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2000 12 15

(73) 416

(72) 14-1

(74)
:

(54)

K ; K
+1 -1 ;
2 K-1 ; K-1 ;
K 가 ; K 가
, DS-CDMA K

5

1
2a
2b 2a (K-1) PN
3a
3b 3a
4
5

(Pseudo Noise, PN) (Direct-Sequence
 , DS) (Code Division Multiple Access, CDMA) IS(Interim Standard)
 CDMA (Spread-Spectrum) , IMT(International Mobile Telecommunication)-2000
 -95 가 가 가 CDMA 가
 PN (jamming) (spreading) 가 (intercept) 가 (RAKE) (diversity)
 IS-95 (symbol duration) DS (chip) DS PN PN
 (binary) 64 PN
 64 DS (despreading) PN (code acquisition) (tracking)
 PN DS PN PN (p
 DS PN PN , 가
 artial correlation) PN (threshold) (search)
 가 PN 가 PN
 가 PN (uncertainty region) IS-95 PN 가 327
 68(=2¹⁵) 32768
 (serial), (parallel), (hybrid)
 가
 가 가
 가
 (active correlator) PN (matched)
 PN N PN N-
 (chip-by-chip)
 1 PN (100),
 (MUX, 102, 103, 104), (105, 106, 107)
 K PN PN (100) K PN
 PN PN 가 0 +d_n
 , 1 -d_n , MUX(102, 103, 104) (chip rate) PN 가 0 d_n
 PN PN 가 0 d_n , PN 가 1 -d_n PN
 UX(102, 103, 104) K PN 가 1
 K PN S₀ ~ S_{K-1}

, N
 2a PN (201), 2 (202) K 2a N (200),
 N 1 (200) PN (201, 202, 203) PN 가
 (200) 가 N S₀ ~ S_{K-1}
 , 가
 2b 2a PN (K-1) PN PN
 2b PN (K-1) (203), (211, 212, 213) (214)
 (211, 212, 213) 2a (200) N d_{N-1} ~ d₀ N
 C_{K-1,N-1} ~ C_{K-1,0} S₀ ~ S_{K-1} (214) (211, 212, 213) K-1
 , PN
 , 가 K
 가
 PN PN
 K K PN PN
 PN DS-CDMA PN
 , K ; K
 , K
 ; 2^{K-1} +1 ; -1 ; K
 -1 ; 가 K 가 ; K
 ; ; K N N ; K N
 ; ; N N ;
 ; 가 K 2^{K-1} 가 ;
 K ;
 N ; K ; K
 , K
 가 K ; K
 ;
 3a PN 3a PN PN 가 (
 300), (MUX, 310), (Addressing Logic, 320), (330), (340), 가 (
 350) (360) PN PN PN PN
 3a PN , PN (sub-sum)
 , K K-1 , K
 PN PN

PN (300) d_n K PN

$c_{0,n}, c_{1,n}, \dots, c_{K-1,n}$ (310) d_n PN (300) PN $c_{0,n}$

0 $d_n, c_{0,n}$ 1 $-d_n$, ,

$c_{0,n}$ (320) 2^{K-1} (340) MUX(310) 3b (XOR, 371, 373)

(320) K-1 (380) XOR(371, 372, 373) $c_{0,n}, c_{1,n}, c_{2,n}$

2, 373) K-1 (380) $c_{0,n}=0$ $[c_{1,n}, c_{2,n}, \dots, c_{K-1,n}]$, $c_{0,n}=1$

$c_{1,n}, \dots, c_{K-1,n}$ [$c_{1,n}, c_{2,n}, \dots, c_{K-1,n}$]

(330) (380) MUX(310) 2^{K-1} (340) PN

(340) 가 (350) (340) 가 , K PN

MUX(310) S_0, \dots, S_{K-1} 가 , K PN

(360) PN S_0, \dots, S_{K-1} 가 , K PN

(320), (330), (340) 가 (350)

$c_{k,n}$ (0 n $N-1$) 가 PN C_0, C_1, \dots, C_{K-1} , C_k (0 k $K-1$)

1

$$C_0 = [c_{0,0} \ c_{0,1} \ \dots \ c_{0,N-1}]$$

$$C_1 = [c_{1,0} \ c_{1,1} \ \dots \ c_{1,N-1}]$$

...

$$C_{K-1} = [c_{K-1,0} \ c_{K-1,1} \ \dots \ c_{K-1,N-1}]$$

(KxN) C

2

$$C = [C_0 \ C_1 \ \dots \ C_{K-1}]^T = [D_0 \ D_1 \ \dots \ D_{K-1}]$$

PN C , K=2 K=2 $D_n = (c_{0,n}, c_{1,n})$ 가

가 $(1,1), (-1,-1), (1,-1), (-1,1)$ 가 $c_{0,n} = c_{1,n}$

$c_{0,n} = -c_{1,n}$ 2 D_n G_0 D_n

가 d_0, d_1, \dots, d_4 , 가 $C_0 = \{1 \ 1 \ -1 \ 1 \ -1\}$, $C_1 = \{1 \ 1 \ 1 \ -1 \ -1\}$,

PN 가 S_0, S_1

3

$$S_0 = (d_0 + d_1 - d_4) + (-d_2 + d_3) = S_{00} + S_{01}$$

$$S_1 = (d_0 + d_1 - d_4) - (-d_2 + d_3) = S_{00} - S_{01}$$

$$S_{00} \ C_0 \ G_0 \ S_{01} \ G_1$$

K=3 , D_n $2^2 = 4$ 가 가

$G_0 : c_{0,n} = c_{1,n} = c_{2,n}$, $G_1 : c_{0,n} = c_{1,n} = -c_{2,n}$, $G_2 : c_{0,n} = -c_{1,n} = c_{2,n}$, $G_3 : -c_{0,n} = c_{1,n} = c_{2,n}$

$D_n = (c_{0,n}, c_{1,n}, c_{2,n}) = (1,1,1) \ (-1,-1,-1) \ (1,1,-1) \ (-1,-1,1)$ G_0 , G_1 , G_2 , G_3

$(-1, 1, -1) G_2, (-1, 1, 1) (1, -1, -1) G_3$. , 가

[1]

	D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆	D ₇
C ₀	1	1	1	1	-1	-1	-1	1
C ₁	1	-1	-1	-1	1	-1	-1	1
C ₂	1	-1	1	-1	-1	1	-1	-1

D₁ D₃ G₃ D₀ D₆ G₀ . 가 , D₅ D₇ G₁ , D₂ D₄ G₂ , S_k 3

4

$$S_0 = (d_0 - d_6) + (-d_5 + d_7) + (d_2 - d_4) + (d_1 + d_3) = S_{00} + S_{01} + S_{02} + S_{03}$$

$$S_1 = (d_0 - d_6) + (-d_5 + d_7) - (d_2 - d_4) - (d_1 + d_3) = S_{00} + S_{01} - S_{02} - S_{03}$$

$$S_2 = (d_0 - d_6) - (-d_5 + d_7) + (d_2 - d_4) - (d_1 + d_3) = S_{00} - S_{01} + S_{02} - S_{03}$$

, S₀₀ ~ S₀₃ G₀ ~ G₃ C₀ . K=3

K=4 , 가 2^{K-1} = 8 . G₀ ~ G₇ C₀ S₀₀ ~ S₀₇ , 0 3 S₀ ~ S₃

5

$$S_0 = S_{00} + S_{01} + S_{02} + S_{03} + S_{04} + S_{05} + S_{06} + S_{07}$$

$$S_1 = S_{00} + S_{01} + S_{02} + S_{03} - S_{04} - S_{05} - S_{06} - S_{07}$$

$$S_2 = S_{00} + S_{01} - S_{02} - S_{03} + S_{04} + S_{05} - S_{06} - S_{07}$$

$$S_3 = S_{00} - S_{01} + S_{02} - S_{03} + S_{04} - S_{05} + S_{06} - S_{07}$$

K=4 8

6

$$S_0 = (S_{00} + S_{01} + S_{02} + S_{03}) + (S_{04} + S_{05} + S_{06} + S_{07}) = S_{000} + S_{001}$$

$$S_1 = (S_{00} + S_{01} + S_{02} + S_{03}) - (S_{04} + S_{05} + S_{06} + S_{07}) = S_{000} - S_{001}$$

S₀₀₀ S₀₀₁ , K=4

7

$$S = \begin{bmatrix} S_{00} & S_{01} & S_{02} & S_{03} & S_{04} & S_{05} & S_{06} & S_{07} \\ S_{00} & S_{01} & S_{02} & S_{03} & -S_{04} & -S_{05} & -S_{06} & -S_{07} \\ S_{00} & S_{01} & -S_{02} & -S_{03} & S_{04} & S_{05} & -S_{06} & -S_{07} \\ S_{00} & -S_{01} & S_{02} & -S_{03} & S_{04} & -S_{05} & S_{06} & -S_{07} \end{bmatrix}$$

S , S₁ ~ 4 S₀ ~ S₃ . S 8

, S
 (S₀₀ = S₀₀ = S₀₀ = S₀₀)
 (S₀₁ = S₀₁ = S₀₁ = -S₀₁)
 D_n G₀ ~ G₇
 G₀
 G₁
 가
 0 ~ G₇
 S
 4
 7
 S
 S'
 0~7
 S'
 1 1
 가
 '+', '0', '-', '1'

8

$$S = \begin{bmatrix} + & + & + & + & + & + & + & + \\ + & + & + & + & - & - & - & - \\ + & + & - & - & + & + & - & - \\ + & - & + & - & + & - & + & - \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \end{bmatrix} = [0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7]$$

0~7
 K
 가
 0 2^{K-1} -1
 K
 2^{K-1}
 S
 K
 2
 , K=4 4

9

$$S_0 = (S_{00} + S_{01} + S_{02} + S_{03}) + (S_{04} + S_{05} + S_{06} + S_{07}) = S_{000} + S_{001}$$

$$S_1 = (S_{00} + S_{01} + S_{02} + S_{03}) - (S_{04} + S_{05} + S_{06} + S_{07}) = S_{000} - S_{001}$$

$$S_2 = (S_{00} - S_{03} + S_{04} - S_{07}) + (S_{01} - S_{02} + S_{05} - S_{06}) = S_{002} + S_{003}$$

$$S_3 = (S_{00} - S_{03} + S_{04} - S_{07}) - (S_{01} - S_{02} + S_{05} - S_{06}) = S_{002} - S_{003}$$

9
 S₀ S₁ S₀₀₀ S₀₀₁, S₂ S₃ S₀₀₂ S
 003
 4
 PN
 (Tapped Delay Line, 410), PN
 (420), (420),
 431, 432, 433), (440), 가 (450) (460)
 (410)
 (420) PN () N PN
 PN [c_{0,0} c_{0,1} ... c_{0,N}] N 2^{K-1}
 (431, 432, 433) (410) (420)
 (440) N (431, 432, 433) (420)
 가 (450) 2^{K-1} 가 , K PN
 (460) S₀, ..., S_{K-1} PN
 S₀, ..., S_{K-1} PN
 IS-95 (forward link) 가 20
 4 PN , K=4 N=20 가
 d₁₉ 4 20 가
 D_n

[2]

	D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆	D ₇	D ₈	D ₉	D ₁₀	D ₁₁	D ₁₂	D ₁₃	D ₁₄	D ₁₅	D ₁₆	D ₁₇	D ₁₈	D ₁₉
C ₀	-1	1	1	1	1	-1	1	-1	-1	-1	-1	1	1	-1	-1	1	-1	-1	1	1
C ₁	-1	1	1	-1	-1	1	-1	-1	1	1	-1	1	-1	1	-1	1	1	-1	1	-1
C ₂	-1	1	-1	1	-1	1	1	-1	1	-1	1	-1	-1	1	1	-1	-1	1	1	-1
C ₃	1	-1	-1	1	1	-1	-1	1	1	-1	1	1	-1	1	-1	1	1	-1	1	-1
n of C _i	1	1	3	4	6	6	5	1	7	4	3	2	7	7	2	2	5	2	0	7

2⁴⁻¹ = 8

PN C₀

10

$$G_0: S_{00} = d_{18}$$

$$G_1: S_{01} = -d_0 + d_1 - d_7$$

$$G_2: S_{02} = d_{11} - d_{14} + d_{15} - d_{17}$$

$$G_3: S_{03} = d_2 - d_{10}$$

$$G_4: S_{04} = -d_3 - d_9$$

$$G_5: S_{05} = d_6 - d_{16}$$

$$G_6: S_{06} = d_4 - d_5$$

$$G_7: S_{07} = -d_8 + d_{12} - d_{13} + d_{19}$$

10

20

4

11

$$S_0 = (S_{00} + S_{01} + S_{02} + S_{03}) + (S_{04} + S_{05} + S_{06} + S_{07}) = S_{000} + S_{001}$$

$$S_1 = (S_{00} + S_{01} + S_{02} + S_{03}) - (S_{04} + S_{05} + S_{06} + S_{07}) = S_{000} - S_{001}$$

$$S_2 = (S_{00} - S_{03} + S_{04} - S_{07}) + (S_{01} - S_{02} + S_{05} - S_{06}) = S_{002} + S_{003}$$

$$S_3 = (S_{00} - S_{03} + S_{04} - S_{07}) - (S_{01} - S_{02} + S_{05} - S_{06}) = S_{002} - S_{003}$$

5 44 24 4 4x20=80
 DS-CDMA 5 PN (500),
 (510), (520), (530) PN (500),
 (500) (chip rate) d_n K
 PN (310,) N PN (50
 0) K PN PN
 (520) (510) 가 PN
 (530) (520) PN
 (510) (411,) (312)
 (511) PN (500) K
 가 (sub-sum) K
 (312) (311) PN PN

, DS-CDMA , K

N K 가 , K가 가 KxN , PN
 가 K 가 K

(57)

1. K ; +1 -1
 K ;

2 K-1 ;
 K-1 ;

K 가 K 가 ;

2. 1 , K-1 K-1 ;

K-1
 2 K-1 ;

3. K N ;
 N N K N ;

2 K-1 가 K 가 ;

4. K ;

K K N , K 가 ;

K , ;

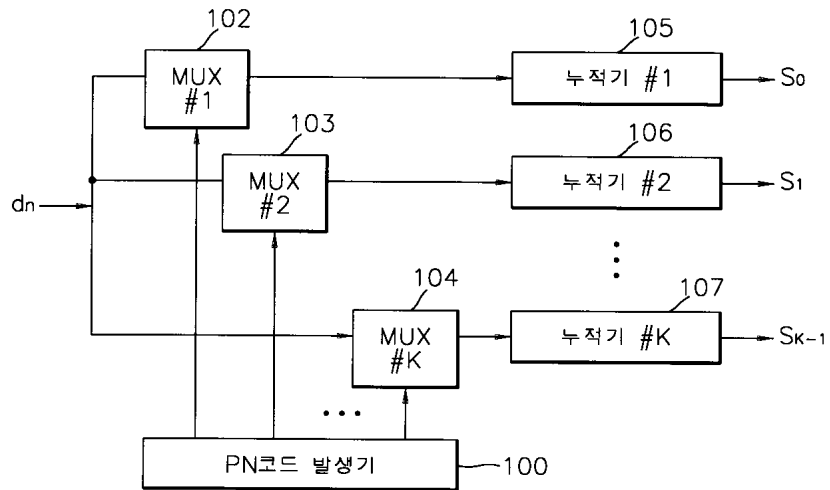
5. 4 K , K 가 ;

K ;

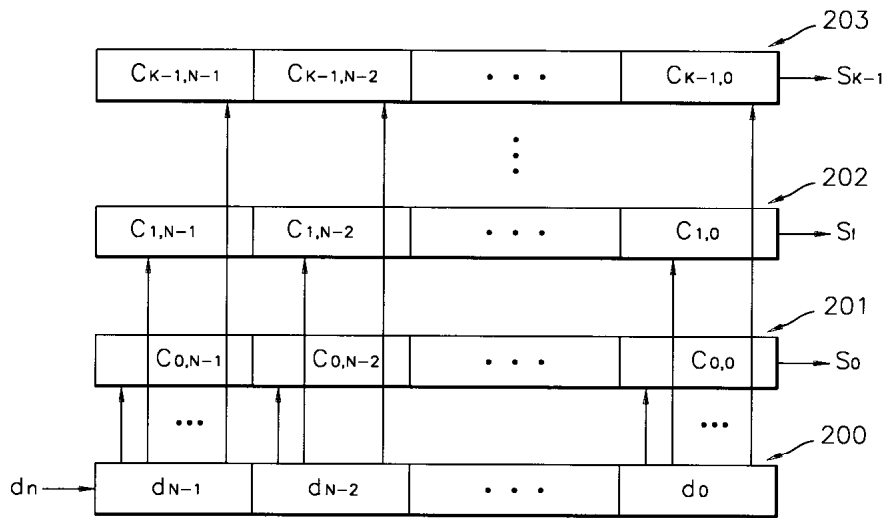
6. 5 ,

$+1$ -1 K ; 2^{K-1} ;
 $K-1$; 가 K 가 ;
 K .
 7. , $K-1$ $K-1$; ;
 2^{K-1} ;
 8. , K N ; ;
 N N ; ;
 2^{K-1} 가 K ; 가 ;
 K .

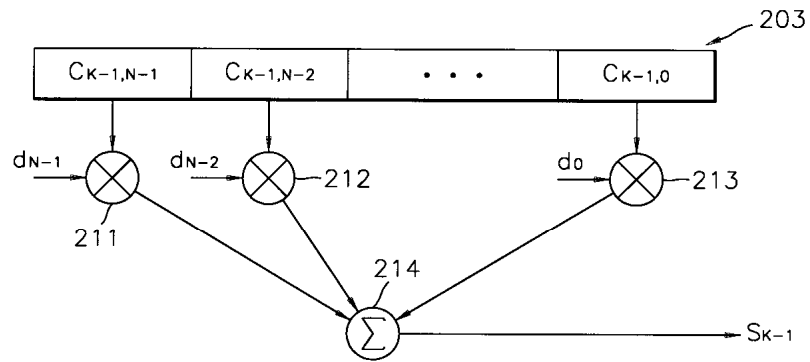
1



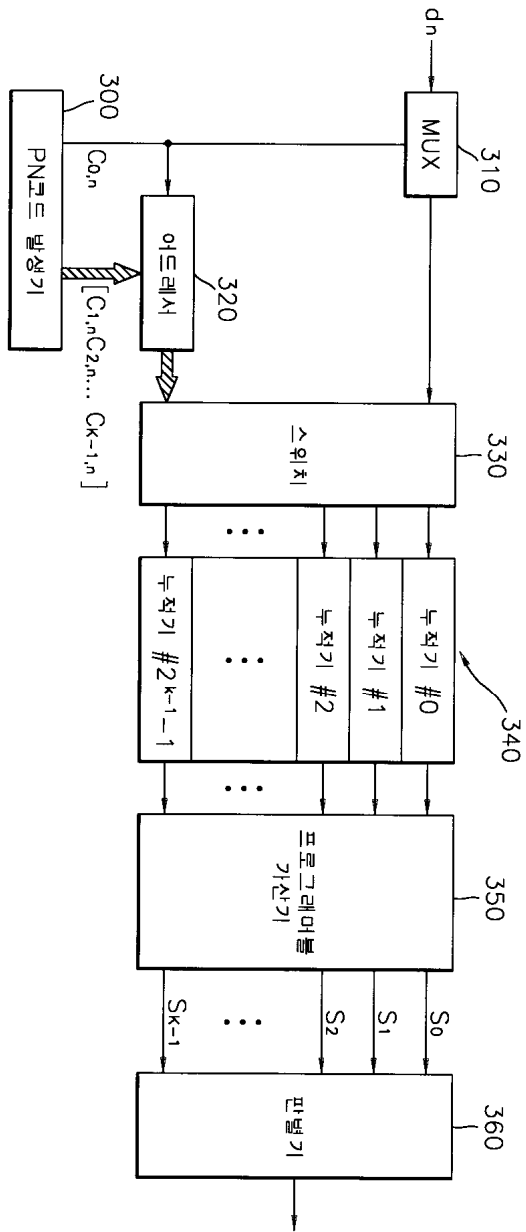
2a



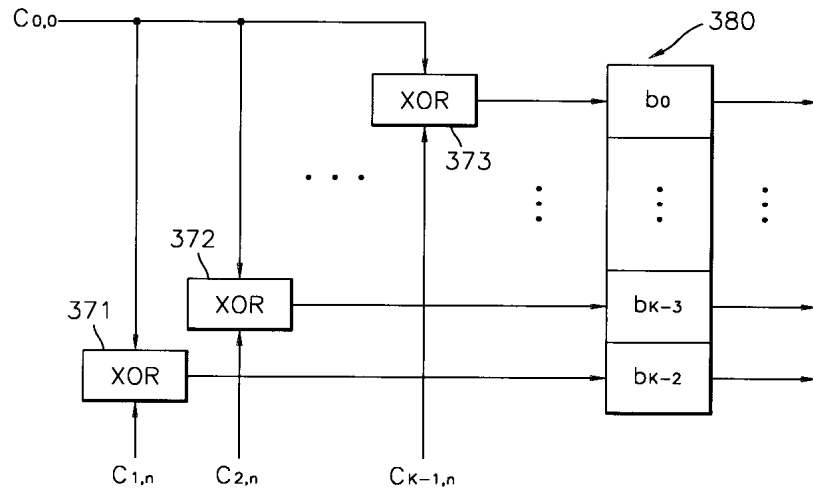
2b



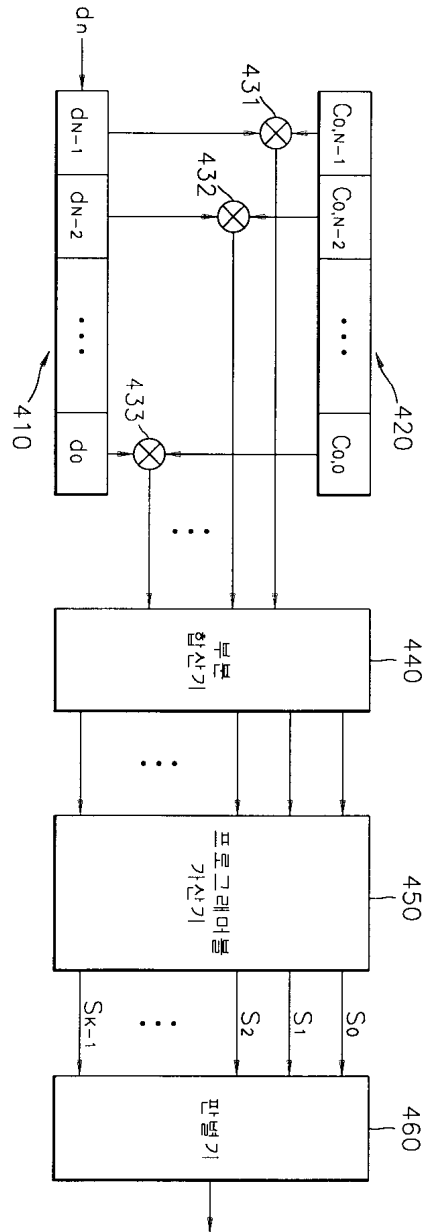
3a



3b



4



5

