(19) (KR)
(12) (A)

(11) 10-2010-0041694
(43) 2010 04 22

(51) Int. Cl.

H04J 11/00 (2006.01) *H04B 7/26* (2006.01)

(21) 10-2009-7011805
(22) ( ) 2008 07 11

(85) 2009 06 08
(86) PCT/KR2008/004101
(87) WO 2009/011523
2009 01 22
(30)
60/950,002 2007 07 16 (US)
( )

: 20

(71)
416

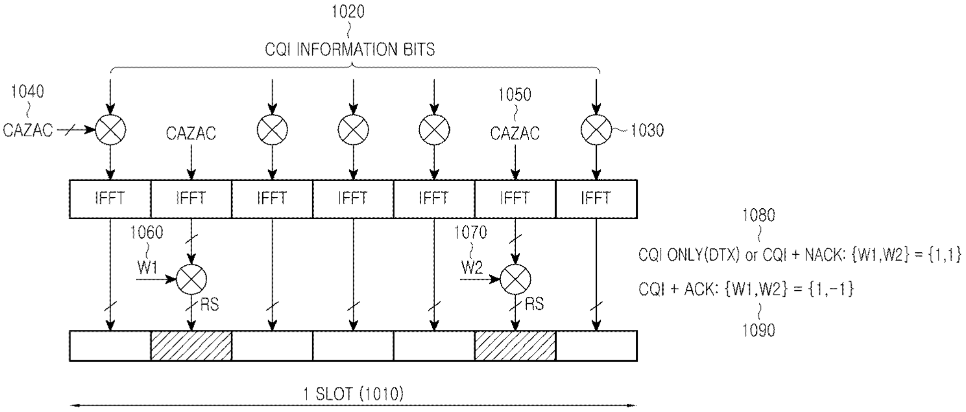
(72)
,
, 75204, , 3530
317
2
224 101

(74)

(54) -

(57)

SC-FDMA CQI TTI(transmission time interval) UE Node B (ACK NACK,) CQI . UE . UE ACK NACK CQI TTI (RS : Reference Signal) UE . Node B , UE ACK NACK RS . , ACK/NACK NACK .


1020
CQI INFORMATION BITS
1040
CAZAC
CAZAC
1050
CAZAC
1030
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
1060
W1
RS
1070
W2
RS
1080
CQI ONLY(DTX) or CQI + NACK: {W1,W2} = {1,1}
CQI + ACK: {W1,W2} = {1,−1}
1090
1 SLOT (1010)

(30)

60/954,171	2007	08	06	(US)
61/019,624	2008	01	08	(US)

1

(duration) , 1 2
, 1 , 2 2
1 ,

1 1 , 1 1 ;

1 2 , 2 1 ;

1 .

2

1 , 1 ,

(ACK) (NACK) (ACK/NACK)
.

3

1 , 2 ,

CQI(Channel Quality Indication) .

4

1 ,

1 2 , 1 {1, 1} , 2 {1, -1}
.

5

, 1 2 ,
1 , 2 2
1 ,

1 1 1 ;

1 1 ;

2 2 1 ;

2 2 ;

1 2 ;

1 2 1 1
;

2 1 1 2
.

6

5 , 1 ,

(ACK) (NACK) (ACK/NACK)

.

7

5 , 2 ,

CQI(Channel Quality Indication) .

8

5 ,

1 2 , 1 1

, 2 1 , 1 2

.

9

5 ,

1 2 , 1 {1, 1} , 2 {1, -1}

.

10

(ACK/NACK) , ,

1 2 , 1

(positive) (negative) (ACK/NACK)

,

(NACK) , 1 1 ;

(ACK) , 2 1 ;

, 1 1 ;

1 .

11

10 ,

1 2 , 1 {1, 1} , 2 {1, -1}

.

12

10 , ,

.

13

, 1 2 ,
1 , 2 2
1 ,

1 1 , 1 1 , 1
2 , 2 1 ;

1 .

14

13 , 1 ,

(ACK) (NACK) (ACK/NACK)
.

15

13 , 2 ,

CQI .

16

13 , 1 2 , 1 {1, 1} , 2
{1, -1} .

17

13 , ,

.

18

(ACK/NACK) , ,
1 2 , 1
(positive) (negative) (ACK/NACK)
,

(NACK) , 1 1
, (ACK) , 2 1 ;

1 .

19

18 , 1 2 , 1 {1, 1} , 2 {1, -1} .

20

18 , ,

.

[0001] , SC-FDMA(Single-Carrier Frequency Division Multiple Access) , 3GPP(3rd Generation Partnership Project) E-UTRA(Evolved Universal Terrestrial Radio Access) LTE(Long Term Evolution) .

[0002] , SC-FDMA (positive) (negative) (ACKs NACKs,) CQI(Channel Quality Indicator) .

[0003] (proper functionality) . (content) (UpLink: UL) UE(User Equipment) (serving) (Base Station(BS) Node B) , (DownLink: DL) Node B UE .

[0004] UL , PUSCH(Physical Uplink Shared CHannel) UE , , PUCCH(Physical Uplink Control Channel) UE . (terminal) (mobile station) UE , (wireless device), (cellular phone), (personal computer device), (wireless modem card) . Node B , BTS(Base Transceiver System), (access point) .

[0005] ACK/NACK HARQ(Hybrid Automatic Repeat reQuest) (application) , (HARQ-ACK) DL (reception) (correct) (incorrect) . NACK , ACK .

[0006] CQI , DL operating bandwidth DL operating bandwidth SINR(Signal-to-Interference and Noise Ratio) Node B . UE ACK/NACK CQI .

[0007] UE - (sub-frame) TTI(Transmission Time Interval) .

[0008] 1 - (110) . -

(slot) . (120) / . (130) CP(Cyclic Prefix) . operating bandwidth . , (pilot) RS(Reference Signal) , (pilot) (coherent) . - TTI .

[0009] (Transmission BandWidth) RB(Resource Block) (unit) . RB 12 - (sub-carrier) , UE PUSCH RB , PUCCH 1 RB . , , .

[0010] 2 SC-FDMA (210) CQI . CQI (220) (230) CAZAC(Constant Amplitude Zero Auto-Correlation) (240) , QPSK 16QAM . IFFT(Inverse Fast Fourier Transform) UE . CQI , RS CQI Node B . , SC-FDMA RS (250) .

[0011] , CQI RS CAZAC (sequence) . < 1> .

1

[0012]

$$c_k(n) = \exp\left[\frac{j2\pi k}{L}\left(n + n\frac{n+1}{2}\right)\right]$$

[0013] < 1> L CAZAC , n n={0, 1, 2, ... , L-1} (element) , k . L , L , L-1 (distinct sequence) . , CAZAC {1, 2, ... , L-1} k . CQI RS CAZAC .

[0014] L CAZAC , L-1 . RB 12 - RB CAZAC ACK/NACK ( ) ( ) (, length 13) CAZAC (, length 11) CAZAC . CAZAC CAZAC (computer) .

[0015] 3 SC-FDMA CAZAC . 3 PUCCH CQI .

[0016] 3 , CAZAC (310) (CQI , RS) , (shift)(320) . DFT(Discrete Fourier Transform)(330) , - (340) (350), IFFT (360), CP(Cyclic prefix)(370) (380) . (zero padding) (guard) - ( ) UE - (reference) UE .

[0017] , , 3 - (digital-to-analog

converter), , , 3 . , QPSK CQI .

[0018] (inverse)( ) . 3 4 .

[0019] ( ), RF(radio-frequency) , (, , - , -) (time windowing unit)(420) CP (430). , FFT(440) , - (460) (450), Inverse DFT(IDFT)(470) , RS CQI (de-multiplexe)( )(480) , RS( ) , CQI (490) .

[0020] , , .

[0021] 5 CAZAC .

[0022] 5 , CAZAC . CAZAC (version) (510)(, CAZAC DFT , (chain) .), (550) IFFT(540) . - (530) (520) , (580) CP(560) (570) ( ) 3 .

[0023] 5 CAZAC- . 6 , (610) (620) CP (630). , (640), FFT(650) , - (660) (665). 6 CAZAC- (670) . , (690) RS - (interpolator) , CAZAC- CQI , .

[0024] , 3 5 CAZAC- ( ) , RS . CQI , CAZAC- CQI (, QPSK). 3 5 CQI CAZAC . 2 CAZAC .

[0025] CAZAC CAZAC . , CAZAC RS CQI RB UE , UE . 7 . 7 , CAZAC (710, 730, 750, 770) (root) CAZAC (720, 740, 760 780) , Δ(790) D( ) . T_S (duration) , T_S/D (floor) . 12 66 (1 - 14) , 5.5 . , , 6 11 .

[0026] - 2 1RB 5CQI 2RS CQI UL .(2 , .) - operating bandwidth , operating bandwidth .(RB .) , .

[0027] , UE UE PUCCH CQI - , DL

ACK/NACK .(, UE PUSCH .) ACK/NAK CQI (capacity) UE ACK/NACK CQI . 8 .

[0028] (810) ACK/NACK 2 , CQI SC-FDMA RS (840) CQI (830 835) ACK/NACK (820) . CQI , ACK/NACK CAZAC- (860) (850). - , - . , CQI RS ACK/NACK CAZAC .

[0029] 8 CQI - ACK/NACK , CQI CQI . , CQI , (codeword) .(ACK/NACK .)

[0030] CQI CQI , 8 ACK/NACK (CQI) (, RS .) , ACK/NACK ACK/NACK .

[0031] , PUCCH ACK/NACK CQI (puncturing) .

[0032] , CQI ACK/NACK CQI - ACK/NACK .

[0033] CQI CQI - ACK/NACK .

[0034] , CQI - ACK/NACK .

[0035] , , UE ACK/NACK CQI .

[0036] , ACK/NACK CQI ACK/NACK CQI .

[0037] , ACK/NACK CQI , ACK/NACK CQI .

[0038] , ACK/NACK .

[0039] , CQI ACK/NACK .

[0040] , B(serving Node B) , UE ACK/NACK ACK/NACK CQI (robust) .

[0041] , ACK/NACK CQI Node B ACK/NACK , CQI

UE .

[0042] , (hypothesis) .

[0043] , ACK/NACK CQI Node B ACK/NACK , CQI UE .

[0044] , ACK/NACK CQI Node B UE ACK/NACK (potential) , CQI Node B .

[0056] . , . , , , .

[0057] , SC-FDMA , FDM , OFDMA(Orthogonal FDMA), OFDM, FDMA, DFT(Discrete Fourier Transform)-spread OFDM, DFT-spread OFDMA, SC-OFDMA(Single-Carrier OFDMA), SC OFDM .

[0058] UE CQI (ACK/NACK) , , ACK/NACK CQI , , CQI (signaling) .

[0059] , PUCCH UE CQI , , UE HARQ(Hybrid Automatic Repeat reQuest)(HARQ-ACK) ACK/NACK - . AKC/NACK , CQI . , CQI , CQI (drop) .

[0060] (SC-FDMA) CQI (RS) ACK/NACK . UE ACK/NACK RS .

[0061] ACK/NACK ACK/NACK CQI RS 9 . 2 9 , (910) CQI (920) , CAZAC- (940) (930) . RS(950) ( ) CAZAC- . -2 , W1(960) W2(970) RS . (ACK) (NACK) . , ACK/NACK UE , ACK/NACK RS .

[0062] 9 RS (-2 / (Walsh/Hadamard code)) , Node B CQI ACK/NACK , - , RS . , (noise) .

[0063] , , (decision metric) , CQI, CQI ACK, CQI NACK .

(RS power) ,
. CQI ACK/NACK
.

[0064] , Node B , - , RS
. (complex signal)
.
. , ,
RS , CQI
RS .

[0065] RS
, ACK/NACK .
CQI . , CQI ACK/NACK
, ACK/NACK .

[0066] , 9 W1 W2 . IFFT RS(1)
, (invert)(-1) . UE RS (RS
RS) , RS

, , RS
.

[0067] RS CQI ACK/NACK
. , ACK/NACK RS
, QPSK ACK/NACK RS .

[0068] RS CQI ACK/NACK
, ACK/NACK .

[0069] , UE , Node B
ACK/NACK , ,
CQI ACK/NACK .
UE ACK/NACK , (ACK/NACK)
(Discontinuous Transmission, "DTX") .

[0070] Node B UE ,
, ACK DTX Node B .

, .

[0071] NACK DTX Node B , HARQ
NACK DTX , , DTX NACK
, ,
.

[0072] , (systematic)
,
, . ,
, .

[0073] (trade-off) Node B 3- (ACK, NACK, DTX) 2-
. ACK/NACK
.

[0074] PUCCH CQI RS
. DTX NACK

, Node B DTX NACK .

[0075] 1- ACK/NACK , 10 . 10 , 9
ACK NACK .

[0076] 10 , DTX NACK (1080) , .
CQI(ACK/NACK) , RS
, DTX NACK {1, 1} . , CQI ACK RS
{1, -1} (1090) .

[0077] ACK/NACK PUCCH CQI , Node B 10
(binary) ,
. {1, -1}(ACK) 2 RS SC-FDMA
("-1") , {1, 1}(DTX NACK)
. , Node B UE (10)
.

[0078] ,
,
.

[0045] , ,
;

[0046] 1 SC-FDMA .

[0047] 2 CQI 1 .

[0048] 3 CAZAC- CQI (reference signal)
SC-FDMA .

[0049] 4 CAZAC- CQI (reference signal)
SC-FDMA .

[0050] 5 CAZAC- CQI (reference signal)
SC-FDMA .

[0051] 6 CAZAC- CQI (reference signal)
SC-FDMA .

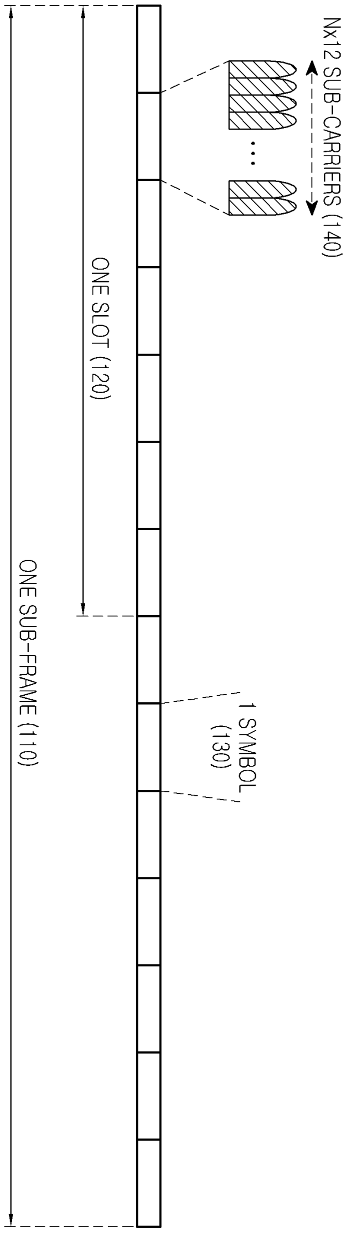
[0052] 7 (root) CAZAC- CAZAC-
.

[0053] 8 CQI ACK/NACK CQI ACK/NACK
.

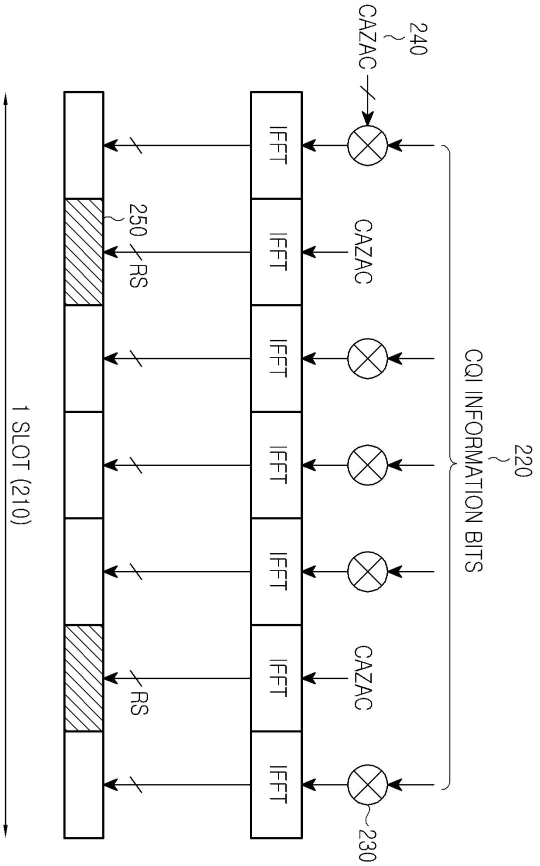
[0054] 9 (reference signal) CQI
ACK/NACK , ACK/NACK
.

[0055] 10 (reference signal) , CQI
ACK/NACK , ACK/NACK
, NACK , ACK/NACK
.

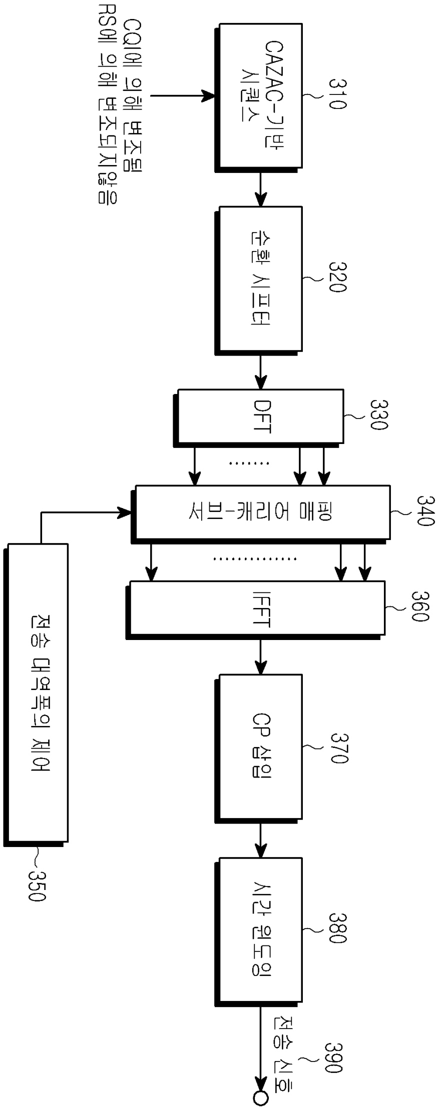
1


Nx12 SUB-CARRIERS (140)
ONE SLOT (120)
1 SYMBOL (130)
ONE SUB-FRAME (110)

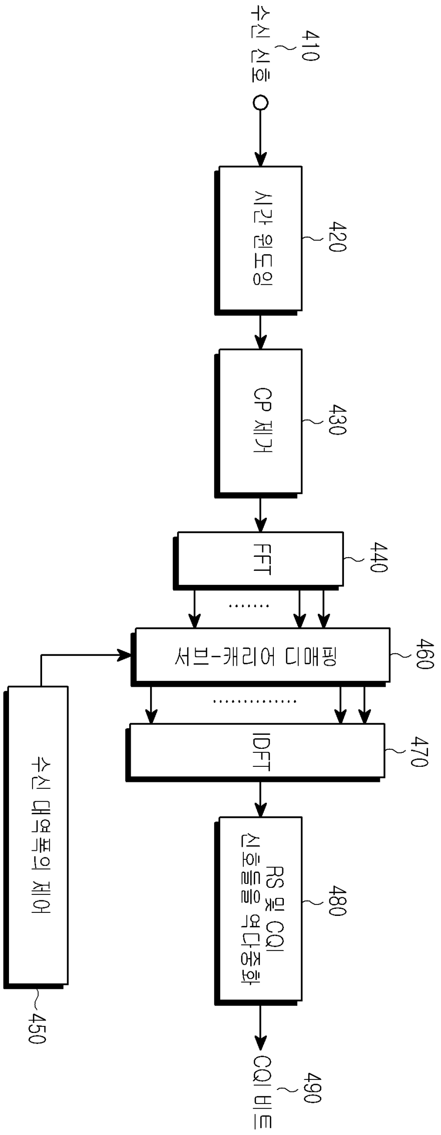
2


240
CAZAC
CQI INFORMATION BITS
220
CAZAC
CAZAC
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
250
RS
RS
230
1 SLOT (210)

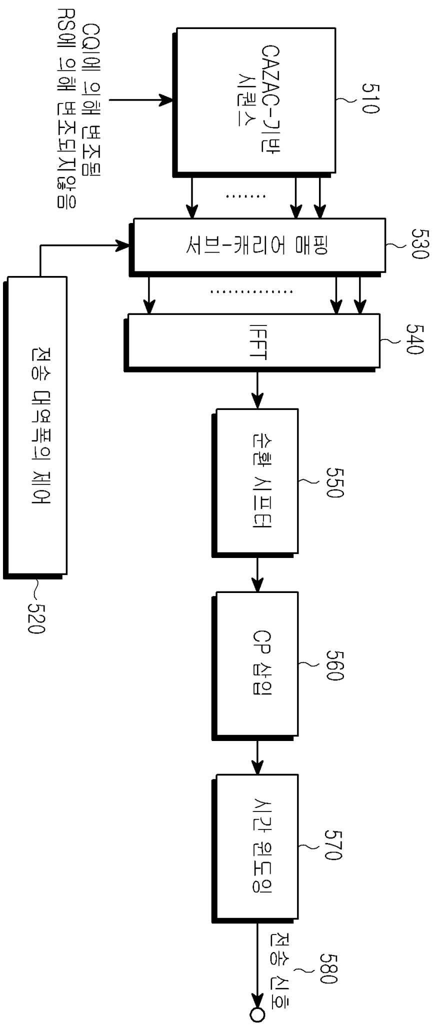
3


310
CAZAC-기반 시퀀스
CQI에 의해 변조됨
RS에 의해 변조되지 않음
320
순환 시프터
330
DFT
340
서브-캐리어 매핑
360
IFFT
350
전송 대역폭의 제어
370
CP 삽입
380
시간 윈도잉
390
전송 신호

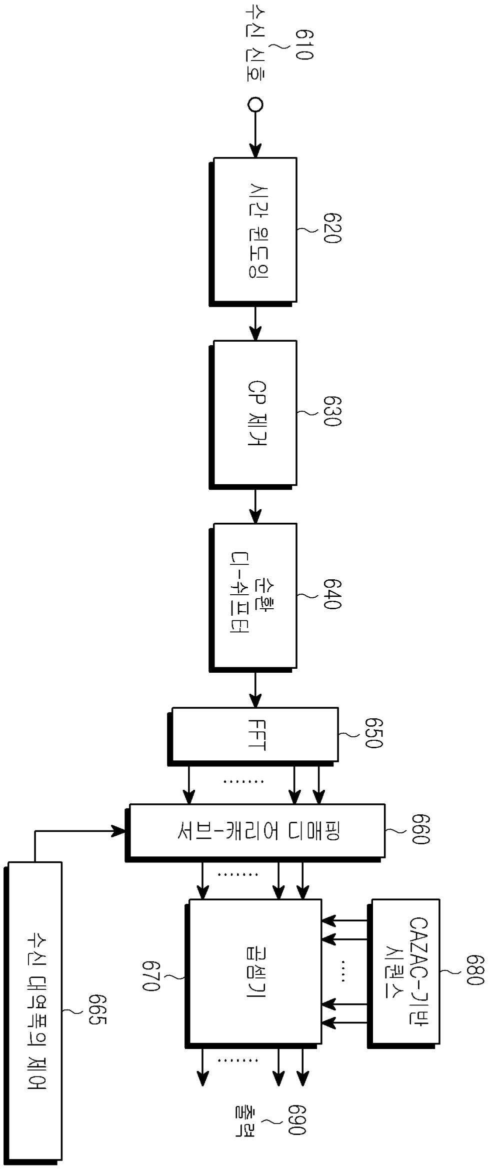
4


410
수신 신호
420
시간 윈도잉
430
CP 제거
440
FFT
460
서브-캐리어 디매핑
470
IDFT
480
RS 및 CQI 신호들을 역다중화
490
CQI 비트
450
수신 대역폭의 제어

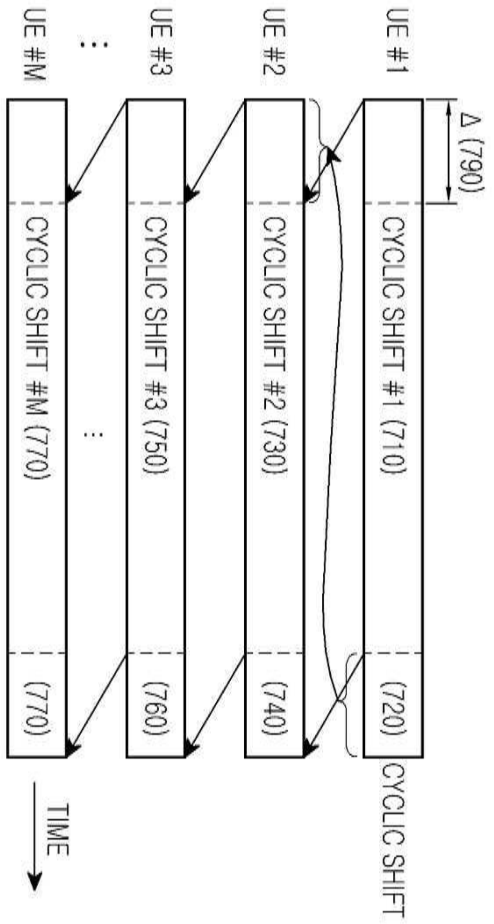
5


510
CAZAC-기반 시퀀스
CQI에 의해 변조됨
RS에 의해 변조되지않음
530
서브-캐리어 매핑
520
전송 대역폭의 제어
540
IFFT
550
순환 시프터
560
CP 삽입
570
시간 윈도잉
580
전송 신호

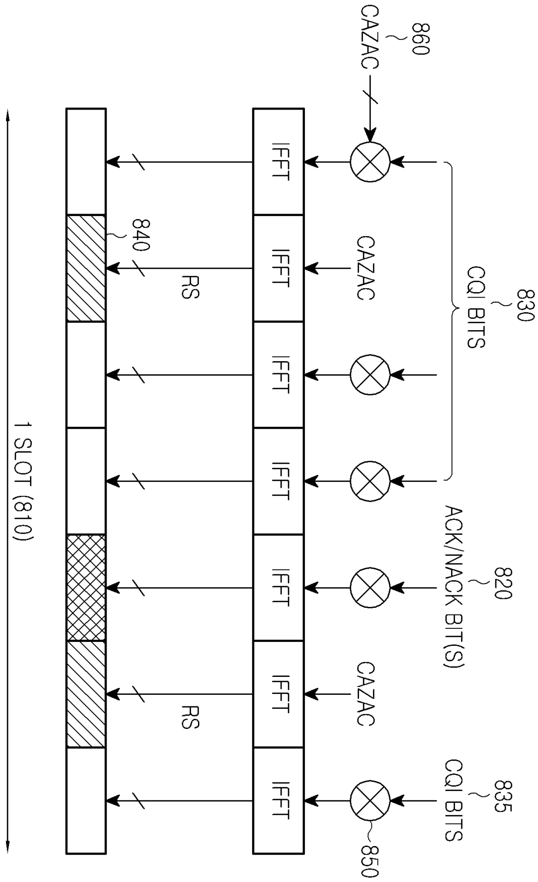
6


610
수신 신호
620
시간 윈도잉
630
CP 제거
640
순환 디-쉬프터
650
FFT
660
서브-캐리어 디매핑
665
수신 대역폭의 제어
670
곱셈기
680
CAZAC-기반 시퀀스
690
출력

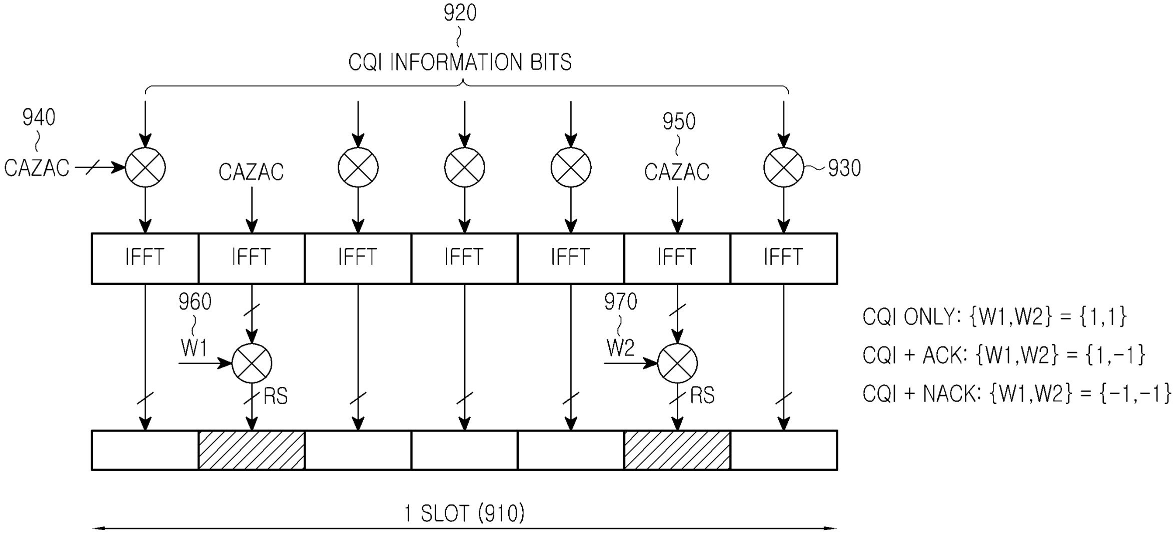
7


UE #1
UE #2
UE #3
…
UE #M
Δ (790)
CYCLIC SHIFT #1 (710)
(720)
CYCLIC SHIFT
CYCLIC SHIFT #2 (730)
(740)
CYCLIC SHIFT #3 (750)
(760)
CYCLIC SHIFT #M (770)
(770)
TIME

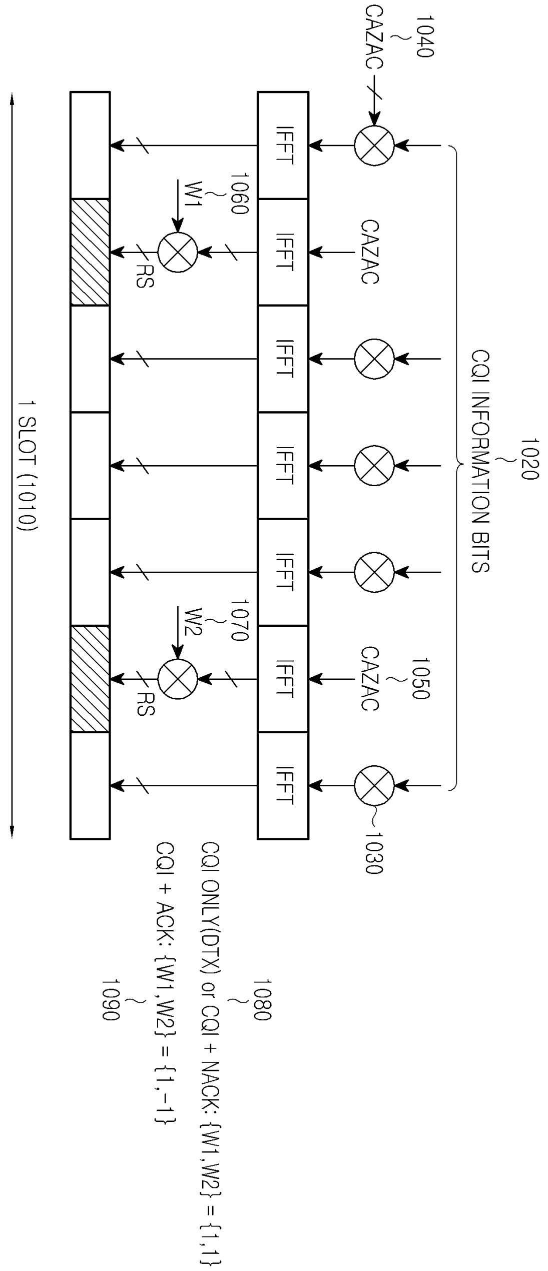
8


860
CAZAC
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
CAZAC
830
CQI BITS
820
ACK/NACK BIT(S)
CAZAC
835
CQI BITS
850
840
RS
RS
1 SLOT (810)

9


920
CQI INFORMATION BITS
940
CAZAC
CAZAC
950
CAZAC
930
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
IFFT
960
W1
RS
970
W2
RS
1 SLOT (910)
CQI ONLY: {W1,W2} = {1,1}
CQI + ACK: {W1,W2} = {1,-1}
CQI + NACK: {W1,W2} = {-1,-1}

10


1040
CAZAC
1020
CQI INFORMATION BITS
1050
CAZAC
1030
IFFT
1060
W1
RS
1070
W2
RS
1 SLOT (1010)
1080
CQI ONLY(DTX) or CQI + NACK: {W1,W2} = {1,1}
1090
CQI + ACK: {W1,W2} = {1,-1}