CLAIMS

1. A method of wireless communication,

obtaining N groups of spread data by multiplying N groups of data with N spreading codes;

combining the N groups of spread data into a data sequence;

modulating the data sequence onto 2K subcarriers; and

transmitting the modulated data sequence,

wherein an individual spreading code of the N spreading codes comprises 2K elements organized as a sequence of K pairs, wherein the pairs comply with at least one of (1) two elements in a pair have a 180-degree phase difference or (2) corresponding elements in neighboring pairs have a 180-degree phase difference, and

wherein N and K are integers greater than 1 and $N < 2K$.

2. The method of claim 1, further comprising:

selecting the N spreading codes from 2K spreading codes that are orthogonal to each other, wherein the N spreading codes comprise one spreading code that complies with: two elements in every pair have a 180-degree phase difference.

3. The method of claim 1, wherein the combining the N groups of spread data comprises:

applying a coefficient to each of the N groups of spread data to generate multiple groups of weighted spread data; and

adding the multiple groups of weighted spread data to generate the data sequence,

wherein coefficients for the N groups of spread data are ordered based on corresponding absolute values of the coefficients.

4. The method of claim 1, wherein centers of the 2K subcarriers are separated by an equal distance in frequency domain, wherein the equal distance in frequency domain is equivalent to a frequency-domain spacing of m subcarriers, $m \geq 1$.

5. The method of claim 1, wherein the spreading codes comprise at least one of: S1 = [C, -C, -C, C], S2=[C, -C, C, -C], or S3=[C, C, -C, -C], C being a complex number.

6. A method of wireless communication, comprising:

receiving a data sequence modulated on 2K subcarriers, wherein the data sequence is generated by combining N groups spread data, the N groups of spread data obtained by multiplying N groups of data with N spreading codes; and

demodulating the data sequence based on the N spreading codes to obtain the N groups of the data,

wherein an individual spreading code of the N spreading codes comprises 2K elements organized as a sequence of K pairs, wherein the pairs comply with at least one of (1) two elements in a pair have a 180-degree phase difference or (2) corresponding elements in neighboring pairs have a 180-degree phase difference, and

wherein N and K are integers greater than 1 and $N < 2K$.

7. The method of claim 6, wherein the N spreading codes are selected from 2K spreading codes that are orthogonal to each other, and wherein the N spreading codes comprise one spreading code that complies with: two elements in every pair have a 180-degree phase difference.

8. The method of claim 6, the data sequence is generated based on:

applying a coefficient to each of the N groups of spread data to generate multiple groups of weighted spread data; and

adding the multiple groups of weighted spread data together,

wherein coefficients for the N groups of spread data are ordered based on corresponding absolute values of the coefficients.

9. The method of claim 6, wherein centers of the 2K subcarriers are separated by an equal distance in frequency domain, wherein the equal distance in frequency domain is equivalent to a frequency-domain spacing between centers of neighboring subcarriers.

10. The method of claim 6, wherein the spreading codes comprise at least one of: S1 = [C, -C, -C, C], S2=[C, -C, C, -C], or S3=[C, C, -C, -C], C being a complex number.

11. An apparatus for wireless communication, comprising:

a processor; and

a memory including processor executable code, wherein the processor executable code upon execution by the processor configures the processor to:

obtain N groups of spread data by multiplying N groups of data with N spreading codes;

combine the N groups of spread data into a data sequence;

modulate the data sequence onto 2K subcarriers; and

transmit the modulated data sequence,

wherein an individual spreading code of the N spreading codes comprises 2K elements organized as a sequence of K pairs, wherein the pairs comply with at least one of (1) two elements in a pair have a 180-degree phase difference or (2) corresponding elements in neighboring pairs have a 180-degree phase difference, and

wherein N and K are integers greater than 1 and $N < 2K$.

12. The apparatus of claim 11, wherein the processor is configured to:

select the N spreading codes from 2K spreading codes that are orthogonal to each other, wherein the N spreading codes comprise one spreading code that complies with: two elements in every pair have a 180-degree phase difference.

13. The apparatus of claim 11, wherein the processor is configured to combine the N groups of spread data based on:

applying a coefficient to each of the N groups of spread data to generate multiple groups of weighted spread data; and

adding the multiple groups of weighted spread data to generate the data sequence,

wherein coefficients for the N groups of spread data are ordered based on corresponding absolute values of the coefficients.

14. The apparatus of claim 11, wherein centers of the 2K subcarriers are separated by an equal distance in frequency domain, wherein the equal distance in frequency domain is equivalent to a frequency-domain spacing between centers of neighboring subcarriers.

15. The apparatus of claim 11, wherein the spreading codes comprise at least one of: S1 = [C, -C, -C, C], S2=[C, -C, C, -C], or S3=[C, C, -C, -C], C being a complex number.

16. An apparatus for wireless communication, comprising:

a processor; and

a memory including processor executable code, wherein the processor executable code upon execution by the processor configures the processor to:

receive a data sequence modulated on 2K subcarriers, wherein the data sequence is generated by combining N groups spread data, the N groups of spread data obtained by multiplying N groups of data with N spreading codes; and

demodulate the data sequence based on the N spreading codes to obtain the N groups of the data,

wherein an individual spreading code of the N spreading codes comprises 2K elements organized as a sequence of K pairs, wherein the pairs comply with at least one of (1) two elements in a pair have a 180-degree phase difference or (2) corresponding elements in neighboring pairs have a 180-degree phase difference, and

wherein N and K are integers greater than 1 and $N < 2K$.

17. The apparatus of claim 16, wherein the N spreading codes are selected from 2K spreading codes that are orthogonal to each other, and wherein the N spreading codes comprise one spreading code that complies with: two elements in every pair have a 180-degree phase difference.

18. The apparatus of claim 16, wherein the data sequence is generated based on:

applying a coefficient to each of the N groups of spread data to generate multiple groups of weighted spread data; and

adding the multiple groups of weighted spread data together,

wherein coefficients for the N groups of spread data are ordered based on corresponding absolute values of the coefficients.

19. The apparatus of claim 16, wherein centers of the 2K subcarriers are separated by an equal distance in frequency domain, wherein the equal distance in frequency domain is equivalent to a frequency-domain spacing between centers of neighboring subcarriers.

20. The apparatus of claim 16, wherein the spreading codes comprise at least one of: S1 = [C, -C, -C, C], S2=[C, -C, C, -C], or S3=[C, C, -C, -C], C being a complex number.