CLAIMS

1. A method for modulating a plurality of K-ary symbols to be transmitted over a transmission channel, characterised in that each K-ary symbol is transformed into a Zadoff-Chu sequence associated with this symbol, said Zadoff-Chu sequence being of length N, root r and frequency offset q where N is a positive integer such that $\log_2 N \geq K$, r is an integer such that $r > 1$ and prime to N, q is a relative integer, and that any two K-ary symbols of said plurality are associated with Zadoff-Chu sequences having distinct frequency offsets, each K-ary symbol being modulated in the form of a sequence, of length greater than or equal to 2^K, of consecutive complex elements of the Zadoff-Chu sequence associated with said K-ary symbol.

2. The modulation method according to claim 1, characterised in that the sequence of consecutive complex elements consists of all the elements of said Zadoff-Chu sequence.

3. The modulation method according to claim 2, characterised in that the length of the Zadoff-Chu sequence is equal to a power of 2.

4. The modulation method according to claim 1, characterised in that the length of said Zadoff-Chu sequence is chosen equal to the smallest prime number greater than 2^K and that the sequence of consecutive complex elements is obtained by truncating said Zadoff-Chu sequence to 2^K elements.

5. The modulation method according to any of claims 1 to 4, characterised in that the length of the Zadoff-Chu sequence is chosen greater than the difference between a maximum frequency offset to modulate the K-ary symbols and the time spread of the transmission channel, expressed in number of transmission periods of elements of that sequence.

6. The modulation method according to one of claims 1 to 5, characterised in that the real part and the imaginary part of the elements of the sequence of consecutive complex elements of a Zadoff-Chu sequence associated with a K-ary symbol respectively modulate two quadrature carriers and that the modulated signal thus obtained is transmitted over the transmission channel.

7. The modulation method according to any of claims 1 to 5, characterised in that a phase signal is generated in baseband, obtained as the phase of the consecutive complex elements of the Zadoff-Chu sequence associated with a K-ary symbol, and that the phase signal is translated into RF-band, the RF signal thus obtained being transmitted over the transmission channel.

8. A method for transmitting data over a plurality of communications to or from different users, characterised in that the data to be transmitted are transformed into K-ary symbols, the K-ary symbols of the different users being modulated by means of the modulation method according to one of the preceding claims, the roots of the Zadoff-Chu sequences used to modulate the K-ary symbols of two distinct users being chosen distinct and their lengths chosen equal to a common length.

9. The data transmission method according to claim 8, characterised in that the roots used to modulate the K-ary symbols of two distinct users are chosen such that the absolute value of their difference is prime to said common length.

10. A modulation device to modulate a plurality of K-ary symbols to be transmitted over a transmission channel, characterised in that it comprises a binary to decimal converter (110) transforming the bits K of each K-ary symbol into a distinct integer value, and a Zadoff-Chu sequence generator (120), having as input parameters a sequence length N and a root r such as integer r, $r > 1$ and prime to N, as well as a frequency offset q, q being a relative integer, said generator generating, for each K-ary symbol, a sequence having a length greater than or equal to 2^K, formed by complex elements of a Zadoff-Chu sequence of length N, root r and frequency offset equal to the integer value provided by said binary to decimal converter, said Zadoff-Chu sequence generator being configured so that any two K-ary symbols of said plurality are associated with Zadoff-Chu sequences having distinct frequency offsets.

11. A method for demodulating a signal representing a Zadoff-Chu sequence modulated in frequency offset by means of a modulation method according to one of claims 1 to 7, characterised in that said signal is baseband sampled to provide a sequence of complex samples, that said sequence of complex samples is correlated by cyclic correlation (710) with a reference Zadoff-Chu sequence to provide a cyclic correlation result and that the time position of a correlation peak in the modulus of the cyclic correlation result thus obtained is detected (740), and that a frequency

offset is deduced therefrom, $\hat{q}$ corresponding to this time position, said frequency offset being then converted by a decimal to binary converter (750) into an K-ary symbol.

12. A device for demodulating a signal representing a Zadoff-Chu sequence modulated in frequency offset by means of a modulation method according to one of claims 1 to 7, said signal is baseband sampled to provide a first block of complex elements of size N, characterised in that said device comprises a DFT module (610) configured to perform discrete Fourier transform of size N of the first block of complex elements to provide a first block of complex frequency elements, a multiplier (620) for multiplying term by term the complex frequency elements of the first block with the complex frequency elements of a second block obtained by complex conjugation of a discrete Fourier transform of a reference Zadoff-Chu sequence, a modulus calculator (630) for calculating the modulus of the multiplication results of the first and second complex frequency elements, the modulus values thus obtained being compared in a correlation peak detector (640) to determine the frequency position of a cyclic correlation peak, and that the frequency offset, $\hat{q}$, corresponding to that frequency position is deduced, said frequency offset being provided to a decimal to binary converter (650) to generate an K-ary symbol.

13. ~~The~~ A device for demodulating a signal representing a Zadoff-Chu sequence modulated in frequency offset by means of a modulation method according to one of claims 1 to 7, said signal is baseband sampled to provide a first block of complex elements of size N, characterised in that it comprises a cyclic correlator (710) of size N for cyclically correlating said first block with a second block, said second block consisting of a reference Zadoff-Chu sequence, a modulus calculator (730) calculating the modulus of said cyclic correlation and a correlation peak detector (740) determining, from this modulus, the time position of a cyclic correlation peak and deducing a frequency offset $\hat{q}$ corresponding to said time position therefrom, said frequency offset being provided to a decimal to binary converter to generate a K-ary symbol.

14. A transmitter/receiver characterised in that it comprises at least one modulation device according to claim 10 and at least one demodulation device according to one of claims 12 or 13.

15. The transmitter/receiver according to claim 14, characterised in that it comprises a plurality of modulation devices according to claim 10, each modulation device of said plurality corresponding to a different root value, and/or a plurality of demodulation devices according to

one of claims 12 or 13, each demodulation device of said plurality corresponding to a different root value.