(12) BẢN MÔ TẢ SÁNG CHẾ THUỘC BẰNG ĐỘC QUYỀN SÁNG CHẾ

(19) **Cộng hòa xã hội chủ nghĩa Việt Nam (VN)**
CỤC SỞ HỮU TRÍ TUỆ

(11) **1-0038141**

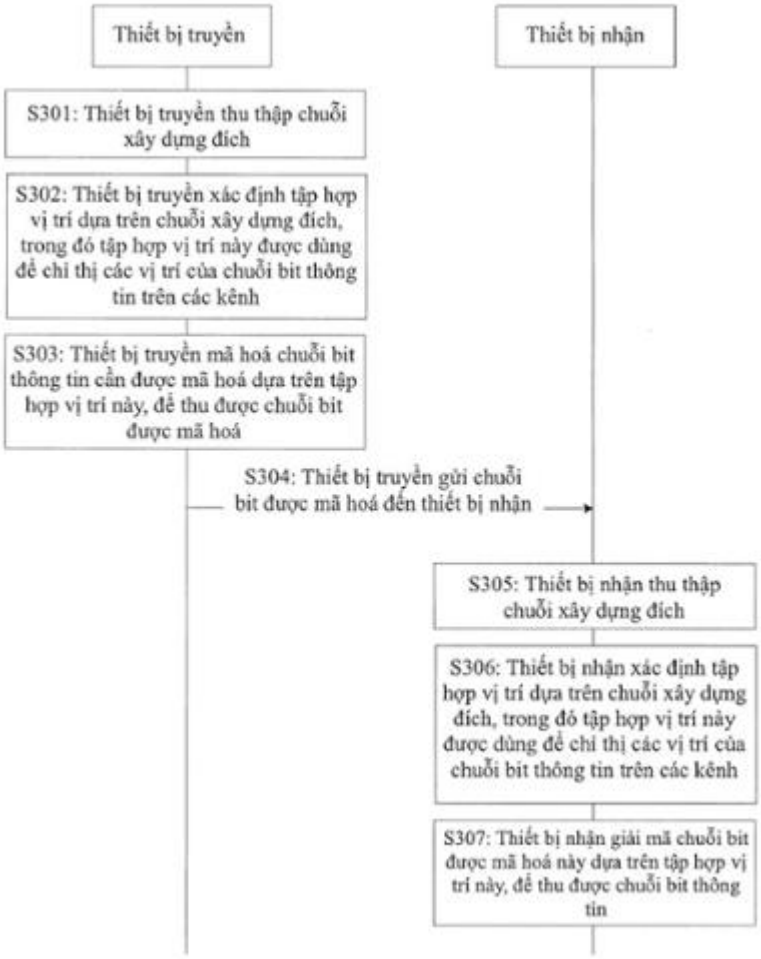
(51)[7] **H04L 1/00**

(13) **B**

(21) 1-2019-05628
(22) 24/03/2018
(86) PCT/CN2018/080393 24/03/2018
(87) WO/2018/171789 27/09/2018
(30) 201710184322.X 24/03/2017 CN; 201710374785.2 24/05/2017 CN
(45) 25/01/2024 430
(43) 30/01/2020 382A
(73) HUAWEI TECHNOLOGIES CO., LTD. (CN)
Huawei Administration Building, Bantian, Longgang District, Shenzhen, Guangdong 518129, P. R. China
(72) CHEN, Ying (CN); ZHANG, Gongzheng (CN); HUANG, Lingchen (CN); LI, Rong (CN); ZHANG, Huazi (CN); LUO, Hejia (CN).
(74) Công ty Luật TNHH T&G (TGVN)

(54) PHƯƠNG PHÁP VÀ THIẾT BỊ LẬP MÃ CỰC, VÀ PHƯƠNG TIỆN PHI NHẤT THỜI ĐỌC ĐƯỢC BẰNG MÁY TÍNH

(57) Theo các phương án, sáng chế đề xuất phương pháp và thiết bị mã hoá, phương pháp và thiết bị giải mã, và phương tiện lưu trữ. Phương pháp này bao gồm các bước: thu thập, bởi thiết bị truyền, chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được xếp thứ tự dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp; xác định, bởi thiết bị truyền, tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh; mã hoá, bởi thiết bị truyền, chuỗi bit thông tin này dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá; và gửi, bởi thiết bị truyền, chuỗi bit được mã hoá này đến thiết bị nhận. Các phương án theo sáng chế có thể cải thiện sự linh hoạt trong việc thu thập tập hợp vị trí của các bit thông tin.


Thiết bị truyền
Thiết bị nhận
S301: Thiết bị truyền thu thập chuỗi xây dựng đích
S302: Thiết bị truyền xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh
S303: Thiết bị truyền mã hoá chuỗi bit thông tin cần được mã hoá dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá
S304: Thiết bị truyền gửi chuỗi bit được mã hoá đến thiết bị nhận
S305: Thiết bị nhận thu thập chuỗi xây dựng đích
S306: Thiết bị nhận xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh
S307: Thiết bị nhận giải mã chuỗi bit được mã hoá này dựa trên tập hợp vị trí này, để thu được chuỗi bit thông tin

Lĩnh vực kỹ thuật được đề cập

Sáng chế đề cập đến các công nghệ truyền thông, cụ thể là đề cập đến phương pháp và thiết bị truyền thông để mã hoá, giải mã, thiết bị truyền thông, phương tiện lưu trữ, thiết bị mã hoá và thiết bị giải mã.

Tình trạng kỹ thuật của sáng chế

Mã cực là loại mã hoá kênh mới, được đề xuất năm 2008 bởi giáo sư người Thổ Nhĩ Kỳ là Arikan. Mã cực được thiết kế dựa trên sự phân cực kênh, và là sơ đồ mã hoá xây dựng thứ nhất mà có thể được chứng minh thông qua phương pháp toán học chính xác để đạt được dung lượng kênh. Mã cực là mã khối tuyến tính. Ma trận sinh của nó là F_N, và tiến trình mã hoá của nó là $x_1^N = u_1^N F_N$, trong đó $u_1^N = (u_1, u_2, \ldots, u_N)$ là vectơ hàng nhị phân với chiều dài N (N được gọi là chiều dài mã mẹ), F_N là ma trận $N \times N$, và $F_N = F_2^{\otimes(\log_2(N))}$, trong đó $F_2 = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$, và $F_2^{\otimes(\log_2(N))}$ được xác định là tích Kronecker của $\log_2 N$ ma trận F_2.

Trong tiến trình mã hoá của mã cực, thì một số bit trong u_1^N được dùng để mang thông tin, và được gọi là các bit thông tin, và tập hợp chỉ số của các bit này được biểu thị là I; và các bit còn lại được thiết đặt bằng các giá trị cố định mà được thoả thuận trước bởi đầu nhận và đầu truyền, và được gọi là các bit đóng băng, và tập hợp chỉ số của các bit đóng băng này được biểu diễn bằng I^c, là bù của I. Tập hợp chỉ số I của bit thông tin là được chọn bằng phương pháp sau: thu thập, bằng thuật toán xây dựng mã cực, xác suất lỗi kênh $P_e^{(i)}$ hoặc kết quả ước lượng dung lượng kênh $C^{(i)}$ tương ứng với bit có số tuần tự i, và chọn K số tuần tự với các giá trị $P_e^{(i)}$ nhỏ nhất hoặc các giá trị $C^{(i)}$ lớn nhất, để xây dựng tập hợp I.

Xác suất lỗi kênh $P_e^{(i)}$ hoặc kết quả ước lượng dung lượng kênh $C^{(i)}$ là liên

quan đến độ tin cậy của kênh. Thông thường, độ tin cậy của kênh có thể được tính bằng công thức (1):

$$W_1^{2^i} = \left[W_1^{2^{i-1}}, W_{2^{i-1}+1}^{2^i} \right], W_1^2 = [01] \quad (1)$$

trong đó $W_{2^{i-1}+1}^{2^i} = W_1^{2^{i-1}} + \beta_i$, $\beta_i = \left(2^{i-1}\right)^{1/4}$, $W_1^{2^i}$ là độ tin cậy của kênh có số tuần tự của kênh là 1-đến-2^i, và i là số tuần tự của kênh.

Ngoài ra, độ tin cậy của kênh có thể được tính theo cách khác bằng công thức (2):

$$W_i = \sum_{j=0}^{n-1} B_j * 2^{j*\frac{1}{4}} \quad (2)$$

trong đó $i \triangleq B_{n-1}B_{n-2}...B_0$, $B_j \in \{0,1\}$, $j \in \{0,1,\cdots n-1\}$, và $B_{n-1}B_{n-2}...B_0$ là sự biểu diễn nhị phân của i.

Sau khi độ tin cậy của kênh được tính theo cách nêu trên, thì trình tự kênh thu được là được cố định, do đó, tập hợp vị trí xác định được của các bit thông tin là tương đối đơn điệu.

Bản chất kỹ thuật của sáng chế

Theo các phương án, sáng chế đề xuất phương pháp và thiết bị mã hoá, phương pháp và thiết bị giải mã, và thiết bị, để giải quyết vấn đề kỹ thuật là tập hợp vị trí xác định được của các bit thông tin là tương đối đơn điệu.

Theo khía cạnh thứ nhất, theo các phương án, sáng chế đề xuất phương pháp mã hoá, phương pháp này bao gồm các bước:

thu thập, bởi thiết bị truyền, chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp;

xác định, bởi thiết bị truyền, tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh;

mã hóa, bởi thiết bị truyền, chuỗi bit thông tin cần được mã hoá dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá; và

gửi, bởi thiết bị truyền, chuỗi bit được mã hoá này đến thiết bị nhận.

Theo giải pháp này, thì thiết bị truyền, tức là bộ mã hoá, có thể là thiết bị mạng hoặc có thể là thiết bị đầu cuối, và theo đó, thiết bị nhận, tức là bộ giải mã, có thể là thiết bị đầu cuối hoặc có thể là thiết bị mạng. Giải pháp này có thể được sử dụng cho việc trao đổi thông tin giữa thiết bị đầu cuối và thiết bị mạng, hoặc có thể được áp dụng cho việc trao đổi thông tin giữa các thiết bị đầu cuối, chứ việc này không bị giới hạn theo giải pháp này.

Ngoài ra, theo các phương án, sáng chế còn đề xuất chuỗi xây dựng được dùng để xác định các vị trí mã hoá của các bit thông tin. Chuỗi xây dựng này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp.

Các chiều dài mã mẹ khác nhau là tương ứng với các chuỗi được sắp xếp và/hoặc các chuỗi được lượng tử hoá khác nhau.

Trong tiến trình mã hoá, thì thiết bị truyền sẽ thu thập chuỗi xây dựng đích, và xác định tập hợp vị trí dựa trên chuỗi xây dựng đích này, để mã hoá chuỗi bit thông tin, để tập hợp vị trí của các bit thông tin có thể được xác định một cách linh hoạt hơn.

Theo một cách thức thực hiện cụ thể, thì chuỗi xây dựng đích là chuỗi xây dựng thu được từ nhiều chuỗi xây dựng.

Theo giải pháp này, khi có nhiều chuỗi xây dựng, thì thiết bị truyền sẽ thu thập một trong số các chuỗi xây dựng đó làm chuỗi xây dựng đích. Thiết bị nhận thu thập chuỗi xây dựng đích từ các chuỗi xây dựng đó cũng theo cách đó. Thiết bị truyền và thiết bị nhận có thể thoả thuận về một hoặc nhiều chuỗi xây dựng đích dựa trên các thông số liên quan, chẳng hạn như chiều dài mã và tốc độ mã.

Theo một cách thức thực hiện cụ thể, thì các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Theo một cách thức thực hiện cụ thể, thì độ tin cậy là được tính dựa trên công thức $W_i = \sum_{j=0}^{n-1} B_j * \beta^j$, trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62.

Theo giải pháp này, thì khoảng giá trị của β có thể là từ 1 đến 1,62. Tuỳ ý, khi khoảng giá trị của β nằm trong khoảng 1,16 đến 1,21, thì độ tin cậy của kênh tính được là tương đối chính xác. Theo một cách thức thực hiện khả thi, khi giá trị của β được chọn từ 1,1870 đến 1,2000 với các nấc là 0,0001, thì độ tin cậy của kênh tính được thậm chí còn chính xác hơn.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo giải pháp này, sau khi độ tin cậy của mỗi kênh được tính toán, thì các kênh có thể được sắp xếp dựa trên độ tin cậy của các kênh, ví dụ, các kênh được sắp xếp theo thứ tự giảm dần của độ tin cậy, hoặc các kênh được sắp xếp theo thứ tự tăng dần của độ tin cậy, và P kênh có độ tin cậy cao nhất thì được chọn làm các vị trí của các bit thông tin.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là L kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo giải pháp này, sau khi độ tin cậy của mỗi kênh được tính, thì độ tin cậy của các kênh được chuẩn hoá. Xác định rằng chuỗi được lượng tử hoá được chuẩn hoá là thu được bằng cách lượng tử hoá độ tin cậy từ 1 hoặc 0 với độ chính xác là 1, và L kênh có độ tin cậy cao nhất được chọn từ chuỗi được xử lý, làm các vị trí của các bit thông tin.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là: $Q1_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 33, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 8, 25, 37, 12, 41, 14, 20, 15, 49, 22, 36, 23, 26, 38, 27, 39, 42, 29, 43, 16, 50, 45, 51, 24, 53, 28, 40, 57, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 32, 61, 48, 56, 60, 62, 63,

64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là: $Q2_1^{64}$ =[1, 2, 3, 5, 9, 17, 33, 4, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 25, 37, 8, 41, 12, 49, 14, 20, 15, 22, 36, 23, 26, 38, 27, 39, 42, 29, 43, 50, 45, 51, 16, 53, 24, 57, 28, 40, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 61, 32, 48, 56, 60, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là: $Q3_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 33, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 25, 8, 37, 12, 41, 14, 20, 49, 15, 22, 36, 23, 26, 38, 27, 39, 42, 29, 43, 50, 16, 45, 51, 24, 53, 28, 57, 40, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 32, 61, 48, 56, 60, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là: $Q4_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 6, 33, 7, 10, 11, 18, 13, 19, 34, 21, 8, 35, 25, 37, 12, 14, 41, 20, 15, 22, 49, 36, 23, 26, 38, 27, 39, 42, 29, 16, 43, 50, 45, 24, 51, 53, 28, 40, 30, 57, 44, 31, 46, 52, 47, 54, 55, 58, 32, 59, 61, 48, 56, 60, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là: $Q5_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 6, 33, 7, 10, 11, 18, 13, 19, 34, 21, 8, 35, 25, 12, 37, 14, 41, 20, 15, 22, 49, 36, 23, 26, 38, 27, 39, 42, 29, 16, 43, 50, 45, 24, 51, 28, 53, 40, 30, 57, 44, 31, 46, 52, 47, 54, 55, 58, 32, 59, 61, 48, 56, 60, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là: $Q6_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 6, 33, 7, 10, 11, 18, 13, 19, 34, 21, 8, 35, 25, 12, 37, 14, 20, 41, 15, 22, 49, 36, 23, 26, 38, 27, 39, 42, 29, 16, 43, 50, 24, 45, 51, 28, 53, 40, 30, 57, 44, 31, 46, 52, 47, 54, 55, 58, 32, 59, 61, 48, 56, 60, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là: $Z1_1^{64}$ =[1, 2, 3, 7, 4, 9, 10, 19, 5, 11, 12, 22, 14, 24, 26, 38, 6, 13, 15, 25, 17, 28, 30, 42, 20, 31, 33, 44, 36, 47, 49, 57, 8, 16, 18, 29, 21, 32, 34, 45, 23, 35, 37, 48, 40, 50, 52, 59, 27, 39, 41, 51, 43, 53, 54, 60, 46, 55, 56, 61, 58, 62,

63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là: $Z2_1^{64}$ =[1, 2, 3, 8, 4, 9, 10, 21, 5, 11, 12, 23, 14, 24, 27, 40, 6, 13, 15, 26, 17, 28, 30, 43, 19, 31, 33, 45, 36, 47, 49, 58, 7, 16, 18, 29, 20, 32, 34, 46, 22, 35, 37, 48, 39, 50, 52, 59, 25, 38, 41, 51, 42, 53, 54, 60, 44, 55, 56, 61, 57, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là: $Z3_1^{64}$ =[1, 2, 3, 7, 4, 9, 10, 20, 5, 11, 12, 22, 14, 24, 27, 39, 6, 13, 15, 25, 17, 28, 30, 42, 19, 31, 33, 44, 36, 47, 49, 57, 8, 16, 18, 29, 21, 32, 34, 46, 23, 35, 37, 48, 40, 50, 52, 59, 26, 38, 41, 51, 43, 53, 54, 60, 45, 55, 56, 61, 58, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là: $Z4_1^{64}$ =[1, 2, 3, 7, 4, 8, 10, 18, 5, 11, 12, 22, 14, 23, 26, 37, 6, 13, 15, 25, 17, 27, 30, 41, 20, 31, 33, 44, 36, 46, 49, 56, 9, 16, 19, 29, 21, 32, 34, 45, 24, 35, 38, 48, 40, 50, 52, 59, 28, 39, 42, 51, 43, 53, 54, 60, 47, 55, 57, 61, 58, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là: $Z5_1^{64}$ =[1, 2, 3, 7, 4, 8, 10, 18, 5, 11, 12, 21, 14, 23, 26, 37, 6, 13, 15, 25, 17, 27, 30, 41, 20, 31, 33, 43, 36, 46, 49, 56, 9, 16, 19, 29, 22, 32, 34, 45, 24, 35, 38, 48, 40, 50, 52, 59, 28, 39, 42, 51, 44, 53, 54, 60, 47, 55, 57, 61, 58, 62, 63, 64].

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là: $Z6_1^{64}$ =[1, 2, 3, 7, 4, 8, 10, 18, 5, 11, 12, 21, 14, 23, 26, 37, 6, 13, 15, 24, 17, 27, 30, 40, 20, 31, 33, 43, 36, 46, 49, 56, 9, 16, 19, 29, 22, 32, 34, 45, 25, 35, 38, 48, 41, 50, 52, 59, 28, 39, 42, 51, 44, 53, 54, 60, 47, 55, 57, 61, 58, 62, 63, 64].

Theo các giải pháp nêu trên thì các chuỗi được mô tả bằng các ví dụ thập phân, và tất nhiên là các chuỗi này có thể được biểu diễn ở dạng nhị phân, dạng bát phân, hoặc dạng thập lục phân.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì kênh mà có số tuần tự là 0, kênh mà có số tuần tự là 1, và kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự tăng dần của độ tin cậy của kênh, với kênh đầu tiên trong chuỗi được sắp xếp là tương ứng với giá trị độ tin cậy nhỏ nhất.

Theo một cách thức thực hiện cụ thể, một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự là 4 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 9 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 1005 trong chuỗi được sắp xếp thì là kênh thứ mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1014 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1015 trong chuỗi được sắp xếp thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1019 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1021 trong chuỗi được sắp xếp thì là kênh thứ ba có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1022 trong chuỗi được sắp xếp thì là kênh thứ hai có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1023 thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Theo các giải pháp nêu trên, thì các kênh là được đánh số từ 0. Trong ứng dụng thực tế, thì các kênh có thể được đánh số từ 1. Tất nhiên là các kênh cũng có thể được đánh số từ số khác.

Theo khía cạnh thứ hai, theo các phương án, sáng chế đề xuất phương pháp giải mã, phương pháp này bao gồm các bước:

thu thập, bởi thiết bị nhận, chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được

sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp;

xác định, bởi thiết bị nhận, tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh;

nhận, bởi thiết bị nhận, chuỗi bit được mã hoá; và

giải mã, bởi thiết bị nhận, chuỗi bit được mã hoá này dựa trên tập hợp vị trí, để thu được chuỗi bit thông tin.

Tương ứng với bộ mã hoá, thiết bị nhận có thể là thiết bị mạng hoặc có thể là thiết bị đầu cuối.

Trong tiến trình giải mã, thì thiết bị nhận nhận chuỗi xây dựng đích, và xác định tập hợp vị trí dựa trên chuỗi xây dựng đích này, để giải mã chuỗi bit thông tin được mã hoá.

Theo một cách thức thực hiện cụ thể, thì chuỗi xây dựng đích là chuỗi xây dựng thu được từ nhiều chuỗi xây dựng.

Theo giải pháp này, khi có nhiều chuỗi xây dựng, thì thiết bị truyền sẽ thu thập một trong số các chuỗi xây dựng đó làm chuỗi xây dựng đích. Thiết bị nhận thu thập chuỗi xây dựng đích từ các chuỗi xây dựng đó cũng theo cách đó. Thiết bị truyền và thiết bị nhận có thể thoả thuận về một hoặc nhiều chuỗi xây dựng đích dựa trên các thông số liên quan, chẳng hạn như chiều dài mã và tốc độ mã.

Theo một cách thức thực hiện cụ thể, thì các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Theo một cách thức thực hiện cụ thể, thì độ tin cậy là được tính dựa trên công thức $W_i = \sum_{j=0}^{n-1} B_j * \beta^j$, trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62.

Theo giải pháp này, thì khoảng giá trị của β có thể là từ 1 đến 1,62. Tuỳ ý,

khi khoảng giá trị của β nằm trong khoảng 1,16 đến 1,21, thì độ tin cậy của kênh tính được là tương đối chính xác. Theo một cách thức thực hiện khả thi, khi giá trị của β được chọn từ 1,1870 đến 1,2000 với các nấc là 0,0001, thì độ tin cậy của kênh tính được thậm chí còn chính xác hơn.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo giải pháp này, sau khi độ tin cậy của mỗi kênh được tính toán, thì các kênh có thể được sắp xếp dựa trên độ tin cậy của các kênh, ví dụ, các kênh được sắp xếp theo thứ tự giảm dần của độ tin cậy, hoặc các kênh được sắp xếp theo thứ tự tăng dần của độ tin cậy, và P kênh có độ tin cậy cao nhất thì được chọn làm các vị trí của các bit thông tin.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là L kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo giải pháp này, sau khi độ tin cậy của mỗi kênh được tính toán, độ tin cậy của các kênh được chuẩn hoá, thì xác định rằng chuỗi được lượng tử hoá được chuẩn hoá là thu được bằng cách lượng tử hoá độ tin cậy từ 1 hoặc 0 với độ chính xác là 1, và L kênh có độ tin cậy cao nhất được chọn từ chuỗi được xử lý, làm các vị trí của các bit thông tin.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là bất kỳ trong số $Q1_1^{64}$, $Q2_1^{64}$, $Q3_1^{64}$, $Q4_1^{64}$, $Q5_1^{64}$, và $Q6_1^{64}$, và dạng cụ thể của chuỗi được sắp xếp đó có thể được tìm thấy trong phần mô tả ở cách thức thực hiện nêu trên.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là bất kỳ trong số $Z1_1^{64}$, $Z2_1^{64}$, $Z3_1^{64}$, $Z4_1^{64}$, $Z5_1^{64}$, và $Z6_1^{64}$, và dạng cụ thể của chuỗi được lượng tử hoá đó có thể được tìm thấy trong phần mô tả ở cách thức thực hiện nêu trên.

Theo các giải pháp nêu trên thì các chuỗi được mô tả bằng các ví dụ thập phân, và tất nhiên là các chuỗi này có thể được biểu diễn ở dạng nhị phân, dạng bát

phân, hoặc dạng thập lục phân.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì kênh mà có số tuần tự là 0, kênh mà có số tuần tự là 1, và kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự tăng dần của độ tin cậy của kênh, kênh mà có số tuần tự là 0 thì có độ tin cậy của kênh nhỏ nhất.

Theo một cách thức thực hiện cụ thể, một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự là 4 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 9 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 1005 trong chuỗi được sắp xếp thì là kênh thứ mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1014 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1015 trong chuỗi được sắp xếp thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1019 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1021 trong chuỗi được sắp xếp thì là kênh thứ ba có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1022 trong chuỗi được sắp xếp thì là kênh thứ hai có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1023 trong chuỗi được sắp xếp thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Theo khía cạnh thứ ba, theo các phương án, sáng chế đề xuất thiết bị mã hoá, thiết bị này bao gồm:

môđun xử lý, được tạo cấu hình để thu thập chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được

sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp; trong đó

môđun xử lý này còn được tạo cấu hình để xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh; và

môđun xử lý này còn được tạo cấu hình để mã hoá chuỗi bit thông tin này dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá; và

môđun gửi, được tạo cấu hình để gửi chuỗi bit được mã hoá đến thiết bị nhận.

Theo một cách thức thực hiện cụ thể, thì chuỗi xây dựng đích là chuỗi xây dựng thu được từ nhiều chuỗi xây dựng.

Theo một cách thức thực hiện cụ thể, thì các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Theo một cách thức thực hiện cụ thể, thì độ tin cậy của kênh là được tính dựa trên công thức $W_i = \sum_{j=0}^{n-1} B_j * \beta^j$, trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là L kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là bất kỳ trong số $Q1_1^{64}$, $Q2_1^{64}$, $Q3_1^{64}$, $Q4_1^{64}$, $Q5_1^{64}$, và $Q6_1^{64}$, và dạng cụ thể của chuỗi được sắp xếp đó có thể được tìm thấy trong phần mô tả ở phương án về phương pháp nêu trên.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là bất kỳ trong số $Z1_1^{64}$, $Z2_1^{64}$, $Z3_1^{64}$, $Z4_1^{64}$, $Z5_1^{64}$, và $Z6_1^{64}$, và

dạng cụ thể của chuỗi được lượng tử hoá đó có thể được tìm thấy trong phần mô tả ở cách thức thực hiện nêu trên.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì kênh mà có số tuần tự là 0, kênh mà có số tuần tự là 1, và kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự tăng dần, với kênh mà có số tuần tự là 0 thì có độ tin cậy của kênh nhỏ nhất.

Một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự là 4 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 9 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 1005 trong chuỗi được sắp xếp thì là kênh thứ mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1014 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1015 trong chuỗi được sắp xếp thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1019 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1021 trong chuỗi được sắp xếp thì là kênh thứ ba có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1022 trong chuỗi được sắp xếp thì là kênh thứ hai có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1023 trong chuỗi được sắp xếp thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Theo khía cạnh thứ tư, theo các phương án, sáng chế đề xuất thiết bị giải mã, thiết bị này bao gồm:

môđun xử lý, được tạo cấu hình để thu thập chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh

được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp; trong đó

môđun xử lý này còn được tạo cấu hình để xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh; và

môđun nhận, được tạo cấu hình để nhận chuỗi bit được mã hoá; trong đó

môđun xử lý còn được tạo cấu hình để giải mã chuỗi bit được mã hoá này dựa trên tập hợp vị trí, để thu được chuỗi bit thông tin.

Theo một cách thức thực hiện cụ thể, thì chuỗi xây dựng đích là chuỗi xây dựng thu được từ nhiều chuỗi xây dựng.

Theo một cách thức thực hiện cụ thể, thì các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Theo một cách thức thực hiện cụ thể, thì độ tin cậy là được tính dựa trên công thức $W_i = \sum_{j=0}^{n-1} B_j * \beta^j$, trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo một cách thức thực hiện cụ thể, thì tập hợp vị trí là L kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là bất kỳ trong số $Q1_1^{64}$, $Q2_1^{64}$, $Q3_1^{64}$, $Q4_1^{64}$, $Q5_1^{64}$, và $Q6_1^{64}$, và dạng cụ thể của chuỗi được sắp xếp đó có thể được tìm thấy trong phần mô tả ở cách thức thực hiện nêu trên.

Các số 1, 2, 3, 4, 5, và 6 sau chữ "Q" chỉ được dùng để chỉ thị các chuỗi khác nhau, chứ không có ý nghĩa cụ thể nào.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là bất kỳ trong số $Z1_1^{64}$, $Z2_1^{64}$, $Z3_1^{64}$, $Z4_1^{64}$, $Z5_1^{64}$, và $Z6_1^{64}$, và dạng cụ thể của chuỗi được lượng tử hoá đó có thể được tìm thấy trong phần mô tả ở cách thức thực hiện nêu trên.

Các số 1, 2, 3, 4, 5, và 6 sau chữ "Z" chỉ được dùng để chỉ thị các chuỗi khác nhau, chứ không có ý nghĩa cụ thể nào.

Theo một cách thức thực hiện cụ thể, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì kênh mà có số tuần tự là 0, kênh mà có số tuần tự là 1, và kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự tăng dần của độ tin cậy của kênh, với kênh đầu tiên trong chuỗi được sắp xếp là tương ứng với giá trị độ tin cậy nhỏ nhất.

Tuỳ ý, một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự là 4 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 9 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 1005 trong chuỗi được sắp xếp thì là kênh thứ mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1014 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1015 trong chuỗi được sắp xếp thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1019 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1021 trong chuỗi được sắp xếp thì là kênh thứ ba theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1022 trong chuỗi được sắp xếp thì là kênh thứ hai có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1023 trong chuỗi được sắp xếp thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Khi chiều dài mã mẹ là nhỏ hơn 1024, thì chuỗi được sắp xếp hoặc chuỗi

được lượng tử hoá có thể là tập hợp con của chuỗi được sắp xếp hoặc chuỗi được lượng tử hoá nêu trên mà có chiều dài mã mẹ là 1024. Ví dụ, tập hợp con này có thể được chọn tuần tự hoặc không tuần tự từ chuỗi được sắp xếp hoặc chuỗi được lượng tử hoá mà có chiều dài mã mẹ là 1024.

Cần hiểu rằng trong quá trình thực hiện thiết bị mã hoá hoặc thiết bị giải mã nêu trên, thì môđun xử lý có thể được thực hiện cụ thể dưới dạng bộ xử lý, môđun gửi có thể được thực hiện dưới dạng bộ phát, và môđun nhận có thể được thực hiện dưới dạng bộ thu.

Theo khía cạnh thứ năm, theo các phương án, sáng chế đề xuất thiết bị truyền, bao gồm bộ nhớ, bộ xử lý, bộ phát, và chương trình máy tính, trong đó chương trình máy tính này được lưu giữ trong bộ nhớ, và bộ xử lý chạy chương trình máy tính này để thực hiện phương pháp mã hoá theo khía cạnh thứ nhất hoặc những cách thức thực hiện của khía cạnh thứ nhất.

Trong quá trình thực hiện cụ thể đối với thiết bị truyền, thì có ít nhất một bộ xử lý, được tạo cấu hình để thực thi chỉ dẫn thực thi được, tức chương trình máy tính, mà được lưu giữ trong bộ nhớ. Do đó, thiết bị truyền thực hiện, thông qua sự trao đổi dữ liệu giữa giao diện truyền thông và thiết bị nhận, phương pháp mã hoá được đề xuất theo khía cạnh thứ nhất hoặc những cách thức thực hiện của khía cạnh thứ nhất, và tuỳ ý, bộ nhớ này có thể còn được tích hợp trong bộ xử lý.

Theo khía cạnh thứ sáu, theo các phương án, sáng chế đề xuất thiết bị nhận, bao gồm bộ nhớ, bộ xử lý, bộ thu, và chương trình máy tính, trong đó chương trình máy tính này được lưu giữ trong bộ nhớ, và bộ xử lý chạy chương trình máy tính này để thực hiện phương pháp giải mã theo khía cạnh thứ hai hoặc những cách thức thực hiện của khía cạnh thứ hai.

Trong quá trình thực hiện cụ thể đối với thiết bị nhận, thì có ít nhất một bộ xử lý, được tạo cấu hình để thực thi chỉ dẫn thực thi được, tức chương trình máy tính, mà được lưu giữ trong bộ nhớ. Do đó, thiết bị nhận này thực hiện, thông qua sự trao đổi dữ liệu giữa giao diện truyền thông và thiết bị truyền, phương pháp giải mã được đề xuất theo khía cạnh thứ hai hoặc những cách thức thực hiện của khía cạnh thứ hai, và tuỳ ý, bộ nhớ này có thể còn được tích hợp trong bộ xử lý.

Theo khía cạnh thứ bảy, theo các phương án, sáng chế đề xuất phương tiện

lưu trữ, bao gồm phương tiện lưu trữ đọc được và chương trình máy tính, trong đó chương trình máy tính này được tạo cấu hình để thực hiện phương pháp mã hoá được đề xuất theo cách thức thực hiện bất kỳ của khía cạnh thứ nhất.

Theo khía cạnh thứ tám, theo các phương án, sáng chế đề xuất phương tiện lưu trữ, bao gồm phương tiện lưu trữ đọc được và chương trình máy tính, trong đó chương trình máy tính này được tạo cấu hình để thực hiện phương pháp giải mã được đề xuất theo cách thức thực hiện bất kỳ của khía cạnh thứ hai.

Theo khía cạnh thứ chín, theo các phương án, sáng chế đề xuất sản phẩm chương trình, trong đó sản phẩm chương trình này bao gồm chương trình máy tính (tức là chỉ dẫn thực thi được), và chương trình máy tính này được lưu giữ ở phương tiện lưu trữ đọc được. Ít nhất một bộ xử lý của thiết bị truyền có thể đọc chương trình máy tính này từ phương tiện lưu trữ đọc được này, và ít nhất một bộ xử lý đó thực thi chương trình máy tính này, để thiết bị truyền này thực hiện phương pháp mã hoá được đề xuất theo khía cạnh thứ nhất hoặc những cách thức thực hiện của khía cạnh thứ nhất.

Theo khía cạnh thứ mười, theo các phương án, sáng chế đề xuất sản phẩm chương trình, trong đó sản phẩm chương trình này bao gồm chương trình máy tính (tức là chỉ dẫn thực thi được), và chương trình máy tính này được lưu giữ ở phương tiện lưu trữ đọc được. Ít nhất một bộ xử lý của thiết bị nhận có thể đọc chương trình máy tính này từ phương tiện lưu trữ đọc được này, và ít nhất một bộ xử lý đó thực thi chương trình máy tính này, để thiết bị nhận này thực hiện phương pháp giải mã được đề xuất theo khía cạnh thứ hai hoặc những cách thức thực hiện của khía cạnh thứ hai.

Theo phương pháp và thiết bị mã hoá, phương pháp và thiết bị giải mã, và thiết bị mà được đề xuất theo các phương án của sáng chế, trong tiến trình mã hoá, thì thiết bị truyền thu thập chuỗi xây dựng đích, và xác định tập hợp vị trí của các bit thông tin dựa trên chuỗi xây dựng đích này, và sau đó mã hoá chuỗi bit thông tin cần được mã hoá dựa trên tập hợp vị trí này. Trong quá trình giải mã tương ứng, thì vẫn tập hợp vị trí đó có thể được dùng để giải mã chuỗi bit nhận được. Vì chuỗi xây dựng có thể được thu thập từ nhiều chuỗi xây dựng, nên dạng chuỗi xây dựng được đa dạng hoá, để tập hợp vị trí của các bit thông tin được chọn một cách linh hoạt hơn.

Mô tả vắn tắt các hình vẽ

Fig.1 là hình vẽ thể hiện lược đồ của quá trình truyền thông không dây cơ bản giữa đầu truyền và đầu nhận;

Fig.2 là hình vẽ thể hiện sơ đồ khối của hệ thống ứng dụng của phương pháp mã hoá và phương pháp giải mã theo các phương án của sáng chế;

Fig.3 là hình vẽ thể hiện lưu đồ tương tác của phương pháp mã hoá và phương pháp giải mã theo các phương án của sáng chế;

Fig.4 là hình vẽ thể hiện sơ đồ khối cấu trúc của môđun mã hoá;

Fig.5 là hình vẽ thể hiện sơ đồ cấu trúc của thiết bị mã hoá theo các phương án của sáng chế;

Fig.6 là hình vẽ thể hiện sơ đồ cấu trúc của thiết bị giải mã theo các phương án của sáng chế; và

Fig.7 là hình vẽ thể hiện sơ đồ cấu trúc của thiết bị mã hoá.

Mô tả chi tiết các phương án thực hiện sáng chế

Các giải pháp kỹ thuật theo các phương án của sáng chế có thể được áp dụng cho hệ thống truyền thông 5G (5th Generation - thế hệ thứ 5) hoặc hệ thống truyền thông tương lai, và cũng có thể được áp dụng cho các hệ thống truyền thông không dây khác nhau, chẳng hạn hệ thống GSM (Global System for Mobile Communications - hệ thống truyền thông di động toàn cầu), hệ thống CDMA (Code Division Multiple Access - đa truy cập phân chia theo mã), hệ thống WCDMA (Wideband Code Division Multiple Access - đa truy cập phân chia theo mã băng rộng), hệ thống GPRS (General Packet Radio Service - dịch vụ vô tuyến gói chung), hệ thống LTE (Long Term Evolution - phát triển lâu dài), hệ thống LTE FDD (Frequency Division Duplex - song công phân chia theo tần số), hệ thống LTE TDD (Time Division Duplex - song công phân chia theo thời gian), và hệ thống UMTS (Universal Mobile Telecommunication System - hệ thống viễn thông di động đa năng).

Fig.1 là hình vẽ thể hiện lược đồ của quá trình truyền thông không dây cơ bản. Như được thể hiện trên Fig.1, tại đầu truyền, thì tín hiệu được gửi từ nguồn tín

hiệu sau khi việc mã hoá nguồn, mã hoá kênh, so khớp tốc độ, và điều chế số được thực hiện lần lượt. Tại đầu nhận, thì tín hiệu được xuất ra đích đến của tín hiệu sau khi việc giải điều chế số, giải so khớp tốc độ, giải mã kênh, và giải mã nguồn được thực hiện lần lượt. Mã cực có thể được sử dụng trong quá trình mã hoá kênh, còn việc giải mã SC, giải mã SCL, v.v., thì có thể được sử dụng trong quá trình giải mã kênh.

Trong tiến trình mã hoá của mã cực, thì độ tin cậy của kênh cần được xác định, và các bit thông tin và các bit đóng băng được đặt tại các vị trí tương ứng dựa trên độ tin cậy của kênh, để thực hiện việc mã hoá đúng. Cách tính để xác định độ tin cậy của kênh là như sau:

$$W_1^{2^i} = \left[W_1^{2^{i-1}}, W_{2^{i-1}+1}^{2^i} \right], W_1^2 = [01] \quad (1)$$

trong đó $W_{2^{i-1}+1}^{2^i} = W_1^{2^{i-1}} + \beta_i$, $\beta_i = \left(2^{i-1}\right)^{1/4}$, $W_1^{2^i}$ là độ tin cậy 1-đến-2^i của số tuần tự của kênh, và i là số tuần tự của kênh. Ngoài ra, độ tin cậy của kênh có thể được tính theo cách khác bằng công thức (2):

$$W_i = \sum_{j=0}^{n-1} B_j * 2^{j*\frac{1}{4}} \quad (2)$$

trong đó $i \triangleq B_{n-1}B_{n-2}...B_0$, $B_j \in \{0,1\}$, $j \in \{0,1,\cdots n-1\}$, và $B_{n-1}B_{n-2}...B_0$ là sự biểu diễn nhị phân của i.

Ngoài ra, những sự biểu diễn chẳng hạn như trọng số phân cực, xác suất lỗi, và dung lượng kênh được phân cực, mà có thể mô tả độ tin cậy tương đối của kênh được phân cực, thì được mô tả chung là độ tin cậy theo các phương án của sáng chế.

Tuy nhiên, sau khi độ tin cậy của kênh được tính toán theo cách nêu trên, thì chuỗi được sắp xếp, mà thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá, mà thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp, là vừa tương đối cố định vừa đơn điệu, do đó, tập hợp vị trí của các bit thông tin cũng tương đối đơn điệu.

Xét đến vấn đề nêu trên, thì theo các phương án, sáng chế đề xuất giải pháp kỹ thuật mà có thể giải quyết vấn đề nêu trên rằng tập hợp vị trí xác định được của các bit thông tin là tương đối cố định và đơn điệu. Phương pháp mã hoá và phương pháp giải mã theo các phương án của sáng chế sẽ được mô tả chi tiết dưới đây dựa

vào các hình vẽ kèm theo.

Fig.2 là hình vẽ thể hiện sơ đồ của hệ thống ứng dụng của phương pháp mã hoá và phương pháp giải mã theo các phương án của sáng chế. Như được thể hiện trên Fig.2, giải pháp này được sử dụng trong quá trình trao đổi thông tin giữa thiết bị mạng và thiết bị đầu cuối. Bộ mã hoá có thể là thiết bị mạng hoặc thiết bị đầu cuối, và theo cách tương ứng, bộ giải mã có thể là thiết bị đầu cuối hoặc thiết bị mạng. Tuỳ ý, giải pháp này cũng có thể được áp dụng cho quá trình trao đổi thông tin giữa các thiết bị đầu cuối. Điều này không bị giới hạn theo giải pháp này.

Fig.3 là hình vẽ thể hiện lưu đồ tương tác của phương pháp mã hoá và phương pháp giải mã theo các phương án của sáng chế. Như được thể hiện trên Fig.3, các bước thực hiện cụ thể của phương pháp mã hoá và phương pháp giải mã này là như sau.

S301: Thiết bị truyền thu thập chuỗi xây dựng đích.

Chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp.

S302: Thiết bị truyền xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh.

Theo các bước trên đây, khi thiết bị truyền cần gửi thông tin, thì trước hết, thiết bị truyền cần thu thập chuỗi bit thông tin, và xác định các vị trí kênh của các bit thông tin dựa trên chuỗi xây dựng đích thu được. Ví dụ, khi có 64 kênh, thì các bit trong chuỗi bit thông tin 111 là lần lượt nằm trên kênh thứ nhất, kênh thứ ba, và kênh thứ mười sáu.

Ngoài ra, khi chuỗi xây dựng chỉ bao gồm chuỗi được sắp xếp, thì thiết bị truyền xác định tập hợp vị trí chỉ dựa trên chuỗi được sắp xếp đó; khi chuỗi xây dựng chỉ bao gồm chuỗi được lượng tử hoá, thì thiết bị truyền xác định tập hợp vị trí chỉ dựa trên chuỗi được lượng tử hoá đó; và khi chuỗi xây dựng bao gồm chuỗi được sắp xếp và chuỗi được lượng tử hoá, thì thiết bị truyền xác định tập hợp vị trí một cách riêng biệt dựa trên chuỗi được sắp xếp và chuỗi được lượng tử hoá đó.

Tuỳ ý, có thể có một chuỗi xây dựng, và một chuỗi xây dựng đó là chuỗi xây dựng đích. Tuỳ ý, có thể có nhiều chuỗi xây dựng, và trong trường hợp này, thì thiết bị truyền thu thập một trong số các chuỗi xây dựng đó làm chuỗi xây dựng đích.

Khi có nhiều chuỗi xây dựng, thì thiết bị nhận thu thập chuỗi xây dựng đích từ các chuỗi xây dựng đó cũng theo cách đó. Thiết bị truyền và thiết bị nhận có thể thoả thuận về một hoặc nhiều chuỗi xây dựng đích dựa trên các thông số liên quan, chẳng hạn như chiều dài mã và tốc độ mã.

Tuỳ ý, các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Cụ thể là, độ tin cậy có thể được tính dựa trên công thức (3):

$$W_i = \sum_{j=0}^{n-1} B_j * \beta^j \qquad (3)$$

trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62, trong đó j, B_j, và β là các thông số mã hoá được thiết đặt trước. Ngoài ra, khoảng giá trị của β là từ 1 đến 1,62. Tuỳ ý, khi khoảng giá trị của β nằm trong khoảng 1,16 đến 1,21, thì độ tin cậy của kênh tính được là tương đối chính xác. Theo một cách thức thực hiện khả thi, khi giá trị của β được chọn từ 1,1870 đến 1,2000 với các nấc là 0,0001, thì độ tin cậy của kênh tính được thậm chí còn chính xác hơn.

Ngoài ra, độ tin cậy có thể được tính dựa trên thuật toán khác, miễn là độ tin cậy của mỗi kênh có thể được tính. Cách thức cụ thể để xác định độ tin cậy là không bị giới hạn theo phương án này.

Theo một cách thức thực hiện, thì tập hợp vị trí của các bit thông tin là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Cụ thể là, sau khi độ tin cậy của mỗi kênh được tính dựa trên công thức (3), thì các kênh có thể được sắp xếp dựa trên độ tin cậy của kênh, ví dụ, độ tin cậy của kênh theo thứ tự giảm dần, hoặc theo thứ tự tăng dần, và P kênh có độ tin cậy của kênh cao nhất thì được chọn làm các vị trí của các bit thông tin. Ngoài ra, P có thể là

lượng bit của các bit thông tin, hoặc có thể là lượng bit của các bit thông tin và các bit kiểm tra. Bit kiểm tra có thể là, ví dụ, bit kiểm độ dư vòng (Cyclic Redundancy Check - CRC) hoặc bit kiểm tra chẵn lẻ (Parity Check - PC). Do đó, P là số nguyên lớn hơn hoặc bằng lượng bit của các bit thông tin. Ví dụ, chiều dài mã mẹ tối đa là 64. Khi $\beta = 2^{1/4}$, thì chuỗi được sắp xếp thu được theo thứ tự tăng dần của độ tin cậy của kênh là: $Q1_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 33, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 8, 25, 37, 12, 41, 14, 20, 15, 49, 22, 36, 23, 26, 38, 27, 39, 42, 29, 43, 16, 50, 45, 51, 24, 53, 28, 40, 57, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 32, 61, 48, 56, 60, 62, 63, 64]. Nếu có năm bit thông tin, thì kênh thứ 56, kênh thứ 60, kênh thứ 62, kênh thứ 63, và kênh thứ 64 được chọn làm các vị trí của các bit thông tin.

Theo cách thức thực hiện khác, thì tập hợp vị trí của các bit thông tin là L kênh có độ tin cậy của kênh cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Cụ thể là, sau khi độ tin cậy của mỗi kênh được tính dựa trên công thức (3), thì độ tin cậy của các kênh được chuẩn hoá. Xác định rằng chuỗi được lượng tử hoá được chuẩn hoá là thu được bằng cách lượng tử hoá độ tin cậy từ 1 hoặc 0 với độ chính xác là 1. L kênh có độ tin cậy cao nhất được chọn từ chuỗi được xử lý làm các vị trí của các bit thông tin. Ngoài ra, L có thể là lượng bit của các bit thông tin, hoặc có thể là lượng bit của các bit thông tin và các bit kiểm tra. Bit kiểm tra có thể là, ví dụ, bit CRC hoặc bit kiểm tra chẵn lẻ. Do đó, L là số nguyên lớn hơn hoặc bằng lượng bit của các bit thông tin. Ví dụ, khi N=64, sau khi độ tin cậy của tất cả các kênh được lượng tử hoá, thì chuỗi thu được là: $Z1_1^{64}$ =[1, 2, 3, 7, 4, 9, 10, 19, 5, 11, 12, 22, 14, 24, 26, 38, 6, 13, 15, 25, 17, 28, 30, 42, 20, 31, 33, 44, 36, 47, 49, 57, 8, 16, 18, 29, 21, 32, 34, 45, 23, 35, 37, 48, 40, 50, 52, 59, 27, 39, 41, 51, 43, 53, 54, 60, 46, 55, 56, 61, 58, 62, 63, 64], để biểu diễn độ tin cậy tương đối của kênh thứ nhất đến kênh thứ 64. Ví dụ, Z1(4)=7 và Z1(5)=4 chỉ thị rằng độ tin cậy của kênh thứ tư là 7 và độ tin cậy của kênh thứ năm là 4. Các vị trí có độ tin cậy cao nhất có thể được chọn làm các vị trí của các bit thông tin dựa trên chuỗi được lượng tử hoá.

S303: Thiết bị truyền mã hoá chuỗi bit thông tin dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá.

Fig.4 là hình vẽ thể hiện sơ đồ khối cấu trúc của môđun mã hoá. Như được thể hiện trên Fig.4, trước khi mã hoá mã cực, thì tập hợp vị trí đích I của các bit thông tin là được chọn trước tiên bằng cách sử dụng môđun xây dựng mã cực. Môđun xây dựng mã cực này bao gồm hoạt động tạo chuỗi được sắp xếp hoặc chuỗi lượng tử hoá và tiến trình xác định tập hợp vị trí của các bit thông tin. Theo các phương án của sáng chế, tập hợp vị trí đích I của các bit thông tin được thu thập, sau đó, việc mã hoá cực được thực hiện dựa trên các bit cần được mã hoá và tập hợp vị trí đích I của các bit thông tin, để thu được chuỗi bit được mã hoá, và cuối cùng, việc so khớp tốc độ được thực hiện dựa trên chiều dài mã đích.

S304: Thiết bị truyền gửi chuỗi bit được mã hoá đến thiết bị nhận.

Theo phương án này, sau khi thu được tập hợp vị trí, thì thiết bị truyền mã hoá chuỗi bit thông tin dựa trên các vị trí của các bit thông tin trên các kênh, và gửi chuỗi bit được mã hoá thu được.

Thiết bị nhận nhận chuỗi bit được mã hoá mà được gửi bởi thiết bị truyền.

S305: Thiết bị nhận thu thập chuỗi xây dựng đích.

Chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp.

S306: Thiết bị nhận xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh.

S307: Thiết bị nhận giải mã chuỗi bit được mã hoá dựa trên tập hợp vị trí này, để thu được chuỗi bit thông tin.

Theo phương án này, sau khi thu được chuỗi xây dựng đích và xác định tập hợp vị trí dựa trên chuỗi xây dựng đích này, thì thiết bị nhận giải mã chuỗi bit được mã hoá nhận được dựa trên tập hợp vị trí này, để thu được chuỗi bit thông tin.

Ngoài ra, tuỳ theo các chiều dài khác nhau của chuỗi bit được mã hoá, mà thiết bị nhận có thể trước hết là thực hiện bước S305 và S306, và sau đó nhận chuỗi bit được mã hoá mà được gửi bởi thiết bị truyền; hoặc thiết bị nhận có thể trước hết là nhận chuỗi bit được mã hoá mà được gửi bởi thiết bị truyền, và sau đó thực hiện

bước S305 và S306. Thứ tự của các bước này là không bị giới hạn theo các phương án của sáng chế.

Theo phương pháp mã hoá và phương pháp giải mã theo phương án này, trong tiến trình mã hoá, thì thiết bị truyền thu thập chuỗi xây dựng đích, và xác định tập hợp vị trí của các bit thông tin dựa trên chuỗi xây dựng đích này, và sau đó mã hoá chuỗi bit thông tin dựa trên tập hợp vị trí này. Trong quá trình giải mã tương ứng, thì vẫn tập hợp vị trí đó có thể được dùng để giải mã chuỗi bit thông tin nhận được. Vì chuỗi xây dựng có thể được thu thập từ nhiều chuỗi xây dựng, nên dạng chuỗi xây dựng được đa dạng hoá, để tập hợp vị trí của các bit thông tin được chọn một cách linh hoạt hơn.

Các chuỗi được sắp xếp mà thu được khi chiều dài mã mẹ là 64 và các giá trị khác nhau mà được chọn cho β là được liệt kê dưới đây. Tập hợp vị trí mà thu được bởi thiết bị truyền và thiết bị nhận là tập hợp con của chuỗi được sắp xếp. Khi chiều dài mã mẹ là nhỏ hơn 64, thì chuỗi được sắp xếp và chuỗi được lượng tử hoá là các tập hợp con của các chuỗi sau đây, và không được liệt kê ở đây. Ngoài ra, các chuỗi theo phương án này là được mô tả bằng các ví dụ thập phân, và tất nhiên là các chuỗi này có thể được biểu diễn ở dạng nhị phân, dạng bát phân, hoặc dạng thập lục phân.

Cần lưu ý rằng độ tin cậy của các kênh là có thể được sắp xếp theo thứ tự giảm dần hoặc theo thứ tự tăng dần. Các chuỗi sau đây chỉ chỉ thị mối quan hệ giữa độ tin cậy tương đối của các kênh, và dạng biểu diễn cụ thể của độ tin cậy là không bị giới hạn theo phương án này.

Nếu chiều dài mã mẹ là 64, thì có 64 kênh, và các kênh được đánh số từ 1, chuỗi được sắp xếp là:

$Q1_1^{64}$ =[1, 2, 3, 5, 9, 17, 4, 33, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 8, 25, 37, 12, 41, 14, 20, 15, 49, 22, 36, 23, 26, 38, 27, 39, 42, 29, 43, 16, 50, 45, 51, 24, 53, 28, 40, 57, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 32, 61, 48, 56, 60, 62, 63, 64];

$Q2_1^{64}$ =[1, 2, 3, 5, 9, 17, 33, 4, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 25, 37, 8, 41, 12, 49, 14, 20, 15, 22, 36, 23, 26, 38, 27, 39, 42, 29, 43, 50, 45, 51, 16, 53, 24, 57, 28, 40, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 61, 32, 48, 56, 60, 62, 63, 64];

$Q3_1^{64}$=[1, 2, 3, 5, 9, 17, 4, 33, 6, 7, 10, 11, 18, 13, 19, 34, 21, 35, 25, 8, 37, 12, 41, 14, 20, 49, 15, 22, 36, 23, 26, 38, 27, 39, 42, 29,43, 50,16, 45, 51, 24, 53, 28, 57, 40, 30, 44, 31, 46, 52, 47, 54, 55, 58, 59, 32, 61, 48, 56, 60, 62, 63, 64];

$Q4_1^{64}$=[1, 2, 3, 5, 9, 17, 4, 6, 33, 7, 10, 11, 18, 13, 19, 34, 21, 8, 35, 25, 37, 12, 14, 41, 20, 15, 22, 49, 36, 23, 26, 38, 27, 39, 42, 29, 16, 43, 50, 45, 24, 51, 53, 28, 40, 30, 57, 44, 31, 46, 52, 47, 54, 55, 58, 32, 59, 61, 48, 56, 60, 62, 63, 64];

$Q5_1^{64}$=[1, 2, 3, 5, 9, 17, 4, 6, 33, 7, 10, 11, 18, 13, 19, 34, 21, 8, 35, 25, 12, 37, 14, 41, 20, 15, 22, 49, 36, 23, 26, 38, 27, 39, 42, 29, 16, 43, 50, 45, 24, 51, 28, 53, 40, 30, 57, 44, 31, 46, 52, 47, 54, 55, 58, 32, 59, 61, 48, 56, 60, 62, 63, 64]; hoặc

$Q6_1^{64}$=[1, 2, 3, 5, 9, 17, 4, 6, 33, 7, 10, 11, 18, 13, 19, 34, 21, 8, 35, 25, 12, 37, 14, 20, 41, 15, 22, 49, 36, 23, 26, 38, 27, 39, 42, 29, 16, 43, 50, 24, 45, 51, 28, 53, 40, 30, 57, 44, 31, 46, 52, 47, 54, 55, 58, 32, 59, 61, 48, 56, 60, 62, 63, 64].

Các số 1, 2, 3, 4, 5, và 6 sau chữ "Q" chỉ được dùng để chỉ thị các chuỗi khác nhau, chứ không có ý nghĩa cụ thể nào.

Các chuỗi được sắp xếp mà thu được khi chiều dài mã mẹ là 1024 và các giá trị khác nhau mà được chọn cho β là được liệt kê dưới đây. Tập hợp vị trí mà thu được bởi thiết bị truyền và thiết bị nhận là tập hợp con của chuỗi được sắp xếp. Khi chiều dài mã mẹ là nhỏ hơn 1024, thì chuỗi được sắp xếp là tập hợp con của các chuỗi sau đây, và không được liệt kê ở đây. Ngoài ra, các chuỗi theo phương án này là được mô tả bằng các ví dụ thập phân, và tất nhiên là các chuỗi này có thể được biểu diễn ở dạng nhị phân, dạng bát phân, hoặc dạng thập lục phân.

Cần lưu ý rằng độ tin cậy của các kênh là có thể được sắp xếp theo thứ tự giảm dần hoặc theo thứ tự tăng dần. Các chuỗi sau đây chỉ chỉ thị mối quan hệ giữa độ tin cậy tương đối của các kênh, và dạng biểu diễn cụ thể của độ tin cậy là không bị giới hạn theo phương án này.

Nếu chiều dài mã mẹ là 1024, thì có 1024 kênh, và các kênh được đánh số từ 0, chuỗi được sắp xếp có thể là bất kỳ trong số các chuỗi sau đây:

$Q1_1^{1024}$=[0, 1, 2, 4, 8, 16, 3, 32, 5, 6, 9, 64, 10, 17, 12, 18, 128, 33, 20, 34, 24, 7, 36, 65, 256, 11, 66, 40, 13, 68, 19, 129, 48, 14, 72, 21, 130, 512, 35, 22, 132,

25, 80, 37, 257, 26, 136, 38, 67, 258, 41, 96, 28, 69, 144, 42, 260, 49, 15, 70, 44, 73, 131, 264, 50, 513, 160, 74, 23, 133, 514, 52, 81, 272, 76, 134, 27, 516, 82, 137, 192, 56, 39, 259, 97, 29, 138, 288, 84, 520, 145, 43, 261, 98, 30, 140, 88, 71, 146, 262, 45, 528, 100, 265, 51, 320, 161, 148, 46, 75, 266, 515, 104, 53, 162, 273, 544, 77, 152, 135, 268, 54, 517, 83, 164, 274, 193, 57, 384, 112, 78, 518, 139, 289, 85, 194, 58, 521, 276, 576, 168, 99, 31, 290, 86, 141, 522, 196, 60, 89, 147, 280, 263, 529, 101, 176, 142, 292, 321, 524, 90, 200, 149, 47, 530, 102, 267, 640, 322, 105, 163, 296, 92, 150, 545, 532, 153, 269, 208, 106, 55, 324, 165, 275, 546, 385, 113, 79, 154, 304, 270, 536, 519, 108, 166, 195, 59, 328, 277, 548, 386, 114, 577, 169, 768, 224, 156, 291, 87, 523, 278, 197, 61, 578, 170, 388, 116, 281, 552, 336, 177, 143, 293, 198, 62, 525, 91, 580, 172, 282, 201, 531, 392, 120, 103, 178, 641, 294, 323, 560, 526, 297, 93, 202, 151, 352, 284, 584, 533, 642, 180, 209, 107, 325, 400, 298, 94, 547, 204, 534, 155, 305, 271, 644, 210, 537, 326, 109, 592, 184, 167, 300, 329, 549, 387, 115, 306, 769, 225, 157, 538, 416, 212, 110, 648, 330, 279, 550, 579, 171, 389, 117, 770, 226, 158, 553, 308, 337, 608, 540, 216, 199, 63, 332, 390, 118, 581, 173, 283, 656, 554, 772, 228, 338, 393, 121, 179, 448, 312, 295, 561, 527, 582, 174, 203, 353, 285, 556, 394, 122, 585, 340, 643, 776, 232, 181, 562, 401, 299, 95, 672, 354, 286, 205, 586, 535, 396, 124, 182, 645, 211, 344, 327, 564, 402, 593, 185, 301, 784, 240, 206, 356, 588, 307, 646, 539, 417, 213, 111, 594, 186, 649, 404, 302, 331, 704, 568, 551, 771, 227, 159, 360, 309, 418, 214, 609, 541, 650, 800, 596, 188, 217, 333, 408, 391, 119, 657, 555, 310, 773, 229, 339, 610, 542, 420, 449, 313, 652, 218, 368, 334, 600, 583, 175, 658, 774, 230, 557, 395, 123, 341, 612, 450, 314, 777, 233, 563, 832, 424, 220, 673, 355, 287, 660, 558, 587, 342, 397, 125, 778, 234, 183, 452, 316, 345, 616, 565, 403, 674, 785, 241, 207, 357, 432, 398, 126, 589, 664, 647, 780, 236, 346, 566, 595, 187, 456, 405, 303, 676, 786, 242, 705, 569, 358, 896, 624, 590, 361, 419, 215, 348, 651, 406, 801, 597, 189, 706, 570, 788, 244, 409, 680, 464, 362, 311, 611, 543, 421, 802, 598, 190, 653, 219, 369, 335, 708, 572, 410, 601, 659, 792, 775, 248, 231, 364, 422, 613, 451, 315, 688, 654, 804, 370, 833, 425, 221, 602, 480, 412, 712, 661, 559, 343, 614, 779, 235, 453, 317, 834, 426, 222, 617, 372, 675, 808, 604, 662, 433, 399, 127, 665, 454, 318, 781, 237, 347, 720, 618, 567, 836, 428, 457, 677, 787, 243, 376, 359, 434, 897, 625, 591, 666, 816, 782, 238, 349, 620, 458, 407, 678, 707, 571,

840, 789, 245, 898, 626, 681, 436, 465, 363, 736, 668, 350, 803, 599, 191, 460, 790, 246, 709, 573, 411, 682, 900, 628, 466, 793, 249, 365, 848, 440, 423, 689, 655, 805, 371, 710, 574, 603, 481, 413, 684, 794, 250, 713, 468, 366, 904, 632, 615, 690, 806, 835, 427, 223, 373, 482, 414, 809, 605, 714, 663, 864, 796, 252, 472, 455, 319, 692, 721, 619, 374, 837, 429, 912, 810, 606, 484, 377, 716, 435, 667, 817, 783, 239, 722, 838, 430, 621, 459, 696, 679, 812, 378, 841, 899, 627, 488, 437, 818, 737, 669, 351, 928, 724, 622, 461, 842, 791, 247, 380, 683, 438, 901, 629, 467, 738, 670, 820, 849, 441, 496, 462, 728, 711, 575, 844, 902, 630, 685, 795, 251, 469, 367, 740, 850, 442, 905, 633, 691, 960, 824, 807, 483, 415, 686, 715, 470, 865, 797, 253, 906, 634, 852, 444, 473, 744, 693, 375, 913, 811, 607, 485, 866, 798, 254, 717, 908, 636, 474, 694, 723, 856, 839, 431, 914, 697, 486, 813, 379, 752, 718, 868, 489, 819, 476, 929, 725, 623, 698, 916, 814, 843, 381, 490, 439, 739, 671, 872, 821, 930, 726, 497, 463, 700, 729, 382, 845, 920, 903, 631, 492, 822, 741, 851, 443, 932, 498, 961, 825, 730, 880, 846, 687, 471, 742, 907, 635, 853, 445, 962, 826, 745, 500, 936, 732, 867, 799, 255, 854, 446, 909, 637, 475, 746, 695, 964, 828, 857, 915, 504, 487, 753, 719, 869, 944, 910, 638, 477, 748, 858, 699, 968, 917, 815, 754, 870, 491, 478, 873, 931, 727, 860, 918, 701, 383, 756, 921, 493, 976, 874, 823, 933, 499, 702, 731, 881, 847, 922, 494, 760, 743, 876, 934, 963, 827, 501, 882, 937, 733, 992, 924, 855, 447, 747, 502, 965, 829, 938, 734, 884, 505, 945, 911, 639, 966, 830, 749, 859, 940, 506, 969, 755, 888, 871, 946, 479, 750, 861, 970, 919, 508, 757, 948, 977, 875, 862, 703, 972, 758, 923, 495, 978, 761, 877, 952, 935, 883, 993, 925, 762, 980, 878, 503, 939, 735, 885, 994, 926, 764, 984, 967, 831, 886, 941, 507, 996, 889, 947, 751, 942, 971, 509, 890, 1000, 949, 863, 510, 973, 759, 892, 950, 979, 953, 1008, 974, 763, 981, 879, 954, 995, 927, 982, 765, 956, 985, 887, 997, 766, 986, 943, 998, 891, 1001, 988, 511, 893, 1002, 951, 1009, 975, 894, 1004, 955, 1010, 983, 957, 1012, 767, 958, 987, 1016, 999, 989, 1003, 990, 895, 1005, 1011, 1006, 1013, 959, 1014, 1017, 1018, 991, 1020, 1007, 1015, 1019, 1021, 1022, 1023];

$Q2_1^{1024}$=[0, 1, 2, 4, 8, 16, 3, 32, 5, 6, 9, 64, 10, 17, 12, 18, 128, 33, 20, 34, 7, 24, 36, 65, 256, 11, 66, 40, 13, 68, 19, 129, 14, 48, 21, 72, 130, 512, 35, 22, 132, 25, 80, 37, 257, 26, 136, 38, 67, 258, 41, 28, 96, 69, 42, 144, 260, 15, 49, 70, 44, 73, 131, 264, 50, 513, 160, 23, 74, 133, 514, 52, 81, 272, 76, 134, 27, 516, 82, 137, 39,

56, 192, 259, 29, 97, 138, 84, 288, 520, 43, 145, 261, 30, 98, 140, 71, 88, 146, 262, 45, 528, 100, 265, 51, 320, 161, 46, 148, 75, 266, 515, 53, 104, 162, 273, 544, 77, 135, 152, 268, 54, 517, 83, 164, 274, 57, 193, 78, 112, 384, 518, 139, 85, 289, 58, 194, 521, 276, 168, 576, 31, 99, 86, 290, 141, 522, 60, 196, 89, 147, 263, 280, 529, 101, 142, 176, 292, 321, 524, 90, 47, 149, 200, 530, 102, 267, 640, 322, 105, 163, 92, 296, 150, 545, 532, 153, 269, 55, 106, 208, 324, 165, 275, 546, 79, 113, 385, 154, 270, 304, 519, 536, 108, 166, 59, 195, 277, 328, 548, 114, 386, 169, 577, 156, 224, 768, 87, 291, 523, 278, 61, 197, 170, 578, 116, 388, 281, 552, 336, 143, 177, 293, 62, 198, 525, 91, 172, 580, 282, 201, 531, 103, 120, 392, 178, 641, 294, 323, 526, 560, 93, 297, 151, 202, 284, 352, 533, 584, 642, 180, 107, 209, 325, 94, 298, 400, 547, 204, 534, 155, 271, 305, 644, 210, 537, 326, 109, 167, 184, 592, 300, 329, 549, 115, 387, 306, 157, 225, 769, 538, 110, 212, 416, 648, 279, 330, 550, 171, 579, 117, 389, 158, 226, 770, 553, 308, 337, 540, 608, 63, 199, 216, 332, 118, 390, 173, 581, 283, 554, 656, 228, 772, 338, 121, 393, 179, 295, 312, 448, 527, 561, 174, 582, 203, 285, 353, 556, 122, 394, 585, 340, 643, 181, 232, 776, 562, 95, 299, 401, 672, 286, 354, 205, 535, 586, 124, 396, 182, 645, 211, 327, 344, 564, 402, 185, 593, 301, 206, 240, 784, 356, 588, 307, 646, 539, 111, 213, 417, 186, 594, 649, 302, 404, 331, 551, 568, 704, 159, 227, 771, 309, 360, 214, 418, 541, 609, 650, 188, 596, 800, 217, 333, 119, 391, 408, 555, 657, 310, 229, 773, 339, 542, 610, 420, 313, 449, 652, 218, 334, 368, 175, 583, 600, 658, 230, 774, 557, 123, 395, 341, 612, 314, 450, 233, 777, 563, 220, 424, 832, 673, 287, 355, 558, 660, 587, 342, 125, 397, 183, 234, 778, 316, 452, 345, 565, 616, 403, 674, 207, 241, 785, 357, 126, 398, 432, 589, 647, 664, 236, 780, 346, 566, 187, 595, 303, 405, 456, 676, 242, 786, 569, 705, 358, 590, 624, 896, 361, 215, 419, 348, 651, 406, 189, 597, 801, 570, 706, 244, 788, 409, 680, 311, 362, 464, 543, 611, 421, 190, 598, 802, 653, 219, 335, 369, 572, 708, 410, 601, 659, 231, 248, 775, 792, 364, 422, 613, 315, 451, 654, 688, 804, 370, 221, 425, 833, 602, 412, 480, 559, 661, 712, 343, 614, 235, 779, 317, 453, 222, 426, 834, 617, 372, 675, 604, 808, 662, 127, 399, 433, 665, 318, 454, 237, 781, 347, 567, 618, 720, 428, 836, 457, 677, 243, 787, 359, 376, 434, 591, 625, 897, 666, 238, 782, 816, 349, 620, 407, 458, 678, 571, 707, 245, 789, 840, 626, 898, 681, 436, 363, 465, 668, 736, 350, 191, 599, 803, 460, 246, 790, 573, 709, 411, 682, 628, 900, 466, 249, 793, 365, 423, 440, 848, 655, 689,

805, 371, 574, 710, 603, 413, 481, 684, 250, 794, 713, 366, 468, 615, 632, 904, 690, 806, 223, 427, 835, 373, 414, 482, 605, 809, 663, 714, 252, 796, 864, 319, 455, 472, 692, 619, 721, 374, 429, 837, 606, 810, 912, 484, 377, 716, 435, 667, 239, 783, 817, 722, 430, 838, 621, 459, 679, 696, 812, 378, 841, 627, 899, 437, 488, 818, 669, 737, 351, 622, 724, 928, 461, 247, 791, 842, 380, 683, 438, 629, 901, 467, 670, 738, 820, 441, 849, 462, 496, 575, 711, 728, 844, 630, 902, 685, 251, 795, 367, 469, 740, 442, 850, 633, 905, 691, 807, 824, 960, 415, 483, 686, 715, 470, 253, 797, 865, 634, 906, 444, 852, 473, 693, 744, 375, 607, 811, 913, 485, 254, 798, 866, 717, 636, 908, 474, 694, 723, 431, 839, 856, 914, 697, 486, 813, 379, 718, 752, 868, 489, 819, 476, 623, 725, 929, 698, 814, 916, 843, 381, 439, 490, 671, 739, 821, 872, 726, 930, 463, 497, 700, 729, 382, 845, 631, 903, 920, 492, 822, 741, 443, 851, 932, 498, 825, 961, 730, 846, 880, 687, 471, 742, 635, 907, 445, 853, 826, 962, 745, 500, 732, 936, 255, 799, 867, 446, 854, 637, 909, 475, 695, 746, 828, 964, 857, 915, 487, 504, 719, 753, 869, 638, 910, 944, 477, 748, 858, 699, 815, 917, 968, 754, 870, 491, 478, 873, 727, 931, 860, 918, 701, 383, 756, 921, 493, 823, 874, 976, 933, 499, 702, 731, 847, 881, 922, 494, 743, 760, 876, 934, 827, 963, 501, 882, 733, 937, 924, 992, 447, 855, 747, 502, 829, 965, 734, 938, 884, 505, 639, 911, 945, 830, 966, 749, 859, 940, 506, 969, 755, 871, 888, 946, 479, 750, 861, 919, 970, 508, 757, 948, 875, 977, 862, 703, 972, 758, 923, 495, 978, 761, 877, 935, 952, 883, 925, 993, 762, 878, 980, 503, 735, 939, 885, 926, 994, 764, 831, 967, 984, 886, 941, 507, 996, 889, 947, 751, 942, 971, 509, 890, 949, 1000, 863, 510, 973, 759, 892, 950, 979, 953, 974, 1008, 763, 879, 981, 954, 927, 995, 982, 765, 956, 985, 887, 997, 766, 986, 943, 998, 891, 1001, 988, 511, 893, 951, 1002, 975, 1009, 894, 1004, 955, 1010, 983, 957, 1012, 767, 958, 987, 999, 1016, 989, 1003, 990, 895, 1005, 1011, 1006, 1013, 959, 1014, 1017, 1018, 991, 1020, 1007, 1015, 1019, 1021, 1022, 1023];

$Q3_1^{1024}$=[0, 1, 2, 4, 8, 16, 3, 32, 5, 6, 9, 64, 10, 17, 12, 18, 128, 33, 20, 34, 7, 24, 36, 65, 256, 11, 66, 40, 13, 68, 19, 129, 14, 48, 21, 72, 130, 512, 35, 22, 132, 25, 80, 37, 257, 26, 136, 38, 67, 41, 258, 28, 96, 69, 42, 144, 260, 15, 49, 70, 44, 73, 131, 264, 50, 513, 160, 23, 74, 133, 514, 52, 81, 272, 76, 134, 27, 82, 516, 137, 39, 56, 192, 259, 29, 97, 138, 84, 288, 520, 43, 145, 261, 30, 98, 140, 71, 88, 146, 45, 262, 528, 100, 265, 51, 320, 161, 46, 148, 75, 266, 515, 53, 104, 162, 273, 544, 77,

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$Q276_1^{1024}$=[0, 1, 2, 4, 8, 3, 16, 5, 6, 32, 9, 10, 17, 12, 64, 18, 7, 20, 33, 34, 11, 24, 128, 36, 13, 65, 19, 14, 40, 66, 21, 68, 22, 35, 48, 256, 25, 129, 72, 37, 26, 130, 38, 15, 28, 41, 67, 80, 132, 42, 69, 136, 23, 49, 257, 44, 70, 96, 512, 73, 50, 258, 27, 131, 144, 74, 39, 52, 260, 29, 81, 133, 76, 30, 43, 56, 82, 134, 160, 264, 137, 45, 71, 84, 97, 513, 138, 51, 259, 272, 46, 98, 514, 145, 75, 88, 140, 192, 53, 261, 146, 100, 516, 77, 54, 262, 288, 31, 57, 83, 135, 148, 161, 265, 78, 104, 520, 58, 162, 266, 85, 139, 152, 273, 47, 60, 86, 99, 112, 164, 268, 515, 320, 528, 89, 141, 193, 274, 147, 101, 517, 90, 142, 168, 194, 55, 263, 276, 289, 102, 518, 544, 149, 79, 92, 105, 196, 521, 290, 59, 150, 163, 267, 176, 280, 384, 106, 522, 153, 292, 200, 61, 87, 113, 165, 269, 321, 529, 154, 108, 524, 576, 275, 62, 114, 166, 270, 296, 322, 530, 91, 143, 156, 169, 195, 208, 277, 103, 116, 519, 324, 532, 545, 170, 93, 197, 278, 291, 304, 546, 151, 177, 281, 385, 94, 107, 120, 172, 198, 523, 224, 328, 536, 640, 293, 201, 178, 282, 386, 548, 155, 109, 525, 577, 294, 202, 63, 115, 167, 271, 180, 284, 297, 323, 531, 336, 388, 110, 526, 552, 578, 157, 209, 204, 298, 117, 325, 533, 158, 171, 184, 210, 392, 580, 279, 305, 118, 300, 326, 534, 547, 352, 560, 768, 95, 121, 173, 199, 212, 225, 329, 537, 641, 306, 584, 179, 283, 387, 400, 549, 122, 174, 226, 330, 538, 642, 295, 308, 203, 216, 550, 181, 285, 337, 389, 111, 124, 527, 228, 332, 540, 553, 579, 592, 644, 205, 182, 286, 299, 312, 338, 390, 416, 554, 159, 185, 211, 393, 581, 206, 232, 648, 119, 301, 327, 535, 340, 353, 561, 769, 186, 394, 556, 582, 608, 213, 307, 585, 302, 354, 562, 770, 401, 123, 175, 188, 214, 227, 331, 539, 240, 344, 396, 643, 448, 656, 309, 586, 217, 402, 551, 356, 564, 772, 125, 229, 333, 541, 593, 645, 310, 218, 588, 183, 287, 313, 339, 391, 404, 417, 126, 230, 334, 542, 555, 360, 568, 594, 646, 672, 776, 207, 220, 233, 649, 314, 418, 341, 187, 395, 408, 557, 583, 596, 609, 234, 650, 303, 316, 342, 355, 563, 368, 420, 771, 784, 558, 610, 189, 215, 241, 345, 397, 449, 657, 236, 587, 600, 652, 704, 403, 357, 565, 773, 190, 242,

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Các số 1, 2, 3, …, 275, và 276 sau chữ "Q" là chỉ được dùng để chỉ thị các chuỗi khác nhau, chứ không có ý nghĩa đặc biệt nào.

Có thể thấy từ các chuỗi nêu trên rằng, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì kênh mà có số tuần tự là 0, kênh mà có số tuần tự là 1, và kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự tăng dần của độ tin cậy của kênh, kênh mà có số tuần tự là 0 thì có độ tin cậy của kênh nhỏ nhất. Ngoài ra, một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự là 4 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 9 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 1005 trong chuỗi được sắp xếp thì là kênh thứ mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1014 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1015 trong chuỗi được sắp xếp thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1019 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1021 trong chuỗi được sắp xếp thì là kênh thứ ba có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1022 trong chuỗi được sắp xếp thì là kênh thứ hai có độ tin cậy của kênh theo thứ tự giảm dần

kênh mà có số tuần tự là 1023 trong chuỗi được sắp xếp thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Cần lưu ý ở đây rằng các kênh là được đánh số từ 0. Trong ứng dụng thực tế, thì các kênh có thể được đánh số từ 1. Tất nhiên là các kênh cũng có thể được đánh

số từ số khác. Điều này không bị giới hạn theo phương án này.

Fig.5 là hình vẽ thể hiện sơ đồ cấu trúc của thiết bị mã hoá 10 theo các phương án của sáng chế. Như được thể hiện trên Fig.5, thiết bị mã hoá 10 bao gồm:

môđun xử lý 11, được tạo cấu hình để thu thập chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp; trong đó

môđun xử lý 11 này còn được tạo cấu hình để xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh; và

môđun xử lý 11 này còn được tạo cấu hình để mã hoá chuỗi bit thông tin này dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá; và

môđun gửi 12, được tạo cấu hình để gửi chuỗi bit được mã hoá đến thiết bị nhận.

Thiết bị mã hoá theo phương án này được tạo cấu hình để thực hiện giải pháp kỹ thuật phía thiết bị truyền mà được đề xuất theo bất kỳ trong số các phương án về phương pháp nêu trên. Nguyên lý thực hiện và hiệu quả kỹ thuật của thiết bị mã hoá này là tương tự như của các phương án về phương pháp, nên các chi tiết không được mô tả lại ở đây.

Dựa trên các phương án nêu trên, thì chuỗi xây dựng đích là chuỗi xây dựng thu được từ nhiều chuỗi xây dựng.

Tuỳ ý, các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Tuỳ ý, độ tin cậy là được tính dựa trên công thức $W_i = \sum_{j=0}^{n-1} B_j * \beta^j$, trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62.

Tuỳ ý, tập hợp vị trí là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi

được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Tuỳ ý, tập hợp vị trí là L kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Tuỳ ý, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp có thể là bất kỳ trong số $Q1_1^{64}$, $Q2_1^{64}$, $Q3_1^{64}$, $Q4_1^{64}$, $Q5_1^{64}$, và $Q6_1^{64}$, và dạng cụ thể của chuỗi được sắp xếp đó có thể được tìm thấy trong phần mô tả ở phương án về phương pháp nêu trên.

Nếu chuỗi được lượng tử hoá được dùng làm chuỗi xây dựng, khi chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là bất kỳ trong số $Z1_1^{64}$, $Z2_1^{64}$, $Z3_1^{64}$, $Z4_1^{64}$, $Z5_1^{64}$, và $Z6_1^{64}$, và dạng cụ thể của chuỗi được lượng tử hoá có thể được tìm thấy trong phần mô tả ở phương án về phương pháp nêu trên.

Tuỳ ý, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì độ tin cậy của kênh mà có số tuần tự là 0, độ tin cậy của kênh mà có số tuần tự là 1, và độ tin cậy của kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự bình thường trong chuỗi được sắp xếp, với kênh đầu tiên trong chuỗi được sắp xếp là tương ứng với giá trị độ tin cậy nhỏ nhất.

Tuỳ ý, một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự trong chuỗi được sắp xếp là 4 thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 9 thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1005 thì là kênh thứ mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1014 thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1015 thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1019 thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1021 thì là kênh thứ ba có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1022 thì là kênh thứ hai có độ tin cậy của kênh trong chuỗi được sắp xếp theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự trong chuỗi được sắp xếp là 1023 thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Thiết bị mã hoá theo bất kỳ trong số các phương án nêu trên là được tạo cấu hình để thực hiện giải pháp kỹ thuật của phía thiết bị truyền theo bất kỳ trong số các phương án về phương pháp nêu trên. Nguyên lý thực hiện và hiệu quả kỹ thuật của thiết bị mã hoá này là tương tự như của các phương án về phương pháp, nên các chi tiết không được mô tả lại ở đây.

Fig.6 là hình vẽ thể hiện sơ đồ cấu trúc của thiết bị giải mã 20 theo các phương án của sáng chế. Như được thể hiện trên Fig.6, thiết bị giải mã 20 bao gồm:

môđun xử lý 21, được tạo cấu hình để thu thập chuỗi xây dựng đích, trong đó chuỗi xây dựng đích này bao gồm chuỗi được sắp xếp và/hoặc chuỗi được lượng tử hoá, chuỗi được sắp xếp là chuỗi thu được sau khi các số tuần tự của các kênh được sắp xếp dựa trên độ tin cậy của kênh, và chuỗi được lượng tử hoá là thu được sau khi các kết quả chuẩn hoá độ tin cậy của kênh được sắp xếp; trong đó

môđun xử lý 21 này còn được tạo cấu hình để xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh; và

môđun nhận 22, được tạo cấu hình để nhận chuỗi bit được mã hoá; trong đó

môđun xử lý 21 còn được tạo cấu hình để giải mã chuỗi bit được mã hoá này dựa trên tập hợp vị trí, để thu được chuỗi bit thông tin.

Thiết bị giải mã theo phương án này là được tạo cấu hình để thực hiện giải pháp kỹ thuật của phía thiết bị nhận theo bất kỳ trong số các phương án về phương pháp nêu trên. Nguyên lý thực hiện và hiệu quả kỹ thuật của thiết bị giải mã này là tương tự như của các phương án về phương pháp, nên các chi tiết không được mô tả lại ở đây.

Dựa trên các phương án nêu trên, thì chuỗi xây dựng đích là chuỗi xây dựng

thu được từ nhiều chuỗi xây dựng.

Tuỳ ý, các chuỗi xây dựng này là các chuỗi được xác định dựa trên độ tin cậy của các kênh mà được tính dựa trên chiều dài mã mẹ và thông số mã hoá được thiết đặt trước.

Tuỳ ý, độ tin cậy là được tính dựa trên công thức $W_i = \sum_{j=0}^{n-1} B_j * \beta^j$, trong đó W_i là độ tin cậy của kênh thứ i, $j \in \{0,1,\cdots n-1\}$, $n = \log_2 N$, N là chiều dài mã mẹ, $B_j \in \{0,1\}$, β là hằng số, và khoảng giá trị của β là từ 1 đến 1,62.

Tuỳ ý, tập hợp vị trí là P kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được sắp xếp, và P lớn hơn hoặc bằng lượng bit của các bit thông tin.

Tuỳ ý, tập hợp vị trí là L kênh có độ tin cậy cao nhất mà được chọn từ chuỗi được lượng tử hoá, và L lớn hơn hoặc bằng lượng bit của các bit thông tin.

Tuỳ ý, nếu chiều dài mã mẹ là 64, thì chuỗi được sắp xếp là bất kỳ trong số $Q1_1^{64}$, $Q2_1^{64}$, $Q3_1^{64}$, $Q4_1^{64}$, $Q5_1^{64}$, và $Q6_1^{64}$, và dạng cụ thể của chuỗi được sắp xếp đó có thể được tìm thấy trong phần mô tả ở phương án về phương pháp nêu trên.

Tuỳ ý, nếu chiều dài mã mẹ là 64, thì chuỗi được lượng tử hoá là bất kỳ trong số $Z1_1^{64}$, $Z2_1^{64}$, $Z3_1^{64}$, $Z4_1^{64}$, $Z5_1^{64}$, và $Z6_1^{64}$, và dạng cụ thể của chuỗi được lượng tử hoá đó có thể được tìm thấy trong phần mô tả ở phương án về phương pháp nêu trên.

Tuỳ ý, nếu chiều dài mã mẹ là 1024 và có 1024 kênh, thì kênh mà có số tuần tự là 0, kênh mà có số tuần tự là 1, và kênh mà có số tuần tự là 2, là được sắp xếp theo thứ tự bình thường về độ tin cậy của kênh, trong đó kênh mà có số tuần tự là 0 thì có độ tin cậy của kênh nhỏ nhất.

Tuỳ ý, một số trong số 1024 kênh đó còn tuân theo một hoặc nhiều trong số các quy tắc sau đây:

kênh mà có số tuần tự là 4 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 9 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự tăng dần; hoặc

kênh mà có số tuần tự là 1005 trong chuỗi được sắp xếp thì là kênh thứ

mười sáu có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1014 trong chuỗi được sắp xếp thì là kênh thứ mười một có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1015 trong chuỗi được sắp xếp thì là kênh thứ năm có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1019 trong chuỗi được sắp xếp thì là kênh thứ tư có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1021 trong chuỗi được sắp xếp thì là kênh thứ ba theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1022 trong chuỗi được sắp xếp thì là kênh thứ hai có độ tin cậy của kênh theo thứ tự giảm dần; hoặc

kênh mà có số tuần tự là 1023 trong chuỗi được sắp xếp thì là kênh thứ nhất có độ tin cậy của kênh theo thứ tự giảm dần.

Thiết bị giải mã theo bất kỳ trong số các phương án nêu trên là được tạo cấu hình để thực hiện giải pháp kỹ thuật phía thiết bị nhận theo bất kỳ trong số các phương án về phương pháp nêu trên. Nguyên lý thực hiện và hiệu quả kỹ thuật của thiết bị giải mã này là tương tự như của các phương án về phương pháp, nên các chi tiết không được mô tả lại ở đây.

Fig.7 là hình vẽ thể hiện sơ đồ cấu trúc của thiết bị mã hoá. Cấu trúc của thiết bị giải mã là tương tự như cấu trúc của thiết bị mã hoá. Như được thể hiện trên Fig.7, cần hiểu rằng môđun xử lý ở thiết bị mã hoá hoặc thiết bị giải mã nêu trên có thể là bộ xử lý 21 trong quá trình thực hiện cụ thể, và bộ xử lý 21 có thể được thực hiện bằng phần cứng hoặc phần mềm. Khi bộ xử lý này được thực hiện bằng phần cứng, thì bộ xử lý này có thể là mạch logic, và khi bộ xử lý này được thực hiện bằng phần mềm, thì chương trình máy tính mà được lưu giữ trong bộ xử lý này có thể được đọc bằng bộ xử lý thông dụng, hoặc chức năng của môđun xử lý này có thể được thực hiện bằng cách đọc chương trình máy tính được lưu giữ trong bộ nhớ ngoài. Bộ nhớ 22 có thể lưu giữ các chương trình khác nhau, để thực hiện các chức năng xử lý khác nhau và thực hiện các bước phương pháp theo phương án này.

Môđun gửi nêu trên có thể là bộ phát 20 trong quá trình thực hiện cụ thể, và môđun nhận có thể là bộ thu 24 trong quá trình thực hiện cụ thể.

Theo các phương án, sáng chế còn đề xuất phương tiện lưu trữ, và phương tiện lưu trữ này bao gồm phương tiện lưu trữ đọc được và chương trình máy tính. Phương tiện lưu trữ đọc được này được tạo cấu hình để lưu giữ chương trình máy tính, và chương trình máy tính này bao gồm mã, để thực hiện phương pháp mã hoá theo bất kỳ trong số các phương án nêu trên.

Theo các phương án, sáng chế còn đề xuất phương tiện lưu trữ, và phương tiện lưu trữ này bao gồm phương tiện lưu trữ đọc được và chương trình máy tính. Phương tiện lưu trữ đọc được này được tạo cấu hình để lưu giữ chương trình máy tính, và chương trình máy tính này bao gồm mã, để thực hiện phương pháp giải mã theo bất kỳ trong số các phương án nêu trên.

Theo các phương án, sáng chế còn đề xuất sản phẩm chương trình, và sản phẩm chương trình này bao gồm chương trình máy tính (tức là chỉ dẫn thực thi được). Chương trình máy tính này bao gồm mã, để thực hiện phương pháp mã hoá theo bất kỳ trong số các phương án nêu trên. Ít nhất một bộ xử lý của thiết bị truyền có thể đọc chương trình máy tính này từ phương tiện lưu trữ đọc được này, và ít nhất một bộ xử lý đó thực thi chương trình máy tính này, để thiết bị truyền này thực hiện phương pháp mã hoá theo những cách thức thực hiện nêu trên.

Theo các phương án, sáng chế còn đề xuất sản phẩm chương trình, và sản phẩm chương trình này bao gồm chương trình máy tính (tức là chỉ dẫn thực thi được). Chương trình máy tính này bao gồm mã, để thực hiện phương pháp giải mã theo bất kỳ trong số các phương án nêu trên. Ít nhất một bộ xử lý của thiết bị nhận có thể đọc chương trình máy tính này từ phương tiện lưu trữ đọc được này, và ít nhất một bộ xử lý đó thực thi chương trình máy tính này, để thiết bị nhận này thực hiện phương pháp giải mã theo những cách thức thực hiện nêu trên.

Trong quá trình thực hiện cụ thể của thiết bị truyền hoặc thiết bị nhận, thì cần hiểu rằng bộ xử lý có thể là bộ xử lý trung tâm (Central Processing Unit - CPU), hoặc có thể là bộ xử lý thông dụng khác, bộ xử lý tín hiệu số (Digital Signal Processor - DSP), mạch tích hợp chuyên dụng (Application-Specific Integrated Circuit - ASIC), v.v.. Bộ xử lý thông dụng này có thể là bộ vi xử lý, hoặc bộ xử lý nêu trên có thể là bộ xử lý thông thường bất kỳ, v.v.. Toàn bộ hoặc một số bước để thực hiện các phương án về phương pháp nêu trên là có thể được thực hiện bằng

phần cứng liên quan đến chỉ dẫn chương trình. Chương trình này có thể được lưu giữ trong bộ nhớ đọc được. Khi chương trình này chạy thì các bước của các phương án về phương pháp nêu trên được thực hiện. Bộ nhớ (phương tiện lưu trữ) nêu trên bao gồm: bộ nhớ chỉ đọc (Read-Only Memory - ROM), RAM (Random Access Memory - bộ nhớ truy cập ngẫu nhiên), bộ nhớ flash, đĩa cứng, ổ cứng thể rắn, băng từ, đĩa mềm, đĩa quang, hoặc tổ hợp bất kỳ của chúng.

YÊU CẦU BẢO HỘ

1. Phương pháp lập mã cực, được thực hiện bởi thiết bị trong mạng truyền thông không dây, trong đó phương pháp này bao gồm các bước:

thu thập chuỗi bit thông tin bao gồm K bit thông tin;

mã hoá cực chuỗi bit thông tin này dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá, trong đó chuỗi thứ nhất này bao gồm các số tuần tự của 1024 kênh được xếp thứ tự theo thứ tự tăng dần của độ tin cậy của kênh, trong đó kênh mà có số tuần tự là 0 thì được xếp hạng thứ nhất về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh và có độ tin cậy của kênh nhỏ nhất trong số 1024 kênh đó, kênh mà có số tuần tự là 1 thì được xếp hạng thứ hai về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh, và kênh mà có số tuần tự là 2 thì được xếp hạng thứ ba về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

so khớp tốc độ chuỗi bit được mã hoá này để thu được chuỗi bit được so khớp tốc độ; và

xuất ra chuỗi bit được so khớp tốc độ.

2. Phương pháp theo điểm 1, trong đó bước mã hoá cực chuỗi bit thông tin dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá là bao gồm các bước:

thu thập chuỗi bit thứ hai theo chuỗi thứ nhất, trong đó chuỗi bit thứ hai này có chiều dài là N, và N>K;

xác định các vị trí của K bit thông tin theo chuỗi bit thứ hai này; và

mã hoá cực chuỗi bit thông tin dựa trên vị trí của K bit thông tin này.

3. Phương pháp theo điểm 2, trong đó bước thu thập chuỗi bit thứ hai theo chuỗi thứ nhất là bao gồm bước:

nhận dạng chuỗi con của chuỗi thứ nhất, trong đó chuỗi con này bao gồm N số tuần tự của các kênh mà có các số tuần tự nhỏ hơn hoặc bằng 1024.

4. Phương pháp theo điểm 1, trong đó chuỗi thứ nhất chỉ thị rằng:

kênh mà có số tuần tự là 4 là được xếp hạng thứ tư về độ tin cậy của kênh theo

thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 9 là được xếp hạng thứ mười một về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1014 là được xếp hạng thứ 1014 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1015 là được xếp hạng thứ 1020 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1019 là được xếp hạng thứ 1021 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1021 là được xếp hạng thứ 1022 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1022 là được xếp hạng thứ 1023 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh; và

kênh mà có số tuần tự là 1023 là được xếp hạng thứ 1024 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh.

5. Phương pháp theo điểm 1, trong đó bước mã hoá cực chuỗi bit thông tin là bao gồm các bước:

tạo ra vectơ hàng nhị phân u_1^N, trong đó $u_1^N = (u_1, u_2, ..., u_N)$, và trong đó các vị trí bit thông tin của vectơ hàng nhị phân u_1^N là bị chiếm bởi chuỗi bit thông tin đó; và

mã hoá vectơ hàng nhị phân u_1^N theo công thức mã hoá để thu được chuỗi bit được mã hoá, trong đó công thức mã hoá là:

$$x_1^N = u_1^N G_N ,$$

trong đó $x_1^N = (x_1, x_2, ..., x_N)$ là chuỗi bit được mã hoá, và trong đó G_N là ma trận sinh mã cực có N hàng và N cột.

6. Thiết bị lập mã cực trong mạng truyền thông không dây, trong đó thiết bị này bao gồm:

ít nhất một bộ xử lý; và

bộ nhớ lưu giữ các chỉ dẫn chương trình mà khi được thực thi bởi ít nhất một bộ xử lý này thì khiến ít nhất một bộ xử lý này thực hiện các hoạt động bao gồm:

thu thập chuỗi bit thông tin bao gồm K bit thông tin;

mã hoá cực chuỗi bit thông tin này dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá, trong đó chuỗi thứ nhất này bao gồm các số tuần tự của 1024 kênh được xếp thứ tự theo thứ tự tăng dần của độ tin cậy của kênh, trong đó kênh mà có số tuần tự là 0 thì được xếp hạng thứ nhất về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh và có độ tin cậy của kênh nhỏ nhất trong số 1024 kênh đó, kênh mà có số tuần tự là 1 thì được xếp hạng thứ hai về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh, và kênh mà có số tuần tự là 2 thì được xếp hạng thứ ba về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

so khớp tốc độ chuỗi bit được mã hoá này để thu được chuỗi bit được so khớp tốc độ; và

xuất ra chuỗi bit được so khớp tốc độ.

7. Thiết bị theo điểm 6, trong đó bước mã hoá cực chuỗi bit thông tin dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá là bao gồm các bước:

thu thập chuỗi bit thứ hai theo chuỗi thứ nhất, trong đó chuỗi bit thứ hai này có chiều dài là N, và N>K;

xác định các vị trí của K bit thông tin theo chuỗi bit thứ hai này; và

mã hoá cực chuỗi bit thông tin dựa trên vị trí của K bit thông tin này.

8. Thiết bị theo điểm 7, trong đó bước thu thập chuỗi bit thứ hai theo chuỗi thứ nhất là bao gồm bước:

nhận dạng chuỗi con của chuỗi thứ nhất, trong đó chuỗi con này bao gồm N số tuần tự của các kênh mà có các số tuần tự nhỏ hơn hoặc bằng 1024.

9. Thiết bị theo điểm 6, trong đó: kênh mà có số tuần tự là 4 là được xếp hạng thứ tư về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 9 là được xếp hạng thứ mười một về độ tin cậy của

kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1014 là được xếp hạng thứ 1014 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1015 là được xếp hạng thứ 1020 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1019 là được xếp hạng thứ 1021 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1021 là được xếp hạng thứ 1022 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1022 là được xếp hạng thứ 1023 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh; và

kênh mà có số tuần tự là 1023 là được xếp hạng thứ 1024 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh.

10. Thiết bị theo điểm 6, trong đó bước mã hoá cực là bao gồm các bước:

tạo ra vectơ hàng nhị phân u_1^N, trong đó $u_1^N = (u_1, u_2, ..., u_N)$, và trong đó các vị trí bit thông tin của vectơ hàng nhị phân u_1^N là bị chiếm bởi chuỗi bit thông tin đó; và

mã hoá vectơ hàng nhị phân u_1^N theo công thức mã hoá để thu được chuỗi bit được mã hoá, trong đó công thức mã hoá là:

$$x_1^N = u_1^N G_N ,$$

trong đó $x_1^N = (x_1, x_2, ..., x_N)$ là chuỗi bit được mã hoá, và trong đó G_N là ma trận sinh mã cực có N hàng và N cột.

11. Thiết bị theo điểm 6, trong đó thiết bị này là trạm gốc hoặc thiết bị đầu cuối người dùng.

12. Phương tiện phi nhất thời đọc được bằng máy tính có lưu giữ các mã chương trình trên đó để thực thi bởi ít nhất một bộ xử lý ở thiết bị truyền thông, trong đó các

mã chương trình này bao gồm các chỉ dẫn bao gồm việc:

thu thập chuỗi bit thông tin bao gồm K bit thông tin;

mã hoá cực chuỗi bit thông tin này dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá, trong đó chuỗi thứ nhất này bao gồm các số tuần tự của 1024 kênh được xếp thứ tự theo thứ tự tăng dần của độ tin cậy của kênh, trong đó kênh mà có số tuần tự là 0 thì được xếp hạng thứ nhất về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh và có độ tin cậy của kênh nhỏ nhất trong số 1024 kênh đó, kênh mà có số tuần tự là 1 thì được xếp hạng thứ hai về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh, và kênh mà có số tuần tự là 2 thì được xếp hạng thứ ba về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

so khớp tốc độ chuỗi bit được mã hoá này để thu được chuỗi bit được so khớp tốc độ; và

xuất ra chuỗi bit được so khớp tốc độ.

13. Phương tiện phi nhất thời đọc được bằng máy tính theo điểm 12, trong đó bước mã hoá cực chuỗi bit thông tin dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá là bao gồm các bước:

thu thập chuỗi bit thứ hai theo chuỗi thứ nhất, trong đó chuỗi bit thứ hai này có chiều dài là N, và N>K;

xác định các vị trí của K bit thông tin theo chuỗi bit thứ hai này; và

mã hoá cực chuỗi bit thông tin dựa trên vị trí của K bit thông tin này.

14. Phương tiện phi nhất thời đọc được bằng máy tính theo điểm 13, trong đó bước thu thập chuỗi bit thứ hai theo chuỗi thứ nhất là bao gồm bước:

nhận dạng chuỗi con của chuỗi thứ nhất, trong đó chuỗi con này bao gồm N số tuần tự của các kênh mà có các số tuần tự nhỏ hơn hoặc bằng 1024.

15. Phương tiện phi nhất thời đọc được bằng máy tính theo điểm 12, trong đó: kênh mà có số tuần tự là 4 là được xếp hạng thứ tư về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 9 là được xếp hạng thứ mười một về độ tin cậy của

kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1014 là được xếp hạng thứ 1014 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1015 là được xếp hạng thứ 1020 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1019 là được xếp hạng thứ 1021 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1021 là được xếp hạng thứ 1022 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1022 là được xếp hạng thứ 1023 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh; và

kênh mà có số tuần tự là 1023 là được xếp hạng thứ 1024 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh.

16. Phương tiện phi nhất thời đọc được bằng máy tính theo điểm 12, trong đó các mã chương trình bao gồm các chỉ dẫn để:

tạo ra vectơ hàng nhị phân u_1^N, trong đó $u_1^N = (u_1, u_2, ..., u_N)$, và trong đó các vị trí bit thông tin của vectơ hàng nhị phân u_1^N là bị chiếm bởi chuỗi bit thông tin đó; và

mã hoá vectơ hàng nhị phân u_1^N theo công thức mã hoá để thu được chuỗi bit được mã hoá, trong đó công thức mã hoá là:

$$x_1^N = u_1^N G_N ,$$

trong đó $x_1^N = (x_1, x_2, ..., x_N)$ là chuỗi bit được mã hoá, và trong đó G_N là ma trận sinh mã cực có N hàng và N cột.

17. Thiết bị lập mã cực trong mạng truyền thông không dây, trong đó thiết bị này bao gồm: giao diện đầu vào, mạch, và giao diện đầu ra;

trong đó giao diện đầu vào được tạo cấu hình để nhập vào chuỗi bit thông tin bao gồm K bit thông tin;

trong đó mạch được tạo cấu hình để:

mã hoá cực chuỗi bit thông tin này dựa trên chuỗi thứ nhất để thu được chuỗi bit được mã hoá, trong đó chuỗi thứ nhất này bao gồm các số tuần tự của 1024 kênh được xếp thứ tự theo thứ tự tăng dần của độ tin cậy của kênh, trong đó kênh mà có số tuần tự là 0 thì được xếp hạng thứ nhất về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh và có độ tin cậy của kênh nhỏ nhất trong số 1024 kênh đó, kênh mà có số tuần tự là 1 thì được xếp hạng thứ hai về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh, và kênh mà có số tuần tự là 2 thì được xếp hạng thứ ba về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh; và

so khớp tốc độ chuỗi bit được mã hoá này để thu được chuỗi bit được so khớp tốc độ; và

trong đó giao diện đầu ra được tạo cấu hình để xuất ra chuỗi bit được so khớp tốc độ.

18. Thiết bị theo điểm 17, trong đó mạch nêu trên còn được tạo cấu hình để:

thu thập chuỗi bit thứ hai theo chuỗi thứ nhất, trong đó chuỗi bit thứ hai này có chiều dài là N, và N>K;

xác định các vị trí của K bit thông tin theo chuỗi bit thứ hai này; và

mã hoá cực chuỗi bit thông tin dựa trên vị trí của K bit thông tin này.

19. Thiết bị theo điểm 18, trong đó mạch nêu trên còn được tạo cấu hình để:

nhận dạng chuỗi con của chuỗi thứ nhất, trong đó chuỗi con này bao gồm N số tuần tự của các kênh mà có các số tuần tự nhỏ hơn hoặc bằng 1024.

20. Thiết bị theo điểm 17, trong đó chuỗi thứ nhất chỉ thị rằng:

kênh mà có số tuần tự là 4 là được xếp hạng thứ tư về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 9 là được xếp hạng thứ mười một về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1014 là được xếp hạng thứ 1014 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1015 là được xếp hạng thứ 1020 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1019 là được xếp hạng thứ 1021 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1021 là được xếp hạng thứ 1022 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh;

kênh mà có số tuần tự là 1022 là được xếp hạng thứ 1023 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh; và

kênh mà có số tuần tự là 1023 là được xếp hạng thứ 1024 về độ tin cậy của kênh theo thứ tự tăng dần của độ tin cậy của kênh.

21. Thiết bị theo điểm 17, trong đó mạch nêu trên còn được tạo cấu hình để:

tạo ra vectơ hàng nhị phân u_1^N, trong đó $u_1^N = (u_1, u_2, ..., u_N)$, và trong đó các vị trí bit thông tin của vectơ hàng nhị phân u_1^N là bị chiếm bởi chuỗi bit thông tin đó; và

mã hoá vectơ hàng nhị phân u_1^N theo công thức mã hoá để thu được chuỗi bit được mã hoá, trong đó công thức mã hoá là:

$$x_1^N = u_1^N G_N ,$$

trong đó $x_1^N = (x_1, x_2, ..., x_N)$ là chuỗi bit được mã hoá, và trong đó G_N là ma trận sinh mã cực có N hàng và N cột.

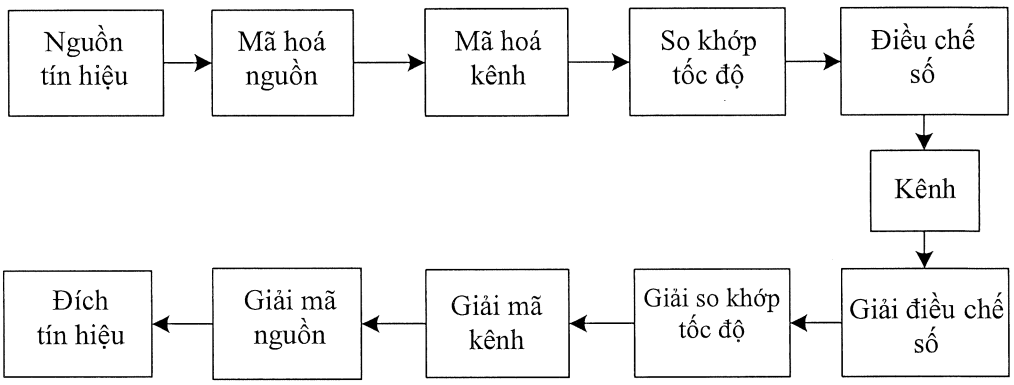
Nguồn tín hiệu
Mã hoá nguồn
Mã hoá kênh
So khớp tốc độ
Điều chế số
Kênh
Giải điều chế số
Giải so khớp tốc độ
Giải mã kênh
Giải mã nguồn
Đích tín hiệu

Fig.1

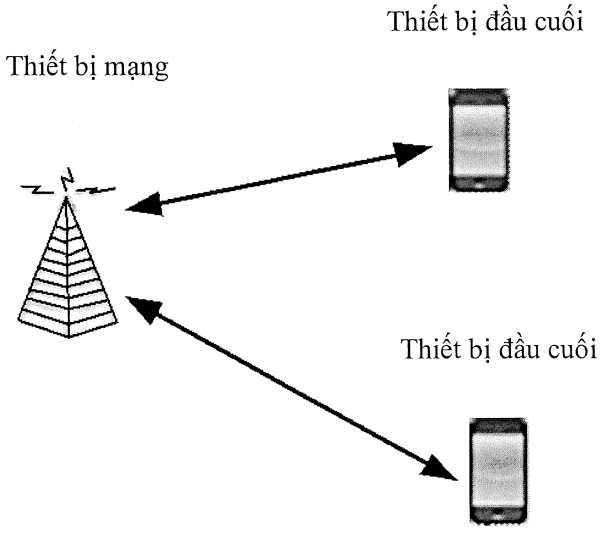
Thiết bị đầu cuối
Thiết bị mạng
Thiết bị đầu cuối

Fig.2

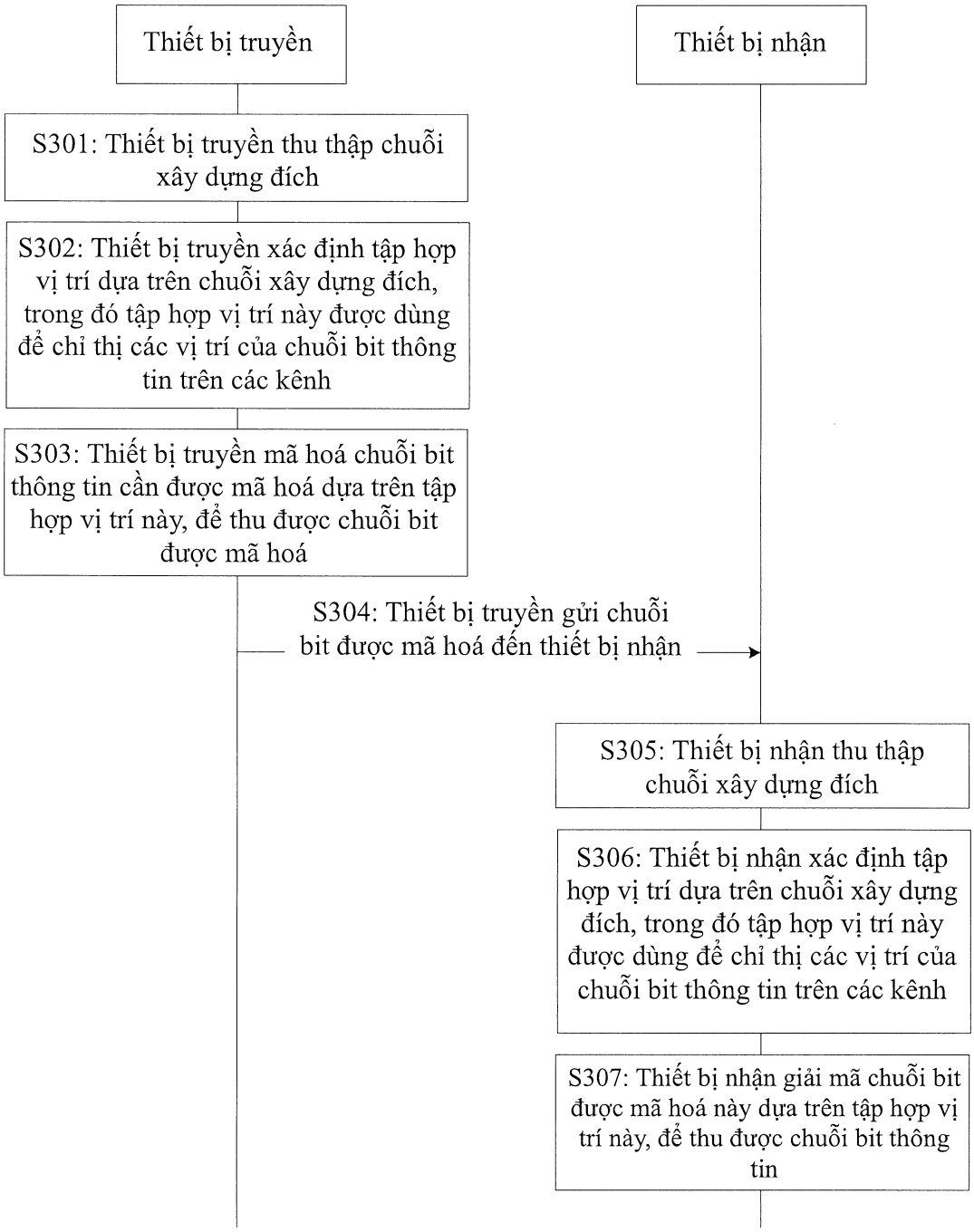
Thiết bị truyền
Thiết bị nhận
S301: Thiết bị truyền thu thập chuỗi xây dựng đích
S302: Thiết bị truyền xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh
S303: Thiết bị truyền mã hoá chuỗi bit thông tin cần được mã hoá dựa trên tập hợp vị trí này, để thu được chuỗi bit được mã hoá
S304: Thiết bị truyền gửi chuỗi bit được mã hoá đến thiết bị nhận
S305: Thiết bị nhận thu thập chuỗi xây dựng đích
S306: Thiết bị nhận xác định tập hợp vị trí dựa trên chuỗi xây dựng đích, trong đó tập hợp vị trí này được dùng để chỉ thị các vị trí của chuỗi bit thông tin trên các kênh
S307: Thiết bị nhận giải mã chuỗi bit được mã hoá này dựa trên tập hợp vị trí này, để thu được chuỗi bit thông tin

Fig.3

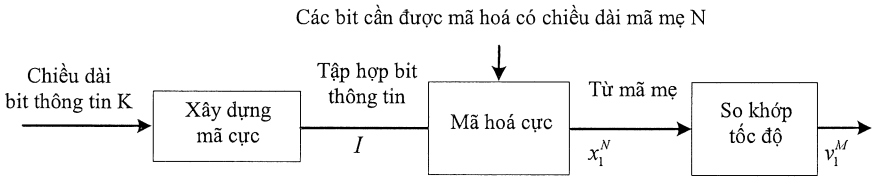

Fig.4

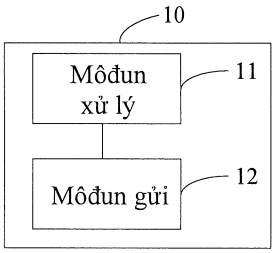

Fig.5

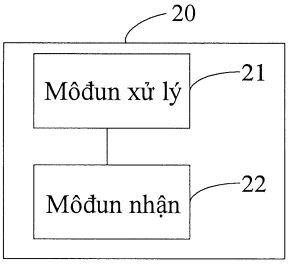

Fig.6

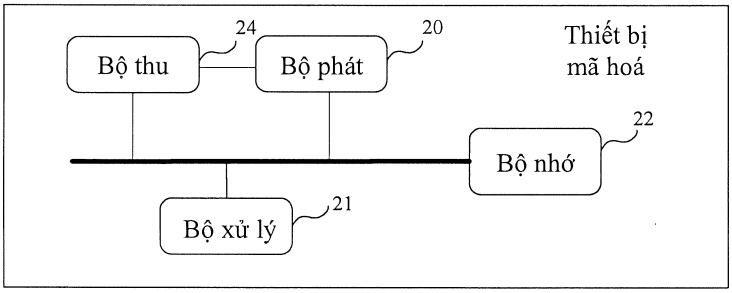

Fig.7