\}$$

or

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and

$\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

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10. The method according to claim 7, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \right. \\ \left. \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ 1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ -e^{j\theta} & e^{j\theta} & e^{j\theta} \\ 1 & 1 & -1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/4 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 15$, and $\lfloor i_2/4 \rfloor$ indicates

the greatest integer not greater than $i_2/4$.

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11. The method according to claim 7, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ j & j & -j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \right\}$$

or

$$\left\{ \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ 1 & -1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ j & -j & j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/2 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 7$, and $\lfloor i_2/2 \rfloor$ indicates the greatest integer not greater than $i_2/2$.

124. The method according to any one of claims 8 to 113, wherein the receiving a precoding matrix indicator PMI sent by the UE comprises:

5 receiving a first precoding matrix indicator PMI₁ and a second precoding matrix indicator PMI₂ that are sent by the UE, wherein the first precoding matrix indicator PMI₁ and the second precoding matrix indicator PMI₂ are respectively used to indicate indexes i_1 and i_2 corresponding to the selected precoding matrix.

135. A user equipment, wherein the user equipment comprises:

10 a receiving module, configured to receive a reference signal sent by a base station;

a selecting module, configured to select a precoding matrix W from a matrix set ~~codebook~~ based on the reference signal received by the receiving module, wherein a

column vector of the precoding matrix W is expressed as $\alpha \begin{bmatrix} \mathbf{v} & e^{j\phi} \mathbf{v} \end{bmatrix}^T$,
 15 $\mathbf{v} = \begin{bmatrix} 1 & e^{j\theta} \end{bmatrix}$, wherein α is a constant, θ and ϕ are phases, and $[]^T$ indicates transposing of a matrix or vector; and

a sending module, configured to send a precoding matrix indicator PMI to the base station, wherein the PMI is corresponding to the precoding matrix W selected by the selecting module;

20 wherein the matrix set is one of:

$$\left\{ \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\};$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or}$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and

$\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

- 5 14. The user equipment according to claim 13, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \end{bmatrix} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \end{bmatrix} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \end{bmatrix} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, and $\lfloor i_2/4 \rfloor$ indicates

the greatest integer not greater than $i_2/4$.

- 10 15. The user equipment according to claim 13, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or}$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and

- 15 $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

16. The user equipment according to claim 13, wherein the precoding matrix W

is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \right. \\ \left. \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ 1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ -e^{j\theta} & e^{j\theta} & e^{j\theta} \\ 1 & 1 & -1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/4 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 15$, and $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

5 17. The user equipment according to claim 13, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ j & j & -j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \right\} \text{ or } \\ \left\{ \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ 1 & -1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ j & -j & j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/2 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 7$, and $\lfloor i_2/2 \rfloor$ indicates

10 the greatest integer not greater than $i_2/2$.

186. The user equipment according to any one of claims 14 to 175, wherein the sending module is specifically configured to:

send a first precoding matrix indicator PMI₁ and a second precoding matrix indicator PMI₂ to the base station, wherein the first precoding matrix indicator PMI₁ and the second precoding matrix indicator PMI₂ are respectively used to indicate indexes i_1 and i_2 corresponding to the selected precoding matrix.

197. A base station, wherein the base station comprises:

a second sending module, configured to send a reference signal to a user

equipment UE;

a second receiving module, configured to receive a precoding matrix indicator PMI sent by the UE, wherein the PMI is corresponding to a precoding matrix W that is selected by the UE from a matrix set~~codebook~~ based on the reference signal, and a

5 column vector of the precoding matrix W is expressed as $\alpha \begin{bmatrix} \mathbf{v} & e^{j\phi} \mathbf{v} \end{bmatrix}^T$, $\mathbf{v} = \begin{bmatrix} 1 & e^{j\theta} \end{bmatrix}$, wherein α is a constant, θ and ϕ are phases, and $\begin{bmatrix} \end{bmatrix}^T$ indicates transposing of a matrix or vector;

wherein the matrix set is one of:

$$\left\{ \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\}.$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or}$$

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and

$\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

15 20. The base station according to claim 19, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ 1 \\ e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ j \\ je^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -1 \\ -e^{j\theta} \end{bmatrix}, \frac{1}{2} \begin{bmatrix} 1 \\ e^{j\theta} \\ -j \\ -je^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, and $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

21. The base station according to claim 19, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ 1 & -1 \\ e^{j\theta} & -e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j\theta} \\ j & -j \\ je^{j\theta} & -je^{j\theta} \end{bmatrix} \right\} \text{ or } \left\{ \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ 1 & -1 \\ e^{j\theta} & -e^{j(\theta+\varphi)} \end{bmatrix}, \frac{1}{\sqrt{8}} \begin{bmatrix} 1 & 1 \\ e^{j\theta} & e^{j(\theta+\varphi)} \\ j & -j \\ je^{j\theta} & -je^{j(\theta+\varphi)} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{16}(2i_1 + \lfloor i_2/4 \rfloor)$, $i_1 = 0, \dots, 15$, $i_2 = 0, \dots, 15$, $\varphi = \frac{\pi}{16}, \frac{\pi}{8}, \dots$, and $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

22. The base station according to claim 19, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \\ 1 & -1 & -1 \\ -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix} \right\}, \left\{ \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} \\ 1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix}, \frac{1}{\sqrt{12}} \begin{bmatrix} 1 & 1 & 1 \\ -e^{j\theta} & e^{j\theta} & e^{j\theta} \\ 1 & 1 & -1 \\ -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/4 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 15$, and $\lfloor i_2/4 \rfloor$ indicates the greatest integer not greater than $i_2/4$.

23. The base station according to claim 19, wherein the precoding matrix W is at least one matrix in the following matrix set:

$$\left\{ \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} 1 & 1 & -1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix} \end{array} \right\}, \left\{ \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & -e^{j\theta} & e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} j & j & -j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \end{array} \right\} \text{--or}$$

$$\left\{ \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} 1 & -1 & 1 & -1 \\ e^{j\theta} & -e^{j\theta} & -e^{j\theta} & e^{j\theta} \end{bmatrix} \end{array} \right\}, \left\{ \begin{array}{c} 1 \begin{bmatrix} 1 & 1 & 1 & 1 \\ e^{j\theta} & e^{j\theta} & -e^{j\theta} & -e^{j\theta} \end{bmatrix} \\ 4 \begin{bmatrix} j & -j & j & -j \\ je^{j\theta} & -je^{j\theta} & -je^{j\theta} & je^{j\theta} \end{bmatrix} \end{array} \right\}$$

wherein $\theta = \frac{\pi}{8}(4i_1 + 2\lfloor i_2/2 \rfloor)$, $i_1 = 0, 1, 2, 3$, $i_2 = 0, \dots, 7$, and $\lfloor i_2/2 \rfloor$ indicates the greatest integer not greater than $i_2/2$.

5 248. The base station according to any one of claims 20 to 23, wherein the second receiving module is specifically configured to:

receive a first precoding matrix indicator PMI₁ and a second precoding matrix indicator PMI₂ that are sent by the user equipment to the base station, wherein the first precoding matrix indicator PMI₁ and the second precoding matrix indicator PMI₂ are
10 respectively used to indicate indexes i_1 and i_2 corresponding to the selected precoding matrix.

25. A computer storage medium, wherein the computer storage medium may store a program, and when the program is executed, a step in any one of claims 1 to 7 or a step in any one of claims 8 to 12 is performed.