CLAIMS

What is claimed is:

1. A signal processing method, wherein the method comprises:

receiving a physical layer protocol data unit (PPDU), wherein the PPDU comprises a preamble, the preamble comprises a long training field (LTF), and the LTF comprises a plurality of LTF symbols; and

processing, according to a first matrix A_{LTF}^{k}, signals received on the plurality of LTF symbols, wherein the first matrix A_{LTF}^{k} is a $\mathrm{P_{n\times n}}$ matrix, or the first matrix A_{LTF}^{k} is obtained according to a $\mathrm{P_{n\times n}}$ matrix, wherein $\mathrm{P_{n\times n}} \times P_{n\times n}^{T} = n \times I$, I is an identity matrix, the $\mathrm{P_{n\times n}}$ matrix comprises n rows and n columns, the $P_{n\times n}^{T}$ matrix is a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix, n is an integer greater than 8, and k indicates a k^{th} subcarrier in each of the plurality of LTF symbols,

wherein $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a submatrix of the $\mathrm{P_{n\times n}}$ matrix, the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a circulant matrix or a Hankel matrix, and

wherein

$$\mathrm{P_{n\times n}} = \begin{bmatrix} \mathrm{S_{(n-1)\times(n-1)}} & a \\ a^{T} & 1 \end{bmatrix};$$

$$\mathrm{P_{n\times n}} = \begin{bmatrix} a & \mathrm{S_{(n-1)\times(n-1)}} \\ 1 & a^{T} \end{bmatrix};$$

$$\mathrm{P_{n\times n}} = \begin{bmatrix} \mathrm{S_{(n-1)\times(n-1)}} & -a \\ a^{T} & 1 \end{bmatrix}; \text{ or}$$

$$\mathrm{P_{n\times n}} = \begin{bmatrix} -a & \mathrm{S_{(n-1)\times(n-1)}} \\ 1 & a^{T} \end{bmatrix}, \text{ wherein}$$

$\mathrm{S_{(n-1)\times(n-1)}}$ matrix comprises n–1 rows and n–1 columns, a is a column vector comprising n–1 elements, each element is 1, a^{T} is a transpose vector of a, and $-a$ indicates a vector obtained through negation of all elements in a.

2. A signal processing method, wherein the method comprises:

generating a physical layer protocol data unit (PPDU), wherein the PPDU comprises a preamble, the preamble comprises a long training field (LTF), the LTF comprises a plurality of LTF symbols, the plurality of LTF symbols are used to carry a sequence obtained according to a first matrix A_{LTF}^{k}, the first matrix A_{LTF}^{k} is a $\mathrm{P_{n\times n}}$ matrix, or the first matrix A_{LTF}^{k} is obtained according to a $\mathrm{P_{n\times n}}$ matrix, wherein $\mathrm{P_{n\times n}} \times P_{n\times n}^{T} = n \times I$, I is an identity matrix, the $\mathrm{P_{n\times n}}$

matrix comprises n rows and n columns, the $P_{n\times n}^{T}$ matrix is a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix, n is an integer greater than 8, and k indicates a k^{th} subcarrier in each of the plurality of LTF symbols; and

sending the PPDU,

wherein $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a submatrix of the $\mathrm{P_{n\times n}}$ matrix, the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a circulant matrix or a Hankel matrix, and

wherein

$\mathrm{P_{n\times n}} = \begin{bmatrix} \mathrm{S_{(n-1)\times(n-1)}} & a \\ a^T & 1 \end{bmatrix}$;

$\mathrm{P_{n\times n}} = \begin{bmatrix} a & \mathrm{S_{(n-1)\times(n-1)}} \\ 1 & a^T \end{bmatrix}$;

$\mathrm{P_{n\times n}} = \begin{bmatrix} \mathrm{S_{(n-1)\times(n-1)}} & -a \\ a^T & 1 \end{bmatrix}$; or

$\mathrm{P_{n\times n}} = \begin{bmatrix} -a & \mathrm{S_{(n-1)\times(n-1)}} \\ 1 & a^T \end{bmatrix}$, wherein

$\mathrm{S_{(n-1)\times(n-1)}}$ matrix comprises n–1 rows and n–1 columns, a is a column vector comprising n–1 elements, each element is 1, a^T is a transpose vector of a, and $-a$ indicates a vector obtained through negation of all elements in a.

3. The method according to claim 1 or 2, wherein

a first row of the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is equal to a first vector x, and x = [1 1 1 –1 1 –1 –1 1 –1 –1 –1];

a first row of the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is obtained by performing one or more of three operations: cyclic shift, reversing, and overall negation on a first vector x, and x = [1 1 1 –1 1 –1 –1 1 –1 –1 –1];

a first row of the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is equal to a second vector y, and y = [1 1 1 –1 –1 –1 –1 1 –1 1 –1 –1 1 1 –1]; or

a first row of the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is obtained by performing one or more of three operations: cyclic shift, reversing, and overall negation on a second vector y, and y = [1 1 1 –1 –1 –1 –1 1 –1 1 –1 –1 1 1 –1].

4. The method according to any one of claims 1 to 3, wherein when n = 12,

$$P_{12\times12}=\begin{bmatrix} 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 \\ -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & 1 \\ -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1 \\ -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 \\ -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & 1 \\ -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 \\ -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{12\times12}=\begin{bmatrix} 1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 \\ 1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 \\ 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 \\ 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{12\times12}=\begin{bmatrix} -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & -1 \\ -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 \\ 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & -1 \\ -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 \\ 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 \\ -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{12\times12}=\begin{bmatrix}-1&-1&-1&-1&1&-1&1&1&-1&1&1&1\\-1&1&-1&-1&-1&1&-1&1&1&-1&1&1\\-1&1&1&-1&-1&-1&1&-1&1&1&-1&1\\-1&1&1&1&-1&-1&-1&1&-1&1&1&-1\\-1&-1&1&1&1&-1&-1&-1&1&-1&1&1\\-1&1&-1&1&1&1&-1&-1&-1&1&-1&1\\-1&1&1&-1&1&1&1&-1&-1&-1&1&-1\\-1&-1&1&1&-1&1&1&1&-1&-1&-1&1\\-1&1&-1&1&1&-1&1&1&1&-1&-1&-1\\-1&-1&1&-1&1&1&-1&1&1&1&-1&-1\\-1&-1&-1&1&-1&1&1&-1&1&1&1&-1\\1&1&1&1&1&1&1&1&1&1&1&1\end{bmatrix}$$; or

$$P_{12\times12}=\begin{bmatrix}1&1&-1&1&-1&-1&1&-1&-1&-1&1&1\\1&-1&1&-1&-1&1&-1&-1&-1&1&1&1\\-1&1&-1&-1&1&-1&-1&-1&1&1&1&1\\1&-1&-1&1&-1&-1&-1&1&1&1&-1&1\\-1&-1&1&-1&-1&-1&1&1&1&-1&1&1\\-1&1&-1&-1&-1&1&1&1&-1&1&-1&1\\1&-1&-1&-1&1&1&1&-1&1&-1&-1&1\\-1&-1&-1&1&1&1&-1&1&-1&-1&1&1\\-1&-1&1&1&1&-1&1&-1&-1&1&-1&1\\-1&1&1&1&-1&1&-1&-1&1&-1&-1&1\\1&1&1&-1&1&-1&-1&1&-1&-1&-1&1\\1&1&1&1&1&1&1&1&1&1&1&1\end{bmatrix}$$

5. The method according to any one of claims 1 to 3, wherein when n = 16,

$$P_{16*16} = \begin{bmatrix} 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 \\ -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & 1 \\ 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 \\ -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & 1 \\ -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 \\ -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 \\ -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 \\ -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & 1 \\ -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & 1 \\ -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{16\times16} = \begin{bmatrix} 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 \\ 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 \\ 1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 \\ 1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 \\ 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}; \text{ or}$$

$$P_{16\times16}=\begin{bmatrix}
-1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & 1\\
-1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1\\
1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1\\
-1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1\\
1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1\\
-1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & 1\\
-1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & 1\\
1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1\\
1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1\\
-1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & 1\\
1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1\\
1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1\\
1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1\\
-1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & 1\\
-1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & 1\\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1
\end{bmatrix}$$

6. The method according to any one of claims 1 to 5, wherein the first matrix A_{LTF}^{k} meets the following conditions:

$$A_{LTF}^{k}=\begin{cases}\mathrm{R_{n\times n}\ if\ the\ k^{th}\ subcarrier\ is\ a\ pilot\ subcarrier}\\ \mathrm{P_{n\times n}\ if\ the\ k^{th}\ subcarrier\ is\ a\ non-pilot\ subcarrier\ or\ a\ data\ subcarrier}\end{cases},$$

wherein

the $\mathrm{R_{n\times n}}$ matrix comprises n rows and n columns, and each row of the $\mathrm{R_{n\times n}}$ matrix is equal to a first row of the $\mathrm{P_{n\times n}}$ matrix.

7. The method according to any one of claims 1 to 5, wherein when the $\mathrm{k^{th}}$ subcarrier is a non-pilot subcarrier, the first matrix is equal to an overall negation matrix of the $\mathrm{P_{n\times n}}$ matrix;

the first matrix is equal to a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix;

the first matrix is equal to a transpose matrix of an overall negation matrix of the $\mathrm{P_{n\times n}}$ matrix; or

the first matrix is equal to an overall negation matrix of a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix.

8. The method according to claim 6 or 7, wherein the $\mathrm{R_{n\times n}}$ matrix is used for phase tracking and/or frequency offset estimation, and the $\mathrm{P_{n\times n}}$ matrix is used for channel estimation.

9. A communication apparatus, wherein the communication apparatus comprises:

a transceiver unit, configured to receive a physical layer protocol data unit (PPDU), wherein the PPDU comprises a preamble, the preamble comprises a long training field (LTF), and the LTF

comprises a plurality of LTF symbols; and

a processing unit, configured to process, according to a first matrix A_{LTF}^{k}, signals received on the plurality of LTF symbols, wherein the first matrix A_{LTF}^{k} is a $\mathrm{P_{n\times n}}$ matrix, or the first matrix A_{LTF}^{k} is obtained according to a $\mathrm{P_{n\times n}}$ matrix, wherein $\mathrm{P_{n\times n}} \times P_{n\times n}^{T} = n \times I$, I is an identity matrix, the $\mathrm{P_{n\times n}}$ matrix comprises n rows and n columns, the $P_{n\times n}^{T}$ matrix is a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix, n is an integer greater than 8, and k indicates a k^{th} subcarrier in each of the plurality of LTF symbols,

wherein $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a submatrix of the $\mathrm{P_{n\times n}}$ matrix, the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a circulant matrix or a Hankel matrix, and

wherein

$$\mathrm{P_{n\times n}} = \begin{bmatrix} \mathrm{S_{(n-1)\times(n-1)}} & a \\ a^{T} & 1 \end{bmatrix};$$

$$\mathrm{P_{n\times n}} = \begin{bmatrix} a & \mathrm{S_{(n-1)\times(n-1)}} \\ 1 & a^{T} \end{bmatrix};$$

$$\mathrm{P_{n\times n}} = \begin{bmatrix} \mathrm{S_{(n-1)\times(n-1)}} & -a \\ a^{T} & 1 \end{bmatrix}; \text{ or}$$

$$\mathrm{P_{n\times n}} = \begin{bmatrix} -a & \mathrm{S_{(n-1)\times(n-1)}} \\ 1 & a^{T} \end{bmatrix}, \text{ wherein}$$

$\mathrm{S_{(n-1)\times(n-1)}}$ matrix comprises n–1 rows and n–1 columns, a is a column vector comprising n–1 elements, each element is 1, a^{T} is a transpose vector of a, and $-a$ indicates a vector obtained through negation of all elements in a.

10. A communication apparatus, wherein the communication apparatus comprises:

a processing unit, configured to generate a physical layer protocol data unit (PPDU), wherein the PPDU comprises a preamble, the preamble comprises a long training field (LTF), the LTF comprises a plurality of LTF symbols, the plurality of LTF symbols are used to carry a sequence obtained according to a first matrix A_{LTF}^{k}, the first matrix A_{LTF}^{k} is a $\mathrm{P_{n\times n}}$ matrix, or the first matrix A_{LTF}^{k} is obtained according to a $\mathrm{P_{n\times n}}$ matrix, wherein $\mathrm{P_{n\times n}} \times P_{n\times n}^{T} = n \times I$, I is an identity matrix, the $\mathrm{P_{n\times n}}$ matrix comprises n rows and n columns, the $P_{n\times n}^{T}$ matrix is a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix, n is an integer greater than 8, and k indicates a k^{th} subcarrier in each of the plurality of LTF symbols; and

a transceiver unit, configured to send the PPDU,

wherein $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a submatrix of the $\mathrm{P_{n\times n}}$ matrix, the $\mathrm{S_{(n-1)\times(n-1)}}$ matrix is a circulant matrix or a Hankel matrix, and

wherein

$P_{n\times n} = \begin{bmatrix} S_{(n-1)\times(n-1)} & a \\ a^T & 1 \end{bmatrix}$;

$P_{n\times n} = \begin{bmatrix} a & S_{(n-1)\times(n-1)} \\ 1 & a^T \end{bmatrix}$;

$P_{n\times n} = \begin{bmatrix} S_{(n-1)\times(n-1)} & -a \\ a^T & 1 \end{bmatrix}$; or

$P_{n\times n} = \begin{bmatrix} -a & S_{(n-1)\times(n-1)} \\ 1 & a^T \end{bmatrix}$, wherein

$S_{(n-1)\times(n-1)}$ matrix comprises n–1 rows and n–1 columns, a is a column vector comprising n–1 elements, each element is 1, a^T is a transpose vector of a, and $-a$ indicates a vector obtained through negation of all elements in a.

11. The communication apparatus according to claim 9 or 10, wherein

a first row of the $S_{(n-1)\times(n-1)}$ matrix is equal to a first vector x, and x = [1 1 1 –1 1 –1 –1 1 –1 –1 –1];

a first row of the $S_{(n-1)\times(n-1)}$ matrix is obtained by performing one or more of three operations: cyclic shift, reversing, and overall negation on a first vector x, and x = [1 1 1 –1 1 –1 –1 1 –1 –1 –1];

a first row of the $S_{(n-1)\times(n-1)}$ matrix is equal to a second vector y, and y = [1 1 1 –1 –1 –1 –1 1 –1 1 –1 –1 1 1 –1]; or

a first row of the $S_{(n-1)\times(n-1)}$ matrix is obtained by performing one or more of three operations: cyclic shift, reversing, and overall negation on a second vector y, and y = [1 1 1 –1 –1 –1 –1 1 –1 1 –1 –1 1 1 –1].

12. The communication apparatus according to any one of claims 9 to 12, wherein when n = 12,

$$P_{12\times12}=\begin{bmatrix} 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 \\ -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & 1 \\ -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1 \\ -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 \\ 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 \\ -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & 1 \\ -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 \\ -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{12\times12}=\begin{bmatrix} 1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 \\ 1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 \\ 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 & 1 \\ 1 & 1 & 1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{12\times12}=\begin{bmatrix} -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 & -1 \\ -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 \\ 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 & -1 \\ -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 \\ 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 \\ -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{12\times12}=\begin{bmatrix}-1&-1&-1&-1&1&-1&1&1&-1&1&1&1\\-1&1&-1&-1&-1&1&-1&1&1&-1&1&1\\-1&1&1&-1&-1&-1&1&-1&1&1&-1&1\\-1&1&1&1&-1&-1&-1&1&-1&1&1&-1\\-1&-1&1&1&1&-1&-1&-1&1&-1&1&1\\-1&1&-1&1&1&1&-1&-1&-1&1&-1&1\\-1&1&1&-1&1&1&1&-1&-1&-1&1&-1\\-1&-1&1&1&-1&1&1&1&-1&-1&-1&1\\-1&1&-1&1&1&-1&1&1&1&-1&-1&-1\\-1&-1&1&-1&1&1&-1&1&1&1&-1&-1\\-1&-1&-1&1&-1&1&1&-1&1&1&1&-1\\1&1&1&1&1&1&1&1&1&1&1&1\end{bmatrix}$$; or

$$P_{12\times12}=\begin{bmatrix}1&1&-1&1&-1&-1&1&-1&-1&-1&1&1\\1&-1&1&-1&-1&1&-1&-1&-1&1&1&1\\-1&1&-1&-1&1&-1&-1&-1&1&1&1&1\\1&-1&-1&1&-1&-1&-1&1&1&1&-1&1\\-1&-1&1&-1&-1&-1&1&1&1&-1&1&1\\-1&1&-1&-1&-1&1&1&1&-1&1&-1&1\\1&-1&-1&-1&1&1&1&-1&1&-1&-1&1\\-1&-1&-1&1&1&1&-1&1&-1&-1&1&1\\-1&-1&1&1&1&-1&1&-1&-1&1&-1&1\\-1&1&1&1&-1&1&-1&-1&1&-1&-1&1\\1&1&1&-1&1&-1&-1&1&-1&-1&-1&1\\1&1&1&1&1&1&1&1&1&1&1&1\end{bmatrix}$$

13. The communication apparatus according to any one of claims 9 to 11, wherein when n = 16,

$$P_{16*16}=\begin{bmatrix} 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 \\ -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & 1 \\ 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 \\ -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & 1 \\ -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 \\ -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 \\ -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 \\ -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & 1 \\ -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & 1 \\ -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};$$

$$P_{16\times16}=\begin{bmatrix} 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 \\ 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 \\ 1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 \\ 1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 \\ 1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 \\ 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix};\ \text{or}$$

$$P_{16\times16}=\begin{bmatrix}
-1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & 1\\
-1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & 1\\
1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1\\
-1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1\\
1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1\\
-1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & 1\\
-1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & 1\\
1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1\\
1 & -1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1\\
-1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & 1\\
1 & 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1\\
1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1\\
1 & -1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1\\
-1 & -1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & 1\\
-1 & -1 & -1 & 1 & -1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 & 1 & -1 & 1\\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1
\end{bmatrix}$$

14. The communication apparatus according to any one of claims 9 to 13, wherein the first matrix A_{LTF}^{k} meets the following conditions:

$$A_{LTF}^{k}=\begin{cases}\mathrm{R_{n\times n}}\ \text{if the k}^{\text{th}}\ \text{subcarrier is a pilot subcarrier}\\ \mathrm{P_{n\times n}}\ \text{if the k}^{\text{th}}\ \text{subcarrier is a non}-\text{pilot subcarrier or a data subcarrier}\end{cases},$$

wherein

the $\mathrm{R_{n\times n}}$ matrix comprises n rows and n columns, and each row of the $\mathrm{R_{n\times n}}$ matrix is equal to a first row of the $\mathrm{P_{n\times n}}$ matrix.

15. The communication apparatus according to any one of claims 9 to 13, wherein when the k^{th} subcarrier is a non-pilot subcarrier, the first matrix is equal to an overall negation matrix of the $\mathrm{P_{n\times n}}$ matrix;

the first matrix is equal to a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix;

the first matrix is equal to a transpose matrix of an overall negation matrix of the $\mathrm{P_{n\times n}}$ matrix; or

the first matrix is equal to an overall negation matrix of a transpose matrix of the $\mathrm{P_{n\times n}}$ matrix.

16. The communication apparatus according to claim 14 or 15, wherein the $\mathrm{R_{n\times n}}$ matrix is used for phase tracking and/or frequency offset estimation, and the $\mathrm{P_{n\times n}}$ matrix is used for channel estimation.

17. A communication apparatus, comprising a processor and a memory, wherein

the memory is configured to store computer-executable instructions; and

the processor is configured to execute the computer-executable instructions, to perform the method according to any one of claims 1 to 8.

18. A communication apparatus, comprising a logic circuit and an interface, wherein the logic circuit is coupled to the interface; and

the interface is configured to input and/or output code instructions, and the logic circuit is configured to execute the code instructions, to perform the method according to any one of claims 1 to 8.

19. A computer-readable storage medium, wherein the computer-readable storage medium is configured to store a computer program, and when the computer program is executed, the method according to any one of claims 1 to 8 is performed.

20. A computer program, wherein when the computer program is executed, the method according to any one of claims 1 to 8 is performed.