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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	1426-077.101
First Named Inventor	Yu-Hsuan Guo
Title	Method and Apparatus for Delivery of Control...
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [✓] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [ ] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✓] **Specification** [*Total Pages* 43] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✓] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 19]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [✓] Newly executed (original or copy)
   b. [ ] A copy from a prior application (37 CFR 1.63(d))
7. [✓] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

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ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✓] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [ ] **Other:** _____

Note:* (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✓] The address associated with Customer Number: 106622 **OR** [ ] Correspondence address below

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Signature	/Sang N. Dang/	Date	June 7, 2016
Name (Print/Type)	Sang N. Dang	Registration No. (Attorney/Agent)	51,186

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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FEE TRANSMITTAL

Complete if known	
Application Number	Not Yet Assigned
Filing Date	Herewith
First Named Inventor	Yu-Hsuan Guo
Examiner Name	Not Yet Assigned
Art Unit	Not Yet Assigned
Practitioner Docket No.	1426-077.101

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) 1600.00

METHOD OF PAYMENT (check all that apply)

☐ Check ☑ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☐ Deposit Account Deposit Account Number: _____ Deposit Account Name: _____

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**Fees Paid ($)**
Utility	280	140*	70	600	300	150	720	360	180	1600.00
Design	180	90	45	120	60	30	460	230	115	
Plant	180	90	45	380	190	95	580	290	145	
Reissue	280	140	70	600	300	150	2,160	1,080	540	
Provisional	260	130	65	0	0	0	0	0	0	

* The $140 small entity status filing fee for a utility application is further reduced to $70 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	**Undiscounted Fee ($)**	**Small Entity Fee ($)**	**Micro Entity Fee ($)**
Each claim over 20 (including Reissues)	80	40	20
Each independent claim over 3 (including Reissues)	420	210	105
Multiple dependent claims	780	390	195

Total Claims		**Extra Claims**	**Fee ($)**		**Fee Paid ($)**
20	-20 or HP =	_____	x _____	=	_____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		**Extra Claims**	**Fee ($)**		**Fee Paid ($)**
3	-3 or HP =	_____	x _____	=	_____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	
Fee ($)	**Fee Paid ($)**
_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		**Extra Sheets**		**Number of each additional 50 or fraction thereof**		**Fee ($)**		**Fee Paid ($)**
62	- 100 =	_____	/ 50 =	_____ (round up to a whole number)	x	_____	=	_____

4. OTHER FEE(S) **Fees Paid ($)**

Non-English specification, $130 fee (no small or micro entity discount) _____

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity) _____

Other (e.g., late filing surcharge): _____ _____

SUBMITTED BY

Signature	/Sang N. Dang/	Registration No. (Attorney/Agent) 51,186	Telephone (714) 839-3800
Name (Print/Type)	Sang N. Dang		Date June 7, 2016

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Attorney Docket No.: 1426-077.101
Client Docket No.: IS1040143-1040154-US
Filed Via EFS

METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present Application claims the benefit of U.S. Provisional Patent Application Serial No. 62/174,716 filed on June 12, 2015 and U.S. Provisional Patent Application Serial No. 62/183,460 filed on June 23, 2015, the entire disclosures of which are incorporated herein in their entirety by reference.

FIELD

[0002] This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for delivery of control signaling in a wireless communication system.

BACKGROUND

[0003] With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

[0004] An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

Samsung Exhibit 1002, Page 3 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

SUMMARY

[0005] A method and apparatus for delivery of control signaling in a wireless communication system are disclosed. In one embodiment, the method includes communicating with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols. The method also includes transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 shows a diagram of a wireless communication system according to one exemplary embodiment.

[0007] FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or UE) according to one exemplary embodiment.

[0008] FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

[0009] FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

[0010] FIG. 5 is a reproduction of Figure 5.1-1 of 3GPP TS 36.300.

[0011] FIG. 6 is a reproduction of Figure 5.1-2 of 3GPP TS 36.300.

[0012] FIG. 7 is a reproduction of Figure 6.2.2-1 of 3GPP TS 36.211.

[0013] FIG. 8 is a reproduction of Table 6.2.3-1 of 3GPP TS 36.211.

[0014] FIG. 9 is a reproduction of Table 6.9.3-1 of 3GPP TS 36.211.

[0015] FIG. 10 is a reproduction of Table 6.10.3.2-1 of 3GPP TS 36.211.

[0016] FIG. 11 is a reproduction of Table 6.10.3.2-2 of 3GPP TS 36.211.

[0017] FIG. 12 is a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300.

[0018] FIG. 13 is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300.

[0019] FIG. 14 is a reproduction of Figure 3-2 of METIS Deliverable D2.4.

[0020] FIG. 15 is a diagram of a subframe according to one exemplary embodiment.

[0021] FIG. 16 is a flow chart according to one exemplary embodiment.

[0022] FIG. 17 is a flow chart according to one exemplary embodiment.

[0023] FIG. 18 is a flow chart according to one exemplary embodiment.

[0024] FIG. 19 is a message diagram according to one exemplary embodiment.

[0025] FIG. 20 is a message diagram according to one exemplary embodiment.

[0026] FIG. 21 is a message diagram according to one exemplary embodiment.

DETAILED DESCRIPTION

[0027] The exemplary wireless communication systems and devices described below employ a wireless communication system, supporting a broadcast service. Wireless communication systems are widely deployed to provide various types of communication such as voice, data, and so on. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), 3GPP LTE (Long Term Evolution) wireless access, 3GPP LTE-A or LTE-Advanced (Long Term Evolution Advanced), 3GPP2 UMB (Ultra Mobile Broadband), WiMax, or some other modulation techniques.

[0028] In particular, the exemplary wireless communication systems devices described below may be designed to support the wireless technology discussed in the various documents, including: " DOCOMO 5G White Paper" by NTT Docomo, Inc. and METIS Deliverable D2.4, "Proposed solutions for new radio access". Furthermore, the exemplary wireless communication systems devices described below may be designed to support one or more standards such as the

standard offered by a consortium named "3rd Generation Partnership Project" referred to herein as 3GPP, including: TS 36.300 V12.5.0, "E-UTRA and E-UTRAN Overall description"; 3GPP TS 36.211 V12.5.0, "E-UTRA Physical channels and modulation"; TS 36.331 V12.5.0, "E-UTRA RRC protocol specification"; TS 36.321 V12.5.0, "E-UTRA MAC protocol specification"; and TS 36.213 V12.5.0, "E-UTRA Physical layer procedures". The standards and documents listed above are hereby expressly incorporated by reference in their entirety.

[0029] FIG. 1 shows a multiple access wireless communication system according to one embodiment of the invention. An access network 100 (AN) includes multiple antenna groups, one including 104 and 106, another including 108 and 110, and an additional including 112 and 114. In FIG. 1, only two antennas are shown for each antenna group, however, more or fewer antennas may be utilized for each antenna group. Access terminal 116 (AT) is in communication with antennas 112 and 114, where antennas 112 and 114 transmit information to access terminal 116 over forward link 120 and receive information from access terminal 116 over reverse link 118. Access terminal (AT) 122 is in communication with antennas 106 and 108, where antennas 106 and 108 transmit information to access terminal (AT) 122 over forward link 126 and receive information from access terminal (AT) 122 over reverse link 124. In a FDD system, communication links 118, 120, 124 and 126 may use different frequency for communication. For example, forward link 120 may use a different frequency then that used by reverse link 118.

[0030] Each group of antennas and/or the area in which they are designed to communicate is often referred to as a sector of the access network. In the embodiment, antenna groups each are designed to communicate to access terminals in a sector of the areas covered by access network 100.

[0031] In communication over forward links 120 and 126, the transmitting antennas of access network 100 may utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 116 and 122. Also, an access network using beamforming to transmit to access terminals scattered randomly through its coverage causes less interference to access terminals in neighboring cells than an access network transmitting through a single antenna to all its access terminals.

[0032] An access network (AN) may be a fixed station or base station used for communicating with the terminals and may also be referred to as an access point, a Node B, a base station, an enhanced base station, an evolved Node B (eNB), or some other terminology. An access terminal (AT) may also be called user equipment (UE), a wireless communication device, terminal, access terminal or some other terminology.

[0033] FIG. 2 is a simplified block diagram of an embodiment of a transmitter system 210 (also known as the access network) and a receiver system 250 (also known as access terminal (AT) or user equipment (UE)) in a MIMO system 200. At the transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to a transmit (TX) data processor 214.

[0034] In one embodiment, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

[0035] The coded data for each data stream may be multiplexed with pilot data using OFDM techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on a particular modulation scheme (e.g., BPSK, QPSK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed by processor 230.

[0036] The modulation symbols for all data streams are then provided to a TX MIMO processor 220, which may further process the modulation symbols (e.g., for OFDM). TX MIMO processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. In certain embodiments, TX MIMO processor 220 applies beamforming weights to the symbols of the data streams and to the antenna from which the symbol is being transmitted.

[0037] Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

[0038] At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r. Each receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

[0039] An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 260 is complementary to that performed by TX MIMO processor 220 and TX data processor 214 at transmitter system 210.

[0040] A processor 270 periodically determines which pre-coding matrix to use (discussed below). Processor 270 formulates a reverse link message comprising a matrix index portion and a rank value portion.

[0041] The reverse link message may comprise various types of information regarding the communication link and/or the received data stream. The reverse link message is then processed by a TX data processor 238, which also receives traffic data for a number of data streams from a data source 236, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

[0042] At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and

processed by a RX data processor 242 to extract the reserve link message transmitted by the receiver system 250. Processor 230 then determines which pre-coding matrix to use for determining the beamforming weights then processes the extracted message.

[0043] Turning to FIG. 3, this figure shows an alternative simplified functional block diagram of a communication device according to one embodiment of the invention. As shown in FIG. 3, the communication device 300 in a wireless communication system can be utilized for realizing the UEs (or ATs) 116 and 122 in FIG. 1 or the base station (or AN) 100 in FIG. 1, and the wireless communications system is preferably the LTE system. The communication device 300 may include an input device 302, an output device 304, a control circuit 306, a central processing unit (CPU) 308, a memory 310, a program code 312, and a transceiver 314. The control circuit 306 executes the program code 312 in the memory 310 through the CPU 308, thereby controlling an operation of the communications device 300. The communications device 300 can receive signals input by a user through the input device 302, such as a keyboard or keypad, and can output images and sounds through the output device 304, such as a monitor or speakers. The transceiver 314 is used to receive and transmit wireless signals, delivering received signals to the control circuit 306, and outputting signals generated by the control circuit 306 wirelessly. The communication device 300 in a wireless communication system can also be utilized for realizing the AN 100 in FIG. 1.

[0044] FIG. 4 is a simplified block diagram of the program code 312 shown in FIG. 3 in accordance with one embodiment of the invention. In this embodiment, the program code 312 includes an application layer 400, a Layer 3 portion 402, and a Layer 2 portion 404, and is coupled to a Layer 1 portion 406. The Layer 3 portion 402 generally performs radio resource control. The Layer 2 portion 404 generally performs link control. The Layer 1 portion 406 generally performs physical connections.

[0045] Frame structure in LTE, as discussed in 3GPP TS 36.300, is organized into radio frames and each radio frame (e.g., 10ms) is divided into ten subframes. Each subframe may include two slots:

5 Physical Layer for E-UTRA

Downlink and uplink transmissions are organized into radio frames with 10 ms duration. Two radio frame structures are supported:

- Type 1, applicable to FDD;
- Type 2, applicable to TDD.

Frame structure Type 1 is illustrated in Figure 5.1-1 [which is reproduced as FIG. 5 of the present application]. Each 10 ms radio frame is divided into ten equally sized sub-frames. Each sub-frame consists of two equally sized slots. For FDD, 10 subframes are available for downlink transmission and 10 subframes are available for uplink transmissions in each 10 ms interval. Uplink and downlink transmissions are separated in the frequency domain.

Frame structure Type 2 is illustrated in Figure 5.1-2 [which is reproduced as FIG. 6 of the present application]. Each 10 ms radio frame consists of two half-frames of 5 ms each. Each half-frame consists of eight slots of length 0.5 ms and three special fields: DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is configurable subject to the total length of DwPTS, GP and UpPTS being equal to 1ms. Both 5ms and 10ms switch-point periodicity are supported. Subframe 1 in all configurations and subframe 6 in configuration with 5ms switch-point periodicity consist of DwPTS, GP and UpPTS. Subframe 6 in configuration with 10ms switch-point periodicity consists of DwPTS only. All other subframes consist of two equally sized slots.

For TDD, GP is reserved for downlink to uplink transition. Other Subframes/Fields are assigned for either downlink or uplink transmission. Uplink and downlink transmissions are separated in the time domain.

[0046] Furthermore, each downlink slot includes $N_{\text{symb}}^{\text{DL}}$ OFDM (Orthogonal Frequency Division Multiplexing) symbols as shown in FIGS. 7 and 8. FIG. 7 is a reproduction of Figure 6.2.2-1 of 3GPP TS 36.211. FIG. 8 is a reproduction of Table 6.2.3-1 of 3GPP TS 36.211.

[0047] LTE has several physical layer downlink control signaling. *MasterInformationBlock* (MIB) provides necessary system information, including downlink bandwidth, system frame number, and PHICH configuration for UEs in the cell, as discussed in 3GPP TS 36.331 as follows:

– ***MasterInformationBlock***

The *MasterInformationBlock* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: E-UTRAN to UE

MasterInformationBlock

```
-- ASN1START

MasterInformationBlock ::=    SEQUENCE {
   dl-Bandwidth               ENUMERATED {
                              n6, n15, n25, n50, n75, n100},
   phich-Config               PHICH-Config,
   systemFrameNumber          BIT STRING (SIZE (8)),
   spare                      BIT STRING (SIZE (10))
}

-- ASN1STOP
```

***MasterInformationBlock* field descriptions**
dl-Bandwidth
Parameter: transmission bandwidth configuration, N_{RB} in downlink, see TS 36.101 [42, table 5.6-1]. n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on.
systemFrameNumber
Defines the 8 most significant bits of the SFN. As indicated in TS 36.211 [21, 6.6.1], the 2 least significant bits of the SFN are acquired implicitly in the P-BCH decoding, i.e. timing of 40ms P-BCH TTI indicates 2 least significant bits (within 40ms P-BCH TTI, the first radio frame: 00, the second radio frame: 01, the third radio frame: 10, the last radio frame: 11). One value applies for all serving cells of a Cell Group (i.e. MCG or SCG). The associated functionality is common (i.e. not performed independently for each cell).

[0048] MIB is carried by the first 4 symbols in the second slot of the first subframe in a radio frame, as discussed in 3GPP TS 36.211 as follows:

6.6.4 Mapping to resource elements

The block of complex-valued symbols $y^{(p)}(0),...,y^{(p)}(M_{\text{symb}}-1)$ for each antenna port is transmitted during 4 consecutive radio frames starting in each radio frame fulfilling $n_{\text{f}} \bmod 4 = 0$ and shall be mapped in sequence starting with $y(0)$ to resource elements (k,l). The mapping to resource elements (k,l) not reserved for transmission of reference signals shall be in increasing order of first the index k, then the index l in slot 1 in subframe 0 and finally the radio frame number. The resource-element indices are given by

$$k = \frac{N_{\text{RB}}^{\text{DL}} N_{\text{sc}}^{\text{RB}}}{2} - 36 + k', \quad k' = 0,1,...,71$$
$$l = 0,1,...,3$$

where resource elements reserved for reference signals shall be excluded. The mapping

operation shall assume cell-specific reference signals for antenna ports 0-3 being present irrespective of the actual configuration. The UE shall assume that the resource elements assumed to be reserved for reference signals in the mapping operation above but not used for transmission of reference signal are not available for PDSCH transmission. The UE shall not make any other assumptions about these resource elements.

[0049] Synchronization signals (e.g., PSS and SSS) in a cell are designed for UEs in the cell to obtain the downlink timing, i.e. the radio frame boundary and subframe boundary. PSS (Primary Synchronization Signal) and SSS (Secondary Synchronization Signal) are each carried by one symbol. For example, for FDD (Frequency Division Duplex) system, PSS is carried by the last symbol in slot 0 and 10, and SSS is carried by the second-last symbol in slot 0 and 10, where slot 0 and slot 10 are the first slot of the first subframe and that of the sixth subframe in a radio frame, as discussed in 3GPP TS 36.211 as follows:

6.11.1.2 Mapping to resource elements

The mapping of the sequence to resource elements depends on the frame structure. The UE shall not assume that the primary synchronization signal is transmitted on the same antenna port as any of the downlink reference signals. The UE shall not assume that any transmission instance of the primary synchronization signal is transmitted on the same antenna port, or ports, used for any other transmission instance of the primary synchronization signal.

The sequence $d(n)$ shall be mapped to the resource elements according to

$$a_{k,l} = d(n), \qquad n = 0,\ldots,61$$
$$k = n - 31 + \frac{N_{\mathrm{RB}}^{\mathrm{DL}} N_{\mathrm{sc}}^{\mathrm{RB}}}{2}$$

For frame structure type 1, the primary synchronization signal shall be mapped to the last OFDM symbol in slots 0 and 10.

For frame structure type 2, the primary synchronization signal shall be mapped to the third OFDM symbol in subframes 1 and 6. Resource elements (k,l) in the OFDM symbols used for

transmission of the primary synchronization signal where

$$k = n - 31 + \frac{N_{\mathrm{RB}}^{\mathrm{DL}} N_{\mathrm{sc}}^{\mathrm{RB}}}{2}$$
$$n = -5,-4,...,-1,62,63,...66$$

are reserved and not used for transmission of the primary synchronization signal.

6.11.2.2 Mapping to resource elements

The mapping of the sequence to resource elements depends on the frame structure. In a subframe for frame structure type 1 and in a half-frame for frame structure type 2, the same antenna port as for the primary synchronization signal shall be used for the secondary synchronization signal.

The sequence $d(n)$ shall be mapped to resource elements according to

$$a_{k,l} = d(n), \qquad n = 0,...,61$$
$$k = n - 31 + \frac{N_{\mathrm{RB}}^{\mathrm{DL}} N_{\mathrm{sc}}^{\mathrm{RB}}}{2}$$
$$l = \begin{cases} N_{\mathrm{symb}}^{\mathrm{DL}} - 2 & \text{in slots 0 and 10} \quad \text{for frame structure type 1} \\ N_{\mathrm{symb}}^{\mathrm{DL}} - 1 & \text{in slots 1 and 11} \quad \text{for frame structure type 2} \end{cases}$$

Resource elements (k,l) where

$$k = n - 31 + \frac{N_{\mathrm{RB}}^{\mathrm{DL}} N_{\mathrm{sc}}^{\mathrm{RB}}}{2}$$
$$l = \begin{cases} N_{\mathrm{symb}}^{\mathrm{DL}} - 2 & \text{in slots 0 and 10} \quad \text{for frame structure type 1} \\ N_{\mathrm{symb}}^{\mathrm{DL}} - 1 & \text{in slots 1 and 11} \quad \text{for frame structure type 2} \end{cases}$$
$$n = -5,-4,...,-1,62,63,...66$$

are reserved and not used for transmission of the secondary synchronization signal.

[0050] Cell-specific Reference Signal (CRS) is for UEs to measure downlink radio condition of the cell. The symbol carrying CRS depends on the number of CRS port. As an example, for a cell configured with two port CRS, CRS is carried by the first symbol and the third-last symbol in both slots of a subframe, as discussed in 3GPP TS 36.211 as follows:

6.10.1.2 Mapping to resource elements

The reference signal sequence $r_{l,n_s}(m)$ shall be mapped to complex-valued modulation symbols $a_{k,l}^{(p)}$ used as reference symbols for antenna port p in slot n_s according to

$$a_{k,l}^{(p)} = r_{l,n_s}(m')$$

where

$$\begin{aligned} k &= 6m + (v + v_{\text{shift}}) \bmod 6 \\ l &= \begin{cases} 0, N_{\text{symb}}^{\text{DL}} - 3 & \text{if } p \in \{0,1\} \\ 1 & \text{if } p \in \{2,3\} \end{cases} \\ m &= 0,1,\ldots,2 \cdot N_{\text{RB}}^{\text{DL}} - 1 \\ m' &= m + N_{\text{RB}}^{\max,\text{DL}} - N_{\text{RB}}^{\text{DL}} \end{aligned}$$

The variables v and v_{shift} define the position in the frequency domain for the different reference signals where v is given by

$$v = \begin{cases} 0 & \text{if } p = 0 \text{ and } l = 0 \\ 3 & \text{if } p = 0 \text{ and } l \neq 0 \\ 3 & \text{if } p = 1 \text{ and } l = 0 \\ 0 & \text{if } p = 1 \text{ and } l \neq 0 \\ 3(n_s \bmod 2) & \text{if } p = 2 \\ 3 + 3(n_s \bmod 2) & \text{if } p = 3 \end{cases}$$

The cell-specific frequency shift is given by $v_{\text{shift}} = N_{\text{ID}}^{\text{cell}} \bmod 6$.

[0051] Physical downlink control channel (PDCCH) signaling provides resource allocation of downlink or uplink transmission, e.g., on PDSCH (Physical Downlink Shared Channel) or PUSCH (Physical Uplink Shared Channel). PDCCH is carried by one or several symbols in the beginning of a subframe depending on the signaling on PCFICH (Physical

Control Format Indicator Channel). For example, when PCFICH indicating the number of symbols used for PDCCH transmission in a subframe is 2, PDCCH is carried by the first two symbols of the subframe, as discussed in 3GPP TS 36.211 as follows:

6.8.5 Mapping to resource elements

The mapping to resource elements is defined by operations on quadruplets of complex-valued symbols. Let $z^{(p)}(i) = \left\langle y^{(p)}(4i), y^{(p)}(4i+1), y^{(p)}(4i+2), y^{(p)}(4i+3) \right\rangle$ denote symbol quadruplet i for antenna port p.

The block of quadruplets $z^{(p)}(0),\ldots,z^{(p)}(M_{\text{quad}}-1)$, where $M_{\text{quad}} = M_{\text{symb}}/4$, shall be permuted resulting in $w^{(p)}(0),\ldots,w^{(p)}(M_{\text{quad}}-1)$. The permutation shall be according to the sub-block interleaver in clause 5.1.4.2.1 of 3GPP TS 36.212 [3] with the following exceptions:

- the input and output to the interleaver is defined by symbol quadruplets instead of bits
- interleaving is performed on symbol quadruplets instead of bits by substituting the terms "bit", "bits" and "bit sequence" in clause 5.1.4.2.1 of 3GPP TS 36.212 [3] by "symbol quadruplet", "symbol quadruplets" and "symbol-quadruplet sequence", respectively

<NULL> elements at the output of the interleaver in 3GPP TS 36.212 [3] shall be removed when forming $w^{(p)}(0),\ldots,w^{(p)}(M_{\text{quad}}-1)$. Note that the removal of <NULL> elements does not affect any <NIL> elements inserted in clause 6.8.2.

The block of quadruplets $w^{(p)}(0),\ldots,w^{(p)}(M_{\text{quad}}-1)$ shall be cyclically shifted, resulting in $\overline{w}^{(p)}(0),\ldots,\overline{w}^{(p)}(M_{\text{quad}}-1)$ where $\overline{w}^{(p)}(i) = w^{(p)}\left((i+N_{\text{ID}}^{\text{cell}}) \bmod M_{\text{quad}}\right)$.

Mapping of the block of quadruplets $\overline{w}^{(p)}(0),\ldots,\overline{w}^{(p)}(M_{\text{quad}}-1)$ is defined in terms of resource-element groups, specified in clause 6.2.4, according to steps 1–10 below:

1) Initialize $m' = 0$ (resource-element group number)
2) Initialize $k' = 0$

3) Initialize $l'=0$

4) If the resource element (k',l') represents a resource-element group and the resource-element group is not assigned to PCFICH or PHICH then perform step 5 and 6, else go to step 7

5) Map symbol-quadruplet $\overline{w}^{(p)}(m')$ to the resource-element group represented by (k',l') for each antenna port p

6) Increase m' by 1

7) Increase l' by 1

8) Repeat from step 4 if $l'<L$, where L corresponds to the number of OFDM symbols used for PDCCH transmission as indicated by the sequence transmitted on the PCFICH

9) Increase k' by 1

10) Repeat from step 3 if $k'<N_{\mathrm{RB}}^{\mathrm{DL}}\cdot N_{\mathrm{sc}}^{\mathrm{RB}}$

[0052] Physical Hybrid ARQ Indicator Channel (PHICH) carries HARQ (Hybrid Automatic Repeat reQuest) feedback in response to uplink transmissions. PHICH is carried by one or several symbols in the beginning of a subframe depending on the configured PHICH duration as well as the subframe type. For example, for the case of a non-MBSFN subframe of a FDD cell with extended PHICH duration configuration, the PHICH is carried by the first three symbols of the subframe, as discussed in 3GPP TS 36.211 as follows:

6.9.3 Mapping to resource elements

The sequence $\overline{y}^{(p)}(0),\ldots,\overline{y}^{(p)}(M_{\mathrm{symb}}^{(0)}-1)$ for each of the PHICH groups is defined by

$$\overline{y}^{(p)}(n)=\sum y_i^{(p)}(n)$$

where the sum is over all PHICHs in the PHICH group and $y_i^{(p)}(n)$ represents the symbol sequence from the i:th PHICH in the PHICH group.

PHICH groups are mapped to PHICH mapping units.

For normal cyclic prefix, the mapping of PHICH group m to PHICH mapping unit m' is defined by

$$\tilde{y}^{(p)}_{m'}(n) = \bar{y}^{(p)}_{m}(n)$$

where

$$m' = m = \begin{cases} 0,1,\ldots,N^{\text{group}}_{\text{PHICH}} - 1 & \text{for frame structure type 1} \\ 0,1,\ldots,m_i \cdot N^{\text{group}}_{\text{PHICH}} - 1 & \text{for frame structure type 2} \end{cases},$$

and where m_i is given by Table 6.9-1.

For extended cyclic prefix, the mapping of PHICH group m and $m+1$ to PHICH mapping unit m' is defined by

$$\tilde{y}^{(p)}_{m'}(n) = \bar{y}^{(p)}_{m}(n) + \bar{y}^{(p)}_{m+1}(n)$$

where

$$m' = m/2$$

$$m = \begin{cases} 0,2,\ldots,N^{\text{group}}_{\text{PHICH}} - 2 & \text{for frame structure type 1} \\ 0,2,\ldots,m_i \cdot N^{\text{group}}_{\text{PHICH}} - 2 & \text{for frame structure type 2} \end{cases}$$

and where m_i is given by Table 6.9-1.

Let $z^{(p)}(i) = \left\langle \tilde{y}^{(p)}(4i), \tilde{y}^{(p)}(4i+1), \tilde{y}^{(p)}(4i+2), \tilde{y}^{(p)}(4i+3) \right\rangle$, $i = 0,1,2$ denote symbol quadruplet i for antenna port p. Mapping to resource elements is defined in terms of symbol quadruplets according to steps 1–10 below:

1) For each value of l'
   2) Let $n_{l'}$ denote the number of resource element groups not assigned to PCFICH in OFDM symbol l'
   3) Number the resource-element groups not assigned to PCFICH in OFDM symbol l' from 0 to $n_{l'} - 1$, starting from the resource-element group with the lowest frequency-domain index.
4) Initialize $m' = 0$ (PHICH mapping unit number)

5) For each value of $i = 0,1,2$

6) Symbol-quadruplet $z^{(p)}(i)$ from PHICH mapping unit m' is mapped to the resource-element group represented by $(k',l')_i$ as defined in clause 6.2.4 where the indices k_i' and l_i' are given by steps 7 and 8 below:

7) The time-domain index l_i' is given by

$$l_i' = \begin{cases} 0 & \text{normal PHICH duration, all subframes} \\ (\lfloor m'/2 \rfloor + i + 1) \bmod 2 & \text{extended PHICH duration, MBSFN subframes} \\ (\lfloor m'/2 \rfloor + i + 1) \bmod 2 & \text{extended PHICH duration, subframe 1 and 6 in frame structure type 2} \\ i & \text{otherwise} \end{cases}$$

8) Set the frequency-domain index k_i' to the resource-element group assigned the number $\overline{n}_i$ in step 3 above, where $\overline{n}_i$ is given by

$$\overline{n}_i = \begin{cases} \left(\lfloor N_{\mathrm{ID}}^{\mathrm{cell}} \cdot n_{l_i'}/n_1 \rfloor + m'\right) \bmod n_{l_i'} & i = 0 \\ \left(\lfloor N_{\mathrm{ID}}^{\mathrm{cell}} \cdot n_{l_i'}/n_1 \rfloor + m' + \lfloor n_{l_i'}/3 \rfloor\right) \bmod n_{l_i'} & i = 1 \\ \left(\lfloor N_{\mathrm{ID}}^{\mathrm{cell}} \cdot n_{l_i'}/n_1 \rfloor + m' + \lfloor 2n_{l_i'}/3 \rfloor\right) \bmod n_{l_i'} & i = 2 \end{cases}$$

in case of extended PHICH duration in MBSFN subframes, or extended PHICH duration in subframes 1 and 6 for frame structure type 2 and by

$$\overline{n}_i = \begin{cases} \left(\lfloor N_{\mathrm{ID}}^{\mathrm{cell}} \cdot n_{l_i'}/n_0 \rfloor + m'\right) \bmod n_{l_i'} & i = 0 \\ \left(\lfloor N_{\mathrm{ID}}^{\mathrm{cell}} \cdot n_{l_i'}/n_0 \rfloor + m' + \lfloor n_{l_i'}/3 \rfloor\right) \bmod n_{l_i'} & i = 1 \\ \left(\lfloor N_{\mathrm{ID}}^{\mathrm{cell}} \cdot n_{l_i'}/n_0 \rfloor + m' + \lfloor 2n_{l_i'}/3 \rfloor\right) \bmod n_{l_i'} & i = 2 \end{cases}$$

otherwise.

9) Increase m' by 1.

10) Repeat from step 5 until all PHICH mapping units have been assigned.

The PHICH duration is configurable by higher layers according to Table 6.9.3-1 [which is reproduced as FIG. 9 of the present application].

[0053] Demodulation Reference Signal (DMRS) is the reference signal to help UE(s) demodulate EPDCCH (Enhanced Physical Downlink Control Channel) or PDSCH. DMRS is carried by four symbols in a subframe while the location of the four symbols depends on cyclic-

prefix (CP) length and subframe type. As an example, for the case of FDD cell with normal CP, DMRS is carried by the last two symbols of both slots in a subframe, as discussed in 3GPP TS 36.211:

6.10.3.2 Mapping to resource elements

For antenna ports $p=7$, $p=8$ or $p=7,8,\ldots,\upsilon+6$, in a physical resource block with frequency-domain index n_{PRB} assigned for the corresponding PDSCH transmission, a part of the reference signal sequence $r(m)$ shall be mapped to complex-valued modulation symbols $a_{k,l}^{(p)}$ in a subframe according to

Normal cyclic prefix:

$$a_{k,l}^{(p)} = w_p(l') \cdot r(3 \cdot l' \cdot N_{\mathrm{RB}}^{\max,\mathrm{DL}} + 3 \cdot n_{\mathrm{PRB}} + m')$$

where

$$w_p(i) = \begin{cases} \overline{w}_p(i) & (m'+n_{\mathrm{PRB}}) \bmod 2 = 0 \\ \overline{w}_p(3-i) & (m'+n_{\mathrm{PRB}}) \bmod 2 = 1 \end{cases}$$

$$k = 5m' + N_{\mathrm{sc}}^{\mathrm{RB}} n_{\mathrm{PRB}} + k'$$

$$k' = \begin{cases} 1 & p \in \{7,8,11,13\} \\ 0 & p \in \{9,10,12,14\} \end{cases}$$

$$l = \begin{cases} l' \bmod 2 + 2 & \text{if in a special subframe with configuration 3, 4, 8 or 9 (see Table 4.2-1)} \\ l' \bmod 2 + 2 + 3\lfloor l'/2 \rfloor & \text{if in a special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \\ l' \bmod 2 + 5 & \text{if not in a special subframe} \end{cases}$$

$$l' = \begin{cases} 0,1,2,3 & \text{if } n_s \bmod 2 = 0 \text{ and in a special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \\ 0,1 & \text{if } n_s \bmod 2 = 0 \text{ and not in special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \\ 2,3 & \text{if } n_s \bmod 2 = 1 \text{ and not in special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \end{cases}$$

$$m' = 0,1,2$$

The sequence $\overline{w}_p(i)$ is given by Table 6.10.3.2-1 [which is reproduced as FIG. 10 of the present application].

Extended cyclic prefix:

$$a_{k,l}^{(p)} = w_p(l' \bmod 2) \cdot r(4 \cdot l' \cdot N_{\mathrm{RB}}^{\max,\mathrm{DL}} + 4 \cdot n_{\mathrm{PRB}} + m')$$

where

$$w_p(i) = \begin{cases} \overline{w}_p(i) & m' \bmod 2 = 0 \\ \overline{w}_p(1-i) & m' \bmod 2 = 1 \end{cases}$$

$$k = 3m' + N_{sc}^{RB} n_{PRB} + k'$$

$$k' = \begin{cases} 1 & \text{if } n_s \bmod 2 = 0 \text{ and } p \in \{7,8\} \\ 2 & \text{if } n_s \bmod 2 = 1 \text{ and } p \in \{7,8\} \end{cases}$$

$$l = l' \bmod 2 + 4$$

$$l' = \begin{cases} 0,1 & \text{if } n_s \bmod 2 = 0 \text{ and in a special subframe with configuration 1, 2, 3, 5 or 6 (see Table 4.2 - 1)} \\ 0,1 & \text{if } n_s \bmod 2 = 0 \text{ and not in a special subframe} \\ 2,3 & \text{if } n_s \bmod 2 = 1 \text{ and not in a special subframe} \end{cases}$$

$$m' = 0,1,2,3$$

The sequence $\overline{w}_p(i)$ is given by Table 6.10.3.2-2 [which is reproduced as FIG. 11 of the present invention.

For extended cyclic prefix, UE-specific reference signals are not supported on antenna ports 9 to 14.

Resource elements (k,l) used for transmission of UE-specific reference signals to one UE on any of the antenna ports in the set S, where $S = \{7,8,11,13\}$ or $S = \{9,10,12,14\}$ shall

- not be used for transmission of PDSCH on any antenna port in the same slot, and
- not be used for UE-specific reference signals to the same UE on any antenna port other than those in S in the same slot.

[0054] As for downlink data in LTE, it is transmitted on PDSCH and carried by symbols excluding the first or first several symbols of a subframe, i.e. excluding the symbols which are (maybe) occupied by the physical control channels, as mentioned above and discussed in 3GPP TS 36. 211 as follows:

6.4 Physical downlink shared channel

The physical downlink shared channel shall be processed and mapped to resource elements as described in clause 6.3 with the following additions and exceptions:

- In resource blocks in which UE-specific reference signals are not transmitted, the PDSCH shall be transmitted on the same set of antenna ports as the PBCH, which is one of $\{0\}$, $\{0,1\}$, or $\{0,1,2,3\}$.
- In resource blocks in which UE-specific reference signals are transmitted, the PDSCH shall be transmitted on antenna port(s) $\{5\}, \{7\}, \{8\}$, or $p \in \{7,8,\ldots,\upsilon+6\}$, where υ is the number of layers used for transmission of the PDSCH.
- If PDSCH is transmitted in MBSFN subframes as defined in 3GPP TS 36.213 [4], the PDSCH shall be transmitted on one or several of antenna port(s) $p \in \{7,8,\ldots,\upsilon+6\}$, where υ is the number of layers used for transmission of the PDSCH.
- PDSCH is not mapped to resource elements used for UE-specific reference signals associated with PDSCH
- In mapping to resource elements, the positions of the cell-specific reference signals are given by clause 6.10.1.2 with the number of antenna ports and the frequency shift of the cell-specific reference signals derived as described in clause 6.10.1.2, unless other values for these parameters are provided by clause 7.1.9 in 3GPP TS 36.213 [4], in which case these values are used in the resource blocks indicated by the relevant DCI.
- If the DCI associated with the PDSCH uses the C-RNTI or semi-persistent C-RNTI, the PDSCH is not mapped to resource elements assumed by the UE to be used for transmission of:
  - zero-power CSI reference signals, where the positions of the CSI reference signals are given by clause 6.10.5.2.The configuration for zero power CSI reference signals is
    - obtained as described in clause 6.10.5.2, unless other values for these parameters are provided by clause 7.1.9 in 3GPP TS 36.213 [4], in which case these values are used in the resource blocks indicated by the relevant DCI, and

- obtained by higher-layer configuration of up to five reserved CSI-RS resources as part of the discovery signal configuration following the procedure for zero-power CSI-RS in clause 6.10.5.2.

- non-zero-power CSI reference signals for CSI reporting, where the positions of the non-zero-power CSI reference signals for CSI reporting are given by clause 6.10.5.2. The configuration for non-zero power CSI reference signals is obtained as described in clause 6.10.5.2.

- PDSCH is not mapped to any physical resource-block pair(s) carrying an EPDCCH associated with the PDSCH.

- The index l in the first slot in a subframe fulfils $l \geq l_{\text{DataStart}}$ where $l_{\text{DataStart}}$ is given by clause 7.1.6.4 of 3GPP TS 36.213 [4].

- In mapping to resource elements, if the DCI associated with the PDSCH uses the C-RNTI or semi-persistent C-RNTI and transmit diversity according to clause 6.3.4.3 is used, resource elements in an OFDM symbol assumed by the UE to contain CSI-RS shall be used in the mapping if and only if all of the following criteria are fulfilled:

  - there is an even number of resource elements for the OFDM symbol in each resource block assigned for transmission, and

  - the complex-valued symbols $y^{(p)}(i)$ and $y^{(p)}(i+1)$, where i is an even number, can be mapped to resource elements (k,l) and $(k+n,l)$ in the same OFDM symbol with $n<3$.

[0055] The concept of radio access for 5G is discussed in the DOCOMO 5G White Paper. One key point is to efficiently integrate both lower and higher frequency bands. Higher frequency bands provide opportunities for wider spectrum but have coverage limitations because of higher path loss. The DOCOMO 5G White Paper proposes that the 5G system has a two-layer structure that consists of a coverage layer (e.g., consisting of macro cell(s)) and a capacity layer (e.g., consisting of small cell(s) or phantom cell(s)). The coverage layer uses existing lower

frequency bands to provide basic coverage and mobility. The capacity layer uses new higher frequency bands to provide high data rate transmission. The coverage layer could be supported by enhanced LTE RAT while the capacity layer could be supported by a new RAT dedicated to higher frequency bands. The efficient integration of the coverage and capacity layers is enabled by the tight interworking (dual connectivity) between the enhanced LTE RAT and the new RAT. In addition, a cell in 5G may contain a single transmission point (TP)/transmission and reception point (TRP) or multiple TPs/TRPs and a network node (e.g., eNB) communicates with UEs in the cell via these TPs/TRPs.

[0056] As discussed in 3GPP TS 36.300, dual connectivity is a mode of operation of a UE in RRC_CONNECTED, configured with a Master Cell Group (i.e., a group of serving cells associated with the MeNB (Master eNB), comprising of the PCell and optionally one or more SCells) and a Secondary Cell Group (i.e., a group of serving cells associated with the SeNB (Secondary eNB), comprising of PSCell (Primary Secondary Cell) and optionally one or more SCells). A UE configured with dual connectivity generally means that the UE is configured to utilize radio resources provided by two distinct schedulers, located in two eNBs (MeNB and SeNB) connected via a non-ideal backhaul over the X2 interface. Further details of dual connectivity can be found in 3GPP TS 36.300.

[0057] In dual connectivity, the random access procedure is also performed on at least PSCell upon SCG (Secondary Cell Group) addition/modification (if instructed), upon DL data arrival during RRC_CONNECTED requiring random access procedure (e.g., when UL synchronisation status is non-synchronized), or upon UL data arrival during RRC_CONNECTED requiring random access procedure (e.g., when UL synchronization status is non-synchronized or there are no available PUCCH (Physical Uplink Control Channel) resources for SR. The UE-initiated random access procedure is performed only on PSCell for SCG.

[0058] The random access procedure has two different types: contention-based and non-contention based. The contention based random access procedure is shown in FIG. 12, which is

a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300. FIG. 12 includes the following four steps:

1. Random Access Preamble on RACH (Random Access Channel) mapped to PRACH (Physical Random Access Channel) in uplink
2. Random Access Response generated by MAC (Medium Access Channel) on DL-SCH (Downlink Shared Channel)
3. First scheduled UL (Uplink) transmission on UL-SCH (Uplink Shared Channel)
4. Contention Resolution on DL.

[0059] The non-contention based random access procedure is shown in FIG. 13, which is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300. FIG. 13 includes the following three steps:

0. Dedicated Random Access Preamble assignment via dedicated signalling in DL
1. Non-contention Random Access Preamble on RACH mapped to PRACH in uplink
2. Random Access Response on DL-SCH

[0060] Details of each step in a random access procedure can be found in 3GPP TS 36.300 and 36.321.

[0061] Regarding frame structure for the next generation radio access technology, a TDD optimized physical subframe structure for a UDN system proposed by METIS Deliverable D2.4 is illustrated in FIG. 14, following these main design principles:

- A bi-directional (including both DL and UL resources) control part is embedded to the beginning of each subframe and time-separated from data part.
- Data part in one subframe contains data symbols for either transmission or reception. Demodulation reference signal (DMRS) symbols, which used to estimate the channel and its covariance matrix, could be located in the first OFDM symbol in the dynamic data part and could be precoded with the same vector/matrix as data.

- Short subframe lengths (e.g., 0.25 ms on cmW frequencies when assuming 60 kHz SC spacing) are feasible. By following the principles of harmonized OFDM concept, the frame numerology is further scaled when moving to mmW, leading to even shorter frame length (e.g., in the order of 50 μs).
- In frequency direction, the spectrum can be divided to separate allocable frequency resources.

[0062] Furthermore, cells on the capacity layer may use beamforming. Beamforming is generally a signal processing technique used in antenna arrays for directional signal transmission or reception. This is achieved by combining elements in a phased array in such a way that signals at particular angles experience constructive interference while others experience destructive interference. Beamforming could be used at both the transmitting and receiving ends to achieve spatial selectivity. The improvement compared with omnidirectional reception/transmission is known as the receive/transmit gain.

[0063] Beamforming is frequently applied in radar systems. The beam created by a phased array radar is comparatively narrow and highly agile compared to a moving dish. This characteristic gives the radar the ability to detect small, fast targets like ballistic missiles in addition to aircrafts.

[0064] The benefit of co-channel interference reduction also makes beamforming attractive to a mobile communication system designer. US Provisional Application Serial No. 62/107,814, entitled "Method and Apparatus for Beam Tracking in a Wireless Communication System", generally discloses the concept of beam division multiple access (BDMA) based on beamforming technique. In BDMA, a base station could communicate with a mobile device via a narrow beam to obtain the receive/transmit gain. Furthermore, two mobile devices in different beams could share the same radio resources at the same time; and thus the capacity of a mobile communication system can increase greatly. To achieve that, the base station should know in which beam a mobile device is located.

[0065] A cell, transmission point (TP), or transmission and reception point (TRP) could use beamforming for directional signal transmission or reception. Due to power saving or

hardware limitation (e.g., insufficient number of transceivers), the cell, TP, or TRP may not be able to generate all beams to cover all directions within the coverage of the cell, TP, or TRP. In other words, the cell, TP, or TRP may generate part of the beams for directional signal transmission or reception at a time. For example, the maximum number of beams which can be generated by a cell, TP, or TRP at one time could be less than the total number of beams in the cell or the total number of beams of the TP or TRP. At the same time, directional signal transmission or reception on other non-generated beams would be impossible. Thus, it would take multiple times for a cell, TP, or TRP to scan all beams of the cell, TP, or TRP.

[0066] The downlink control signaling can generally be categorized into 2 types:

• Type 1 - Common signaling (transmitted periodically) intended for all or plurality of UEs in the cell or UEs connecting to the TP or TRP (e.g., system information, PSS/SSS, CRS, control signaling for broadcast message, etc.)

• Type 2: - UE specific signaling (transmitted dynamically or periodically), e.g., PDCCH, PHICH, DMRS, etc.

[0067] If the cell, TP, or TRP has limitation of beam generation as described above, it is assumed that type 1 signaling is transmitted on predefined beams in a specific timing (e.g., subframe(s) or symbol(s)). As a result, transmissions (e.g., type 2 control signaling or data) to UEs not covered by the predefined beams in the same specific timing would be impossible. Then, network scheduling flexibility is limited. Designing a frame structure to improve network scheduling flexibility should be considered.

[0068] Communication between a network node and a UE could be organized into frames. A frame could contain multiple subframes. A subframe could contain multiple symbols. A subframe could contain a downlink control region which contains one or multiple symbols and is used to carry control signaling.

[0069] FIG. 15 is a diagram of a subframe 1500 in according with one exemplary embodiment. In general, the concept of the invention is that in downlink control region 1505 of a subframe, there is at least a first part of the downlink control region (e.g., consisting of at least

one symbol) used to transmit UE specific downlink control signaling (e.g., type 2) 1510 , and not used to transmit common downlink control signaling (e.g., type 1). Then, the network could flexibly use the first part of downlink control region to transmit signaling on beam(s) of certain UE(s), and is not limited by the beams for type 1 signaling.

[0070] In addition, there could be a second part of the downlink control region (e.g., consisting of at least one symbol) used to transmit common downlink control signaling (e.g., type 1) 1515 . The second part could also be used to transmit UE specific downlink control signaling (e.g., type 2) if the associated UE is covered by predefined beams used for transmitting the type 1 signaling. Alternatively, the second part could not be used to transmit UE specific downlink control signaling (e.g., type 2). The subframe 1500 could also include a data region 1520.

[0071] Furthermore, the UE specific downlink control signaling (e.g., for one specific UE) could include at least one of the following signals or signalings:

- A signaling (e.g., on PDCCH) to allocate resource for a DL or UL transmission;
- A signaling (e.g., on PHICH) to carry HARQ feedback in response to at least one UL transmission; and/or
- A reference signal used to help an UE demodulate a DL transmission (e.g., DMRS).

[0072] In addition, the common downlink control signaling (e.g., for multiple UEs) could include at least one of the following signals or signalings:

- A signaling indicating system frame number of the cell, TP, or TRP;
- A signaling (e.g., on PDCCH) allocate resource for a broadcast message (e.g., system information, paging, random access response) for UE(s) in the cell or for UE(s) connecting to the TP or TRP;
- A synchronization signal for UE(s) in the cell or for UE(s) connecting to the TP or TRP to obtain downlink timing; and/or
- A reference signal for UE(s) to measure downlink radio condition (e.g., CRS).

[0073] Also, every subframe with downlink control region could contain the first part and the second part. In one embodiment, beam(s) of the cell, TP, or TRP generated in the first part would be different from beam(s) of the cell, TP, or TRP generated in the second part.

[0074] In addition, the general concept of the invention could be applied to the LTE frame structure (discussed in 3GPP TS 36.300). Alternatively, the concept could be applied to the METIS frame structure (discussed in METIS Deliverable D2.4).

[0075] Another general concept of the invention is that in downlink control region of a subframe, there is at least a first part of the downlink control region (e.g., consisting of at least one symbol) and a second part of the downlink control region (e.g., consisting of at least one symbol), wherein beam(s) of the cell, TP, or TRP generated in the first part is completely or partially different from beam(s) of the cell, TP, or TRP generated in the second part.

[0076] In one embodiment, the first part could be used to transmit the common downlink control signaling (e.g., type 1) and/or the UE specific downlink control signaling (e.g., type 2). Similarly, the second part could be used to transmit the common downlink control signaling (e.g., type 1) and/or the UE specific downlink control signaling (e.g., type 2).

[0077] In one embodiment, the subframe could contain a data region for UL, a data region for DL, and/or an uplink control region. The data region could also contain symbols, wherein beam(s) of the cell, TP, or TRP generated in different symbols is completely or partially different.

[0078] Furthermore, a signaling transmitted in the first part of the downlink control region of the subframe could be associated with resources in first symbol(s) of the data region in the subframe; and a signaling transmitted in the second part of the downlink control region of the subframe could be associated with resources in second symbol(s) of the data region in the subframe. The first symbol(s) and the second symbol(s) are completely or partially different.

[0079] In addition, the common downlink control signaling in the first part and the common downlink control signaling in the second part could be synchronization signals with

different sequences. The UE could detect the subframe boundary according to the sequence used by the synchronization signals.

[0080] Also, the common downlink control signaling in the first part and the common downlink control signaling in the second part could be synchronization signals on different frequency resources. The UE could detect the subframe boundary according to the frequency resources used by the synchronization signals.

[0081] Also, the common downlink control signaling in the first part and the common downlink control signaling in the second part could be transmitted on different frequency resources.

[0082] FIG. 16 is a flow chart 1600 for defining a communication between a cell, TP, or TRP and a UE in accordance with one exemplary embodiment. In step 1605, the communication is organized into radio frames, wherein each radio frame includes multiple subframes and each subframe includes multiple symbols. In step 1610, a downlink control region is included in a subframe. In step 1615, a first symbol is included in the downlink control region, wherein the first symbol is used to carry a UE specific signal and is not used to carry a common signal.

[0083] In one embodiment, the downlink control region could include a second symbol, wherein the second symbol is used to carry the common signal. Furthermore, the second symbol is used to carry the UE specific signal. Alternatively, the second symbol is not used to carry the UE specific signal.

[0084] Referring back to FIGS. 3 and 4, in one exemplary embodiment for defining a communication between a cell, TP, or TRP and a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 (i) to organize the communication into radio frames, wherein each radio frame includes multiple subframes and each subframe includes multiple symbols, (ii) to include a downlink control region in a subframe, and (iii) to include a first symbol in the downlink control region, wherein the first symbol is used to carry a UE specific signal and is not used to carry a common signal. Furthermore, the CPU

308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[0085] FIG. 17 is a flow chart 1700 from the perspective of a network node controlling a cell, TP, or TRP in accordance with one exemplary embodiment. Step 1705 includes communicating with a UE in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols. Step 1710 includes transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol.

[0086] In one embodiment, as shown in step 1715, the network node transmits, in the cell, the common signal in a second symbol of the downlink control region. Furthermore, as shown in step 1720, the network node transmits the UE specific signal in the second symbol. Alternatively, the network node is not allowed to transmit the UE specific signal in the second symbol.

[0087] Referring back to FIGS. 3 and 4, in one embodiment from the perspective of a network node controlling a cell, TP, or TRP, the device 300 includes a program code 312 stored in memory 310. The CPU 308 could execute program code 312 to enable the network node (i) to communicate with a UE in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols, and (ii) to transmit, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol. In one embodiment, the CPU could further execute program code 312 to enable the network node (i) to transmits, in the cell, the common signal in a second symbol of the downlink control region, and/or (ii) to transmit the UE specific signal in the second symbol. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[0088] FIG. 18 is a flow chart 1800 in accordance with one exemplary embodiment from the perspective of a UE. In step 1805, the UE communicates with a network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols. In step 1810, the UE monitors, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol.

[0089] In one embodiment, as shown in step 1815, the UE could monitor, in the cell, the common signal in a second symbol of the downlink control region. Furthermore, as shown in step 1820, the UE could monitor the UE specific signal in the second symbol. Alternatively, the UE does not monitor the UE specific signal in the second symbol.

[0090] Referring back to FIGS. 3 and 4, in one embodiment from the perspective of a UE, the device 300 includes a program code 312 stored in memory 310 of the transmitter. The CPU 308 could execute program code 312 to enable the UE (i) to communicate with a network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols, and (ii) to monitor, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol. In one embodiment, the CPU could further execute program code 312 to enable the network node (i) to monitor, in the cell, the common signal in a second symbol of the downlink control region, and/or (ii) to monitor the UE specific signal in the second symbol. In addition, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[0091] With respect to the various embodiments disclosed and discussed, the subframe could include a data region for UL, a data region for DL, and/or an UL control region in one embodiment. Besides, the network node could be a base station.

[0092] Furthermore, in one embodiment, the UE specific signal could be for one specific UE. In addition, the UE specific signal could be transmitted on beam(s) of the cell, TP, or TRP

corresponding to the UE. Also, the UE specific signal could be a signaling indicating resource allocation (e.g., PDCCH), a signaling indicating HARQ feedback (e.g., PHICH – "Physical Hybrid ARQ Indicator Channel"), and/or a reference signal for demodulation (e.g., DMRS). Furthermore, the UE specific signal could be associated with a UE specific reference signal (e.g., DMRS). In addition, the UE specific signal could be demodulated based on reception of a UE specific reference signal (e.g., DMRS).

[0093] In one embodiment, the common signal is for multiple UEs. The common signal is to be transmitted on every beam of the cell, TP, or TRP. In addition, the common signal could be a signaling indicating a system frame number (SFN), a signaling (e.g., on PDCCH) indicating resource allocation for a broadcast message (e.g., system information, paging, random access response) for UE(s) in the cell or for UE(s) connecting to the TP or TRP, a synchronization signal (e.g., a PSS or a SSS), and/or a reference signal for DL radio condition measurement (e.g., CRS). Furthermore, the common signal could be associated with a common reference signal (e.g., CRS). Also, the common signal could be demodulated based on reception of a common reference signal (e.g., CRS).

[0094] In one embodiment, all of the multiple subframes (for DL) could have the first symbol. Alternatively, not all of the multiple subframes (for DL) have the first symbol. In another embodiment, all of the multiple subframes (for DL) could have the second symbol. Alternatively, not all of the multiple subframes (for DL) have the second symbol

[0095] In one embodiment, the first symbol could be in front of the second symbol in the subframe. Alternatively, the second symbol could be in front of the first symbol in the subframe.

[0096] In one embodiment, beam(s) of the cell, TP, or TRP generated in the first symbol is different from beam(s) generated in the second symbol. In one embodiment, the symbol could be an OFDM (Orthogonal Frequency Division Multiplexing) symbol.

[0097] As discussed above, a cell, TP, or TRP on the capacity layer may use beamforming for directional signal transmission or reception. To perform beamforming with a UE in the cell or a UE connecting to the TP or TRP, a base station should know which beam(s)

of the cell, TP, or TRP the UE is located on, e.g. beam set of the UE. It is proposed in METIS Deliverable 2.4 that a UE transmits its position and speed to the base station and then the base station determines the direction of a downlink beam for the mobile device according to the received position and speed. However, information of the position and speed is not always available and reliable in the UE. Thus, it would better to find another way for the base station to determine the beam set of a UE.

[0098] Currently as discussed in 3GPP TS 36.300 and 36.331, a random access (RA) procedure needs to be performed by a UE before data can be transferred via a cell, TP, or TRP. One possible way is that the base station could determine the initial beam set of a UE during the RA procedure, e.g., the beam set could be determined according to the beam(s) via which the dedicated RA preambles are received from the UE. However, with this method the base station needs to process the preambles on all beams of the cell, TP, or TRP, which would result in a very high system load. Therefore, it would be simpler to use a reference signal (RS) for beam set determination, i.e., the UE transmits the reference signal in the cell or to the TP or TRP. And the RA procedure could be initiated after the initial UE beam set has been determined. In this situation, the base station would only need to process the preamble(s) on the beam(s) in the UE beam set. It is expected that the beam number of a UE beam set (e.g., 4) would be much less than the total number of beams for one cell, TP, or TRP (e.g., 32, 64, or more). As a result, signal processing complexity could be reduced significantly.

[0099] According to the above concept, a random access (RA) procedure will be initiated after the beam set of a UE has been determined. One possible way to initiate the RA procedure is that the base station could transmit a request to the UE via the beam set of the UE to initiate the RA procedure. However, delay compensation (e.g., of a downlink transmission on different beams to the UE) would be required when the downlink transmission is performed via multiple beams. Otherwise, the UE may not be able to successfully decode the downlink transmission (e.g., including the request to initiate the RA procedure). Furthermore, it does not seem feasible for the base station to measure the delay of each beam based on the RS used for beam set

determination. Therefore, a means or mechanism to let the UE initiate a random access procedure on the cell or to access the TP or TRP at proper timing should be considered.

[00100] The general concept of the invention is that a first base station (e.g., MeNB) controlling a first cell, TP, or TRP (e.g., in coverage layer) could provide configuration of a timer (or a counter) to a UE via the first cell, TP, or TRP. The UE would decide the timing to initiate a random access procedure (or to transmit a random access preamble) on a second cell or to access a second TP or TRP (e.g., in capacity layer) controlled by a second base station (e.g., SeNB) based on at least the timer (or the counter).

[00101] In one embodiment, the configuration could be included in a signaling. The signaling is a RRC message, e.g., a *RRCConnectionReconfiguration* message as discussed in 3GPP TS 36.331. The signaling could configure the UE to perform dual connectivity. The signaling could also be used to configure the second cell, TP, or TRP as a serving cell, TP, or TRP of the UE.

[00102] In addition, the signaling could also configure the UE to transmit a signal in the second cell or to the second TP or TRP. The signal could be transmitted periodically. The signal could be used to help the second base station detect beam(s) of the second cell, TP, or TRP for the UE. In one embodiment, the signal could be a reference signal (RS).

[00103] In one embodiment, the UE could start the timer (i) upon reception of the configuration, (ii) upon transmission of the signal (if the timer is not running), (iii) upon first transmission of the signal, or (iv) upon completion of synchronizing to the second cell, TP, or TRP. The counter could also be used to count transmission times of the signal.

[00104] In one embodiment, the UE could (i) initiate the random access procedure upon the timer expiry, (ii) transmit a random access preamble in response to the timer expiry, (iii) initiate the random access procedure upon reaching the maximum value of the counter, or (iv) transmit a random access preamble in response to reaching the maximum value of the counter.

[00105] In one embodiment, the uplink time of the UE is not aligned in the second cell, TP, or TRP (e.g., *timeAlignmentTimer*, as discussed in 3GPP TS 36.321, associated with the second cell, TP, or TRP is not running).

[00106] An alternative concept of the invention is that a second base station (e.g., SeNB) controlling a second cell, TP, or TRP (e.g., in capacity layer) determines beams of the second cell, TP, or TRP for a UE (i.e., a beam set for the UE). The second base station selects (only) one beam in the beam set (i.e., a first beam), and transmits a request (e.g., PDCCH order as discussed in 3GPP TS 36.321) on the first beam to the UE to initiate a random access procedure on the second cell or to access the second TP or TRP.

[00107] In one embodiment, the beam set includes multiple beams where a signal from the UE in the second cell or to the second TP or TRP has been detected. The first beam is where the signal has been detected with the largest received power. Received power of the signal on the first beam is larger than a threshold. Received power of the signal on multiple beams of the beam set is larger than the threshold. The signal could be a reference signal.

[00108] In one embodiment, delay compensation for beams in the beam set is not determined when transmitting the request. In other words, before delay compensation for beams in the beam set is determined, the second base station selects only one beam in the beam set for transmission to the UE. After delay compensation for beams in the beam set is determined, the second base station could select multiple beams in the beam set for transmission to the UE. Uplink time of the UE is not aligned in the second cell, TP, or TRP (e.g. *timeAlignmentTimer*, as discussed in 3GPP TS 36.321, associated with the second cell, TP, or TRP is not running, when transmitting the request).

[00109] FIG. 19 is a message diagram 1900 in accordance with one embodiment. In step 1905, the UE receives a signaling indicating a configuration related to a timer or a counter. In step 1910, the UE initiates a random access procedure based on the timer or the counter. In one embodiment, the random access procedure is initiated on a second cell or is initiated to access a second TP or TRP. Furthermore, the random access procedure could be initiated upon expiry of the timer or upon reaching a specific value of the counter.

[00110] FIG. 20 is a message diagram 2000 in accordance with one embodiment. In step 2005, the UE receives a signaling indicating a configuration related to a timer or a counter. In step 2010, the UE transmits a random access preamble based on at least the timer or the counter. In one embodiment, the random access preamble is transmitted in a second cell or is transmitted to a second TP or TRP. Furthermore, the random access preamble could be transmitted in response to expiry of the timer, or in response to reaching a specific value of the counter.

[00111] With respect to the embodiments illustrated in FIGS. 19 and 20 and discussed above, the configuration could indicate a value of the timer or maximum value of the counter. Furthermore, the second cell, TP, or TRP could be controlled by a second base station. In addition, the signaling could be transmitted in a first cell or is transmitted to a first TP or TRP.

[00112] In one embodiment, the signaling could be transmitted by a first base station to control when the UE initiates the random access procedure or transmits the random access preamble. The first cell, TP, or TRP could be controlled by the first base station. Furthermore, the first base station could be an eNB (e.g., MeNB).

[00113] In one embodiment, the timer could be maintained by the UE. Furthermore, the timer could be started upon reception of the signaling, upon transmission of a specific signal (if the timer is not running), or upon first transmission of the specific signal.

[00114] In one embodiment, the counter is maintained by the UE. Furthermore, the counter is related to transmission times of a specific signal. The counter could be set to 0 upon reception of the signaling or upon first transmission of a specific signal.

[00115] In one embodiment, the signaling could indicate a configuration related to the specific signal, e.g. resource and/or periodicity. Furthermore, the signaling could tell the UE to perform dual connectivity. In addition, the signaling could indicate addition of the second cell, TP, or TRP as a serving cell, TP, or TRP of the UE. In one embodiment, the signaling could be a RRC message or a *RRCConnectionReconfiguration* message.

[00116] FIG. 21 is a message diagram 2100 in accordance with one embodiment from the perspective of a second base station controlling a second cell, TP, or TRP. In step 2105, a beam

set for a UE is determined, wherein the beam set includes multiple beams. In step 2110, a first beam (B_x) is selected from the beam set. In step 2115, a request, which is used to ask the UE to initiate a random access procedure on the second cell or to access the second TP or TRP, is transmitted only on the first beam (B_x) to the UE. In one embodiment, the request could be a PDCCH order.

[00117] In one embodiment, beams in the beam set could be where a specific signal from the UE is received. Furthermore, beams in the beam set could be where a specific signal from the UE is received with a received power of the specific signal is larger than a first threshold.

[00118] In one embodiment, the beam set could be determined based on at least reception of a specific signal from the UE in the second cell or from the UE to the second TP or TRP. Furthermore, a specific signal could be received from the UE on the first beam with the largest received power. In addition, the first beam could be selected from the beam set based on a received power of a specific signal from the UE. The received power of a specific signal from the UE on the first beam could be larger than a second threshold. Also, the received power of a specific signal from the UE on multiple beams in the beam set could be larger than a second threshold. Furthermore, the second threshold could be larger than the first threshold.

[00119] In one embodiment, delay compensation of downlink transmission(s) to the UE for beams in the beam set is not determined.

[00120] With respect to the embodiments illustrated in FIGS. 19, 20, and 21 and discussed above, the random access procedure could be non-contention based. Furthermore, the random access procedure could be successfully completed in response to reception of a Timing Advance Command (e.g., in a MAC control element as discussed in 3GPP TS 36.321).

[00121] In one embodiment, the second cell, TP, or TRP uses beamforming. Furthermore, the second cell, TP, or TRP could have multiple beams. In addition, the UE could perform dual connectivity to connect to multiple cells, TPs, TRPs, or base stations.

[00122] In one embodiment, the specific signal could be transmitted periodically. Furthermore, the specific signal could be a reference signal (e.g., SRS as discussed in 3GPP TS

36.213). In addition, the specific signal could be transmitted in the second cell, or could be transmitted to the second TP or TRP.

[00123] In one embodiment, the specific signal is used to identify a beam set for the UE. In addition, the uplink timing of the UE is not aligned (e.g., in the second cell, TP, or TRP).

[00124] Various aspects of the disclosure have been described above. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative. Based on the teachings herein one skilled in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. As an example of some of the above concepts, in some aspects concurrent channels may be established based on pulse repetition frequencies. In some aspects concurrent channels may be established based on pulse position or offsets. In some aspects concurrent channels may be established based on time hopping sequences. In some aspects concurrent channels may be established based on pulse repetition frequencies, pulse positions or offsets, and time hopping sequences.

[00125] Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[00126] Those of skill would further appreciate that the various illustrative logical blocks, modules, processors, means, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two, which may be designed using source coding or some other technique), various forms of program or design code

incorporating instructions (which may be referred to herein, for convenience, as "software" or a "software module"), or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[00127] In addition, the various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented within or performed by an integrated circuit ("IC"), an access terminal, or an access point. The IC may comprise a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components, or any combination thereof designed to perform the functions described herein, and may execute codes or instructions that reside within the IC, outside of the IC, or both. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[00128] It is understood that any specific order or hierarchy of steps in any disclosed process is an example of a sample approach. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

[00129] The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module (e.g., including executable instructions and related data) and other data may reside in a data memory such as RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of computer-readable storage medium known in the art. A sample storage medium may be coupled to a machine such as, for example, a computer/processor (which may be referred to herein, for convenience, as a "processor") such the processor can read information (e.g., code) from and write information to the storage medium. A sample storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in user equipment. In the alternative, the processor and the storage medium may reside as discrete components in user equipment. Moreover, in some aspects any suitable computer-program product may comprise a computer-readable medium comprising codes relating to one or more of the aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

[00130] While the invention has been described in connection with various aspects, it will be understood that the invention is capable of further modifications. This application is intended to cover any variations, uses or adaptation of the invention following, in general, the principles of the invention, and including such departures from the present disclosure as come within the known and customary practice within the art to which the invention pertains.

CLAIMS

1. A method for a network node controlling a cell, comprising:

communicating with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols; and

transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol.

2. The method of claim 1, wherein the network node transmits, in the cell, the common signal in a second symbol of the downlink control region.

3. The method of claim 2, wherein the network node transmits the UE specific signal in the second symbol.

4. The method of claim 1, wherein the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region.

5. The method of claim 1, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

6. The method of claim 1, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

7. The method of claim 1, wherein beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol.

8. A method for a User Equipment (UE), comprising:

communicating with a network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols; and

monitoring, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol.

9. The method of claim 8, wherein the UE monitors, in the cell, the common signal in a second symbol of the downlink control region.

10. The method of claim 9, wherein the UE monitors the UE specific signal in the second symbol.

11. The method of claim 8, wherein the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region.

12. The method of claim 8, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

13. The method of claim 8, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

14. The method of claim 8, wherein beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol.

15. A User Equipment (UE) for communication with a network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

communicate with the network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols; and

monitor, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol.

16. The UE of claim 15, wherein the UE monitors, in the cell, the common signal in a second symbol of the downlink control region.

17. The UE of claim 16, wherein the UE monitors the UE specific signal in the second symbol.

18. The UE of claim 15, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

19. The UE of claim 15, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

20. The UE of claim 15, wherein beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol.

ABSTRACT

A method and apparatus for delivery of control signaling in a wireless communication system are disclosed. In one embodiment, the method includes communicating with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols. The method also includes transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol.

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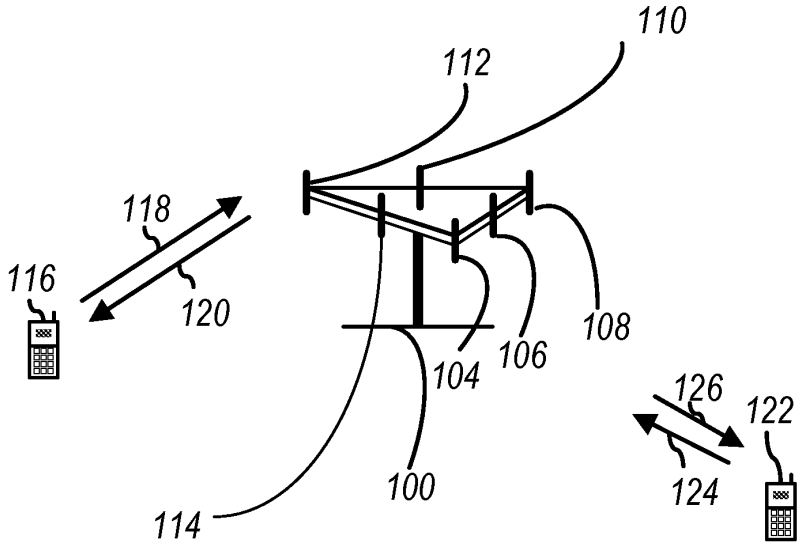


FIG. 1

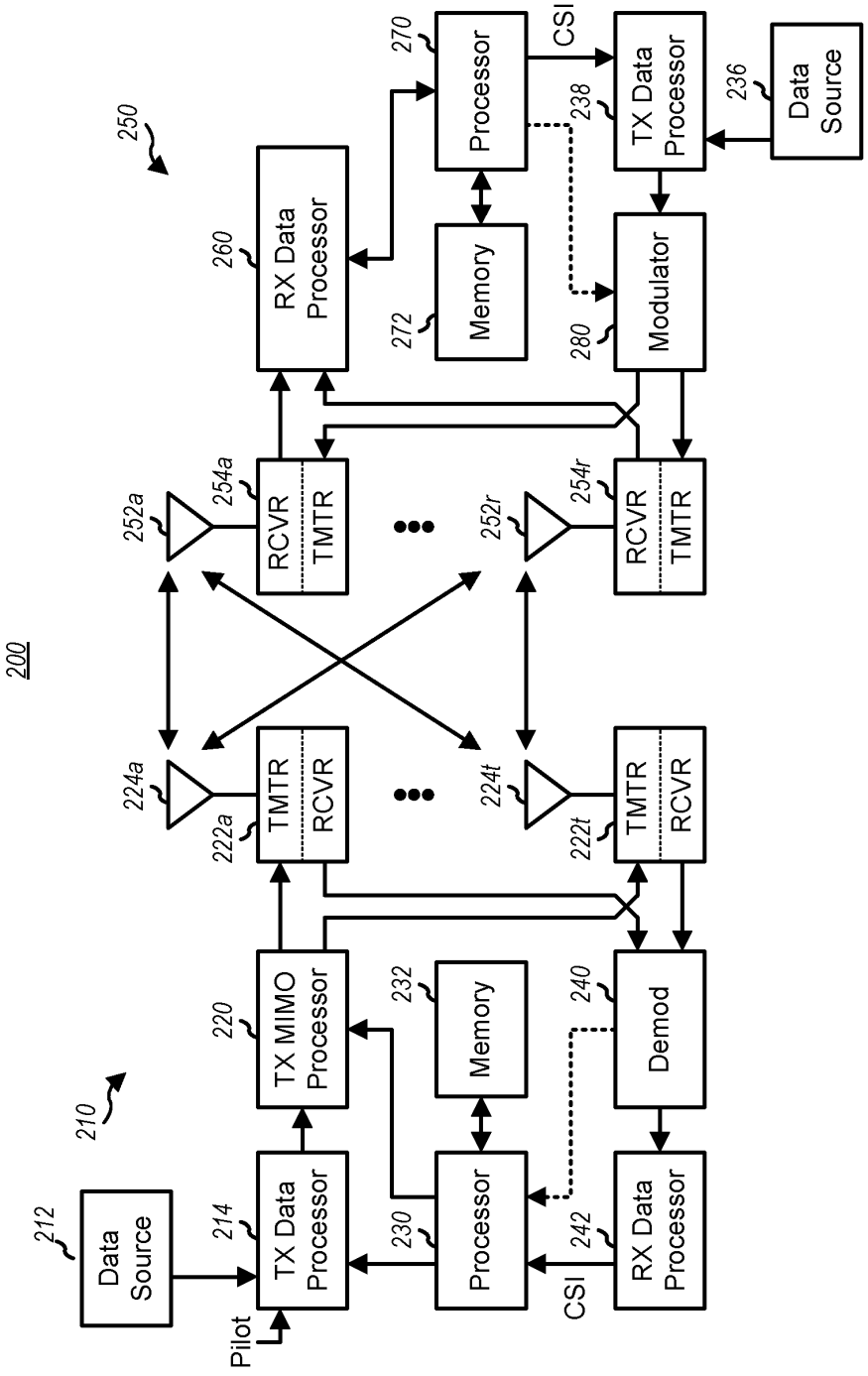

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Data Source
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Pilot
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TMTR
RCVR
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Processor
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Memory
240
Demod
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RX Data Processor
CSI
250
252a
254a
RCVR
TMTR
252r
254r
260
RX Data Processor
270
Processor
CSI
272
Memory
280
Modulator
238
TX Data Processor
236
Data Source

FIG. 2

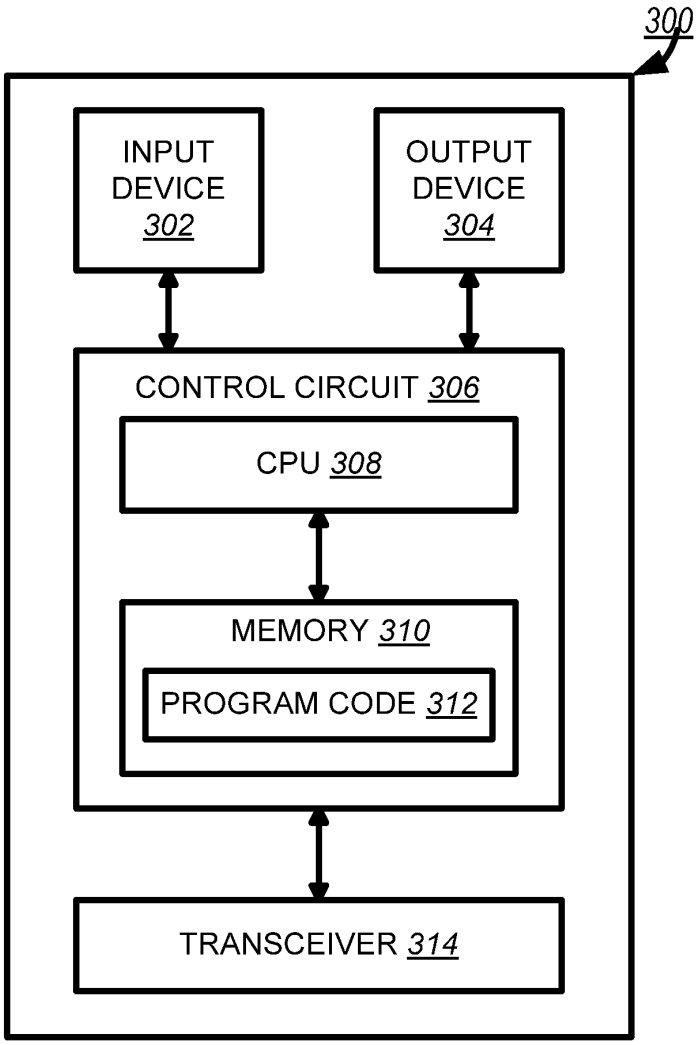

300
INPUT DEVICE 302
OUTPUT DEVICE 304
CONTROL CIRCUIT 306
CPU 308
MEMORY 310
PROGRAM CODE 312
TRANSCEIVER 314

FIG. 3

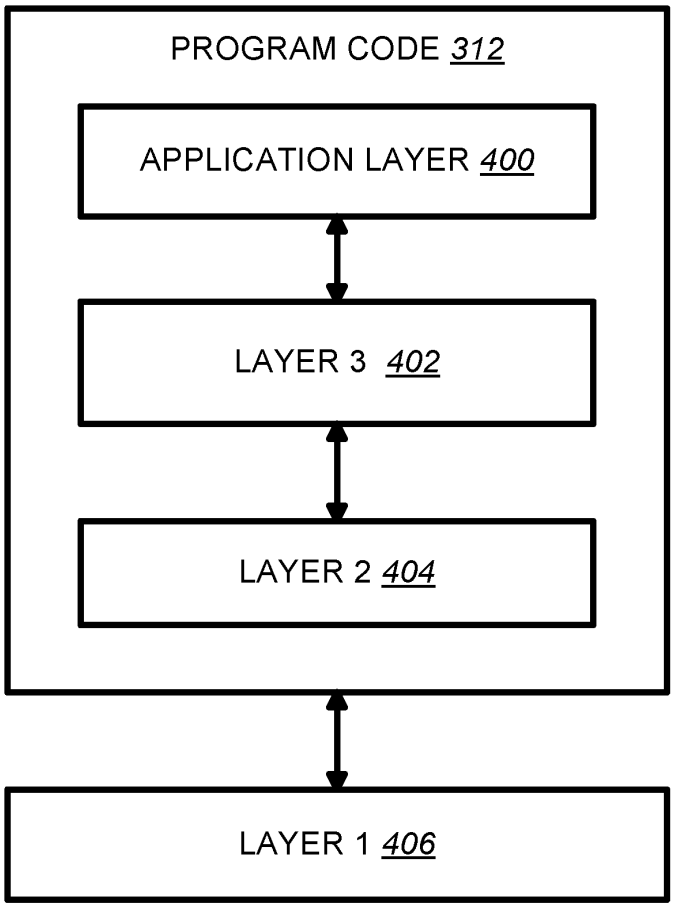

PROGRAM CODE 312
APPLICATION LAYER 400
LAYER 3 402
LAYER 2 404
LAYER 1 406

FIG. 4

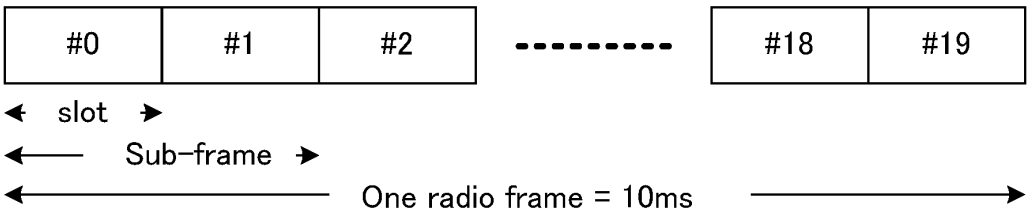


FIG. 5 (PRIOR ART)

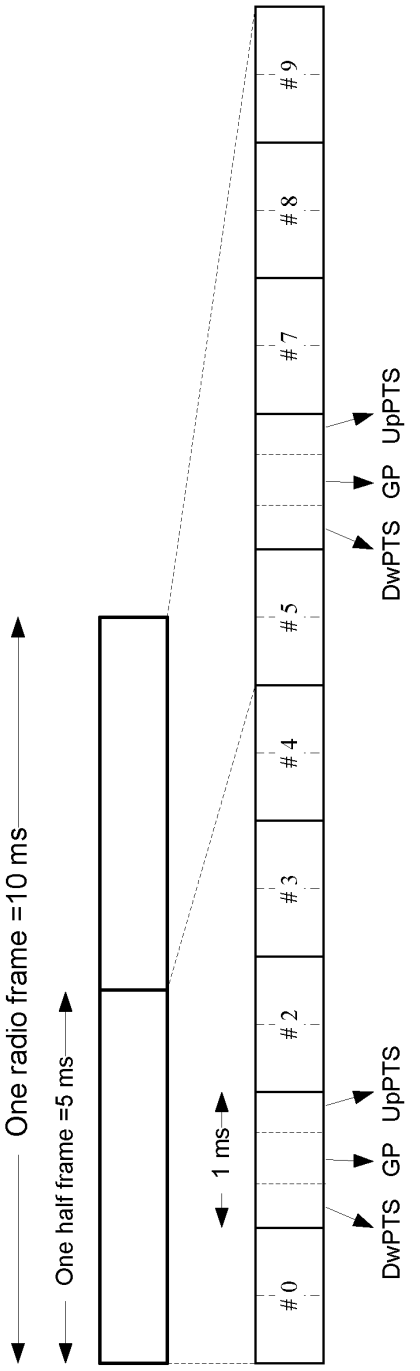


FIG. 6 (PRIOR ART)

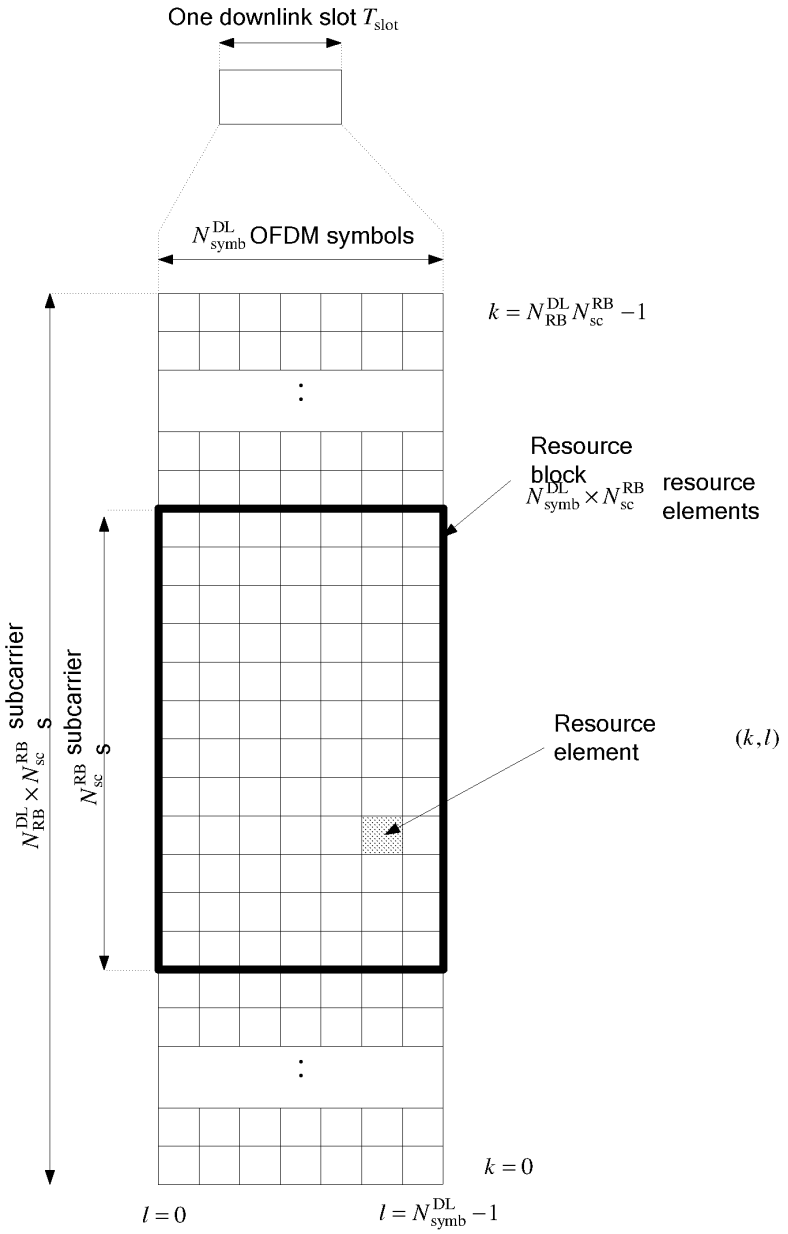


FIG. 7 (PRIOR ART)

Configuration		N_{sc}^{RB}	N_{symb}^{DL}
Normal cyclic prefix	$\Delta f = 15$ kHz	12	7
Extended cyclic prefix	$\Delta f = 15$ kHz		6
	$\Delta f = 7.5$ kHz	24	3

FIG. 8 (PRIOR ART)

PHICH duration	Non-MBSFN subframes		MBSFN subframes on a carrier supporting PDSCH
	Subframes 1 and 6 in case of frame structure type 2	All other cases	
Normal	1	1	1
Extended	2	3	2

FIG. 9 (PRIOR ART)

Antenna port p	$[\bar{w}_p(0) \quad \bar{w}_p(1) \quad \bar{w}_p(2) \quad \bar{w}_p(3)]$
7	$[+1 \quad +1 \quad +1 \quad +1]$
8	$[+1 \quad -1 \quad +1 \quad -1]$
9	$[+1 \quad +1 \quad +1 \quad +1]$
10	$[+1 \quad -1 \quad +1 \quad -1]$
11	$[+1 \quad +1 \quad -1 \quad -1]$
12	$[-1 \quad -1 \quad +1 \quad +1]$
13	$[+1 \quad -1 \quad -1 \quad +1]$
14	$[-1 \quad +1 \quad +1 \quad -1]$

FIG. 10 (PRIOR ART)

Antenna port p	$[\bar{w}_p(0) \quad \bar{w}_p(1)]$
7	$[+1 \quad +1]$
8	$[-1 \quad +1]$

FIG. 11 (PRIOR ART)

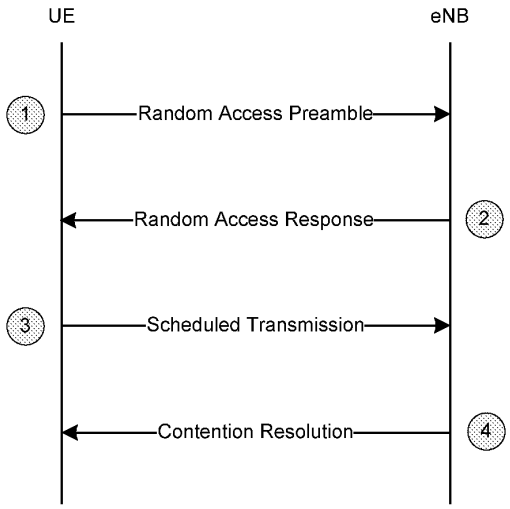


FIG. 12 (PRIOR ART)

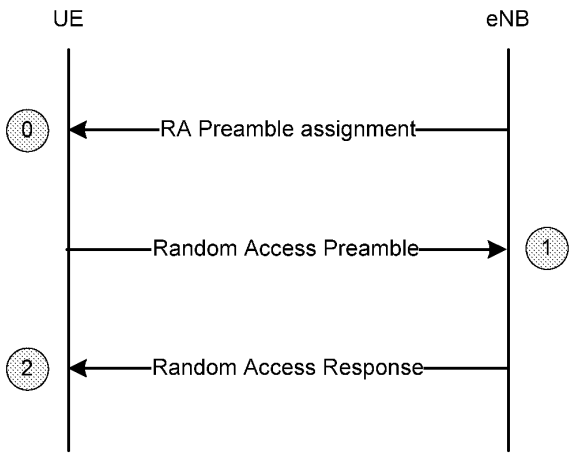


FIG. 13 (PRIOR ART)

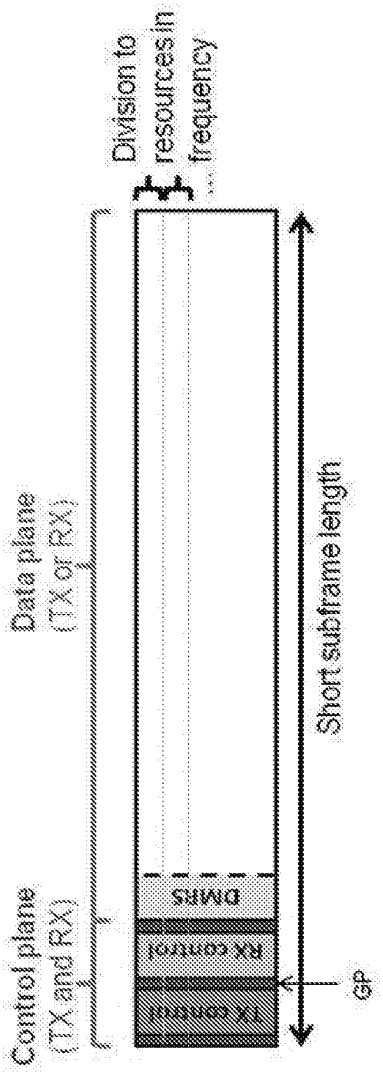


FIG. 14 (PRIOR ART)

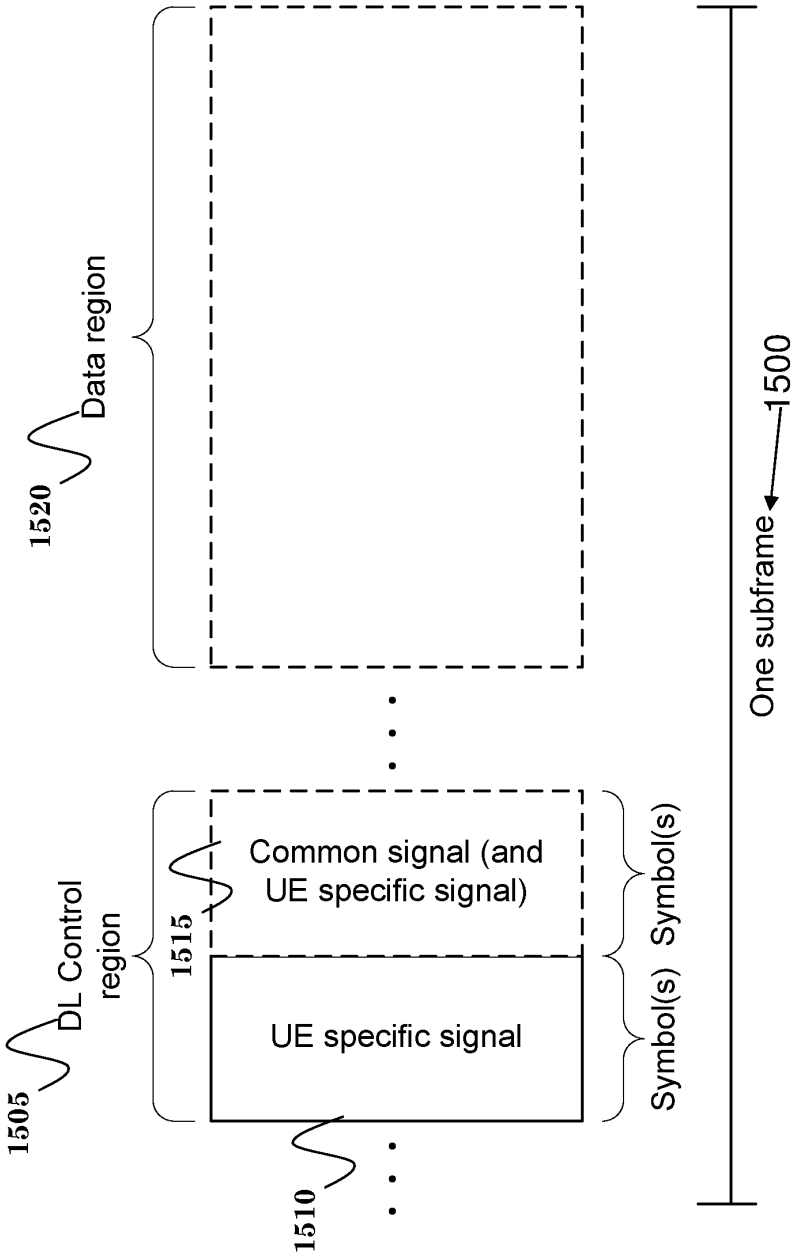

Data region
1520
One subframe
1500
Common signal (and UE specific signal)
1515
DL Control region
1505
UE specific signal
Symbol(s)
Symbol(s)
1510

FIG. 15

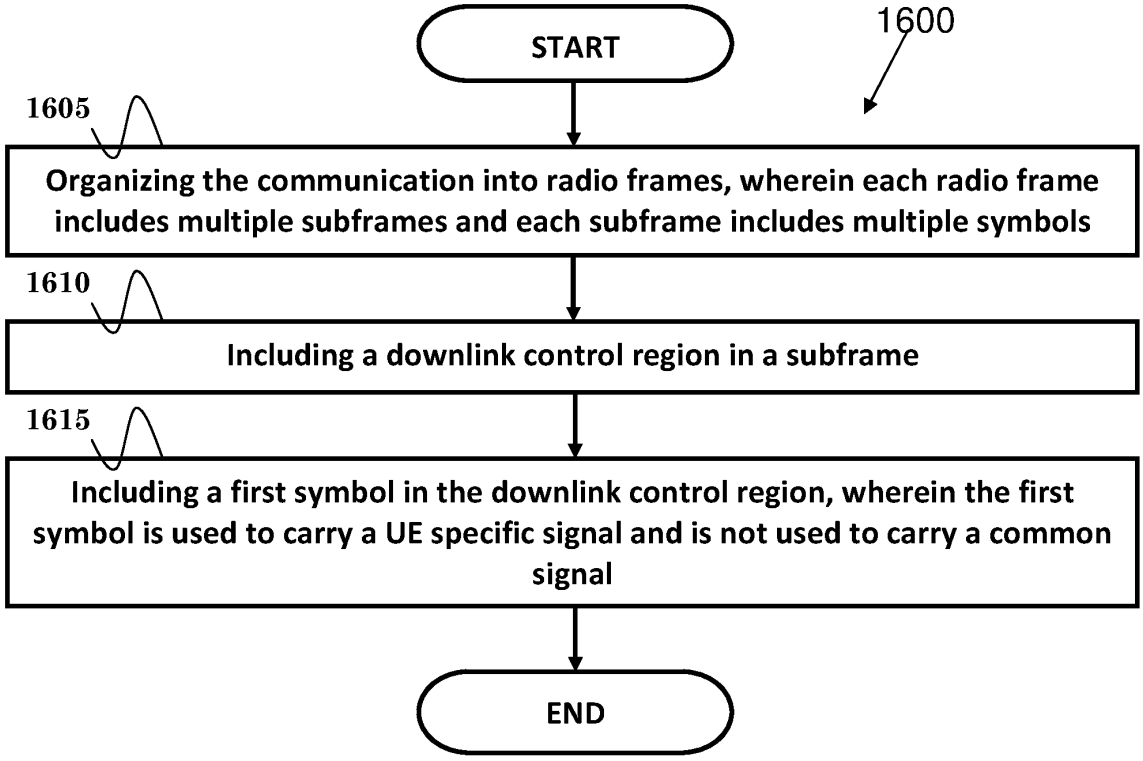

START
1600
1605
Organizing the communication into radio frames, wherein each radio frame includes multiple subframes and each subframe includes multiple symbols
1610
Including a downlink control region in a subframe
1615
Including a first symbol in the downlink control region, wherein the first symbol is used to carry a UE specific signal and is not used to carry a common signal
END

FIG. 16

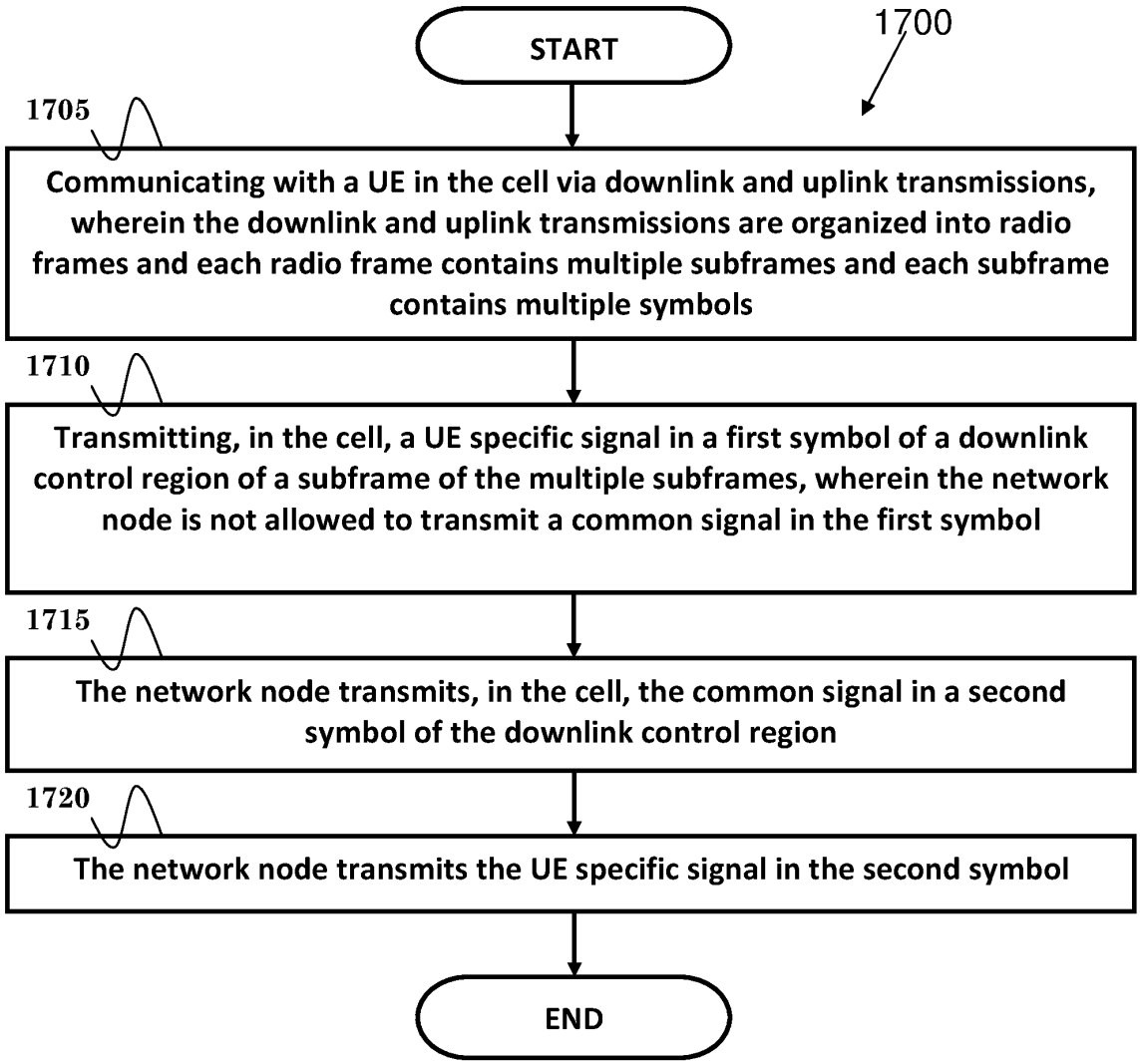

START
1700
1705
Communicating with a UE in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols
1710
Transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol
1715
The network node transmits, in the cell, the common signal in a second symbol of the downlink control region
1720
The network node transmits the UE specific signal in the second symbol
END

FIG. 17

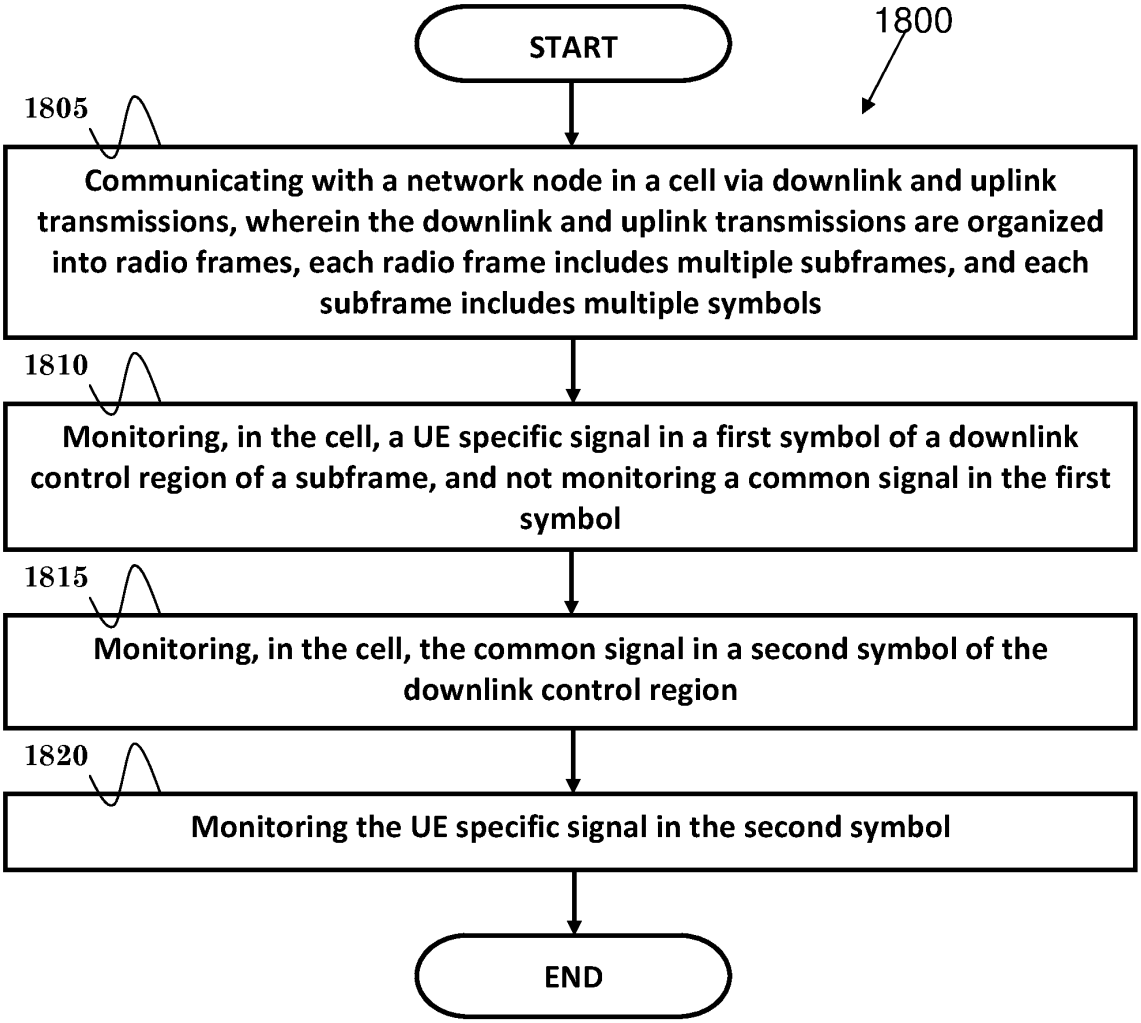

START
1800
1805
Communicating with a network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols
1810
Monitoring, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol
1815
Monitoring, in the cell, the common signal in a second symbol of the downlink control region
1820
Monitoring the UE specific signal in the second symbol
END

FIG. 18

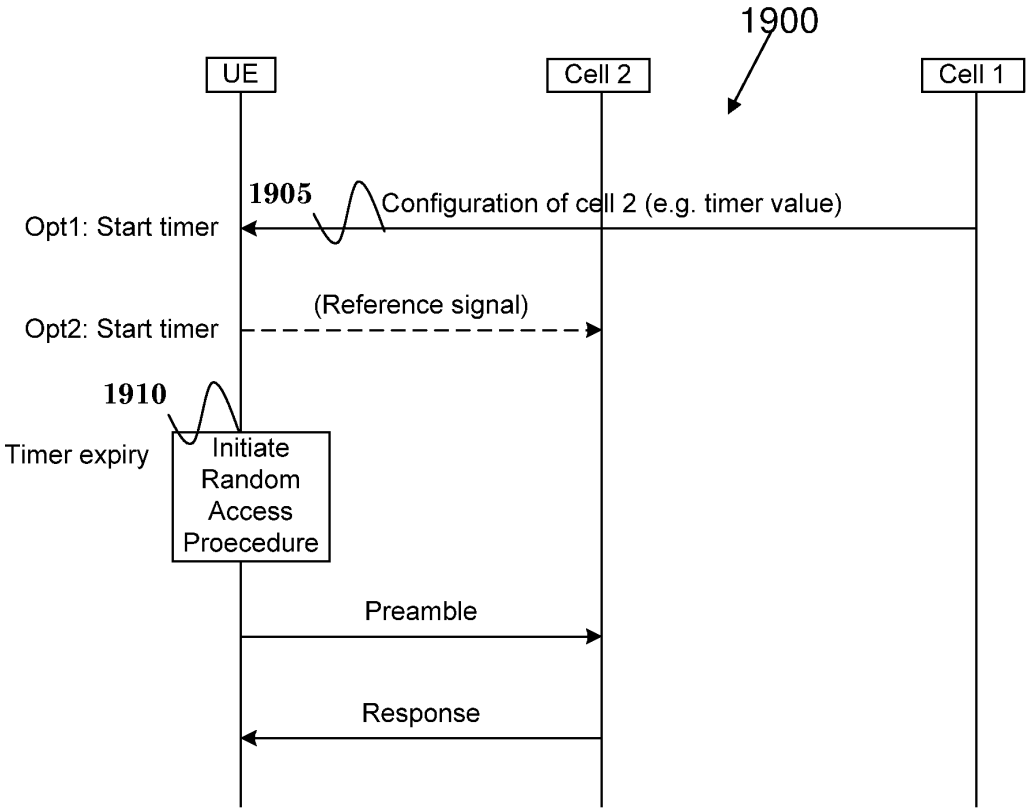

1900
UE
Cell 2
Cell 1
1905
Configuration of cell 2 (e.g. timer value)
Opt1: Start timer
(Reference signal)
Opt2: Start timer
1910
Timer expiry
Initiate Random Access Proecedure
Preamble
Response

FIG. 19

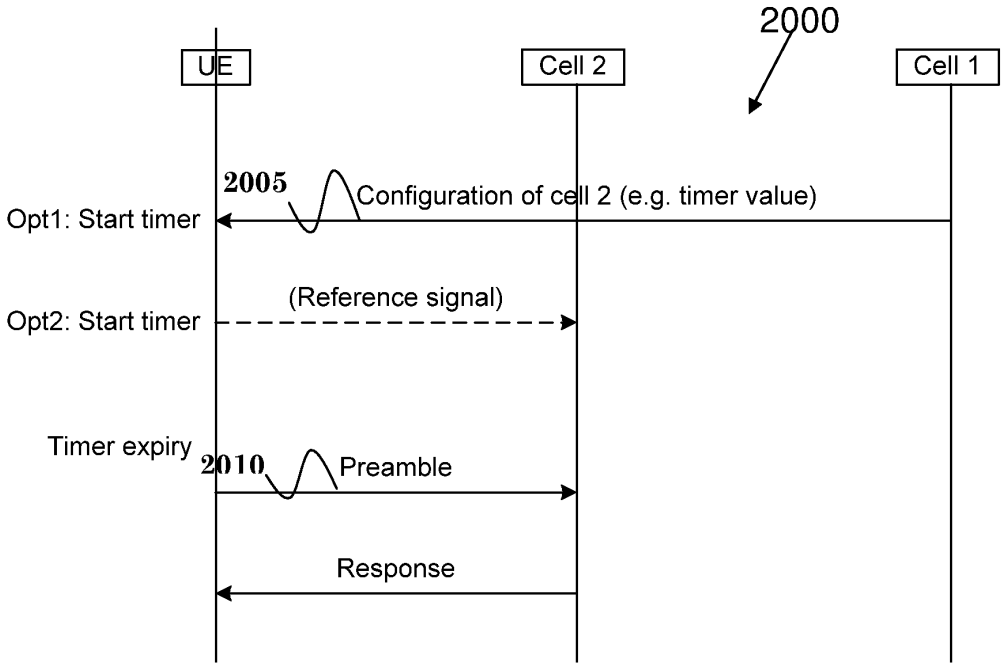

2000
UE
Cell 2
Cell 1
2005
Configuration of cell 2 (e.g. timer value)
Opt1: Start timer
(Reference signal)
Opt2: Start timer
Timer expiry
2010
Preamble
Response

FIG. 20

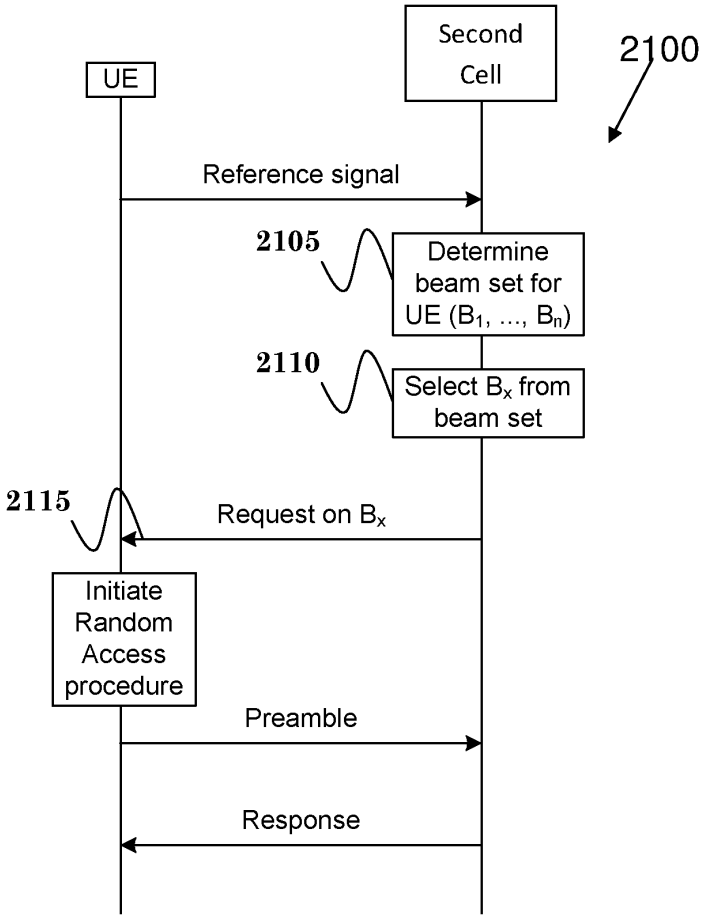

Second Cell
2100
UE
Reference signal
2105
Determine beam set for UE (B_1, ..., B_n)
2110
Select B_x from beam set
2115
Request on B_x
Initiate Random Access procedure
Preamble
Response

FIG. 21

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Guo, Yu-Hsuan Date (Optional): 2016.6.2

Signature: Guo, Yu-Hsuan

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

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LEGAL NAME OF INVENTOR

Inventor: Lin, Ko-Chiang Date (Optional): 2016.6.2.

Signature: Lin, Ko-Chiang

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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LEGAL NAME OF INVENTOR

Inventor: Richard Lee-Chee Kuo Date (Optional): June 2, 2006

Signature: Richard Lee-Chee Kuo

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: Sun, Chung-Ming Date (Optional): June 2, 2016

Signature: _____

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Doc Code: PA..
Document Description: Power of Attorney

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NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	Not Yet Assigned
Filing Date	Herewith
First Named Inventor	Yu-Hsuan Guo
Title	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	1426-077.101

SIGNATURE of Applicant or Patent Practitioner

Signature	/Sang N. Dang/	Date (Optional)	June 7, 2016
Name	Sang N. Dang	Registration Number	51,186
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Doc Code: PA..
Document Description: Power of Attorney

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 106622

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	MING-HSIU HSU	Date (Optional)	Aug. 28, 2015
Name	MING-HSIU HSU		
Title	Director of ASUSTek Computer Inc.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Yu-Hsuan Guo; Ko-Chiang Lin; Richard Lee-Chee Kuo; and Chung-Ming Sun	
Title:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	TBD	Filed: Herewith
Examiner:	TBD	Group Art Unit: TBD
Attorney Docket No.:	1426-077.101 (1040143-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 1 Page Utility Transmittal; 1 Page Fee Transmittal; 9 Page Application Data Sheet; 43 Page Specification; 19 Page Drawings; 4 Page executed Declaration; and 2 Page Power of Attorney are being transmitted to the United States Patent and Trademark Office via EFS-Web on June 7, 2016.

Date: June 7, 2016 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-077.001

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1600**

Electronic Acknowledgement Receipt	
EFS ID:	25992750
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.001
Receipt Date:	07-JUN-2016
Filing Date:	
Time Stamp:	16:11:31
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1600
RAM confirmation Number	2607
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	WebADS.pdf	151454 a1f82714e2d8e21b8b0f7ed9bd8a686087a5b4e6	no	9
Warnings:					
Information:					
2		1426-077-101--PackageAsFiledv2.pdf	2739009 74e79c3b2be9846ccf3962f2ec90d282067aacff	yes	71

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal of New Application	1	1
Fee Worksheet (SB06)	2	2
Specification	3	41
Claims	42	44
Abstract	45	45
Drawings-only black and white line drawings	46	64
Oath or Declaration filed	65	68
Power of Attorney	69	70
Miscellaneous Incoming Letter	71	71

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	35232 0cc79c808c690d947db59dde9aab1156a435a851	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2925695		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1

Legal Name				
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Yu-Hsuan		Guo	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	**State/Province**	OT
Postal Code		**Country** i	TW

Inventor 2

Legal Name				
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Ko-Chiang		Lin	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	**State/Province**	OT
Postal Code		**Country** i	TW

Inventor 3

Legal Name

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Richard	Lee-Chee	Kuo	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country i	TW

Inventor 4

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Chung-Ming		Sun	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country i	TW

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	106622		
Email Address		Add Email	Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM		
Attorney Docket Number	1426-077.001	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	19	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	106622		

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	
					Remove
Registration Number					

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	62174716	2015-06-12

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	62183460	2015-06-23

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

WEB ADS 1.0

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:	

If the Applicant is an Organization check here. ☒

Organization Name	ASUSTeK Computer Inc.

Mailing Address Information For Applicant:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	**State/Province**	OT
Country[i]	TW	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e. g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Sang N. Dang/			Date (YYYY-MM-DD)	
First Name	Sang N.	Last Name	Dang	Registration Number	51186

Additional Signature may be generated within this form by selecting the Add button.

DocCode - SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 15175673 Document Date: 06/07/2016

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

- Drawings – Other than Black and White Line Drawings

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

To access the documents in the SCORE database, refer to instructions below.

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- Examiners may access SCORE content via the eDAN interface.
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Form Revision Date: September 30, 2013

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/175,673	06/07/2016	2414	1600	1426-077.001	20	3

CONFIRMATION NO. 7587

106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

FILING RECEIPT

OC000000083988085

Date Mailed: 06/30/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Yu-Hsuan Guo, Taipei City, TAIWAN;
Ko-Chiang Lin, Taipei City, TAIWAN;
Richard Lee-Chee Kuo, Taipei City, TAIWAN;
Chung-Ming Sun, Taipei City, TAIWAN;

Applicant(s)

ASUSTeK Computer Inc., Taipei City, TAIWAN;

Power of Attorney: The patent practitioners associated with Customer Number 106622

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/174,716 06/12/2015
and claims benefit of 62/183,460 06/23/2015

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 06/27/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/175,673**

Projected Publication Date: 12/15/2016

Non-Publication Request: No

Early Publication Request: No

Title

METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/175,673

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1600

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101

CONFIRMATION NO. 7587

106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

PUBLICATION NOTICE

OC000000087917922

Title:METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

Publication No.US-2016-0366687-A1
Publication Date:12/15/2016

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

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Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15175673
Filing Date	2016-06-07
First Named Inventor	Yu-Hsuan Guo
Art Unit	2464
Examiner Name	Ricky Quoc Ngo
Attorney Docket Number	1426-077.101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20130183987		2013-07-18	Sophie Vrzic et al.	
	2	20130201925		2016-08-08	Xiaodong Li et al.	

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	15175673
	Filing Date	2016-06-07
	First Named Inventor	Yu-Hsuan Guo
	Art Unit	2464
	Examiner Name	Ricky Quoc Ngo
	Attorney Docket Number	1426-077.101

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Erik Dahlman et al., "Downlink Physical-Layer Processing - Chapter 10" In:"4G LTE/LTE-Advanced for Mobile Broadband", 7 October 2013 (2013-10-07), Elsevier, XP055249210, pages 161-240,	☐
	2	European Search Report from corresponding EP Application No. 16173601.2, dated August 31, 2016	☐

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Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Electronic Acknowledgement Receipt

EFS ID:	28021941
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	10-JAN-2017
Filing Date:	07-JUN-2016
Time Stamp:	14:09:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	1426-077-101--IDSasFiled01102017.pdf	96422 e35681c84c2425a3b8cefccecfee64ff233d6a02	no	2
Warnings:					

Information:					
This is not an USPTO supplied IDS fillable form					
2	Non Patent Literature	downlinkphysical-layerprocessingv2.pdf	18200968 19ffa75d03e8181bf6e9ec5a0bbfa926239bd97e	no	80
Warnings:					
Information:					
3	Non Patent Literature	OFFICIALCOM-2016093920v2.pdf	1941296 f9432821224805691344bb5b6572170f90e5b55d	no	10
Warnings:					
Information:					
			Total Files Size (in bytes):	20238686	

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PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15175673
	Filing Date	2016-06-07
	First Named Inventor	Yu-Hsuan Guo
	Art Unit	2464
	Examiner Name	Ricky Quoc Ngo
	Attorney Docket Number	1426-077.101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20130201925		2013-08-08	Li et al.	
	2	20130183987		2013-07-18	Vrzic et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15175673
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	First Named Inventor	Yu-Hsuan Guo
	Art Unit	2464
	Examiner Name	Ricky Quoc Ngo
	Attorney Docket Number	1426-077.101

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	3GPP TS 36.211 V12.5.0 (2015-03-26).	☐
	2	Project Name:Mobile and wireless communications Enablers for the Twenty-twenty Information Society (METIS) Deliverable D2.4 ,Document Number: ICT-317669-METIS/D2.4 (2015-02-28).	☐
	3	3GPP TS 36.331 V12.5.0 (2015-03-27).	☐
	4	Notice of Non-Final Rejection from corresponding Korean Application No. 10-2016-0071321, dated August 21, 2017.	☒

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Electronic Acknowledgement Receipt

EFS ID:	30212408
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	29-AUG-2017
Filing Date:	07-JUN-2016
Time Stamp:	14:12:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	1426-077-101--IDSasFiled08292017.pdf	54951 18d7ff375ff5cc7ab106eab46284ef266fa7fec3	no	2
Warnings:					

Information:					
This is not an USPTO supplied IDS fillable form					
2	Non Patent Literature	1NPL--3GPPTS36-211.pdf	1981623 03fcbc34ee890cce0e58206b6a5a982ea1c4ebee	no	136
Warnings:					
Information:					
3	Non Patent Literature	2NPL-DeliverableD2-4.pdf	14326024 2d34c0f67cccdf0ae361162e056a52c141e7b6c1	no	190
Warnings:					
Information:					
4	Non Patent Literature	3NPL-3GPPTS36-331.pdf	4495994 296eb2563feef09a1dd21912b491b35099ede9f3	no	445
Warnings:					
Information:					
5	Non Patent Literature	4NPL-KROfficeAction.pdf	1782368 99ca50af6d82c9093757f933116e37b65e2cec6c	no	12
Warnings:					
Information:					
		Total Files Size (in bytes):	22640960		

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New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

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New International Application Filed with the USPTO as a Receiving Office

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PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15175673
Filing Date	2016-06-07
First Named Inventor	Yu-Hsuan Guo
Art Unit	2472
Examiner Name	Brian D. Nguyen
Attorney Docket Number	1426-077-101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20150016370		2015-01-15	Kazuaki Takeda	
	2	20150188684		2015-07-02	Kazuaki Takeda	

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2013-157822	JP		2013-08-15	NTT DOCOMO Inc.		☒
	2	2013119659	WO		2013-08-15	Neocific, Inc.		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15175673
	Filing Date	2016-06-07
	First Named Inventor	Yu-Hsuan Guo
	Art Unit	2472
	Examiner Name	Brian D. Nguyen
	Attorney Docket Number	1426-077-101

	3	2013-504248	JP		2013-02-04	LG Electronics Inc.		☒
	4	2013168562	WO		2013-11-14	NTT DOCOMO, Inc.		☐
	5	2011031058	WO		2011-03-17	LG Electronics Inc.		☐

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Office Action from Japanese Patent Office from corresponding JP Patent Application No. 2016-114736, dated September 21, 2017.	☒

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RADIO BASE STATION DEVICE, USER TERMINAL, RADIO COMMUNICATION SYSTEM, AND RADIO COMMUNICATION METHOD

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Abstract of JP2013157822 (A)

PROBLEM TO BE SOLVED: To appropriately perform an allocation of a radio resource for an extended control channel in a structure in which a downlink control channel is extended.SOLUTION: The radio base station device includes: a mapping part for dividing and mapping a common search space that is a candidate region on which common control information common between user terminals is arranged and a specific search space that is a candidate region on which specific control information specific to each user terminal is arranged in a unit of predetermined frequency domain constituting system bands; and a transmission part for performing frequency division multiplexing and transmitting an extended downlink control channel on which the common control information is arranged in the common search space and the specific control information is arranged in the specific search space, and a downlink common data channel, where the mapping part maps the common search space to a unit of a plurality of frequency domains so that the common search space is distributed in the system bands.

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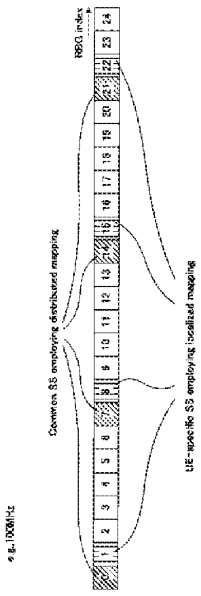
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(54)【発明の名称】無線基地局装置、ユーザ端末、無線通信システム及び無線通信方法

(57)【要約】
【課題】下り制御チャネルを拡張した構成において、拡張した制御チャネル用の無線リソースの割当てを適切に行うこと。
【解決手段】本発明の無線基地局装置は、ユーザ端末間で共通の共通制御情報が配置される候補領域である共通サーチスペースと各ユーザ端末に固有の固有制御情報が配置される候補領域である固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位で分離してマッピングするマッピング部と、前記共通サーチスペース内に前記共通制御情報が配置されるとともに前記固有サーチスペース内に前記固有制御情報が配置される拡張下り制御チャネルを、下り共有データチャネルと周波数分割多重して送信する送信部と、を具備し、前記マッピング部は、前記共通サーチスペースが前記システム帯域内に分散されるように、前記共通サーチスペースを複数の周波数領域単位にマッピングすることを特徴とする。
【選択図】図５



載の無線基地局装置。
【請求項８】
前記共通サーチスペースがマッピングされた前記複数の周波数領域単位は、上位レイヤシグナリングを用いて前記ユーザ端末にシグナリングされることを特徴とする請求項１から請求項７のいずれかに記載の無線基地局装置。
【請求項９】
前記共通サーチスペースがマッピングされた前記複数の周波数領域単位は、報知情報として、報知されることを特徴とする請求項１から請求項７のいずれかに記載の無線基地局装置。
【請求項１０】
前記所定の周波数領域単位は、物理リソースブロックであることを特徴とする請求項１から請求項９のいずれかに記載の無線基地局装置。
【請求項１１】
前記所定の周波数領域単位は、周波数方向に連続する複数の物理リソースブロックからなるリソースブロックグループであることを特徴とする請求項１から請求項９のいずれかに記載の無線基地局装置。
【請求項１２】
下り共有データチャネルと周波数分割多重されており、ユーザ端末間で共通の共通制御情報が共通サーチスペース内に配置されるとともに各ユーザ端末に固有の固有制御情報が固有サーチスペース内に配置される拡張下り制御チャネルを受信する受信部と、
前記共通サーチスペース内に配置される前記共通制御情報をブラインドデコーディングするとともに、前記固有サーチスペース内に配置される前記固有制御情報をブラインドデコーディングする復号部と、を具備し、
前記共通サーチスペースと前記固有サーチスペースとはシステム帯域を構成する所定の周波数領域単位で分離されており、
前記共通サーチスペースは、前記システム帯域内に分散されるように、複数の周波数領域単位にマッピングされていることを特徴とするユーザ端末。
【請求項１３】
ユーザ端末間で共通の共通制御情報が配置される候補領域である共通サーチスペースと各ユーザ端末に固有の固有制御情報が配置される候補領域である固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位で分離してマッピングするマッピング部と、
前記共通サーチスペース内に前記共通制御情報が配置されるとともに前記固有サーチスペース内に前記固有制御情報が配置される拡張下り制御チャネルを、下り共有データチャネルと周波数分割多重して送信する送信部と、を備えた無線基地局装置と、
前記拡張下り制御チャネルを受信する受信部と、
前記共通サーチスペース内に配置される前記共通制御情報をブラインドデコーディングするとともに、前記固有サーチスペース内に配置される前記固有制御情報をブラインドデコーディングする復号部と、を備えたユーザ端末と、を具備し、
前記マッピング部は、前記共通サーチスペースが前記システム帯域内に分散されるように、前記共通サーチスペースを複数の周波数領域単位にマッピングすることを特徴とする無線通信システム。
【請求項１４】
無線基地局装置が下り共有データチャネルと周波数分割多重された拡張下り制御チャネルをユーザ端末に送信する無線通信方法であって、
前記無線基地局装置が、ユーザ端末間で共通の共通制御情報が配置される候補領域である共通サーチスペースと各ユーザ端末に固有の固有制御情報が配置される候補領域である固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位で分離してマッピングするステップと、
前記無線基地局装置が、前記共通サーチスペース内に前記共通制御情報が配置されると

ともに前記固有サーチスペース内に前記固有制御情報が配置される拡張下り制御チャネルを、下り共有データチャネルと周波数分割多重して送信するステップと、
前記ユーザ端末が、前記拡張下り制御チャネルを受信するステップと、
前記ユーザ端末が、前記共通サーチスペース内に配置される前記共通制御情報をブラインドデコーディングするとともに前記固有サーチスペース内に配置される前記固有制御情報をブラインドデコーディングするステップと、を有し、
前記無線基地局装置は、前記共通サーチスペースが前記システム帯域内に分散されるように、前記共通サーチスペースを不連続の複数の周波数領域単位にマッピングすることを特徴とする無線通信方法。

【発明の詳細な説明】

【技術分野】

【０００１】

本発明は、次世代無線通信システムにおける無線基地局装置、ユーザ端末、無線通信システム及び無線通信方法に関する。

【背景技術】

【０００２】

ＵＭＴＳ（Universal Mobile Telecommunications System）ネットワークにおいて、更なる高速データレート、低遅延などを目的としてロングタームエボリューション（ＬＴＥ：Long Term Evolution）が検討されている（非特許文献１）。ＬＴＥではマルチアクセス方式として、下り回線（下りリンク）にＯＦＤＭＡ（Orthogonal Frequency Division Multiple Access）をベースとした方式を用い、上り回線（上りリンク）にＳＣ－ＦＤＭＡ（Single Carrier Frequency Division Multiple Access）をベースとした方式を用いている。

【０００３】

また、ＬＴＥからのさらなる広帯域化及び高速化を目的として、ＬＴＥの後継システム（例えば、ＬＴＥアドバンスト又はＬＴＥエンハンスメントと呼ぶこともある（以下、「ＬＴＥ－Ａ」という）も検討されている。ＬＴＥ（Rel.8）やＬＴＥ－Ａ（Rel.9、Rel.10）においては、複数のアンテナでデータを送受信し、周波数利用効率を向上させる無線通信技術としてＭＩＭＯ（Multi Input Multi Output）技術が検討されている。ＭＩＭＯ技術においては、送受信機に複数の送信／受信アンテナを用意し、異なる送信アンテナから同時に異なる送信情報系列を送信する。

【先行技術文献】

【非特許文献】

【０００４】

【非特許文献１】3GPP TR 25.913 "Requirements for Evolved UTRA and Evolved UTRAN"

【発明の概要】

【発明が解決しようとする課題】

【０００５】

ところで、ＬＴＥの後継システムとなるＬＴＥ－Ａでは、異なる送信アンテナから同時に異なるユーザに送信情報系列を送信するマルチユーザＭＩＭＯ（ＭＵ－ＭＩＭＯ：Multiple User MIMO）伝送が規定されている。このＭＵ－ＭＩＭＯ伝送は、Ｈｅｔｎｅｔ（Heterogeneous network）やＣｏＭＰ（Coordinated Multi-Point）伝送にも適用されることが検討されている。

【０００６】

将来のシステムでは、無線基地局装置に接続されるユーザ数が増加することにより、下り制御信号を送信する下り制御チャネルの容量が不足することが想定される。このため、従来の無線リソースの割当て方法ではＭＵ－ＭＩＭＯ伝送等の将来のシステムの特性を十分に発揮できないおそれがある。

【０００７】

このような問題を解決する決法として、下り制御チャネルを割当てる領域を拡張して、より多くの下り制御信号を送信する方法が考えられる。下り制御チャネルを拡張する場合、拡張した下り制御チャネル用の無線リソースをどのように割り当てるか重要な問題となる。また、無線基地局装置のカバレッジエリア内に小型基地局装置が重畳的に配置されるＨｅｔＮｅｔでは、無線基地局装置と小型基地局装置との間での干渉の影響を考慮して、拡張した下り制御チャネル用の無線リソースを割り当てることが重要である。

【０００８】

本発明はかかる点に鑑みてなされたものであり、拡張した下り制御チャネル用の無線リソースを適切に割り当てることができる無線基地局装置、ユーザ端末、無線通信システム及び無線通信方法を提供することを目的とする。

【課題を解決するための手段】

【０００９】

本発明の無線基地局装置は、ユーザ端末間で共通の共通制御情報が配置される候補領域である共通サーチスペースと各ユーザ端末に固有の固有制御情報が配置される候補領域である固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位で分離してマッピングするマッピング部と、前記共通サーチスペース内に前記共通制御情報が配置されるとともに前記固有サーチスペース内に前記固有制御情報が配置される拡張下り制御チャネルを、下り共有データチャネルと周波数分割多重して送信する送信部と、を具備し、前記マッピング部は、前記共通サーチスペースが前記システム帯域内に分散されるように、前記共通サーチスペースを複数の周波数領域単位にマッピングすることを特徴とする。

【００１０】

本発明のユーザ端末は、下り共有データチャネルと周波数分割多重されており、ユーザ端末間で共通の共通制御情報が共通サーチスペース内に配置されるとともに各ユーザ端末に固有の固有制御情報が固有サーチスペース内に配置される拡張下り制御チャネルを受信する受信部と、前記共通サーチスペース内に配置される前記共通制御情報をブラインドデコーディングするとともに、前記固有サーチスペース内に配置される前記固有制御情報をブラインドデコーディングする復号部と、を具備し、前記共通サーチスペースと前記固有サーチスペースとはシステム帯域を構成する所定の周波数領域単位で分離されており、前記共通サーチスペースは、前記システム帯域内に分散されるように、複数の周波数領域単位にマッピングされていることを特徴とする。

【００１１】

本発明の無線通信システムは、ユーザ端末間で共通の共通制御情報が配置される候補領域である共通サーチスペースと各ユーザ端末に固有の固有制御情報が配置される候補領域である固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位で分離してマッピングするマッピング部と、前記共通サーチスペース内に前記共通制御情報が配置されるとともに前記固有サーチスペース内に前記固有制御情報が配置される拡張下り制御チャネルを、下り共有データチャネルと周波数分割多重して送信する送信部と、を備えた無線基地局装置と、前記拡張下り制御チャネルを受信する受信部と、前記共通サーチスペース内に配置される前記共通制御情報をブラインドデコーディングするとともに、前記固有サーチスペース内に配置される前記固有制御情報をブラインドデコーディングする復号部と、を備えたユーザ端末と、を具備し、前記マッピング部は、前記共通サーチスペースが前記システム帯域内に分散されるように、前記共通サーチスペースを複数の周波数領域単位にマッピングすることを特徴とする。

【００１２】

本発明の無線通信方法は、無線基地局装置が下り共有データチャネルと周波数分割多重された拡張下り制御チャネルをユーザ端末に送信する無線通信方法であって、前記無線基地局装置が、ユーザ端末間で共通の共通制御情報が配置される候補領域である共通サーチスペースと各ユーザ端末に固有の固有制御情報が配置される候補領域である固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位で分離してマッピングするステップと、前記無線基地局装置が、前記共通サーチスペース内に前記共通制御情報が配置

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されるとともに前記固有サーチスペース内に前記固有制御情報が配置される拡張下り制御チャネルを、下り共有データチャネルと周波数分割多重して送信するステップと、前記ユーザ端末が、前記拡張下り制御チャネルを受信するステップと、前記ユーザ端末が、前記共通サーチスペース内に配置される前記共通制御情報をブラインドデコーディングするとともに前記固有サーチスペース内に配置される前記固有制御情報をブラインドデコーディングするステップと、を有し、前記無線基地局装置は、前記共通サーチスペースが前記システム帯域内に分散されるように、前記共通サーチスペースを不連続の複数の周波数領域単位にマッピングすることを特徴とする。

【発明の効果】

【００１３】

本発明によれば、下り制御チャネルを拡張した構成において、拡張した下り制御チャネル用の無線リソースを適切に割り当てることができる。

【図面の簡単な説明】

【００１４】

【図１】ＭＵ－ＭＩＭＯが適用されるＨｅｔｎｅｔの概略図である。

【図２】下りリンクのＭＵ－ＭＩＭＯ伝送が行われるサブフレームの一例を示す図である。

【図３】拡張ＰＤＣＣＨのサブフレーム構成の説明図である。

【図４】システム帯域に対する拡張ＰＤＣＣＨの割当ての一例を示す図である。

【図５】拡張ＰＤＣＣＨの共通サーチスペース及びＵＥ固有サーチスペースの割当ての一例を示す図である。

【図６】拡張ＰＤＣＣＨの共通サーチスペース対する拡張用チャネル制御要素（ｅＣＣＥ）の関係を示す図である。

【図７】第１の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピング方法の一例を示す図である。

【図８】第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピング方法を説明するための図である。

【図９】第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピング方法の一例を示す図である。

【図１０】第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピング方法の一例を示す図である。

【図１１】第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピング方法の他の例を示す図である。

【図１２】第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピング方法の他の例を示す図である。

【図１３】実施の形態に係る無線通信システムのシステム構成の説明図である。

【図１４】実施の形態に係る無線基地局装置の全体構成の説明図である。

【図１５】実施の形態に係るユーザ端末の全体構成の説明図である。

【図１６】実施の形態に係る無線基地局装置のベースバンド処理部及び一部の上位レイヤを示す機能ブロック図である。

【図１７】実施の形態に係るユーザ端末のベースバンド処理部の機能ブロック図である。

【発明を実施するための形態】

【００１５】

図１は、ＭＵ－ＭＩＭＯ伝送が適用されるＨｅｔｎｅｔの一例を示す図である。図１に示すシステムは、無線基地局装置（例えば、ｅＮＢ：eNodeB）のカバレッジエリア内に局所的なカバレッジエリアを有する小型基地局装置（例えば、ＲＲＨ：Remote Radio Head）が設けられ、階層的に構成されている。このようなシステムにおける下りリンクのＭＵ－ＭＩＭＯ伝送では、無線基地局装置の複数のアンテナから複数のユーザ端末ＵＥ（User Equipment）＃１及び＃２に対するデータが同時に送信される。また、複数の小型基地局装置の複数のアンテナから複数のユーザ端末ＵＥ＃３、＃４に対するデータも同時に

送信される。

【００１６】

図２は、下りリンクのＭＵ－ＭＩＭＯ伝送が適用される無線フレーム（例えば、１サブフレーム）の一例を示す図である。図２に示すように、ＭＵ－ＭＩＭＯ伝送が適用されるシステムでは、各サブフレームにおいて先頭から所定のＯＦＤＭシンボル（１～３ＯＦＤＭシンボル）まで、下り制御チャネル（ＰＤＣＣＨ：Physical Downlink Control Channel）用のリソース領域（ＰＤＣＣＨ領域）として確保される。また、サブフレームの先頭から所定のシンボルより後の無線リソースに、下り共有データチャネル（ＰＤＳＣＨ：Physical Downlink Shared Channel）用のリソース領域（ＰＤＳＣＨ領域）が確保される。

【００１７】

ＰＤＣＣＨ領域には、ユーザ端末ＵＥ（ここでは、ＵＥ＃１～＃４）に対する下り制御情報（ＤＣＩ：Downlink Control Information）が割当てられる。下り制御情報（ＤＣＩ）には、ＰＤＳＣＨ領域における割当て情報が含まれる。このように、各サブフレームにおいて、ユーザ端末ＵＥに対する下りデータ用の信号と、当該下りデータを受信するための下り制御情報（ＤＣＩ）用の信号とは時分割多重されて送信される。

【００１８】

ＭＵ－ＭＩＭＯ伝送においては、同一時間及び同一周波数で複数のユーザ端末ＵＥに対するデータ送信が可能となる。このため、図２のＰＤＳＣＨ領域において、ユーザ端末ＵＥ＃１に対するデータとユーザ端末ＵＥ＃５に対するデータを同一の周波数領域に多重することが考えられる。同様に、ユーザ端末ＵＥ＃４に対するデータとユーザ端末ＵＥ＃６に対するデータを同一の周波数領域に多重することも考えられる。

【００１９】

しかしながら、多くのユーザ端末ＵＥの下り制御情報をＰＤＣＣＨ領域に割当てる場合、図２に示すように、ユーザ端末ＵＥ＃５及び＃６に対応する下り制御情報を伝送するためのＰＤＣＣＨ領域が足りなくなる場合がある。この場合には、ＰＤＳＣＨ領域に多重できるユーザ端末ＵＥの数が制限されてしまう。

【００２０】

このように、ＭＵ－ＭＩＭＯ伝送により同一の無線リソースに多重されるユーザ端末数を増加させても、下り制御情報を伝送するためのＰＤＣＣＨ領域が不足する場合には、ＰＤＳＣＨ領域の利用効率を十分に図れないおそれがある。

【００２１】

このようなＰＤＣＣＨ領域の不足を解決する方法として、サブフレームの先頭から最大３ＯＦＤＭシンボルの制御領域以外にＰＤＣＣＨの割当て領域を拡張する（既存のＰＤＳＣＨ領域にＰＤＣＣＨ領域を拡張する）ことが考えられる。例えば、ＰＤＳＣＨ領域においてＰＤＳＣＨとＰＤＣＣＨとを周波数分割多重する方法（周波数分割（ＦＤＭ）アプローチ）が考えられる。このようなＰＤＳＣＨと周波数分割多重されるＰＤＣＣＨは、既存のＰＤＣＣＨと区別するために、拡張ＰＤＣＣＨ（拡張下り制御チャネル、Ｅ－ＰＤＣＣＨ、Enhanced ＰＤＣＣＨ、ＦＤＭ型ＰＤＣＣＨ、ＵＥ－ＰＤＣＣＨ等とも呼ぶ）と呼ばれる。

【００２２】

周波数分割アプローチを適用する場合、ユーザ固有の参照信号（ＤＭ－ＲＳ：DeModulation-Reference Signal）を用いて拡張ＰＤＣＣＨの復調を行うことでビームフォーミングゲインを得ることが可能となる。この場合、ユーザ端末ＵＥに対して個別にビームフォーミングが可能となることによって十分な受信品質が得られるため、容量の増大に有効となると考えられる。

【００２３】

ところで、拡張ＰＤＣＣＨのフォーマットとしては、既存のＰＤＣＣＨと同様に各ユーザの下り制御信号を複数のリソース要素グループ（ＲＥＧ）からなる制御チャネル要素（ＣＣＥ）単位で割当てる方法（with cross interleaving）と、各ユーザの下り制御信

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号をＰＲＢ単位で割当てる方法（without cross interleaving）のいずれかが適用できる。

【００２４】

without cross interleavingでは、拡張ＰＤＣＣＨに対して、各ユーザの下りリンク制御信号がＶＲＢ単位で割当てられる。また、拡張ＰＤＣＣＨが配置される可能性のある無線リソースにはユーザ個別の下り参照信号であるＤＭ－ＲＳが配置される。このため、拡張ＰＤＣＣＨの復調をＤＭ－ＲＳを用いて行うことができる。この場合、ＰＲＢ単位でのチャネル推定が可能であり、各移動端末装置ＵＥに対して効果的にビームフォーミングを形成できる。

【００２５】

図３に、周波数分割アプローチを適用する場合のフレーム構成の一例を示す。図３Ａに示すフレーム構成では、既存のＰＤＣＣＨと拡張ＰＤＣＣＨが配置されている。送信時間間隔となるフレーム（以下、「サブフレーム」と記す）の先頭から所定のＯＦＤＭシンボル（最大３ＯＦＤＭシンボル）まではシステム帯域全体にわたり既存のＰＤＣＣＨが配置される。既存のＰＤＣＣＨが配置されたＯＦＤＭシンボルより後の無線リソースに、拡張ＰＤＣＣＨがＰＤＳＣＨと周波数分割して配置されている。

【００２６】

また、図３Ｂに示すように、システム帯域は所定の周波数領域単位で構成される。この所定の周波数領域単位としては、例えば、物理リソースブロック（ＰＲＢ）（単に、リソースブロック（ＲＢ）ともいう）や、複数の連続する物理リソースブロックからなるリソースブロックグループ（ＲＢＧ）などがある。図３Ｂでは、所定の周波数領域単位としてリソースブロックが用いられており、システム帯域の一部のリソースブロックが拡張ＰＤＣＣＨに割り当てられる。なお、リソースブロックは、スケジューリングの一単位でもある。

【００２７】

また、Ｒｅｌ．１１以降のフレーム構成として、サブフレームにおいて先頭から所定のＯＦＤＭシンボル（最大３ＯＦＤＭシンボル）までのＰＤＣＣＨ領域を持たないキャリアタイプ（Extension carrier）が検討されている。このExtension carrierタイプが適用されるサブフレームでは、既存ＰＤＣＣＨを割当てず、拡張ＰＤＣＣＨのみを割り当てることができる。なお、Extension carrierタイプが適用されるサブフレームでは、先頭から最大３ＯＦＤＭシンボルにおいて拡張ＰＤＣＣＨが割り当てられてもよい（図３Ｃ参照）。

【００２８】

このような周波数分割アプローチを適用する場合、拡張ＰＤＣＣＨをシステム帯域にどのようにマッピングするかが問題となる。上述のように、拡張ＰＤＣＣＨは、ＰＤＳＣＨと周波数分割多重され、システム帯域の一部にマッピングされるためである。

【００２９】

図４に、拡張ＰＤＣＣＨのマッピングの一例を示す。図４では、１１個の物理リソースブロック（ＰＲＢ：Physical Resource Block）でシステム帯域が構成されている。１１個のＰＲＢには、周波数方向に沿ってＰＲＢインデックス（ＰＲＢ＃０～＃１０）が付されている。図４において、拡張ＰＤＣＣＨは、不連続の４個のＰＲＢ＃１、＃４、＃８、＃１０にマッピングされる。このように、拡張ＰＤＣＣＨを不連続の４個のＰＲＢにマッピングすることで拡張ＰＤＣＣＨをシステム帯域内に分散させることができる。この結果、拡張ＰＤＣＣＨについての周波数ダイバーシチ効果を得ることができる。

【００３０】

なお、図４では、拡張ＰＤＣＣＨは、ＰＲＢ単位でマッピングされているが、これに限られるものではない。例えば、連続する複数のＰＲＢ（例えば、２個又は４個のＰＲＢ）からなるＲＢＧ（Resource Block Group）単位で行われてもよい。

【００３１】

ところで、既存のＰＤＣＣＨでは、ユーザ端末ＵＥが下り制御情報（ＤＣＩ）のブライ

ンドデコーディングを行う範囲を示すサーチスペース（ＳＳ）が定義されている。ユーザ端末ＵＥは、無線基地局装置からシグナリングされた（例えば、ＲＲＣシグナリング）サーチスペース内でブラインドデコーディングを行う。

【００３２】

このようなサーチスペースの種類としては、共通サーチスペース（ＣＳＳ：Common Search Space）とＵＥ固有サーチスペース（ＵＥ－ＳＳ：ＵＥ-specific Search Space）（固有サーチスペースともいう）とがある。共通サーチスペースとは、セル内のユーザ端末ＵＥが共通制御情報をブラインドデコーディングすべき範囲を示すものである。また、ＵＥ固有サーチスペースとは、各ユーザ端末ＵＥが固有制御情報をブラインドデコーディングすべき範囲を示すものである。

【００３３】

なお、共通制御情報とは、セル内のユーザ端末ＵＥに共通の下り制御情報であり、例えば、ＤＣＩフォーマット０、１Ａ等で定義される情報である。また、固有制御情報とは、セル内の各ユーザ端末ＵＥに固有の下り制御情報であり、例えば、下り共有データチャネルの割り当て情報（DL Assignment）や、上り共有データチャネルのスケジューリング情報（UL grant）などが含まれる。

【００３４】

以上のようなサーチスペースは、既存のＰＤＣＣＨの割り当て単位である制御チャネル要素（ＣＣＥ：Channel Control Element）と、既存のＰＤＣＣＨに対してＣＣＥを何個連続で割り当てられるかを示すアグリゲーションレベル（Aggregation Level）とによって定義される。例えば、アグリゲーションレベル１では１ＣＣＥ単位で、アグリゲーションレベル２では２ＣＣＥ単位で、アグリゲーションレベル３では４ＣＣＥ単位で、アグリゲーションレベル４では８ＣＣＥ単位で、サーチスペースが定義される。なお、共通サーチスペースは、アグリゲーションレベル３、４をサポートし、ＵＥ固有サーチスペースは、アグリゲーションレベル１～４をサポートする。また、アグリゲーションレベルは、ユーザ端末ＵＥにおける信号の受信品質に基づいて決定される。

【００３５】

既存のＰＤＣＣＨでは、以上のようなサーチスペースが定義されることにより、ユーザ端末ＵＥにおけるブラインドデコーディングの回数を削減できる。したがって、without cross interleavingを適用する拡張ＰＤＣＣＨにおいても、ユーザ端末ＵＥにおけるブラインドデコーディングの回数を削減するために、共通サーチスペースとＵＥ固有サーチスペースとを定義することが望まれていた。そこで、本発明者らは、拡張ＰＤＣＣＨにおける共通サーチスペースとＵＥ固有サーチスペースのマッピングについて検討し、本願発明に至った。

【００３６】

（第１の態様）

図５～図７を参照して、第１の態様に係る拡張ＰＤＣＣＨのマッピング方法の一例について説明する。なお、以下では、拡張ＰＤＣＣＨをＲＢＧ単位でマッピングする例を示すが、これに限られるものではない。

【００３７】

図５に、第１の態様に係る拡張ＰＤＣＣＨのマッピングの一例を示す。図５では、１００Ｍｈｚのシステム帯域の例が示されており、周波数方向に１００個のＰＲＢ（不図示）が連続して配置される。ここで、システム帯域が１００個のＰＲＢで構成される場合、１つのＲＢＧは４個の連続するＰＲＢで構成される。よって、図５では、２５個のＲＢＧが示されている。また、２５個のＲＢＧには、周波数方向に沿ってＲＢＧインデックス（ＲＢＧ＃０～＃２４）が付されている。

【００３８】

なお、システム帯域、ＰＲＢの数、１つのＲＢＧを構成するＰＲＢの数は、図５に示す例に限られるものではない。例えば、システム帯域が２５個のＰＲＢで構成される場合、１つのＲＢＧは２つの連続するＰＲＢで構成され、１３個のＲＢＧが示される。

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【００３９】
図５に示すように、無線基地局装置は、共通制御情報が配置される共通サーチスペースと固有制御情報が配置されるＵＥ固有サーチスペースとを、システム帯域を構成するＲＢＧ単位で分離してマッピングする。具体的には、共通サーチスペースは、システム帯域全体に分散されるように、不連続の４個のＲＢＧ（ＲＢＧ＃０、＃７、＃１４、＃２１）にマッピングされる。また、ＵＥ固有サーチスペースは、システム帯域全体に分散されるように、不連続の４個のＲＢＧ（ＲＢＧ＃１、＃８、＃１５、＃２２）にマッピングされる。
【００４０】
共通サーチスペースに配置される共通制御情報は、上述のように、セル内のユーザ端末に共通の下り制御情報であるので、周波数ダイバーシチ効果が得られるように、分散された周波数帯域で送信されることが望ましい。このため、共通サーチスペースは、システム帯域全体に分散された不連続の所定数のＲＢＧ（図５では、４個のＲＢＧ＃０、＃７、＃１４、＃２１）に分散マッピングされる。
【００４１】
また、ＵＥ固有サーチスペースに配置される固有制御情報は、各ユーザ端末ＵＥに固有の下り制御情報であるので、対象のユーザ端末ＵＥにとって最も受信品質が良い周波数帯域で局所的に送信されることが望ましい。このため、ＵＥ固有サーチスペースは、システム帯域全体に分散された不連続の所定数のＲＢＧ（図５では、４個のＲＢＧ＃１、＃８、＃１５、＃２２）に分散マッピングされるが、固有制御情報は、所定のＲＢＧに局所的にマッピングされる。また、受信品質が利用できない場合は、分散マッピングを適用してもよい。
【００４２】
図５に示す共通サーチスペース及びＵＥ固有サーチスペースのマッピング位置は、上位レイヤ（例えば、ＲＲＣレイヤなど）で、ユーザ端末ＵＥにシグナリングされる。このマッピング位置のシグナリングには、ビットマップ（例えば、図５では、２５個のＲＢＧを示す２５ビットのビットマップ）が用いられてもよい。
【００４３】
また、共通サーチスペースのマッピング位置は、報知情報（例えば、ＭＩＢやＳＩＢなど）として、ユーザ端末ＵＥにブロードキャスト送信されてもよい。共通サーチスペースのマッピング位置は、セル内のユーザ端末ＵＥに共通であるためである。この場合にも、ビットマップが用いられてもよい。
【００４４】
なお、図５では、共通サーチスペース及びＵＥ固有サーチスペースは、ＲＢＧ単位で分離してマッピングされるが、これに限られるものではない。例えば、共通サーチスペース及びＵＥ固有サーチスペースは、ＰＲＢ単位で分離してマッピングされてもよい。
【００４５】
また、図５では、共通サーチスペース及びＵＥ固有サーチスペースがマッピングされるＲＢＧの数はそれぞれ４個であるが、これに限られるものではない。また、共通サーチスペース及びＵＥ固有サーチスペースがマッピングされる複数のＲＢＧの一部は連続していてもよい。
【００４６】
次に、図６及び図７を参照し、第１の態様に係る拡張ＰＤＣＣＨの共通サーチスペースの分散マッピングについて詳述する。なお、図６及び図７では、図５と同様に、１００ＭＨｚのシステム帯域の例が示される。また、図６及び図７では、共通サーチスペースがＲＢＧ単位で分散マッピングされる例を説明するが、ＰＲＢ単位で分散マッピングされてもよい。
【００４７】
図６では、不連続の４個のＲＢＧ（ＲＢＧ＃０、＃７、＃１４、＃２１）に分散マッピングされた共通サーチスペースと、拡張制御チャネル要素（ｅＣＣＥ：enhanced Channe

l Control Element）との対応付けが示される。上述のように、既存のＰＤＣＣＨに対する最小割り当て単位はＣＣＥである。拡張ＰＤＣＣＨでは、既存のＣＣＥをリユースできるように、ｅＣＣＥが定義される。すなわち、拡張ＰＤＣＣＨに対する最小割り当て単位は、ｅＣＣＥとなる。このため、拡張ＰＤＣＣＨの共通サーチスペースはｅＣＣＥ単位で管理される。

【００４８】

図６において、１個のＲＢＧは４個のＲＢ（ＰＲＢ）で構成される。１個のＲＢ（ＰＲＢ）は２個のｅＣＣＥに対応する。このため、４個のＲＢＧにマッピングされた共通サーチスペースは、４×４×２＝３２個のｅＣＣＥで定義されることになる。図６では、周波数方向に沿ってＲＢＧインデックス＃０、＃７、＃１４、＃２１の小さい方から順番にｅＣＣＥにインデックス番号＃０～＃３１をナンバリングしている。なお、１個のＰＲＢを構成するｅＣＣＥの数は、２個に限定されず、その他の数（例えば、４個）としてもよい。

【００４９】

第１の態様では、拡張ＰＤＣＣＨにおける共通サーチスペースを構成するｅＣＣＥをそれぞれ分割して、分割されたｅＣＣＥ同士が周波数帯域の異なるＲＢＧにそれぞれ分散されるようにマッピングする。これにより、共通サーチスペースで伝送される共通制御情報について、周波数ダイバーシチ効果が得られることとなる。

【００５０】

具体的には、図７Ａに示すように、無線基地局装置は、共通サーチスペースとして割り当てられたｅＣＣＥ＃０～＃３１をそれぞれ２個に分割する。１ｅＣＣＥを２個に分割する場合、１個のＲＢＧ（例えば、ＲＢＧ＃０）に対して、１６個のｅＣＣＥ（例えば、ｅＣＣＥ＃０、＃０、＃１、＃１、…＃７、＃７）が対応することとなる。

【００５１】

次に、図７Ｂに示すように、図７Ａで分割されたｅＣＣＥが、複数の仮想リソース領域に分散配置される。図７Ｂでは、仮想リソース領域として４つの仮想リソースブロックグループ（ＶＲＢＧ）＃１～＃４が定義され、図７Ａに示す６４個のｅＣＣＥがＶＲＢＧ＃１～＃４に分散配置される。

【００５２】

具体的には、図７Ａにおいて同じインデックス番号が付されたｅＣＣＥは、図７Ｂにおいて異なるインデックス番号のＶＲＢＧに配置される。例えば、同じインデックス番号が付された２個のｅＣＣＥ＃０は、ＶＲＢＧ＃１とＶＲＢＧ＃２に配置される。同様に、２個のｅＣＣＥ＃１は、ＶＲＢＧ＃３とＶＲＢＧ＃４に配置される。ｅＣＣＥ＃２～＃３１についても同様である。

【００５３】

図７Ｃに示すように、ｅＣＣＥが分散配置された複数の仮想リソース領域（ＶＲＢＧ＃１～＃４）は、インタリーブされ、元のＲＢＧ＃０、＃７、＃１４、＃２１にマッピングされる。図７Ｃでは、奇数インデックス番号のＶＲＢＧを元のＲＢＧに昇順にマッピングしてから、偶数インデックス番号のＶＲＢＧを元のＲＢＧに昇順にマッピングする例が示される。すなわち、ＶＲＢＧ＃１は元のＲＢＧ＃０に、ＶＲＢＧ＃２は元のＲＢＧ＃７に、ＶＲＢＧ＃３は元のＲＢＧ＃１４に、ＶＲＢＧ＃４は元のＲＢＧ＃２１にマッピングされる。

【００５４】

図７Ｃに示すように、ＶＲＢＧをインタリーブして元のＲＢＧにマッピングすることにより、同じインデックス番号が付されたｅＣＣＥペア間の周波数間隔を拡大することができるため、共通サーチスペースの周波数ダイバーシチ効果を得ることができる。

【００５５】

なお、図６及び図７で説明した分散マッピング方法は、共通サーチスペースだけではなく、ＵＥ固有サーチスペースに適用されてもよい。

【００５６】

以上のように、第１の態様に係る拡張ＰＤＣＣＨのマッピング方法によれば、無線基地局装置は、共通サーチスペースとＵＥ固有サーチスペースとを、ＰＲＢ単位又はＲＢＧ単位で分離してマッピングする。特に、無線基地局装置は、セル内の全ユーザ端末ＵＥの共通制御情報が配置される共通サーチスペースを、システム帯域内に分散されるように複数の周波数領域単位（ＰＲＢ又はＲＢＧ）にマッピングする。このため、周波数ダイバーシチ効果により、セル内の異なる位置に位置するユーザ端末ＵＥが安定して共通制御情報を復号できる。また、無線基地局装置は、特定のユーザ端末ＵＥに固有の固有制御情報が配置されるＵＥ固有サーチスペースを、システム帯域内の一部に局所化されるように複数の周波数領域単位（ＰＲＢ又はＲＢＧ）にマッピングする。このため、特定のユーザ端末ＵＥはより受信品質の良い周波数領域単位（ＰＲＢ又はＲＢＧ）で固有制御情報を復号できる。また、受信品質が利用できない場合は、分散マッピングを適用してもよい。

【００５７】

特に、ＨｅｔＮｅｔの小型基地局装置に上述のマッピング方法を適用することで、小型基地局装置は、ユーザ端末ＵＥに対して、大型基地局装置からＣＲＳ等による干渉の影響が大きい既存ＰＤＣＣＨでなく、干渉の影響が小さい拡張ＰＤＣＣＨを用いて共通制御情報と固有制御情報を送信することができる。より具体的には、拡張ＰＤＣＣＨにおいては、ＤＭ－ＲＳによるビームフォーミング効果が得られるので、後述するＣＲＥ（Cell Range Expansion）により小型基地局装置に接続するユーザ端末ＵＥが、拡張ＰＤＣＣＨに配置された共通サーチスペースをより効果的にブラインドデコーディングすることができる。この結果、ＨｅｔＮｅｔにおける干渉コーディネーションが可能となる。また、Ｌｏｗ ｃｏｓｔ ＭＴＣ Ｄｅｖｉｃｅにも適合することとなる。また、受信品質が利用できない場合は、分散マッピングを適用してもよい。

【００５８】

（第２の態様）

図８～図１２を参照して、第２の態様に係る拡張ＰＤＣＣＨのマッピング方法の一例について説明する。第２の態様は、拡張ＰＤＣＣＨの共通サーチスペースについて、ＨｅｔＮｅｔにより適合したマッピング方法とするものである。よって、第１の態様に係る拡張ＰＤＣＣＨのマッピング方法に第２の態様を組み合わせることも可能である。

【００５９】

ＨｅｔＮｅｔでは、ＣＲＥ（Cell Range Expansion）を行って、小型基地局装置のセル端に位置するユーザ端末ＵＥを小型基地局装置に接続させることが検討されている。図８に、ＨｅｔＮｅｔにおけるＣＲＥの一例を示す。図８では、無線基地局装置（マクロ基地局Ｂ１）の形成するセルＣ１内に、局所的なセルＣ２を形成する小型基地局装置（ピコ基地局Ｂ２）が配置されている。

【００６０】

図８に示すように、ＨｅｔＮｅｔにおけるＣＲＥでは、ピコ基地局Ｂ２からの受信電力にオフセット値を与えることでピコ基地局Ｂ２のセル範囲をセルＣ２’に拡大し、セルＣ２のセル端に位置するユーザ端末ＵＥをピコ基地局Ｂ２に接続させる。こうすることにより、送信電力の小さなピコ基地局Ｂ２のカバレッジを増大することができ、より多くのユーザ端末ＵＥをピコ基地局に接続することができる。

【００６１】

一方、ユーザ端末ＵＥがＣＲＥによってピコ基地局Ｂ２に接続された場合、ユーザ端末ＵＥは、マクロ基地局Ｂ１からの干渉を大きく受けることになる。このような干渉を防ぐため、ピコ基地局Ｂ２からユーザ端末ＵＥに対する信号が送信されるサブフレームにおいて、マクロ基地局Ｂ１は、ＡＢＳ（Ａｌｍｏｓｔ Ｂｌａｎｋ Ｓｕｂｆｒａｍｅ）やＭＢＳＦＮサブフレームを適用する。

【００６２】

ところが、ＡＢＳやＭＢＳＦＮサブフレームでは、データ（例えば、ＰＤＳＣＨ）の送信が停止されるものの、参照信号（Cell specific reference signal（ＣＲＳ））や、同期信号、報知チャネルなどは送信される。このため、ユーザ端末ＵＥがＣＲＥにより

ピコ基地局Ｂ２に接続された場合、マクロ基地局Ｂ１がＡＢＳやＭＢＳＦＮサブフレームを適用していても、図８に示すように、マクロ基地局Ｂ１からのＣＲＳ等による干渉を大きく受けることとなる。

【００６３】

このようなマクロ基地局Ｂ１からのＣＲＳ等による干渉の影響は、ピコ基地局Ｂ２からユーザ端末ＵＥに対する既存のＰＤＣＣＨにおいてより顕著なものとなる。そこで、ピコ基地局Ｂ２では、マクロ基地局Ｂ１からの干渉の影響を軽減できる拡張ＰＤＣＣＨにおいて、共通サーチスペースを定義することが有効となる。

【００６４】

このように、ＨｅｔＮｅｔにおいて、マクロ基地局Ｂ１とピコ基地局Ｂ２との双方が拡張ＰＤＣＣＨにおいて共通サーチスペースを定義する場合、マクロ基地局Ｂ１とピコ基地局Ｂ２との間の干渉コーディネーションが重要な問題となる。第２の態様に係る拡張ＰＤＣＣＨのマッピング方法では、マクロ基地局Ｂ１とピコ基地局Ｂ２との間の干渉コーディネーションを可能とする、共通サーチスペースのマッピングを検討する。

【００６５】

図９及び図１０を参照し、第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペースのマッピングの一例を詳述する。なお、図９及び図１０では、図５～７と同様に、１００ＭＨｚのシステム帯域の例が示される。また、図９及び図１０では、共通サーチスペースがＲＢＧ単位でマッピングされる例を説明するが、これに限られるものではなく、例えば、ＰＲＢ単位でマッピングされてもよい。また、図９において、不図示のＵＥ固有サーチスペースがマッピングされていてもよい。

【００６６】

図９に示すように、ＨｅｔＮｅｔのマクロ基地局Ｂ１及びピコ基地局Ｂ２は、拡張ＰＤＣＣＨの共通サーチスペースを、共通の複数のＲＢＧ（ＲＢＧ＃０、＃７、＃１４、＃２１）にマッピングする。すなわち、図９では、マクロ基地局Ｂ１とピコ基地局Ｂ２との双方において、複数のＲＢＧ（ＲＢＧ＃０、＃７、＃１４、＃２１）が共通サーチスペース用に割り当てられる。

【００６７】

一方、複数のＲＢＧを構成するｅＣＣＥは、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で別々に割り当てられる。具体的には、マクロ基地局Ｂ１に対しては、所定の周波数方向（図９では、周波数の小さい方向）から順番に連続するインデックス番号が付された複数のｅＣＣＥ（ｅＣＣＥ＃０～＃１５）が割り当てられる。また、ピコ基地局Ｂ２に対しては、残りの連続するインデックス番号が付された複数のｅＣＣＥ（ｅＣＣＥ＃１６～＃３１）が割り当てられる。

【００６８】

このように、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で、共通サーチスペースをマッピングする複数のＲＢＧを共通させる一方、ｅＣＣＥは別々とする。より具体的には、マクロ基地局Ｂ１に対して一方のｅＣＣＥ、ピコ基地局Ｂ２に対して他方のｅＣＣＥが割り当てられる。この結果、共通サーチスペースをマッピングする複数のＲＢＧを共通させても、以下の分散マッピングを適用することで、周波数ダイバーシチ効果を得ることができる。

【００６９】

分散マッピングでは、マクロ基地局Ｂ１用に割り当てられたｅＣＣＥ＃０～＃１５、ピコ基地局Ｂ２用に割り当てられたｅＣＣＥ＃１６～＃３１をそれぞれ分割して、分割されたｅＣＣＥ同士が周波数帯域の異なるＲＢＧにそれぞれ分散されるようにマッピングする。これにより、マクロ基地局Ｂ１用の共通サーチスペースに配置される共通制御情報と、ピコ基地局Ｂ２用の共通サーチスペースに配置される共通制御情報とを、周波数帯域の異なるＲＢＧ＃０、＃７、＃１４、＃２１に分散させることができる。すなわち、マクロ基地局Ｂ１とピコ基地局Ｂ２との間の干渉の影響を軽減すると共に、共通制御情報の周波数ダイバーシチ効果を得ることができる。

【００７０】
具体的には、図１０Ａに示すように、マクロ基地局Ｂ１は、マクロ基地局Ｂ１用に割り当てられたｅＣＣＥ＃０～＃１５をそれぞれ２個に分割し、分割したｅＣＣＥ同士に同じインデックス番号（図１０Ａでは、ｅＣＣＥ＃０、＃０…、＃１５、＃１５）を付す。同様に、ピコ基地局Ｂ２は、ピコ基地局Ｂ２用に割り当てられたｅＣＣＥ＃１６～＃３１をそれぞれ２個に分割し、分割したｅＣＣＥ同士に同じインデックス番号（図１０Ａでは、ｅＣＣＥ＃１６、＃１６…、＃３１、＃３１）を付す。
【００７１】
次に、図１０Ｂに示すように、図１０Ａで分割されたｅＣＣＥが、複数の仮想リソース領域に分散配置される。図１０Ｂでは、仮想リソース領域として４つの仮想リソースブロックグループ（ＶＲＢＧ）＃１～＃４が定義され、図１０Ａに示す６４個のｅＣＣＥがＶＲＢＧ＃１～＃４に分散配置される。
【００７２】
具体的には、図１０Ａにおいて同じインデックス番号が付されたｅＣＣＥは、図１０Ｂにおいて異なるインデックス番号のＶＲＢＧに配置される。さらに、マクロ基地局Ｂ１に割り当てられた３２個のｅＣＣＥは、インデックス番号に基づいてＶＲＢＧ＃１～＃４に分散配置される。同様に、ピコ基地局Ｂ２に割り当てられた３２個のｅＣＣＥは、インデックス番号に基づいてＶＲＢＧ＃１～＃４に分散配置される。例えば、図１０Ｂでは、マクロ基地局Ｂ１及びピコ基地局Ｂ２に割り当てられた偶数インデックス番号のｅＣＣＥはＶＲＢＧ＃１及び＃２に配置され、奇数インデックス番号のｅＣＣＥはＶＲＢＧ＃３及び＃４に配置される。
【００７３】
図１０Ｃに示すように、ｅＣＣＥが分散配置された複数の仮想リソース領域（ＶＲＢＧ＃１～＃４）は、インタリーブされ、元のＲＢＧ＃０、＃７、＃１４、＃２１にマッピングされる。図１０Ｃでは、奇数インデックス番号のＶＲＢＧを元のＲＢＧに昇順にマッピングしてから、偶数インデックス番号のＶＲＢＧを元のＲＢＧに昇順にマッピングする例が示される。すなわち、ＶＲＢＧ＃１は元のＲＢＧ＃０に、ＶＲＢＧ＃２は元のＲＢＧ＃７に、ＶＲＢＧ＃３は元のＲＢＧ＃１４に、ＶＲＢＧ＃４は元のＲＢＧ＃２１にマッピングされる。
【００７４】
図１０Ｃに示すように、ＶＲＢＧをインタリーブしてＲＢＧにマッピングすることにより、同じインデックス番号が付されたｅＣＣＥペア間の周波数間隔を拡大することができる。さらに、マクロ基地局Ｂ１用のｅＣＣＥペア間、ピコ基地局Ｂ２用のｅＣＣＥペア間の周波数間隔を拡大できるので、マクロ基地局Ｂ１の共通サーチスペースとピコ基地局Ｂ２の共通サーチスペースとの双方について、周波数ダイバーシチ効果を得ることができる。このようにマクロ基地局Ｂ１とピコ基地局Ｂ２でサーチスペースを別々に割当てることで、マクロ基地局Ｂ１とピコ基地局Ｂ２との間の干渉の影響を軽減しつつ、分散マッピングにより周波数ダイバーシチ効果が得られるため、マクロ基地局Ｂ１のセルＣ１内のユーザ端末ＵＥとピコ基地局Ｂ２のセルＣ２内のユーザ端末ＵＥとがそれぞれ安定して共通制御情報を復号可能となる。
【００７５】
以上のような第２の態様に係る拡張ＰＤＣＣＨのマッピング方法によれば、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で、共通サーチスペースをマッピングする複数のＲＢＧを共通させる一方、それぞれの共通サーチスペースをインデックス番号が異なるｅＣＣＥにマッピングする。このため、マクロ基地局Ｂ１とピコ基地局Ｂ２間の干渉を軽減しつつ，分散マッピングにより得られる周波数ダイバーシチ効果により、マクロ基地局Ｂ１のセルＣ１内に位置するユーザ端末ＵＥとピコ基地局Ｂ２のセルＣ２内に位置するユーザ端末ＵＥとがそれぞれ安定して共通制御情報を復号可能となる。
【００７６】
次に、図１１及び図１２を参照し、第２の態様に係る拡張ＰＤＣＣＨの共通サーチスペ

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ースのマッピングの別の例を詳述する。図９で説明したマッピングの一例では、マクロ基地局Ｂ１の共通サーチスペースとピコ基地局Ｂ２の共通サーチスペースとがｅＣＣＥ単位で分離された。本例では、図１１に示すように、マクロ基地局Ｂ１の共通サーチスペースとピコ基地局Ｂ２の共通サーチスペースとがＲＢＧ単位で分離される点が異なる。なお、図示しないが、ＰＲＢ単位で分離されてもよい。

【００７７】

図１１に示すように、マクロ基地局Ｂ１の共通サーチスペースは、ＲＢＧ＃０及び＃１４にマッピングされる。一方、ピコ基地局Ｂ２の共通サーチスペースは、ＲＢＧ＃７及び＃２１にマッピングされる。このように、本例では、マクロ基地局Ｂ１及びピコ基地局Ｂ２は、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で、共通サーチスペースをそれぞれ異なるＲＢＧにマッピングする。この結果、以下の分散マッピングを適用することで、周波数ダイバーシチ効果を得ることができる。

【００７８】

マクロ基地局Ｂ１の共通サーチスペースとピコ基地局Ｂ２の共通サーチスペースとがＲＢＧ単位で分離される場合、マクロ基地局Ｂ１とピコ基地局Ｂ２とでｅＣＣＥも別々に定義される。図１１では、マクロ基地局Ｂ１用のＲＢＧ＃０及び＃１４に対応して、ｅＣＣＥ＃０～＃１５が定義されている。同様に、ピコ基地局Ｂ２用のＲＢＧ＃７及び＃２１に対応して、ｅＣＣＥ＃０～＃１５が定義されている。なお、図６で説明したように、１個のＲＢＧは４個のＰＲＢで構成され、１個のＰＲＢは２個のｅＣＣＥに対応する。図６では、マクロ基地局Ｂ１の共通サーチスペースは、２個のＲＢＧにマッピングされるので、１６個のｅＣＣＥ（ｅＣＣＥ＃０～＃１５）に対応することとなる。ピコ基地局Ｂ２の共通サーチスペースについても同様である。

【００７９】

また、図１２Ａに示すように、マクロ基地局Ｂ１用の共通サーチスペースを構成するｅＣＣＥ＃０～＃１５はそれぞれ分割されて、分割されたｅＣＣＥ同士が周波数帯域の異なるＲＢＧ＃０及び＃１４にそれぞれ分散されるようにマッピングされる。上述のように、分割されたｅＣＣＥ同士には同じインデックス番号が付されて、同じインデックス番号が付されたｅＣＣＥを異なるＶＲＢＧ＃１及び＃２に配置する。そして、ＶＲＢＧ＃１及び＃２がそれぞれ元のＲＢＧ＃１４及び＃０にマッピングされる。これにより、同じインデックス番号が付されたｅＣＣＥペア間の周波数間隔を拡大することができるため、マクロ基地局Ｂ１の共通サーチスペースの周波数ダイバーシチ効果を得ることができる。

【００８０】

同様に、図１２Ｂに示すように、ピコ基地局Ｂ２用の共通サーチスペースを構成するｅＣＣＥ＃０～＃１５はそれぞれ分割されて、分割されたｅＣＣＥ同士が周波数帯域の異なるＲＢＧ＃７及び＃２１にそれぞれ分散されるようにマッピングされる。なお、マッピングの詳細は、図１２Ａと同様であるため、説明を省略する。

【００８１】

以上のような第２の態様の別の例に係る拡張ＰＤＣＣＨのマッピング方法によれば、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で、それぞれ共通サーチスペースを異なるＲＢＧにマッピングする。このため、マクロ基地局Ｂ１とピコ基地局Ｂ２間の干渉を軽減しつつ，分散マッピングにより得られる周波数ダイバーシチ効果により、マクロ基地局Ｂ１のセルＣ１内に位置するユーザ端末ＵＥとピコ基地局Ｂ２のセルＣ２内に位置するユーザ端末ＵＥとがそれぞれ安定して共通制御情報を復号可能となる。

【００８２】

（無線通信システムの構成）

以下、本実施の形態に係る無線通信システムについて詳細に説明する。図１３は、本実施の形態に係る無線通信システムのシステム構成の説明図である。なお、図１３に示す無線通信システムは、例えば、ＬＴＥシステム或いは、その後継システムが包含されるシステムである。この無線通信システムでは、ＬＴＥシステムのシステム帯域を一単位とする複数の基本周波数ブロックを一体としたキャリアアグリゲーションが用いられている。ま

た、この無線通信システムは、ＩＭＴ－Ａｄｖａｎｃｅｄと呼ばれても良いし、４Ｇと呼ばれても良い。

【００８３】

図１３に示すように、無線通信システム１は、無線基地局装置２０と、この無線基地局装置２０と通信する複数のユーザ端末１０とを含んで構成されている。無線基地局装置２０は、上位局装置３０と接続され、この上位局装置３０は、コアネットワーク４０と接続される。また、無線基地局装置２０（２０Ａ、２０Ｂ）は、有線接続又は無線接続により相互に接続されている。各ユーザ端末１０（１０Ａ、１０Ｂ）は、セルＣ１、Ｃ２において無線基地局装置２０（２０Ａ、２０Ｂ）と通信を行うことができる。なお、相対的に大きいセルＣ１を形成する無線基地局装置２０Ａは、マクロ基地局、ｅＮＢ（eNodeB）、ＨｅＮＢ（Home eNodeB）などと呼ばれてもよい。また、セルＣ１内に配置され、局所的なセルＣ２を形成する無線基地局装置２０Ｂは、ピコ基地局、フェムト基地局、ＲＲＨ、リレー局などと呼ばれてもよい。

【００８４】

なお、上位局装置３０には、例えば、アクセスゲートウェイ装置、無線ネットワークコントローラ（ＲＮＣ）、モビリティマネジメントエンティティ（ＭＭＥ）等が含まれるが、これに限定されない。

【００８５】

各ユーザ端末１０は、ＬＴＥ端末及びＬＴＥ－Ａ端末を含むが、以下においては、特段の断りがない限りユーザ端末として説明を進める。

【００８６】

無線通信システム１においては、無線アクセス方式として、下りリンクについてはＯＦＤＭＡ（直交周波数分割多元接続）が、上りリンクについてはＳＣ－ＦＤＭＡ（シングルキャリア－周波数分割多元接続）が適用されるが、上りリンクの無線アクセス方式はこれに限定されない。ＯＦＤＭＡは、周波数帯域を複数の狭い周波数帯域（サブキャリア）に分割し、各サブキャリアにデータをマッピングして通信を行うマルチキャリア伝送方式である。ＳＣ－ＦＤＭＡは、システム帯域を端末毎に１つ又は連続したリソースブロックからなる帯域に分割し、複数の端末が互いに異なる帯域を用いることで、端末間の干渉を低減するシングルキャリア伝送方式である。

【００８７】

ここで、通信チャネルについて説明する。下りリンクの通信チャネルは、各ユーザ端末１０で共有される下りデータチャネルとしてのＰＤＳＣＨ（Physical Downlink Shared Channel）と、下りＬ１／Ｌ２制御チャネル（ＰＤＣＣＨ、ＰＣＦＩＣＨ、ＰＨＩＣＨ）と、ＰＤＣＣＨを拡張した拡張ＰＤＣＣＨとを有する。ＰＤＳＣＨにより、ユーザデータ及び上位制御情報が伝送される。ＰＤＣＣＨ（Physical Downlink Control Channel）により、ＰＤＳＣＨおよびＰＵＳＣＨのスケジューリング情報等が伝送される。ＰＣＦＩＣＨ（Physical Control Format Indicator Channel）により、ＰＤＣＣＨに用いるＯＦＤＭシンボル数が伝送される。ＰＨＩＣＨ（Physical Hybrid-ARQ Indicator Channel）により、ＰＵＳＣＨに対するＨＡＲＱのＡＣＫ/ＮＡＣＫが伝送される。

【００８８】

拡張ＰＤＣＣＨにより、ＰＤＳＣＨ及びＰＵＳＣＨのスケジューリング情報等が伝送される。拡張ＰＤＣＣＨは、ＰＤＳＣＨが割り当てられるリソース領域を用いてＰＤＣＣＨの容量不足をサポートするために使用される。

【００８９】

上りリンクの通信チャネルは、各ユーザ端末で共有される上りデータチャネルとしてのＰＵＳＣＨ（Physical Uplink Shared Channel）と、上りリンクの制御チャネルであるＰＵＣＣＨ（Physical Uplink Control Channel）とを有する。このＰＵＳＣＨにより、ユーザデータや上位制御情報が伝送される。また、ＰＵＣＣＨにより、下りリンクの無線品質情報（CQI：Channel Quality Indicator）、ＡＣＫ/ＮＡＣＫ等が伝送される。

【００９０】
図１４を参照しながら、本実施の形態に係る無線基地局装置の全体構成について説明する。無線基地局装置２０は、ＭＩＭＯ伝送のための複数の送受信アンテナ２０１と、アンプ部２０２と、送受信部（送信部）２０３と、ベースバンド信号処理部２０４と、呼処理部２０５と、伝送路インターフェース２０６とを備えている。
【００９１】
下りリンクにより無線基地局装置２０からユーザ端末１０に送信されるユーザデータは、上位局装置３０から伝送路インターフェース２０６を介してベースバンド信号処理部２０４に入力される。
【００９２】
ベースバンド信号処理部２０４では、ＰＤＣＰレイヤの処理、ユーザデータの分割・結合、ＲＬＣ（Radio Link Control）再送制御の送信処理などのＲＬＣレイヤの送信処理、ＭＡＣ（Medium Access Control）再送制御、例えば、ＨＡＲＱの送信処理、スケジューリング、伝送フォーマット選択、チャネル符号化、逆高速フーリエ変換（IFFT：Inverse Fast Fourier Transform）処理、プリコーディング処理が行われて各送受信部２０３に転送される。また、下りリンクの制御チャネルの信号に関しても、チャネル符号化や逆高速フーリエ変換等の送信処理が行われて、各送受信部２０３に転送される。
【００９３】
また、ベースバンド信号処理部２０４は、報知チャネルにより、ユーザ端末１０に対して、当該セルにおける通信のための制御情報を通知する。当該セルにおける通信のための情報には、例えば、上りリンク又は下りリンクにおけるシステム帯域幅、ユーザ端末１０に割当てたリソースブロック情報、ユーザ端末１０におけるプリコーディングのためのプリコーディング情報、ＰＲＡＣＨ（Physical Random Access Channel）におけるランダムアクセスプリアンブルの信号を生成するためのルート系列の識別情報（Root Sequence Index）等が含まれる。プリコーディング情報はＰＨＩＣＨのような独立の制御チャネルを介して送信されてもよい。
【００９４】
各送受信部２０３は、ベースバンド信号処理部２０４からアンテナ毎にプリコーディングして出力されたベースバンド信号を無線周波数帯に変換する。アンプ部２０２は、周波数変換された無線周波数信号を増幅して送受信アンテナ２０１により送信する。
【００９５】
一方、上りリンクによりユーザ端末１０から無線基地局装置２０に送信されるデータについては、各送受信アンテナ２０１で受信された無線周波数信号がそれぞれアンプ部２０２で増幅され、各送受信部２０３で周波数変換されてベースバンド信号に変換され、ベースバンド信号処理部２０４に入力される。
【００９６】
ベースバンド信号処理部２０４では、入力されたベースバンド信号に含まれるユーザデータに対して、ＦＦＴ処理、ＩＤＦＴ処理、誤り訂正復号、ＭＡＣ再送制御の受信処理、ＲＬＣレイヤ、ＰＤＣＰレイヤの受信処理がなされ、伝送路インターフェース２０６を介して上位局装置３０に転送される。
【００９７】
呼処理部２０５は、通信チャネルの設定や解放等の呼処理や、無線基地局装置２０の状態管理や、無線リソースの管理を行う。
【００９８】
次に、図１５を参照しながら、本実施の形態に係るユーザ端末の全体構成について説明する。ＬＴＥ端末もＬＴＥ-Ａ端末もハードウエアの主要部構成は同じであるので、区別せずに説明する。ユーザ端末１０は、ＭＩＭＯ伝送のための複数の送受信アンテナ１０１と、アンプ部１０２と、送受信部（受信部）１０３と、ベースバンド信号処理部１０４と、アプリケーション部１０５とを備えている。
【００９９】

下りリンクのデータについては、複数の送受信アンテナ１０１で受信された無線周波数信号がそれぞれアンプ部１０２で増幅され、送受信部１０３で周波数変換されてベースバンド信号に変換される。このベースバンド信号は、ベースバンド信号処理部１０４でＦＦＴ処理や、誤り訂正復号、再送制御の受信処理等がなされる。この下りリンクのデータの内、下りリンクのユーザデータは、アプリケーション部１０５に転送される。アプリケーション部１０５は、物理レイヤやＭＡＣレイヤより上位のレイヤに関する処理等を行う。また、下りリンクのデータの内、報知情報もアプリケーション部１０５に転送される。

【０１００】

一方、上りリンクのユーザデータについては、アプリケーション部１０５からベースバンド信号処理部１０４に入力される。ベースバンド信号処理部１０４では、再送制御（Ｈ－ＡＲＱ　（Ｈｙｂｒｉｄ　ＡＲＱ））の送信処理や、チャネル符号化、プリコーディング、ＤＦＴ処理、ＩＦＦＴ処理等が行われて各送受信部１０３に転送される。送受信部１０３は、ベースバンド信号処理部１０４から出力されたベースバンド信号を無線周波数帯に変換する。その後、アンプ部１０２は、周波数変換された無線周波数信号を増幅して送受信アンテナ１０１により送信する。

【０１０１】

図１６は、本実施の形態に係る無線基地局装置２０が有するベースバンド信号処理部２０４及び一部の上位レイヤの機能ブロック図であり、主にベースバンド信号処理部２０４の送信処理の機能ブロックを示している。図１６には、最大Ｍ個（ＣＣ＃０～ＣＣ＃Ｍ）のコンポーネントキャリア数に対応可能な基地局構成が例示されている。無線基地局装置２０の配下となるユーザ端末１０に対する送信データが上位局装置３０から無線基地局装置２０に対して転送される。

【０１０２】

制御情報生成部３００は、上位レイヤシグナリング（例えばＲＲＣシグナリング）する上位制御情報をユーザ単位で生成する。また、上位制御情報は、予め拡張ＰＤＣＣＨ（ＦＤＭ型ＰＤＣＣＨ）をマッピングできるリソースブロック（ＰＲＢ位置）を含むことができる。

【０１０３】

データ生成部３０１は、上位局装置３０から転送された送信データをユーザ別にユーザデータとして出力する。コンポーネントキャリア選択部３０２は、ユーザ端末１０との無線通信に使用されるコンポーネントキャリアをユーザ毎に選択する。

【０１０４】

スケジューリング部３１０は、システム帯域全体の通信品質に応じて、配下のユーザ端末１０に対するコンポーネントキャリアの割当てを制御する。また、スケジューリング部３１０は、各コンポーネントキャリアＣＣ＃１－ＣＣ＃Ｍにおけるリソースの割り当てを制御している。ＬＴＥ端末ユーザとＬＴＥ－Ａ端末ユーザとを区別してスケジューリングを行う。スケジューリング部３１０は、上位局装置３０から送信データ及び再送指示が入力されると共に、上りリンクの信号を測定した受信部からチャネル推定値やリソースブロックのＣＱＩが入力される。

【０１０５】

また、スケジューリング部３１０は、入力された再送指示、チャネル推定値及びＣＱＩを参照しながら、上下制御情報及び上下共有チャネル信号のスケジューリングを行う。移動通信における伝搬路は、周波数選択性フェージングにより周波数毎に変動が異なる。そこで、スケジューリング部３１０は、各ユーザ端末１０へのユーザデータについて、サブフレーム毎に通信品質の良好なリソースブロック（マッピング位置）を指示する（適応周波数スケジューリングと呼ばれる）。適応周波数スケジューリングでは、各リソースブロックに対して伝搬路品質の良好なユーザ端末１０を選択する。そのため、スケジューリング部３１０は、各ユーザ端末１０からフィードバックされるリソースブロック毎のＣＱＩを用いてリソースブロック（マッピング位置）を指示する。

【０１０６】

同様に、スケジューリング部３１０は、適応周波数スケジューリングによって拡張ＰＤＣＣＨで送信される制御情報等について、サブフレーム毎に通信品質の良好なリソースブロック（マッピング位置）を指示することができる。このため、スケジューリング部３１０は、各ユーザ端末１０からフィードバックされるリソースブロック毎のＣＱＩを用いてリソースブロック（マッピング位置）を指示することができる。

【０１０７】

また、スケジューリング部３１０は、ユーザ端末１０との間の伝搬路状況に応じてアグリゲーション数を制御する。既存のＰＤＣＣＨの場合にはＣＣＥアグリゲーション数、拡張ＰＤＣＣＨの場合にはｅＣＣＥアグリゲーション数を制御する。セル端ユーザに対してはＣＣＥアグリゲーション数及びｅＣＣＥアグリゲーション数を上げることになる。また、割り当てたリソースブロックで所定のブロック誤り率を満たすＭＣＳ（符号化率、変調方式）を決定する。スケジューリング部３１０が決定したＭＣＳ（符号化率、変調方式）を満足するパラメータがチャネル符号化部３０３、３０８、３１２、変調部３０４、３０９、３１３に設定される。

【０１０８】

なお、既存のＰＤＣＣＨの場合、共通サーチスペースのＣＣＥアグリゲーション数としては、「４」、「８」がサポートされ、ＵＥ固有サーチスペースのＣＣＥアグリゲーション数としては、「１」、「２」、「４」、「８」がサポートされる。また、拡張ＰＤＣＣＨの場合、共通サーチスペースのｅＣＣＥアグリゲーション数としては、「４」、「８」がサポートされ、ＵＥ固有サーチスペースのｅＣＣＥアグリゲーション数としては、「１」、「２」、「４」、「８」がサポートされる。

【０１０９】

ベースバンド信号処理部２０４は、１コンポーネントキャリア内での最大ユーザ多重数Ｎに対応したチャネル符号化部３０３、変調部３０４、マッピング部３０５を備えている。チャネル符号化部３０３は、データ生成部３０１から出力されるユーザデータ（一部の上位制御信号を含む）で構成される下り共有データチャネル（ＰＤＳＣＨ）を、ユーザ毎にチャネル符号化する。変調部３０４は、チャネル符号化されたユーザデータをユーザ毎に変調する。マッピング部３０５は、変調されたユーザデータを無線リソースにマッピングする。

【０１１０】

また、ベースバンド信号処理部２０４は、ユーザ固有の下り制御情報である下り共有データチャネル用制御情報を生成する下り制御情報生成部（生成部）３０６と、ユーザ共通の下り制御情報である下り共通制御チャネル用制御情報を生成する下り共通チャネル用制御情報生成部３０７とを備えている。

【０１１１】

下り制御情報生成部３０６は、下り共有データチャネル（ＰＤＳＣＨ）を制御するための下り共有データチャネル用制御情報（DL assignment等）を生成する。当該下り共有データチャネル用制御情報は、ユーザ毎に生成される。

【０１１２】

ベースバンド信号処理部２０４は、１コンポーネントキャリア内での最大ユーザ多重数Ｎに対応したチャネル符号化部３０８、変調部３０９を備えている。チャネル符号化部３０８は、下り制御情報生成部３０６及び下り共通チャネル用制御情報生成部３０７で生成される制御情報をユーザ毎にチャネル符号化する。変調部３０９は、チャネル符号化された下り制御情報を変調する。

【０１１３】

また、ベースバンド信号処理部２０４は、上り制御情報生成部（生成部）３１１と、チャネル符号化部３１２と、変調部３１３とを備える。上り制御情報生成部３１１は、上り共有データチャネル（ＰＵＳＣＨ)を制御するための上り共有データチャネル用制御情報（UL Grant等）を生成する。当該上り共有データチャネル用制御情報は、ユーザ毎に生成される。

【０１１４】
上記変調部３０９、３１３でユーザ毎に変調された制御信号は制御チャネル多重部３１４で多重される。既存ＰＤＣＣＨ用の下り制御信号は、サブフレームの先頭の１～３ＯＦＤＭシンボルに多重され、インタリーブ部３１５でインタリーブされる。一方、拡張ＰＤＣＣＨ用の下り制御信号は、所定のＯＦＤＭシンボル数より後のリソース領域において下り共有データチャネル信号と周波数分割多重されて、マッピング部３１９でリソースブロック（ＰＲＢ）にマッピングされる。この場合、マッピング部３１９は、スケジューリング部３１０からの指示に基づき、上記した図５～７、９～１２を用いて説明した方法を適用してマッピングする。

【０１１５】
マッピング部３１９は、拡張ＰＤＣＣＨにおける共通サーチスペースとＵＥ固有サーチスペースとを、システム帯域を構成する所定の周波数領域単位（ＰＲＢ又はＲＢＧ）で分離してマッピングする。具体的には、マッピング部３１９は、拡張ＰＤＣＣＨにおける共通サーチスペースがシステム帯域内に分散されるように、共通サーチスペースを不連続の複数の周波数領域単位（ＰＲＢ又はＲＢＧ）にマッピングする。また、マッピング部３１９は、拡張ＰＤＣＣＨにおけるＵＥ固有サーチスペースがシステム帯域内に分散されるように不連続複数の周波数領域単位（ＰＲＢ又はＲＢＧ）にマッピングする。一方で、マッピング部３１９は、ＵＥ固有サーチスペースを構成する複数の周波数領域単位のうち、特定のユーザ端末ＵＥの最も受信品質の良い周波数領域単位に、当該特定のユーザ端末ＵＥ用の固有制御情報を局所化してマッピングする。また、受信品質が利用できない場合は、分散マッピングを適用してもよい。

【０１１６】
また、マッピング部３１９は、共通サーチスペースがマッピングされた複数の周波数領域単位（ＰＲＢ又はＲＢＧ）の各々を複数のｅＣＣＥを含むように構成するとともに、各ｅＣＣＥを分割し、分割されたｅＣＣＥ同士を異なる周波数領域単位（ＰＲＢ又はＲＢＧ）に分散して配置する。

【０１１７】
ここで、共通サーチスペースがマッピングされた複数の周波数領域単位（ＰＲＢ又はＲＢＧ）に含まれる各ｅＣＣＥには周波数方向に沿ってインデックス番号が付され、分割されたｅＣＣＥ同士には同じインデックス番号が付される。マッピング部３１９は、同じインデックス番号が付されたｅＣＣＥ同士を周波数方向に並んだ異なる仮想周波数領域単位（ＶＰＲＢ又はＶＲＢＧ）に配置した後、複数の仮想周波数領域単位（ＶＰＲＢ又はＶＲＢＧ）をインタリーブする。これにより、同じインデックス番号が付されたｅＣＣＥ同士の周波数間隔が拡大するため、周波数ダイバーシチ効果を効果的に得ることが可能となる。

【０１１８】
また、マッピング部３１９は、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で、それぞれの共通サーチスペースを共通の周波数領域単位（ＰＲＢ又はＲＢＧ）にマッピングする一方、それぞれの共通サーチスペースを異なるｅＣＣＥに割り当ててもよい。かかる場合、例えば、マクロ基地局Ｂ１に対しては、所定の周波数方向から連続するインデックス番号が付された複数のｅＣＣＥ（図９では、ｅＣＣＥ＃０～＃１５）が割り当てられ、ピコ基地局Ｂ２に対しては、残りの連続するインデックス番号が付された複数のｅＣＣＥ（図９では、ｅＣＣＥ＃１６～＃３１）が割り当てられる。

【０１１９】
また、マッピング部３１９は、マクロ基地局Ｂ１とピコ基地局Ｂ２との間で、それぞれの共通サーチスペースを異なる周波数領域単位（ＰＲＢ又はＲＢＧ）に割り当ててもよい。

【０１２０】
参照信号生成部３１８は、チャネル推定、シンボル同期、ＣＱＩ測定、モビリティ測定等の様々な目的に使用されるセル固有参照信号（ＣＲＳ：Cell-specific Reference Si

gnal)を生成する。また、参照信号生成部３１８は、ユーザ個別の下りリンク復調用参照信号であるＤＭ－ＲＳを生成する。ＤＭ－ＲＳは、ユーザデータの復調だけでなく、拡張ＰＤＣＣＨで送信される下り制御情報の復調に用いられる。

【０１２１】

また、複数のアンテナ毎に、サブキャリアにマッピングされた送信データ及びユーザ個別の復調用参照信号（ＤＭ－ＲＳ）の位相及び／又は振幅を制御（シフト）するプリコーディングウエイト乗算部を有していてもよい。プリコーディングウエイト乗算部により、位相及び／又は振幅シフトされた送信データ及びユーザ個別の復調用参照信号（ＤＭ－ＲＳ）は、ＩＦＦＴ部３１６に出力される。

【０１２２】

ＩＦＦＴ部３１６には、インタリーブ部３１５及びマッピング部３１９から制御信号が入力され、マッピング部３０５からユーザデータが入力され、参照信号生成部３１８から参照信号が入力される。ＩＦＦＴ部３１６は、下りチャネル信号を逆高速フーリエ変換して周波数領域の信号から時系列の信号に変換する。サイクリックプレフィックス挿入部３１７は、下りチャネル信号の時系列信号にサイクリックプレフィックスを挿入する。なお、サイクリックプレフィックスは、マルチパス伝搬遅延の差を吸収するためのガードインターバルとして機能する。サイクリックプレフィックスが付加された送信データは、送受信部２０３に送出される。

【０１２３】

図１７は、ユーザ端末１０が有するベースバンド信号処理部１０４の機能ブロック図であり、ＬＴＥ－Ａをサポートするユーザ端末の機能ブロックを示している。まず、ユーザ端末１０の下りリンク構成について説明する。

【０１２４】

無線基地局装置２０から受信データとして受信された下りリンク信号は、ＣＰ除去部４０１でＣＰが除去される。ＣＰが除去された下りリンク信号は、ＦＦＴ部４０２へ入力される。ＦＦＴ部４０２は、下りリンク信号を高速フーリエ変換（ＦＦＴ：Fast Fourier Transform）して時間領域の信号から周波数領域の信号に変換し、デマッピング部４０３へ入力する。デマッピング部４０３は、下りリンク信号をデマッピングし、下りリンク信号から複数の制御情報が多重された多重制御情報、ユーザデータ、上位制御情報を取り出す。なお、デマッピング部４０３によるデマッピング処理は、アプリケーション部１０５から入力される上位制御情報に基づいて行われる。デマッピング部４０３から出力された多重制御情報は、デインタリーブ部４０４でデインタリーブされる。

【０１２５】

また、ベースバンド信号処理部１０４は、制御情報を復調する制御情報復調部４０５、下り共有データを復調するデータ復調部４０６及びチャネル推定部４０７を備えている。制御情報復調部４０５は、多重制御情報から下り共通制御チャネル用制御情報を復調する共通制御チャネル用制御情報復調部（復調部）４０５ａと、多重制御情報から上り共有データチャネル用制御情報を復調する上り共有データチャネル用制御情報復調部（復調部）４０５ｂと、多重制御情報から下り共有データチャネル用制御情報を復調する下り共有データチャネル用制御情報復調部４０５ｃとを備えている。データ復調部４０６は、ユーザデータ及び上位制御信号を復調する下り共有データ復調部４０６ａと、下り共通チャネルデータを復調する下り共通チャネルデータ復調部４０６ｂとを備えている。

【０１２６】

共通制御チャネル用制御情報復調部４０５ａは、下り制御チャネル（ＰＤＣＣＨ）及び拡張下り制御チャネル（拡張ＰＤＣＣＨ）の共通サーチスペースのブラインドデコーディング処理、復調処理、チャネル復号処理などによりユーザ共通の制御情報である共通制御チャネル用制御情報（共通制御情報）を取り出す。共通制御チャネル用制御情報は、下りリンクのチャネル品質情報（ＣＱＩ）を含んでおり、マッピング部４１５に入力され、無線基地局装置２０への送信データの一部としてマッピングされる。既存のＰＤＣＣＨの場合、共通サーチスペースとしてシグナリングされた複数のＣＣＥ候補について、ブライン

ドデコーディング処理が行なわれる。また、拡張ＰＤＣＣＨの場合、共通サーチスペースとしてシグナリングされた複数のｅＣＣＥ候補について、ブラインドデコーディング処理が行なわれる。

【０１２７】

上り共有データチャネル用制御情報復調部４０５ｂは、下り制御チャネル（ＰＤＣＣＨ）及び拡張下り制御チャネル（拡張ＰＤＣＣＨ）のＵＥ固有サーチスペースのブラインドデコーディング処理、復調処理、チャネル復号処理などにより上り共有データチャネル用制御情報（固有制御情報）（例えば、UL Grant）を取り出す。既存のＰＤＣＣＨの場合には、ＵＥ固有サーチスペースとしてシグナリングされた複数のＣＣＥ候補について、ブラインドデコーディング処理が行われる。また、拡張ＰＤＣＣＨの場合、ＵＥ固有サーチスペースとしてシグナリングされた複数のｅＣＣＥ候補について、ブラインドデコーディング処理が行われる。復調された上り共有データチャネル用制御情報は、マッピング部４１５に入力されて、上り共有データチャネル（ＰＵＳＣＨ）の制御に使用される。

【０１２８】

下り共有データチャネル用制御情報復調部４０５ｃは、下り制御チャネル（ＰＤＣＣＨ）及び拡張下り制御チャネル（拡張ＰＤＣＣＨ）のＵＥ固有サーチスペースのブラインドデコーディング処理、復調処理、チャネル復号処理などにより下り共有データチャネル用制御情報（固有制御情報）（例えば、DL assignment）を取り出す。既存のＰＤＣＣＨの場合には、ＵＥ固有サーチスペースとしてシグナリングされた複数のＣＣＥ候補について、ブラインドデコーディング処理が行われる。また、拡張ＰＤＣＣＨの場合、ＵＥ固有サーチスペースとしてシグナリングされた複数のｅＣＣＥ候補について、ブラインドデコーディング処理が行われる。復調された下り共有データチャネル用制御情報は、下り共有データ復調部４０６ａへ入力されて、下り共有データチャネル（ＰＤＳＣＨ）の制御に使用され、下り共有データ復調部４０６ａに入力される。

【０１２９】

下り共有データ復調部４０６ａは、下り共有データチャネル用制御情報復調部４０５ｃから入力された下り共有データチャネル用制御情報に基づいて、ユーザデータや上位制御情報を取得する。上位制御情報に含まれる拡張ＰＤＣＣＨがマッピング可能なＰＲＢ位置（或いはＲＢＧ位置）は、下り共有データチャネル用制御情報復調部４０５ｃに出力される。下り共通チャネルデータ復調部４０６ｂは、上り共有データチャネル用制御情報復調部４０５ｂから入力された上り共有データチャネル用制御情報に基づいて、下り共通チャネルデータを復調する。

【０１３０】

チャネル推定部４０７は、ユーザ固有の参照信号（ＤＭ－ＲＳ）、またはセル固有の参照信号（ＣＲＳ）を用いてチャネル推定する。既存ＰＤＣＣＨを復調する場合には、セル固有の参照信号を用いてチャネル推定する。一方、拡張ＰＤＣＣＨ及びユーザデータを復調する場合には、ＤＭ－ＲＳやＣＲＳを用いてチャネル推定する。推定されたチャネル変動を、共通制御チャネル用制御情報復調部４０５ａ、上り共有データチャネル用制御情報復調部４０５ｂ、下り共有データチャネル用制御情報復調部４０５ｃ及び下り共有データ復調部４０６ａに出力する。これらの復調部においては、推定されたチャネル変動及び復調用の参照信号を用いて復調処理を行う。

【０１３１】

また、拡張ＰＤＣＣＨにおいて同一ＰＲＢ（又は同一ＲＢＧ）内に異なるユーザの複数のｅＣＣＥが周波数分割多重等される場合、ＰＲＢ（又はＲＢＧ）内の周波数リソースの番号に括りつけられたＤＭ－ＲＳのアンテナポートを用いて制御情報が復調される。この場合、ユーザ毎（ｅＣＣＥ毎）に異なるＤＭ－ＲＳの送信ウェイトにより、同一ＰＲＢ（又は同一ＲＢＧ）内のＤＭ－ＲＳをユーザ毎に区別している。一方、送信ダイバーシチを適用する場合には、ＤＭ－ＲＳのアンテナポートを１ＰＲＢ（又は１ＲＢＧ）内に割当てられるユーザ端末で共通化して設定することができる。

【０１３２】

ベースバンド信号処理部１０４は、送信処理系の機能ブロックとして、データ生成部４１１、チャネル符号化部４１２、変調部４１３、ＤＦＴ部４１４、マッピング部４１５、ＩＦＦＴ部４１６、ＣＰ挿入部４１７を備えている。データ生成部４１１は、アプリケーション部１０５から入力されるビットデータから送信データを生成する。チャネル符号化部４１２は、送信データに対して誤り訂正等のチャネル符号化処理を施し、変調部４１３はチャネル符号化された送信データをＱＰＳＫ等で変調する。

【０１３３】

ＤＦＴ部４１４は、変調された送信データを離散フーリエ変換する。マッピング部４１５は、ＤＦＴ後のデータシンボルの各周波数成分を、無線基地局装置２０に指示されたサブキャリア位置へマッピングする。ＩＦＦＴ部４１６は、システム帯域に相当する入力データを逆高速フーリエ変換して時系列データに変換し、ＣＰ挿入部４１７は時系列データに対してデータ区切りでサイクリックプレフィックスを挿入する。

【０１３４】

以上のように、本実施の形態に係る無線基地局装置２０によれば、共通サーチスペースとＵＥ固有サーチスペースとを、所定の周波数領域単位（ＰＲＢ又はＲＢＧ）で分離してマッピングする。特に、無線基地局装置２０は、共通サーチスペースを、システム帯域内に分散されるように不連続の複数の周波数領域単位（ＲＢ又はＲＢＧ）にマッピングする。このため、周波数ダイバーシチ効果により、セル内の全ユーザ端末ＵＥが安定して共通制御情報を復号可能となる。また、無線基地局装置２０は、ＵＥ固有サーチスペースを、システム帯域帯域内に分散されるように不連続の複数の周波数領域単位に（ＰＲＢ又はＲＢＧ）にマッピングする。一方で、無線基地局装置２０は、ＵＥ固有サーチスペースを構成する複数の周波数領域単位のうち、特定のユーザ端末ＵＥの最も受信品質の良い周波数領域単位に、当該手奥鄰のユーザ端末ＵＥ用の固有制御情報を局所化してマッピングする。このため、特定のユーザ端末ＵＥはより受信品質の良い周波数領域単位（ＰＲＢ又はＲＢＧ）で固有制御情報を復号可能となる。また、受信品質が利用できない場合は、分散マッピングを適用してもよい。

【０１３５】

以上、上述の実施形態を用いて本発明について詳細に説明したが、当業者にとっては、本発明が本明細書中に説明した実施形態に限定されるものではないということは明らかである。本発明は、特許請求の範囲の記載により定まる本発明の趣旨及び範囲を逸脱することなく修正及び変更態様として実施することができる。従って、本明細書の記載は、例示説明を目的とするものであり、本発明に対して何ら制限的な意味を有するものではない。

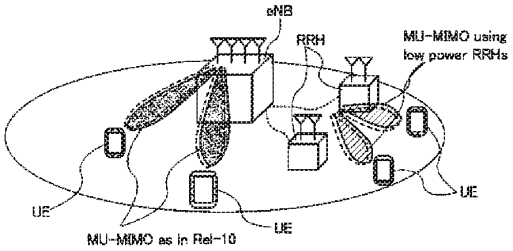
【符号の説明】

【０１３６】

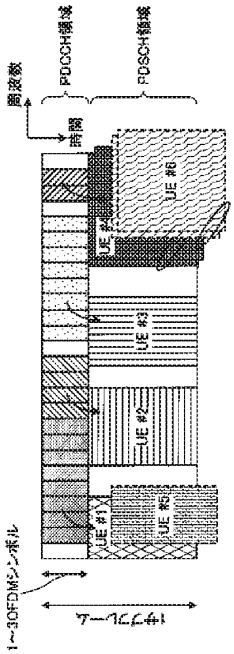
１　無線通信システム
１０　ユーザ端末
２０　無線基地局装置
１０１　送受信アンテナ
１０３　送受信部（受信部）
１０４　ベースバンド信号処理部
２０１　送受信アンテナ
２０３　送受信部（送信部）
２０４　ベースバンド信号処理部
３００　制御情報生成部
３０１　データ生成部
３０５　マッピング部
３０６　下り制御情報生成部
３０７　下り共通チャネル用制御情報生成部
３１０　スケジューリング部
３１１　上り制御情報生成部

３１４　制御チャネル多重部
３１５　インタリーブ部
３１８　参照信号生成部
３１９　マッピング部
４０３　デマッピング部
４０４　デインタリーブ部
４０５　制御情報復調部（復号部）
４０５ａ　共通制御チャネル用制御情報復調部
４０５ｂ　上り共有データチャネル用制御情報復調部
４０５ｃ　下り共有データチャネル用制御情報復調部
４０６　データ復調部
４０６ａ　下り共有データ復調部
４０６ｂ　下り共通チャネルデータ復調部
４０７　チャネル推定部

【図１】



【図２】



【図３】

図 3A

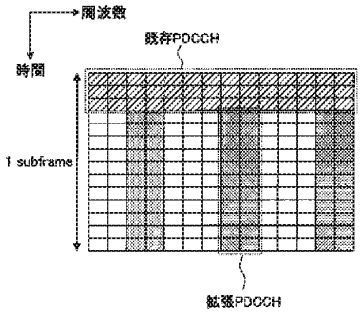


図 3B

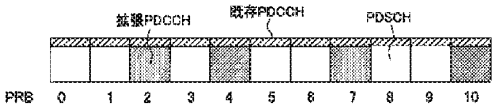
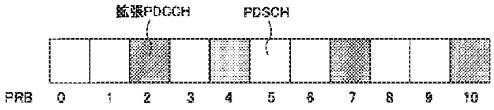
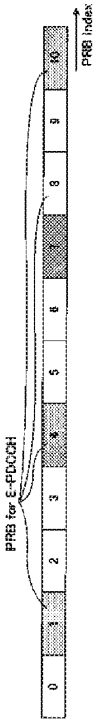


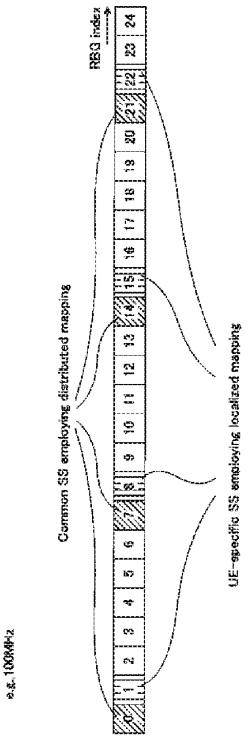
図 3C



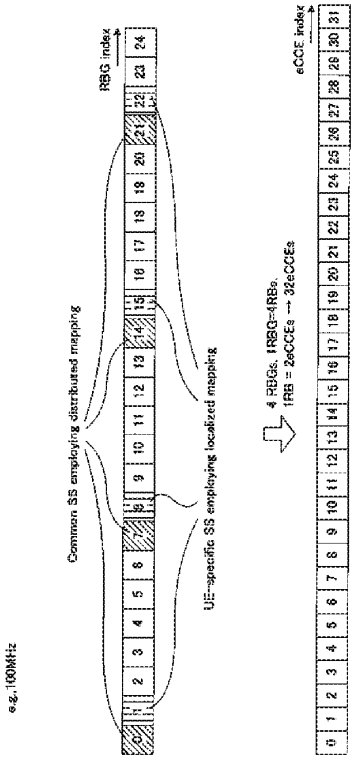
【図４】



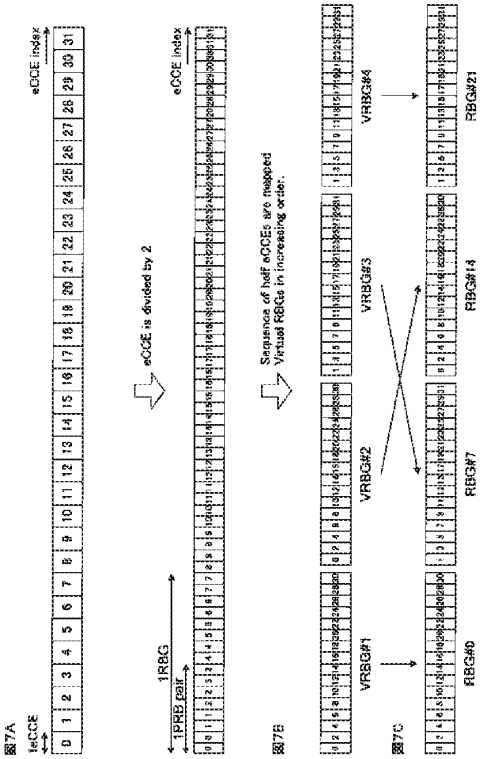
【図５】



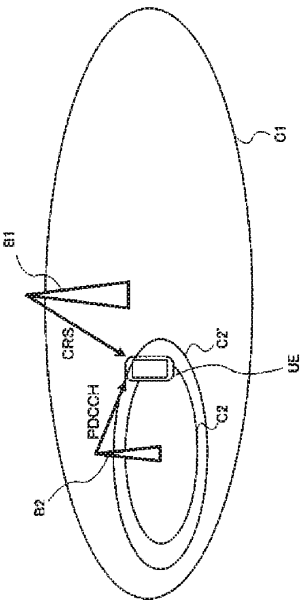
【図６】



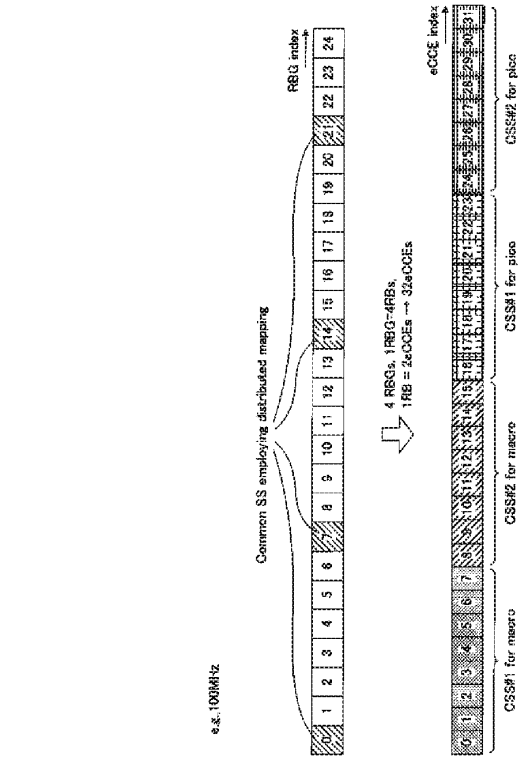
【図７】


図7A
1eCCE
eCCE index
eCCE is divided by 2
1RBG
1PRB pair
Sequence of half eCCEs are mapped
Virtual RBGs in increasing order.
図7B
図7C
VRBG#1
VRBG#2
VRBG#3
VRBG#4
RBG#0
RBG#7
RBG#14
RBG#21

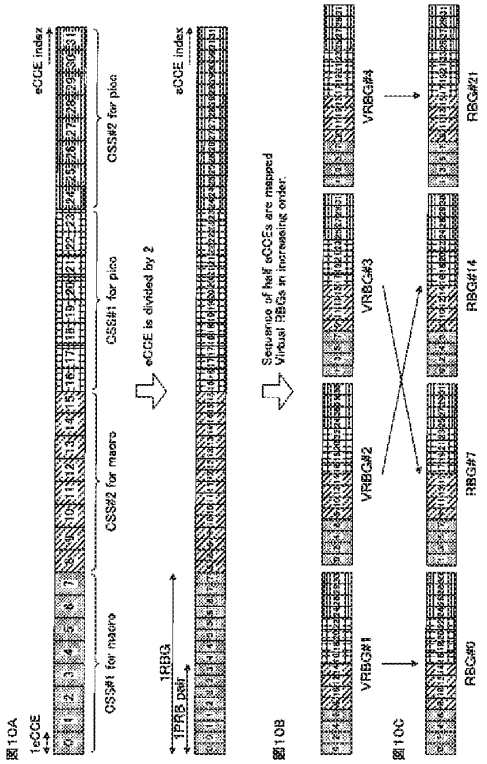
【図８】


B1
B2
CRS
PDCCH
C1
C2'
C2
UE

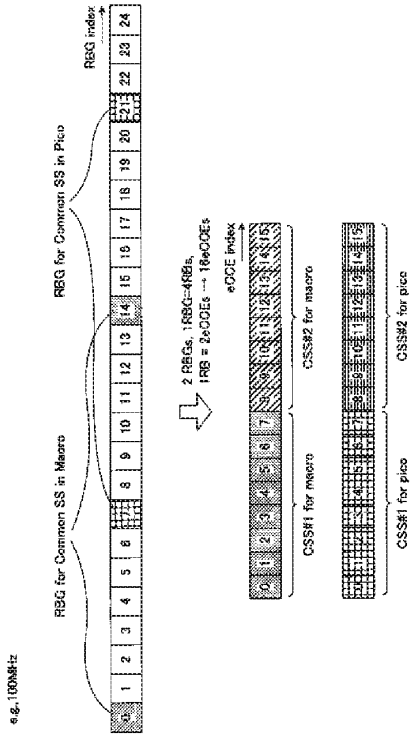
【図９】


e.g. 10MHz
RBG index
Common SS employing distributed mapping
4 RBGs, 1RBG=4RBs,
1RB = 2eCCEs → 32eCCEs
eCCE index
CSS#1 for macro
CSS#2 for macro
CSS#1 for pico
CSS#2 for pico

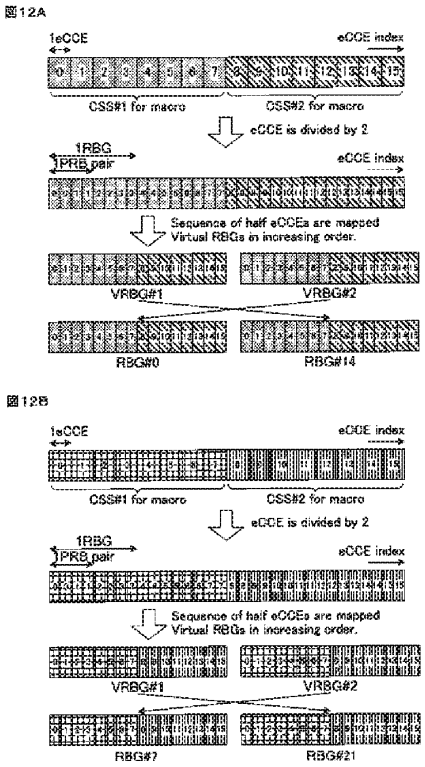
【図１０】


図10A
1eCCE
eCCE index
CSS#1 for macro
CSS#2 for macro
CSS#1 for pico
CSS#2 for pico
eCCE is divided by 2
1RBG
1PRB pair
図10B
Sequence of half eCCEs are mapped
Virtual RBGs in increasing order.
図10C
VRBG#1
VRBG#2
VRBG#3
VRBG#4
RBG#0
RBG#7
RBG#14
RBG#21

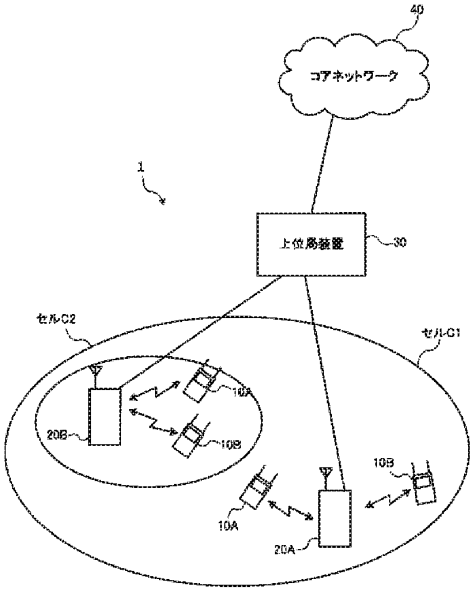
【図１１】



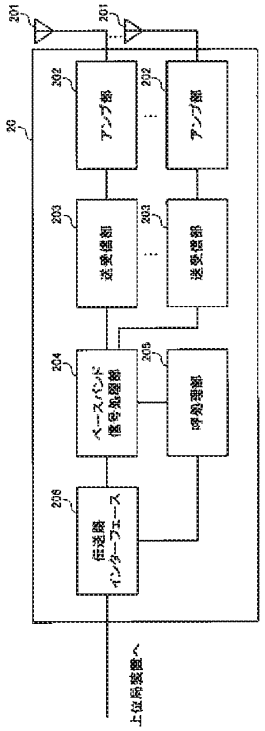
【図１２】



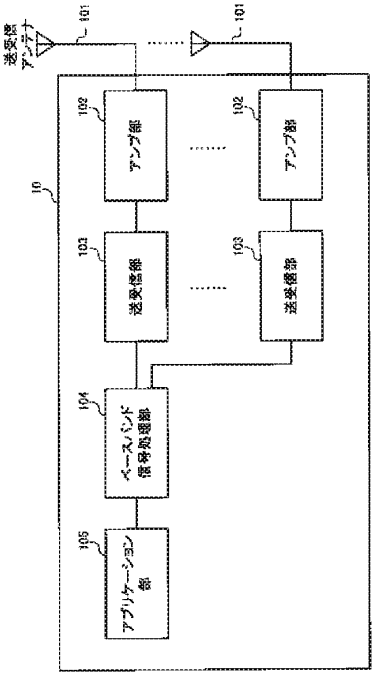
【図１３】



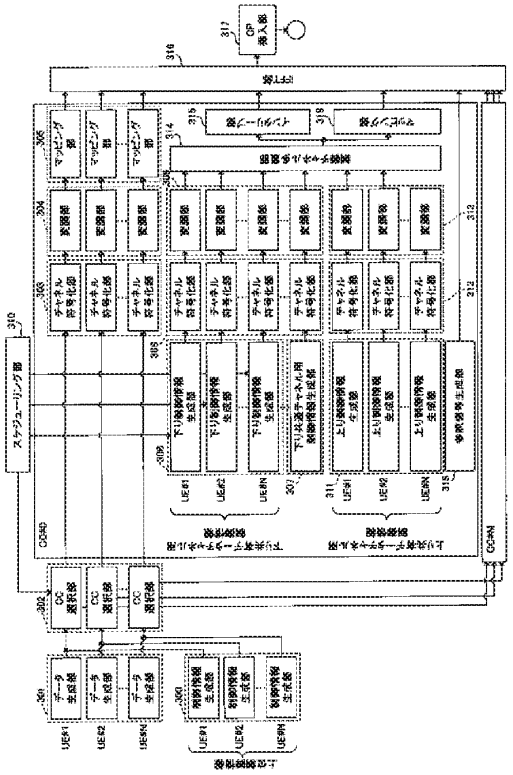
【図１４】



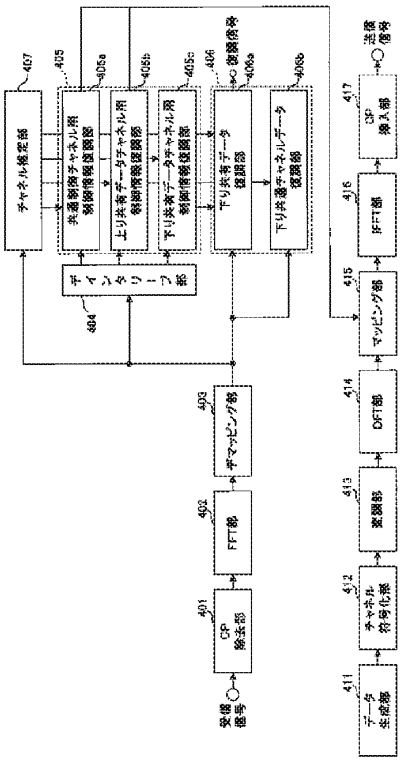
【図１５】


送受信アンテナ
101
102
アンプ部
103
送受信部
104
ベースバンド信号処理部
105
アプリケーション部
10

【図１６】



【図１７】


チャネル推定部
共通制御チャネル用制御情報復調部
上り共有データチャネル用制御情報復調部
下り共有データチャネル用制御情報復調部
下り共有データ復調部
下り共通チャネルデータ復調部
インタリーブ部
CP除去部
FFT部
デマッピング部
復調部
DFT部
マッピング部
IFFT部
CP挿入部
送信信号
受信信号

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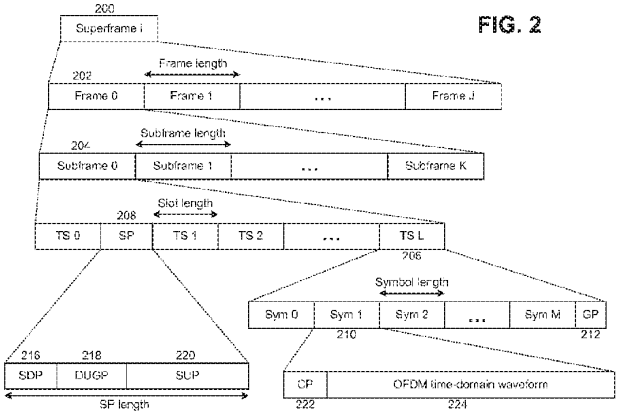
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FIG. 2



(57) Abstract: A first uplink signal is transmitted by a mobile station to a base station on a first set of subcarriers in a first OFDM symbol. The first set of subcarriers is modulated with a first signal sequence known to both the mobile station and the base station. A second uplink signal is transmitted by the mobile station to the base station on a second set of subcarriers in a second OFDM symbol. The second set of subcarriers is modulated with the first signal sequence or a transform of the first signal sequence. The second set of subcarriers is modulated with a second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel. The correspondence between the subcarriers in the third and second set is known to the mobile station and the base station.

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METHODS AND APPARATUS FOR MULTI-CARRIER COMMUNICATIONS WITH EFFICIENT CONTROL SIGNALING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Non-Provisional Application No. 13/414,622, filed March 7, 2012, which claims benefit under 35 U.S.C. § 119(e) of Provisional U.S. Patent Application No. 61/595,570, filed February 6, 2012, the contents of which are incorporated herein by reference in their entirety.

BACKGROUND

[0002] In wireless communications, control channels are used to facilitate the transmission of system control information that is required in its operation. The amount of control information becomes considerably large in a broadband communication system, which is typically used to provide multimedia services. For example, system control information required in a broadband system may include signal acquisition mechanisms for mobile stations, radio resource allocation for DL and UL transmission, control instructions, feedback of system parameters and acknowledgements, and information for other system functionalities. In order to efficiently and effectively transmit such large amounts of control information, certain methods and apparatus are needed to organize the information and to determine when and how the information is transmitted.

SUMMARY

[0003] In accordance with various embodiments of the present invention, a communication system includes a mobile station and a base station. A first uplink signal is transmitted by the mobile station to the base station on a first set of subcarriers in a first Orthogonal Frequency Division Multiplexing (OFDM) symbol. The first set of subcarriers may be modulated with a first signal sequence, the first signal sequence being known to both the mobile station and the base station. A second uplink signal may be transmitted by the mobile station to the base station on a second set of subcarriers in a second OFDM symbol. The second set of subcarriers may be modulated with the first signal sequence or a transform of the first signal sequence. The second set of subcarriers may further be modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel. The

correspondence between the subcarriers in the third set and the subcarriers in the second set may be known to both the mobile station and the base station.

[0004] The foregoing is a summary and thus contains, by necessity, simplifications, generalizations and omissions of detail. Those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention will be thoroughly understood from the detailed description given below and from the accompanying drawings of various embodiments of the invention, which, however, should not be taken to limit the invention to the specific embodiments, but are for explanation and understanding only.

[0006] Figure 1: A cellular wireless network is comprised of a plurality of cells, in each of which the coverage is provided by a BS.

[0007] Figure 2: An example of a frame structure.

[0008] Figure 3: Examples of allocation of TS's for the use of either downlink (DL) transmission (including unicast, multicast, and broadcast) or uplink (UL) transmission.

[0009] Figure 4: An Example of the SDP placement, where the SDP is inserted in between the last UL TS and the following DL TS.

[0010] Figure 5: A scenario of transmission of cell-specific and cell-common control information.

[0011] Figure 6: A specific example of preambles, where two types of preambles are defined: Type-I and Type-II.

[0012] Figure 7: An example of transmitting D-CCCH's with various types of beamforming.

[0013] Figure 8: Examples of TS indexing used in a D-CCCH.

[0014] Figure 9: An example of forming a channel-sounding RCH, where every *n*th subcarriers are used to formed the signal sequence in an interleaving fashion and *n* is a positive integar.

[0015] Figure 10: An example of transmitting the indication of inter-cell interference to the serving BS by an MS.

[0016] Figure 11: An example of a typical FBCH resource region.

[0017] Figure 12: Examples of filling in the FBCH resource region with feedback entries.

[0018] Figure 13: An example of reconfiguring OFDM symbols.

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[0019] Figure 14: An example of reconfiguring TS's.

[0020] Figure 15: An example of encoding across two different TS's.

[0021] Figure 16: An example of an operational procedure for practicing aspects of the present disclosure.

[0022] Figure 17: An example of an operational procedure for practicing aspects of the present disclosure.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0023] Certain specific details are set forth in the following description and figures to provide a thorough understanding of various embodiments of the disclosure. Certain well-known details often associated with computing and software technology are not set forth in the following disclosure to avoid unnecessarily obscuring the various embodiments of the disclosure. Further, those of ordinary skill in the relevant art will understand that they can practice other embodiments of the disclosure without one or more of the details described below. Finally, while various methods are described with reference to steps and sequences in the following disclosure, the description as such is for providing a clear implementation of embodiments of the disclosure, and the steps and sequences of steps should not be taken as required to practice this disclosure.

[0024] The terminology used in the description presented below is intended to be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain specific embodiments of the invention. Certain terms may even be emphasized below; however, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this Detailed Description section.

[0025] It should be understood that the various techniques described herein may be implemented in connection with hardware or software or, where appropriate, with a combination of both. Thus, the methods and apparatus of the disclosure, or certain aspects or portions thereof, may take the form of program code (i.e., instructions) embodied in tangible media, such as floppy diskettes, CD-ROMs, hard drives, or any other machine-readable storage medium wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the disclosure. In the case of program code execution on programmable computers, the computing device generally includes a processor, a storage medium readable by the processor (including volatile and non-volatile memory and/or storage elements), at least one input device, and at least one output device. One or more programs that may implement or utilize the processes described in connection with the disclosure, e.g., through the use of an application programming interface (API), reusable

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controls, or the like. Such programs are preferably implemented in a high level procedural or object oriented programming language to communicate with a computer system. However, the program(s) can be implemented in assembly or machine language, if desired. In any case, the language may be a compiled or interpreted language, and combined with hardware implementations.

[0026] The multi-carrier system mentioned here can be of any format such as Orthogonal Frequency-Division Multiplexing (OFDM), Multi-Carrier Code Division Multiple Access (MC-CDMA), or single carrier-frequency multiplexing (SC-FDMA) possibly implemented in the format of discrete Fourier transform-spreading-OFDM (DFT-S-OFDM). The disclosed methods can also be applied to downlink, uplink, or both, where the duplexing technique is either Time Division Duplexing (TDD) or Frequency Division Duplexing (FDD). Without being explicitly expressed, the term "broadcast" also implies "multicast" throughout this text. Without loss of generality, Orthogonal Frequency-Division Multiple Access (OFDMA) is taken as an example to illustrate the present invention.

[0027] The following description provides specific details for a thorough understanding of the various embodiments and for the enablement of one skilled in the art. However, one skilled in the art will understand that the invention may be practiced without such details. In some instances, well-known structures and functions have not been shown or described in detail to avoid unnecessarily obscuring the description of the embodiments.

[0028] Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise," "comprising," and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to." Words using the singular or plural number in this Detailed Description section also include the plural or singular number respectively. Additionally, the words "herein," "above," "below" and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. When the claims use the word "or" in reference to a list of two or more items, that word covers all of the following interpretations of the word: any of the items in the list, all of the items in the list and any combination of the items in the list.

Cellular Wireless Networks

[0029] Referring to Figure 1, in a cellular wireless network, the geographical region to be serviced by the network is normally divided into smaller areas called cells 100. In each cell 100, coverage is provided by a base station (BS) 104. Thus, this type of structure is normally

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referred to as the cellular structure, as shown in Figure 1. Within each coverage area, there are located mobile stations (MS's) 108 to be used as an interface between the users and the network. BS 104 is connected to the backbone of the network, usually by a dedicated link. Base station 104 also serves as a focal point to distribute information to and collect information from its mobile stations by radio signals. A cell can also be divided into sectors 106. From system engineering point of view each sector can be considered as a cell. In this context, the terms "cell" and "sector" are interchangeable.

Multi-Carrier Signal Format

[0030] The basic structure of a multi-carrier signal in the frequency domain is made up of subcarriers. The subcarriers can be arranged, in a particular manner, into groups to support scalability and multiple-access. The subcarriers forming one group are not necessarily adjacent to each other. The operation bandwidth of a system may vary. A variable bandwidth (VB) system is realized by adjusting the number of usable subcarriers in accordance with the given bandwidth. To facilitate operation of the user terminals in a VB environment, specific signaling and control methods are required. Radio control and operation signaling is realized through the use of a core-band (CB). A core-band, substantially centered at the operating center frequency, is defined as a frequency segment that is not greater than the smallest operating channel bandwidth among all the possible spectral bands that the receiver is designed to operate with.

[0031] The basic unit of a multi-carrier signal in the time domain is generally an OFDM symbol. The OFDM time domain waveform is generated by applying the inverse-fast-Fourier-transform (IFFT) to the OFDM signals in the frequency domain. A copy of the last portion of the time waveform, known as the cyclic prefix (CP), is inserted in the beginning of the waveform itself to form the OFDM symbol. The length of the CP in the OFDM symbols can be varied to meet the requirements of different applications such as various cell sizes or configurations.

[0032] A subchannel is formed by a group of subcarriers over one or more OFDM symbols.

Hierarchical Frame Structure

[0033] In accordance with the principles of the present invention, signal transmission may be carried out using the hierarchical frame structure shown in Figure 2. The top-level transmission unit may be a superframe 200, which may further consist of multiple frames 202. Each frame 202 in turn may consist of multiple subframes 204. The subframe204 may consist of

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a plurality of time-slots (TS's) 206 and a special period (SP) 208. Each TS 206 may comprise multiple OFDM symbols 210 and a small guard period 212. TS 206 can be allocated for the use of either downlink (DL) transmission (including unicast, multicast, and broadcast) or uplink (UL) transmission. For example, in an arrangement 300 shown in Figure 3, where L=6, two TS's are allocated for UL, two are allocated for DL unicast, and three are allocated for DL broadcast within a subframe. Alternatively, in another arrangement 302 two TS's are allocated for UL, three are allocated for DL unicast, and two are allocated for DL broadcast within a subframe. Furthermore, a BS may use the former TS arrangement and another BS may use the latter TS arrangement, as long as they are synchronized in time frame. The DL broadcast TS's can be further grouped into video bursts, each of which carries an application data stream or a video stream.

[0034] SP 208, which is usually placed in the transition from DL transmission to UL transmission, may consist of a special downlink period (SDP) 216, a downlink-to-uplink guard period (DUGP) 218, and a special uplink period (SUP) 220. Alternatively, SDP 416 may be inserted in between the last UL TS and the following DL TS, as shown in Figure 4.

[0035] For the specific example given in Table 1, a superframe, which consists of 10 frames, has the duration of 100 ms. Each 10-ms frame in turn consists of two 5-ms subframes and a subframe consists of 7 TS's and an SP. Each TS has the duration of 675 μs and is comprised of multiple OFDM symbols.

Table 1 Numerology for a frame structure.

	Duration	Composition
Superframe	100 ms	10 frames
Frame	10 ms	2 subframes
Subframe	5 ms	7 time slots + 1 SP
Time slot	675 μs	OFDM symbols

Hierarchical Control Structure

[0036] In accordance with the principles of the present invention, a hierarchical control structure (HCS) may be used in a cellular wireless communication system, wherein the system control information may be grouped into different hierarchies and types such that the control information is transmitted between a BS to its MS's in a spectral-efficient manner. The control information may include signal acquisition mechanisms for mobile stations, radio resource

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allocation for DL and UL transmission, and information and mechanisms to facilitate other system functionalities.

[0037] In accordance with aspects of embodiments of the present invention, the DL control information may be classified into three hierarchies based on their functionality: preambles, superframe control headers (SFCH's), and DL common control channels (D-CCCH's), whereas the UL control channels may include: ranging channels (RCH's) and feedback channels (FBCH's).

[0038] In accordance with aspects of embodiments of the present invention, each hierarchy of control information may be further grouped into different types based on certain criteria. For example, parameters that vary relatively slowly can be grouped together to be transmitted relatively infrequently, whereas parameters that change relatively quickly can be grouped together to be transmitted relatively frequently. In addition, the incremental changes or differences with respect to some control parameters are grouped together and transmitted relatively frequently.

Preambles

[0039] Preambles are transmitted during a SDP with a predetermined fixed length of cyclic prefix. Preambles are designed to

1. carry essential operation parameters,
2. provide mechanisms for the MS's to synchronize with their serving BS,
3. facilitate the measurements of inter-cell interference, and
4. enable other system functions.

[0040] In accordance with embodiments of this invention, multiple types of preambles may be transmitted periodically by a BS. A type of preamble can differ from other types in terms of the information it carries, the way it carries the information, its functionality, the way it is transmitted, and other characteristics. For example, a type of preamble may carry some essential system information, such as the length of the cyclic prefix of the OFDM symbols in various time slots, operation bandwidth, and decoding information for SFCH. Another type of preamble may carry some essential system information for a BS to identify itself or for MS's to synchronize with the network.

[0041] In an embodiment, a type of preamble may be designed to carry essential system information common to a group of cells and a part or the entirety of this type of preamble can be transmitted by such a group of BS's using the same subcarriers, including data and pilot subcarriers, at essentially the same time, wherein macro-diversity can be achieved at the MS to

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decode the corresponding part or the entirety of that preamble. Such a scenario is shown in Figure 5, where BS's 500 502 504 transmit cell-common information to MS 506. The cell-common system information carried in this type of preamble may include

1. the length of the cyclic prefix of the OFDM symbols in various time slots,
2. the operation bandwidth,
3. synchronization mechanism,
4. frequency reuse configuration
5. other information.

[0042] In another embodiment, a type of preamble may be designed to facilitate cell-specific operation functions and this type of preamble may be transmitted by an individual BS 500 using a code sequence in either the time domain or the frequency domain, which uniquely identifies that BS. The sequence can remain fixed from one subframe to the next or can vary from one subframe to the next in accordance with a particular pattern. The information embedded in this type of preamble may include

1. the cell identification (ID) of the transmitting BS,
2. the decoding information for SFCH's,
3. other information.

[0043] In yet another embodiment, a type of preamble may only occupy the core bandwidth, whereas another type of preamble can be designed to either occupy the core bandwidth or the entire channel bandwidth. For example, the use of preambles defined within the core-bandwidth simplifies the complexity in the implementation of initial signal acquisition in that only the signal within the core bandwidth is processed. The use of preambles defined in the entire operation bandwidth enables the MS's to measure inter-cell interference conditions and report to their BS's. Based on the inter-cell interference conditions, a BS may adjust the pilot structure, transmission power, antenna configuration, modulation and coding scheme, subchannel assignment, and operation parameters to optimize the performance/capacity.

[0044] In still another embodiment, channel coding may be applied to a type of preamble over multiple subframes or frames. For example, repetition coding can be used to allow a certain type of combination process over time in decoding at the MS to improve the reception performance.

[0045] The transmission of the multiple types of preambles may be multiplexed

1. in time, wherein different types of preambles are transmitted at different times (e.g., one type in the SDP's of odd-numbered subframes and another type in SDP's of even-

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numbered subframes), where the transmission recurrence of each type of preamble is not necessarily the same;

2. in frequency, wherein one type of preamble is transmitted using a set of subcarriers and another type is transmitted using a different set of subcarriers, where each set does not necessarily consist of the same number of subcarriers; or/and
3. in code, wherein the one type of preamble is transmitted using a code sequence and another is transmitted using a different code sequence, where each code sequence does not necessarily use the same amount of time and frequency resources.

[0046] In an example shown in Figure 6, two types of preambles are defined: Type-I and Type-II. The Type-I preamble is defined within the core bandwidth. The subcarriers in the Type-I preamble are further grouped into two sets: Set-1 600 and Set-2 602. The subcarriers in Set-1 are modulated by a cell-specific sequence and the subcarriers in Set-1 carry cell-common information. The Type-II preamble 604 is defined over the full bandwidth. The characteristics of the two types are given in Table 2.

Table 2 The characteristics of two types of preambles.

	Type-I	Type-II
Functionality	Set-1: for cell search, synchronization Set-2: for carrying system information	Interference measurement, cell search/selection, synchronization
CP length	Fixed	Fixed
Bandwidth	Core bandwidth	Full bandwidth
Composition	Set-1: cell-specific sequence Set-2: Cell-common information-carrying subcarriers	Cell-specific sequence
Information content	Set-1: Cell ID Set-2: CP length for data slots	
Transmission	Set-1: a BS Transmits its own sequence Set-2: macro-diversity by BS's	A BS Transmits its own sequence

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SFCH

[0047] The SFCH's of each superframe may carry relatively detailed control information regarding

1. the transmission configurations of the current superframe,
2. the instructions for decoding the D-CCCH's, and
3. certain system operations.

[0048] The SFCH's can be transmitted in any DL TS. The assignment information of SFCH's, such as their locations, sizes, and/or modulation/coding schemes, may be specified in the preambles. Alternatively, such assignment may be predetermined in the system specifications. For example, the SFCH's in each superframe can be pre-assigned to Subchannel 0 in the TS0 in Subframe 0 in Frame 0.

[0049] In accordance with other embodiments of this invention, multiple types of SFCH's may be transmitted periodically by a BS. A type of SFCH differs from another in terms of the information it carries, its functionality, the way it is transmitted, and other characteristics. For example, a type of SFCH may carry some essential system information, such as video broadcast configuration, BS antenna configuration, the CP lengths of TS's, and D-CCCH decoding information, whereas another type of SFCH may carry some essential system information, such as superframe number index and UL/DL configuration. In addition, a type of SFCH may also carry an optional or reserved field to provide the flexibility to add temporally required information.

[0050] In an embodiment, a type of SFCH may be designed to carry some essential system information common to a group of cells and a part or the entirety of this type of SFCH can be transmitted by such a group of BS's using the same subcarriers, including data and pilot subcarriers, at essentially the same time, wherein macro-diversity can be achieved at the MS to decode the corresponding part or the entirety of that particular SFCH. Such a scenario is shown in Figure 5, where BS's 500 502 504 transmit cell-common information to MS 506. The cell-common system information carried in this type of SFCH may include

1. superframe number index,
2. UL/DL configuration,
3. frequency reuse configuration,
4. other information.

[0051] In another embodiment, a type of SFCH may be designed to carry some essential system information unique to an individual cell and this type of preamble may be

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transmitted by an individual BS 500 using cell-specific physical resources and means, such as time, frequency, coding, and scrambling. The cell-specific system control information carried in this type of SFCH may include

1. TS configuration,
2. video broadcast configuration,
3. BS antenna configuration,
4. the CP lengths of data TS's,
5. D-CCCH decoding information,
6. other information.

[0052] In yet another embodiment, a SFCH can be designed to either occupy the core bandwidth or the entire channel bandwidth.

[0053] In still another embodiment, channel coding may be applied to a type of SFCH over multiple superframes. For example, repetition coding can be used to allow a certain type of combination process over time in decoding at the MS to improve the reception performance.

[0054] In a further embodiment, the transmission of the multiple types of SFCH's may be multiplexed

1. in time, wherein different types of SFCH's are transmitted in different times (e.g., in different OFDM symbols); or/and
2. in frequency, wherein one type of SFCH is transmitted using a set of subcarriers and another type is transmitted using a different set of subcarriers, where each set does not necessarily consist of the same number of subcarriers.

[0055] In accordance with other embodiments of this invention, a serving BS may transmit to its MS's a part or the entirety of a type of SFCH associated with a neighboring cell, wherein information in this type of SFCH may be exchanged between BS's through the backbone network connecting them. These embodiments can be used to facilitate the fast acquisition of system control information from neighboring cells during the handoff, thereby accelerating the handoff process. The information to be exchanged may include

1. TS configuration,
2. video broadcast configuration,
3. BS antenna configuration,
4. the CP lengths of data TS's,
5. D-CCCH decoding information,
6. other information.

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[0056] In an embodiment, such transmission may be carried out periodically or by the request of an MS that is served by this BS. In another embodiment, the time and frequency resource for the transmission may be assigned by a type of SFCH transmitted by the serving BS.

D-CCCH

[0057] The D-CCCH's in a TS may carry detailed control information, instructions for resource allocation, and other directives for the current TS as well as the subsequent multiple TS's. The D-CCCH's can be transmitted in any DL TS (including any data or video TS). In a special case, the SFCH's and D-CCCH's may be transmitted all within a particular DL TS (say, TS0). A typical D-CCCH may include the following entries

1. DL resource assignment entry
2. Access grant entry
3. UL power control entry
4. UL HARQ (hybrid automatic repeat request) ACK (acknowledgement) feedback entry
5. UL resource assignment entry
6. Feedback resource assignment entry

[0058] An entry is a set of specific instructions and information with an appropriate type of message header and/or tail. For example, in the DL resource assignment entry, the MCS, resource, and HARQ instruction for a DL transmission that is associated with a particular MS are provided.

DL resource assignment entry

{

MS ID

MCS instruction

DL resource location and size

HARQ instruction

}

[0059] A D-CCCH may also carry assignment information (e.g., by means of tail-bit indicator) to identify an additional D-CCCH allocated within the current TS or allocated in a subsequent TS, wherein the additional D-CCCH contains supplementary control information. Alternatively, a D-CCCH can be specified through the TS control header (TSCH), which may provide additional flexibility in some systems. The location, size, and/or modulation/coding scheme of the TSCH are specified in a SFCH.

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[0060] In accordance with aspects of embodiments of this invention, multiple types of D-CCCH's may be transmitted periodically by a BS. A type of D-CCCH differs from another in terms of the information it carries, the way it is transmitted, and other characteristics.

[0061] In an embodiment, a type of D-CCCH may be designed to carry detailed control information that is unique to an individual MS and this type of D-CCCH can be transmitted using selective unicast methods. For example, a narrow antenna beam 706 can be formed on the D-CCCH dedicated to the MS as shown in Figure 7.

[0062] In another embodiment, a type of D-CCCH may be designed to carry detailed control information to a particular group of MS's that possess certain characteristics in common. For example, MS's can be grouped together if

1. they are assigned to use the same time-frequency resource for feedback in the UL TS's;
2. they are scheduled to send HARQ feedbacks at essentially the same;
3. they are assigned with the same assignment pattern; and/or
4. they are geographically located in proximity.

[0063] This type of D-CCCH can be transmitted using multicast methods, such as multiple beams (orthogonal or otherwise) or directive beams in azimuth and/or elevation. For example, the D-CCCH for a group of MS's located in proximity can be transmitted using a directive beam 704, as shown in Figure 7. The members in the group can change from one time to another, depending on their commonality. The beamwidth or beam-shape of the beam covering the group may also vary from one time to another, depending on the locations of the MS's in the group.

[0064] In yet another embodiment, a type of D-CCCH may be designed to carry detailed assignment information relevant to all the MS's within a cell and this type of D-CCCH is transmitted using broadcast or multicast methods within a cell. For example, a fixed sector beam 702 is used to broadcast the D-CCCH to all the MS's within the sector, as shown in Figure 7.

[0065] In still another embodiment, a type of D-CCCH may be designed to carry some system information common to a group of cells and a part or the entirety of this type of D-CCCH can be transmitted by such a group of BS's using the same subcarriers, including data and pilot subcarriers, at essentially the same time, wherein macro-diversity can be achieved at the MS to decode the corresponding part or the entirety of that particular D-CCCH. Such a scenario is shown in Figure 5, where BS's 500 502 504 transmit cell-common information to MS 506. The cell-common system information carried in this type of D-CCCH may include scheduling

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information for video bursts, which consists of the control and decoding information for various video streams.

[0066] The transmission of the multiple types of D-CCCH's may be multiplexed

1. in time, wherein different types of D-CCCH's are transmitted in different times (e.g., in different OFDM symbols); or/and
2. in frequency, wherein one type of D-CCCH is transmitted using a set of subcarriers and another type is transmitted using a different set of subcarriers, where each set does not necessarily consist of the same number of subcarriers.

[0067] A D-CCCH may be transmitted using variable modulation and coding schemes (MCS's) and its location, size, and/or MCS may be directly specified in a SFCH. A constant MCS can be used to transmit a type of D-CCCH, where the particular MCS to be used may be predetermined based on system deployment conditions. Alternatively, a semi-static MCS can be used to transmit a type of D-CCCH, where the decision on the particular MCS to be used is based on the long-term coverage statistics reported by the MS's and the MCS is specified in a type of SFCH. Furthermore, AMC can be applied to transmit a type of D-CCCH, where MS's are partitioned into groups according to their DL AMC schemes and the D-CCCH entries for the each group are coded together using the same AMC scheme and protected by a CRC or checksum.

[0068] In accordance with other embodiments of this invention, specific parameters such as the TS index and the group ID may be included in a type of D-CCCH to facilitate a certain transmission process. The TS index is referred to as the number identifying one of the TS's in a subframe, frame, or superframe. The group identification (Group ID) is defined as the number identifying one of the groups to which multiple MS's of a certain commonality belong.

[0069] In an embodiment, a type of D-CCCH may carry the control information for the current TS as well as the control information for the subsequent multiple DL TS's. The control information for a particular TS or for the subsequent TS's can be placed within an information field that is associated with the TS index. For example, in specifying the control information for a set of TS's, an entry of the D-CCCH may be arranged as

For each TS in the set

{

TS Index

Various entries for control information and assignments associated with this TS;

}

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[0070] In a more general case, the control information for multiple contiguous TS's can be specified in a single entry. For example, in specifying the control information multiple TS's, reference point (e.g., starting or ending TS index) is given in the D-CCCH entry, which may be arranged as

For each TS as the starting/ending point

{

Starting/ending TS Index

Various entries for control information and assignments associated with this starting/ending TS;

}

[0071] The TS index in a D-CCCH can be a modular number of L. For example, in the case of L=6, the TS index = 0, 1, 2, 3, 4, 5, 6, 0, 1, 2, 3, 4, 5, 6, … If the TS index of the current TS (i.e., where the D-CCCH is) is n, the immediately following TS indices (n+1, n+2, …, L) correspond to the TS's in the current subframe, the next set of modular numbers (0, 1, …, L) correspond to the TS's in the next subframe, and so on, as depicted in Figure 8. Alternatively, The TS index in a D-CCCH can be a relative number. For example, the current TS is indexed to be 0 (or any default number) and the indices for the subsequent TS's increment by one. The TS index is reset by the next D-CCCH.

[0072] In another embodiment, a type of D-CCCH may carry the control information for one or more groups. The control information for a particular group can be placed within an information field that is associated with the Group ID. For example, a part of the structure of the D-CCCH may be arranged as

For each group to be specified

{

Group ID

Various entries for control information and assignments associated with this group

}

[0073] Each information field associated with a particular group may be encoded individually with some coding and modulation scheme. Furthermore, each group information field can be protected by an error-detection coding scheme (e.g. CRC or checksum) or the entire D-CCCH can be protected by an error-detection coding scheme.

Acquisition by MS

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[0074] In accordance with aspects of the embodiments of this invention, an MS may extract the operation parameters and system information from the preambles, SFCH's and D-CCCH's.

[0075] In an embodiment, an MS may extract system parameters and control information by directly decoding the preambles, SFCH's and D-CCCH's in an orderly manner.

[0076] In another embodiment, an MS may optimize the estimation of synchronization timing for unicast and broadcast differently. In unicast transmission and reception, an MS determines the synchronization timing based on the cell-specific preamble transmitted by its serving BS. In reception of broadcast video, an MS determines the synchronization timing based on the cell-specific preamble and/or cell-common preambles, taking into consideration of the different delays in transmission from BS's other than the serving BS. For example, the MS can take the average (weighted or otherwise) of different delays in determining its synchronization timing.

[0077] In yet another embodiment, the MS may determine some operation parameters such as operation bandwidth, BS transmission mode (e.g., multiple-input multiple-output mode), and DL/UL configuration via ways of signal processing and detection without explicit control information. For example, the operation bandwidth can be determined based on the energy profile of the preambles in the frequency domain; the BS transmission mode can be determined on the pilot structure and/or pilot energy if a transmission mode is uniquely associated with a particular pilot structure and/or pilot energy; or the DL/UL configuration can be determined by finding the UL/DL switching point, which can be achieved based on the difference between the energy profiles in the time and/or frequency domains of the OFDM symbols in UL and DL TS's.

RCH's

[0078] The RCH's provide mechanisms for

1. an MS to report the propagation channel conditions (e.g., delay, attenuation, frequency responses for one or more special channels) to its serving BS,
2. a MS to request access to a particular BS when starting up or when handing-over from another cell
3. a MS to request for bandwidth for transmission
4. other mechanisms.

[0079] In accordance with other embodiments of this invention, multiple types of RCH's can be transmitted by an MS. A type of RCH differs from another in terms of their functionalities. For example, a type of RCH can be used for

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1. initial ranging, wherein after powering up, an MS sends a signal via the RCH to its serving BS to initiate the process of accessing the network;
2. periodic ranging, wherein when connecting to its serving BS, an MS periodically sends a signal via the RCH to the BS to maintain the uplink synchronization;
3. handover ranging, wherein during handover, an MS sends a signal via the RCH to initiate the process to synchronize with the target BS;
4. bandwidth request, wherein an MS sends a signal via the RCH to its serving BS to indicate its request for time-frequency resource for uplink transmission;
5. channel sounding, wherein an MS sends a signal via the RCH to its serving BS to facilitate the BS to estimate the channel responses between the MS and the BS and/or interference levels; or
6. other kinds of system functions.

[0080] A signal sequence via an RCH can be a code sequence in either the time or frequency domain and consists of a set of subcarriers that are distributed over a part of or the entire operation bandwidth. The signal sequence may be known to both the mobile station and the serving base station An MS transmits an RCH signal to its serving BS by self initiation when necessary or by the request of its serving BS (e.g., polling). Either binary or non-binary sequences can be used to modulate with the subcarriers in an RCH. Open-loop or closed-loop power control can also be applied to a type of RCH, including the channel-sound RCH.

[0081] In an embodiment, the RCH's may be normally transmitted during a SUP or can also be inserted in an UL TS. The transmission of the multiple types of RCH's may be multiplexed

1. in time, wherein different types of RCH are transmitted in different times, where the transmission recurrence of each type of RCH is not necessarily the same; for example,
    a. one type of RCH is transmitted in the SUP's of odd-numbered subframes and another type is in the SUP's of even-numbered subframes; or
    b. an SUP is divided into multiple periods (of an equal size or otherwise), via each of which a type of RCH is transmitted, wherein the RCH signal can be a shortened OFDM symbol with a CP that is generated by various methods such as using an IFFT with the corresponding length or taking one of the periodical replica that are produced by applying a full length IFFT to a frequency-domain signal with every n^{th} subcarrier being modulated with a desirable complex amplitude and other subcarriers being zero in amplitude;

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2. in frequency, wherein one type of RCH is transmitted using a set of subcarriers and another type is transmitted using a different set of subcarriers, where each set does not necessarily consist of the same number of subcarriers; or/and
3. in code, wherein the one type of RCH is transmitted using a code sequence and the another is transmitted using a different code sequence, where each code sequence does not necessarily use the same amount of time and frequency resources.

[0082] In an embodiment, the subcarriers in the signal sequence for channel sounding, which may be less than the total usable subcarriers within the entire bandwidth, may be distributed, uniformly or otherwise, across a part of or the entire bandwidth. For example, in a channel-sounding RCH every n^{th} subcarrier is used to form the signal sequence in an interleaving fashion shown in Figure 9. As a result, n non-overlapping signal sequences can be generated for channel-sounding. The subcarrier spacing for channel sounding 900 is preferably less than the coherence bandwidth of the channel. The amplitudes of the subcarriers in an RCH are not necessarily equal.

[0083] In one embodiment, the subcarriers in an RCH may be equal in energy. In another embodiment, the subcarriers in an RCH may be different in energy.

[0084] In another embodiment, an MS can deliver the attribute information on the interference from neighboring BS's to its serving BS via a channel-sounding RCH. This enables the serving BS to assess the level of the signal-to-interference-plus-noise ratio (SINR) at that MS and to assign the appropriate subchannels to that MS according to some criteria. An MS is able to estimate the channel response from a neighboring BS based on a particular signal (e.g., a type of preamble or pilots) sent out by this neighboring BS. Such a channel response is actually the interference experienced by that MS. As shown in Figure 10, an MS 1006 is subject to the interference from the interfering BS's 1002 1004. By processing the signals from the neighboring cells, the MS is able to generate an overall interference/noise profile.

[0085] Let by $I(f)$ denote the attribute information as a function of frequency within the channel bandwidth. To deliver the attribute information to the serving BS 1000, the MS embeds a function of $I(f)$ (e.g., by modulating a signal sequence carrying the attribute information, $I(f)$) in the channel-sounding signal or in a transform (e.g., a conjugation or absolute value) of the channel-sounding signal. For example, the amplitude of the nth subcarrier, $a(f_n)$, in the channel-sounding sequence can be proportional to the inverse of $|I(f_n)|$; that is

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$$a(f_n) = \frac{K}{|I(f_n)|}$$

where K denotes the energy normalization factor. In a more practical implementation, quantization and noise, $N(f_n)$, are also considered,

$$a(f_n) = Q_b\left[\frac{K}{|I(f_n) + N(f_n)|}\right]$$

where $Q_b[\bullet]$ represents the operation of quantization with b bits. $a(f_n)$ can also be determined using a lookup table. At the serving BS, the response of the nth subcarrier in the received signal is given by

$$A(f_n) = a(f_n) \cdot H(f_n)$$

where $H(f)$ denotes the frequency response of the channel between the MS and the serving base. In effect, the serving BS obtains an SINR profile for that MS. The serving BS selects the available subchannels with certain SINR values required by some criteria (e.g., best SINR or SINR sufficient for a particular MCS) and assigns them to the MS for data transmission with an appropriate MCS. In the case where there is UL interference, the response of the nth subcarrier in the received signal becomes

$$R(f_n) = A(f_n) + J(f_n)$$

where $J(f_n)$ denotes the UL interference/noise. A channel-sounding signal modulated with a sequence known to both the MS and BS (e.g., equal amplitudes for all the subcarriers) can be transmitted by the MS to assist the BS to estimate $J(f_n)$ and remove it from $R(f_n)$ to obtain $A(f_n)$.

[0086] In the case where multiple antennas are used at the BS, the serving BS calculates the overall SINR with multiple-antenna transmission based on some algorithm (e.g., maximum ratio combining or equal-gain combining), selects the subchannel with certain overall SINR values by some criteria, and assigns them to the MS for data transmission.

FBCH's

[0087] The FBCH's provide time and frequency resources for one or more MS's to send an acknowledgement (ACK) signal to confirm the success or failure of a particular DL transmission or to report the channel quality indication (CQI) with respect to a particular DL subchannel. In terms of resource, an FBCH consists of multiple subcarriers over one or more OFDM symbols, which are referred to as the FBCH resource region. For example, in Figure 11

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is shown a typical resource region of an FBCH 1100, where there are 16 subcarriers over a TS (8 OFDM symbols). The subcarriers in an FBCH are not necessarily contiguous. A FBCH may consist of subcarriers distributed over the operation bandwidth or of multiple segments distributed over the operation bandwidth, where each segment consists of a plurality of contiguous subcarriers. Pilot subcarriers can be inserted within or outside of the FBCH resource region in a time-division multiplexing, frequency-division multiplexing, or code-division multiplexing manner.

[0088] An FBCH resource region in a UL TS is specified with certain definitions (e.g., its beginning time-frequency coordinates or the beginning coordinate with length) in a particular entry in a D-CCCH.

[0089] An FBCH may have a one-to-one correspondence to a DL TS; that is, the FBCH is used to report feedbacks associated with that DL TS. An FBCH may also correspond to multiple DL TS's, which is usually the case in a TDD system, where there are normally more DL TS's than UL TS's. In one embodiment, one or more FBCH resource regions can be defined in a particular UL TS, each of which is specified via a D-CCCH in a DL TS. In another embodiment, a common FBCH resource region in a particular UL TS is shared by multiple DL TS's, where the resource region is specified via a D-CCCH in one of the DL TS's.

[0090] In an FBCH, there may be multiple feedback entries. A FBCH feedback entry may be defined as the information symbols that an MS uses to report its feedback. Entries from multiple MS's may be multiplexed

1. in frequency, where different entries respectively use different sets of subcarriers in the FBCH resource region, and/or
2. in time, where different entries respectively occupy different OFDM symbols in the FBCH resource region.

[0091] In accordance with other embodiments of this invention, a FBCH feedback entry may be transmitted by an MS using a particular MCS and the modulation method can be either coherent or non-coherent (e.g., orthogonal or bi-orthogonal techniques). Furthermore, the MCS for a type of FBCH (e.g., CQI) may be different from that for another type (e.g., ACK).

[0092] In an embodiment, a fixed MCS can be predefined, based on deployment conditions, for all the feedback entries in an FBCH. Alternatively, a semi-static MCS may be used for all the feedback entries in an FBCH, where the decision on the particular MCS to be used is based on the long-term coverage statistics reported by the MS's and the MCS to be used is specified within a superframe in a type of SFCH.

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[0093] In another embodiment, adaptive modulation and coding (AMC) can also be used for an individual feedback entry or a group of feedback entries in an FBCH, where the decisions on the MCS's are made by the serving BS based on certain criteria (e.g., the history of signal reception quality from previous UL transmission of data or FBCH entries by the MS's). The instructions on the MCS may be provided in an entry or entries in a D-CCCH. The AMC instruction may consist of a number of bits that identify one of the predefined MCS's. For example, the MCS instructions for a type of CQI FBCH are tabulated in Table 3, where each CQI feedback entry uses four information bits.

Table 3 MCS instructions for an FBCH.

FBCH MCS	Required resource
00	16 subcarriers (QPSK with 1/8 spreading)
01	8 subcarriers (QPSK with 1/4 spreading)
10	4 subcarriers (QPSK with 1/2 spreading)
11	No feedback

[0094] In yet another embodiment, the AMC may be used in conjunction with power control to transmission of an FBCH. The MCS for an MS or a group of MS's is first determined and the transmission power level is adjusted based on some criteria. Alternatively, the transmission power level may first be determined and the MCS adjusted to meet some transmission requirements.

[0095] In accordance with other embodiments of this invention, the specifications of the FBCH feedback entries (e.g., their locations, MCS's, and corresponding MS's) may be broadcasted by the serving BS to its MS's via a type of D-CCCH. The specifications of the FBCH feedback entries may be explicitly defined in an entry of a D-CCCH. For example, the FBCH assignment entry can be established in the D-CCCH to provide the specifications of the FBCH feedback entries:

FBCH assignment entry

{

MS ID

MCS for FBCH feedback entry

Location of FBCH feedback entry

}

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[0096] Alternatively, the specifications of the FBCH feedback entries can be embedded in the DL resource assignment entry. For example,

DL resource assignment entry

{

MS ID

MCS instruction for this DL transmission

DL resource location and size

HARQ instruction

MCS for FBCH feedback entry

Location of FBCH feedback entry

}

[0097] In accordance with other embodiments of this invention, rules (explicit or otherwise) may be established to reduce the overhead in the specifications of the FBCH feedback entries and to efficiently make use of a FBCH resource region.

[0098] In an embodiment, a reference point (e.g., the starting coordinate) of a FBCH resource region may be specified in a D-CCCH entry, whereas the location information for each FBCH feedback entry is omitted from the DL resource assignment entry in a D-CCCH. Each MS decodes the relevant information about all the FBCH feedback entries in its group given in the DL resource assignment entries in a D-CCCH and deduce, based on the established rule, the location where its feedback entry is with respect to the given FBCH resource region. The established rule, which is understood by both the serving BS and its MS's without ambiguity, can correspond to the assignment order in the D-CCCH entry, to the MCS instructions, or other type of associations. For example, MS's may fill in the given FBCH resource region with their feedback entries in the same sequential order as they are in the DL resource assignment entry, as depicted in example 1200 in Figure 12. In another example where fragmentation (i.e., a feedback entry is placed across two or more OFDM symbols) is undesirable, MS's may fill in the given FBCH with their feedback entries in the order primarily based on their MCS's and secondarily based on the sequential order in the DL resource assignment entry, as depicted in the other example 1202 in Figure 12.

[0099] Any portion of an FBCH resource region that has not been used for the intended feedbacks can be used for other purposes. For example, the serving BS may explicitly assign the residue resource for some MS's to send other types of feedback entries. Alternatively, MS's can contend for the use of residue resource via a specific random access protocol.

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[0100] In accordance with other embodiments of this invention, multiple antennas (e.g., beamforming or diversity combining) can be used in the reception of an FBCH. The antenna weights at the serving BS can be derived

1. based on the known pilot subcarriers for the FBCH,
2. based on some specific characteristics in the feedback entries in the FBCH (e.g., invariant coding elements in an entry can be used as desired response),
3. by applying a blind algorithm (linear or non-linear) such as the decision-directed technique to an feedback entry, or
4. any combination of the above.

Other Embodiments

[0101] In accordance with other embodiments of this invention, basic transmission units (e.g., OFDM symbols or TS's) in time can be reconfigured to form larger or smaller units to meet the requirements of certain applications, such as for larger or smaller cell operations, or same frequency network (SFN) application (e.g., video broadcast). The information on the reconfiguration of basic units is indicated in the SFCH.

[0102] In an embodiment, multiple regular consecutive OFDM symbols may be combined to form a longer symbol, the CP length of which may be different from that of a regular OFDM symbol. An example is depicted in Figure 13, where two symbols 1300 1302 are combined into a longer symbol 1304. Conversely, a regular OFDM symbol may be divided to form multiple shorter consecutive OFDM symbols.

[0103] In another embodiment, within a subframe, multiple regular consecutive DL TS's may be combined to form a longer time-slot, wherein additional guard times may be inserted to the beginning and the end of the longer time-slot and wherein regular or longer OFDM symbols may be used (see Figure 14).

[0104] In yet another embodiment, during the longer time-slots, some BS's do not transmit while some BS's specifically set up for large area broadcasting are transmitting.

[0105] In accordance with other embodiments of this invention, information data in a TS may be encoded together with the information data in other TS's. These TS's are not necessarily consecutive or within the same subframe, as depicted in Figure 15 by subframes 1500 and 1502.

[0106] In accordance with other embodiments of this invention, an MS may feed back to its serving BS the statistic information on signal propagation conditions related to the applications (e.g., unicast data, broadcast video in the present band, broadcast video in other

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bands) and geographic locations. The serving BS may adjust and reconfigure, based on the long-term statistics collected from multiple MS's, the operation parameters and configurations to optimize system performance. In an embodiment, a BS may transmit data via a broadcast channel and MS's may transmit the statistics about the DL broadcast channel via the UL unicast channels. Based on the feedback information, the BS may adjust the pilot structure, transmission power, antenna configuration, modulation and coding scheme, and operation parameters to optimize the performance/capacity of this particular broadcast channel.

[0107] In accordance with other embodiments of this invention, multiple DL broadcast TS's may be grouped into bursts. Each burst carries an application data stream. A schedule for the bursts indicates the control and decoding information for each stream and is announced to the subscribing MS's via a particular means.

[0108] In one embodiment, the burst schedule may be transmitted periodically in a scheduling message. The resource allocation for the scheduling message is fixed and known to the subscribing MS's. Alternatively, the resource allocation for the scheduling message is specified in the SFCH.

[0109] In another embodiment, the burst schedule can be transmitted in a DL broadcast TS in a DL unicast TS. Furthermore, the burst scheduling information common to a group of cells may be transmitted by such a group of BS's using the same subcarriers, including data and pilot subcarriers, at essentially the same time, wherein macro-diversity can be achieved at the MS to decode the burst scheduling information. Alternatively, the burst scheduling information can be transmitted by each individual BS with cell-specific signals.

[0110] Figure 16 depicts an exemplary operational procedure for signal transmission including operations 1600, 1602, and 1604. In one embodiment, the procedure may be performed by a mobile station in a communication system comprising a plurality of base stations operating in a plurality of cells.

[0111] Referring to Figure 16, operation 1600 begins the operational procedure and operation 1602 illustrates transmitting a first uplink signal is transmitted to a base station on a first set of subcarriers in a first OFDM symbol. In an embodiment, the first set of subcarriers are modulated with a first signal sequence, where the first signal sequence is known to both the mobile station and the base station. Operation 1604 illustrates transmitting a second uplink signal to the base station on a second set of subcarriers in a second OFDM symbol. In one embodiment, the second set of subcarriers are modulated with the first signal sequence or a transform of the first signal sequence. The second set of subcarriers may further be modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of

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subcarriers of a downlink signal received by the mobile station over a downlink channel. In some embodiments, the correspondence between the subcarriers in the third set and the subcarriers in the second set are known to both the mobile station and the base station.

[0112] In some embodiments, the second set of subcarriers contains a same set of subcarriers as in the first set of subcarriers, and the second OFDM symbol is a different OFDM symbol than the first OFDM symbol. Alternatively, the second OFDM symbol is a same OFDM symbol as the first OFDM symbol, and each subcarrier in the second set of the subcarriers is adjacent to a subcarrier in the first set of the subcarriers.

[0113] In other embodiments, the attribute information is related to a downlink channel profile comprising channel coefficients estimated by the mobile station on the third set of subcarriers; the attribute information is related to a downlink interference profile comprising interference levels experienced by the mobile station on the third set of subcarriers; or the attribute information is related to a downlink performance profile comprising signal-to-interference- plus-noise-ratio levels experienced by the mobile station on the third set of subcarriers.

[0114] In some embodiments, the amplitude of a subcarrier of the second uplink signal is set to be inversely proportional to the interference level at a subcarrier of the downlink channel; or the amplitude of a subcarrier of the second uplink signal is set to be inversely proportional to a sum of the interference level and the noise level at a subcarrier of the downlink channel.

[0115] In other embodiments, the transform of the first signal sequence is a conjugate of the first signal sequence. Alternatively, the transform of the first signal sequence is a sequence of magnitudes of each element contained in the first signal sequence.

[0116] In some embodiments, the subcarriers in the first uplink signal or the second uplink signal are a part or the entirety of total usable subcarriers in an OFDM symbol; the subcarriers in the first uplink signal or the second uplink signal are uniformly or non-uniformly distributed across a part of or the entire channel bandwidth; and/or the subcarriers in the first uplink signal or the second uplink signal is are composed of every nth subcarrier in an OFDM symbol, n being a positive integer.

[0117] In an embodiment, the base station is a serving base station in the mobile station's serving cell or a different base station in a different cell. In another embodiment, the downlink channel is a channel from a serving base station in the mobile station's serving cell to the mobile station, or a channel from a different base station in a different cell to the mobile station.

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[0118] Figure 17 depicts an exemplary operational procedure for signal transmission including operations 1700, 1702, and 1704. In one embodiment, the procedure may be performed by a base station in a communication system comprising a plurality of base stations and mobile stations.

[0119] Referring to Figure 17, operation 1700 begins the operational procedure and operation 1702 illustrates receiving a first uplink signal from a mobile station on a first set of subcarriers in a first Orthogonal Frequency Division Multiplexing (OFDM) symbol. In an embodiment, the first set of subcarriers is modulated with a first signal sequence and the first signal sequence is known to both the mobile station and the base station. Operation 1704 illustrates receiving a second uplink signal from the mobile station on a second set of subcarriers in a second OFDM symbol. In an embodiment, the second set of subcarriers is modulated with the first signal sequence or a transform of the first signal sequence. The second set of subcarriers may further be modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel. In some embodiments, the correspondence between the subcarriers in the third set and the subcarriers in the second set are known to both the mobile station and the base station.

[0120] In an embodiment, the base station derives the attribute information contained in the second signal sequence based on the received first uplink signal and the received second uplink signal.

[0121] Any of the above mentioned aspects can be implemented in methods, systems, computer readable media, or any type of manufacture. For example, a computer readable medium can store thereon computer executable instructions for signal detection and signal processing.

[0122] Lastly, while the present disclosure has been described in connection with the preferred aspects, as illustrated in the various figures, it is understood that other similar aspects may be used or modifications and additions may be made to the described aspects for performing the same function of the present disclosure without deviating there from. For example, in various aspects of the disclosure, methods and systems for communicating in a wireless communications system were disclosed. However, other equivalent mechanisms to these described aspects are also contemplated by the teachings herein. Therefore, the present disclosure should not be limited to any single aspect, but rather construed in breadth and scope in accordance with the appended claims.

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What is Claimed:

1. A signal transmission method for a mobile station in a communication system comprising a plurality of base stations operating in a plurality of cells, the method comprising:

transmitting a first uplink signal to a base station on a first set of subcarriers in a first Orthogonal Frequency Division Multiplexing (OFDM) symbol, wherein the first set of subcarriers are modulated with a first signal sequence, the first signal sequence known to both the mobile station and the base station; and

transmitting a second uplink signal to the base station on a second set of subcarriers in a second OFDM symbol, wherein the second set of subcarriers are modulated with the first signal sequence or a transform of the first signal sequence and further modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel, wherein the correspondence between the subcarriers in the third set and the subcarriers in the second set are known to both the mobile station and the base station.

2. The method of claim 1, wherein the second set of subcarriers contains a same set of subcarriers as in the first set of subcarriers, and the second OFDM symbol is a different OFDM symbol than the first OFDM symbol.

3. The method of claim 1, wherein the second OFDM symbol is a same OFDM symbol as the first OFDM symbol, and each subcarrier in the second set of the subcarriers is adjacent to a subcarrier in the first set of the subcarriers.

4. The method of claim 1, wherein the attribute information is related to a downlink channel profile comprising channel coefficients estimated by the mobile station on the third set of subcarriers.

5. The method of claim 1, wherein the attribute information is related to a downlink interference profile comprising interference levels experienced by the mobile station on the third set of subcarriers.

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6. The method of claim 1, wherein the attribute information is related to a downlink performance profile comprising signal-to-interference-plus-noise-ratio levels experienced by the mobile station on the third set of subcarriers.

7. The method of claim 1, wherein an amplitude of a subcarrier of the second uplink signal is set to be inversely proportional to the interference level at a subcarrier of the downlink channel.

8. The method of claim 1, wherein the amplitude of a subcarrier of the second uplink signal is set to be inversely proportional to a sum of the interference level and the noise level at a subcarrier of the downlink channel.

9. The method of claim 1, wherein the transform of the first signal sequence is a conjugate of the first signal sequence.

10. The method of claim 1, wherein the transform of the first signal sequence is a sequence of magnitudes of each element contained in the first signal sequence.

11. The method of claim 1, wherein the subcarriers in the first uplink signal or the second uplink signal are a part or the entirety of total usable subcarriers in an OFDM symbol.

12. The method of claim 1, wherein the subcarriers in the first uplink signal or the second uplink signal are uniformly or non-uniformly distributed across a part of or the entire channel bandwidth.

13. The method of claim 1, wherein the subcarriers in the first uplink signal or the second uplink signal are composed of every nth subcarrier in an OFDM symbol, n being a positive integer.

14. The method of claim 1, wherein the base station is a serving base station in the mobile station's serving cell or a different base station in a different cell.

15. The method of claim 1, wherein the downlink channel is a channel from a serving base station in the mobile station's serving cell to the mobile station, or a channel from a different base station in a different cell to the mobile station.

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16. A signal reception method for a base station in a communication system comprising a plurality of base stations and mobile stations, the method comprising:

receiving a first uplink signal from a mobile station on a first set of subcarriers in a first Orthogonal Frequency Division Multiplexing (OFDM) symbol, the first set of subcarriers modulated with a first signal sequence and the first signal sequence known to both the mobile station and the base station; and

receiving a second uplink signal from the mobile station on a second set of subcarriers in a second OFDM symbol, the second set of subcarriers modulated with the first signal sequence or a transform of the first signal sequence, and further modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel, wherein the correspondence between the subcarriers in the third set and the subcarriers in the second set are known to both the mobile station and the base station.

17. The method of claim 16, wherein the second set of subcarriers contains a same set of subcarriers as in the first set of subcarriers, and the second OFDM symbol is a different OFDM symbol than the first OFDM symbol.

18. The method of claim 16, wherein the second OFDM symbol is a same OFDM symbol as the first OFDM symbol, and each subcarrier in the second set of the subcarriers is adjacent to a subcarrier in the first set of the subcarriers.

19. The method of claim 16, wherein the attribute information is related to a downlink channel profile comprising channel coefficients estimated by the mobile station on the third set of subcarriers.

20. The method of claim 16, wherein the attribute information is related to a downlink interference profile comprising interference levels experienced by the mobile station on the third set of subcarriers.

21. The method of claim 16, wherein the attribute information is related to a downlink performance profile comprising signal-to-interference-plus-noise-ratio levels experienced by the mobile station on the third set of subcarriers.

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22. The method of claim 16, wherein the transform of the first signal sequence is a conjugate of the first signal sequence.

23. The method of claim 16, wherein the transform of the first signal sequence is a sequence of magnitudes of each element contained in the first signal sequence.

24. The method of claim 16, wherein the downlink channel is a channel from the base station to the mobile station, or a channel from a different base station to the mobile station.

25. The method of claim 16, further comprising deriving the attribute information contained in the second signal sequence based on the received first uplink signal and the received second uplink signal.

26. A mobile station in a communication system comprising a plurality of base stations operating a plurality of cells, the mobile station comprising:

a receiver configured for receiving Orthogonal Frequency Division Multiplexing (OFDM) symbols; and

a transmitter configured to:

transmit a first uplink signal to a base station on a first set of subcarriers in a first OFDM symbol, wherein the first set of subcarriers are modulated with a first signal sequence, the first signal sequence known to both the mobile station and the base station; and

transmit a second uplink signal to the base station on a second set of subcarriers in a second OFDM symbol, wherein the second set of subcarriers are modulated with the first signal sequence or a transform of the first signal sequence, and further modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel, wherein the correspondence between the subcarriers in the third set and the subcarriers in the second set are known to both the mobile station and the base station.

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27. The mobile station of claim 26, wherein the second set of subcarriers contains a same set of subcarriers as in the first set of subcarriers, and the second OFDM symbol is a different OFDM symbol than the first OFDM symbol.

28. The mobile station of claim 26, wherein the second OFDM symbol is a same OFDM symbol as the first OFDM symbol, and each subcarrier in the second set of the subcarriers is adjacent to a subcarrier in the first set of the subcarriers.

29. The mobile station of claim 26, wherein the attribute information is related to a downlink channel profile comprising channel coefficients estimated by the mobile station on the third set of subcarriers.

30. The mobile station of claim 26, wherein the attribute information is related to a downlink interference profile comprising interference levels experienced by the mobile station on the third set of subcarriers.

31. The mobile station of claim 26, wherein the transform of the first signal sequence is a conjugate of the first signal sequence.

32. The mobile station of claim 26, wherein the transform of the first signal sequence is a sequence of magnitudes of each element contained in the first signal sequence.

33. A base station in a communication system comprising a plurality of base stations and mobile stations, the base station comprising:

a transmitter configured for transmitting Orthogonal Frequency Division Multiplexing (OFDM) symbols; and

a receiver configured to:

receive a first uplink signal from a mobile station on a first set of subcarriers in a first OFDM symbol, the first set of subcarriers modulated with a first signal sequence and the first signal sequence known to both the mobile station and the base station; and

receive a second uplink signal from the mobile station on a second set of subcarriers in a second OFDM symbol, the second set of subcarriers modulated with the first signal sequence or a transform of the first signal

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sequence, and further modulated with a second signal sequence, the second signal sequence containing attribute information on a third set of subcarriers of a downlink signal received by the mobile station over a downlink channel, wherein the correspondence between the subcarriers in the third set and the subcarriers in the second set known to both the mobile station and the base station.

34. The base station of claim 33, wherein the second set of subcarriers contains a same set of subcarriers as in the first set of subcarriers, and the second OFDM symbol is a different OFDM symbol than the first OFDM symbol.

35. The base station of claim 33, wherein the second OFDM symbol is a same OFDM symbol as the first OFDM symbol, and each subcarrier in the second set of the subcarriers is adjacent to a subcarrier in the first set of the subcarriers.

36. The base station of claim 33, wherein the attribute information is related to a downlink channel profile comprising channel coefficients estimated by the mobile station on the third set of subcarriers.

37. The base station of claim 33, wherein the attribute information is related to a downlink interference profile comprising interference levels experienced by the mobile station on the third set of subcarriers.

38. The base station of claim 33, wherein the transform of the first signal sequence is a conjugate of the first signal sequence.

39. The base station of claim 33, wherein the transform of the first signal sequence is a sequence of magnitudes of each element contained in the first signal sequence.

40. The base station of claim 33, further comprising a processor configured to derive the attribute information contained in the second signal sequence based on the received first uplink signal and the received second uplink signal.

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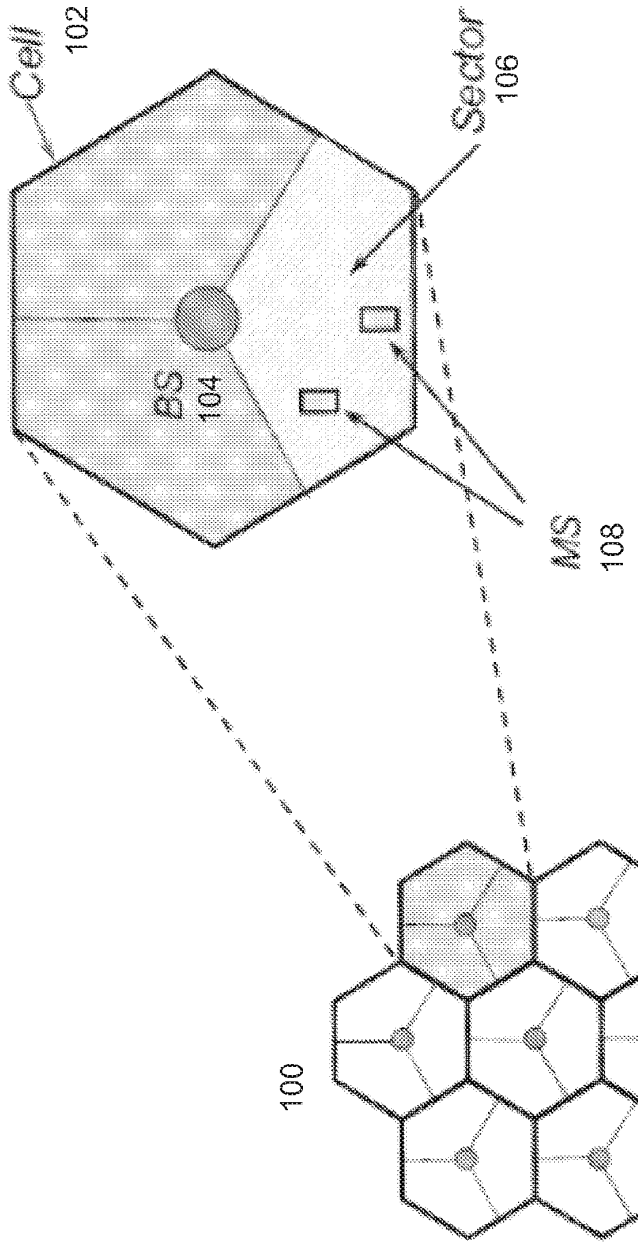
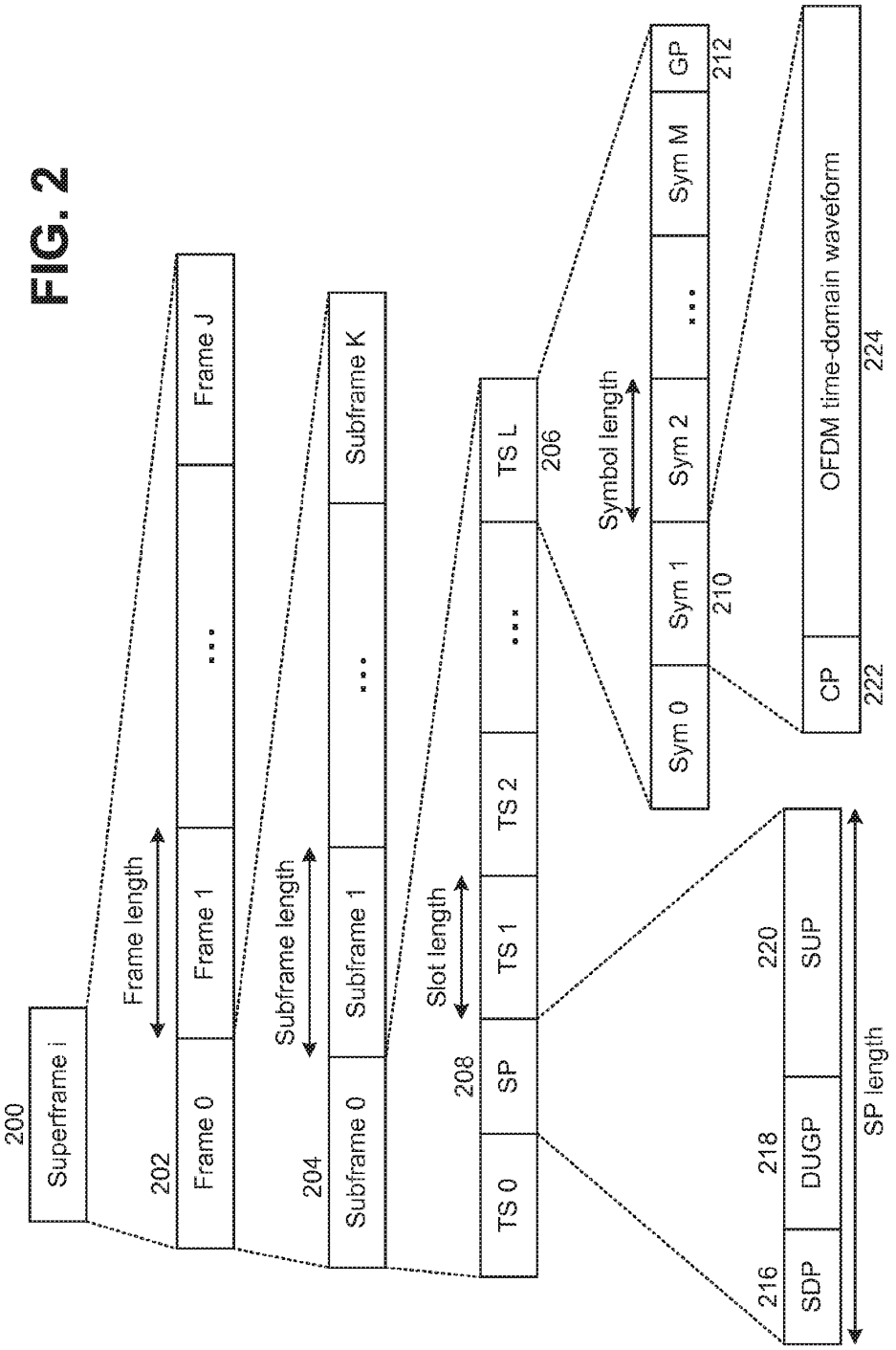


FIG. 1

FIG. 2


200
Superframe i
Frame length
202
Frame 0
Frame 1
...
Frame J
Subframe length
204
Subframe 0
Subframe 1
...
Subframe K
Slot length
208
TS 0
SP
TS 1
TS 2
...
TS L
206
Symbol length
Sym 0
Sym 1
Sym 2
...
Sym M
GP
210
212
CP
OFDM time-domain waveform
222
224
216
SDP
218
DUGP
220
SUP
SP length

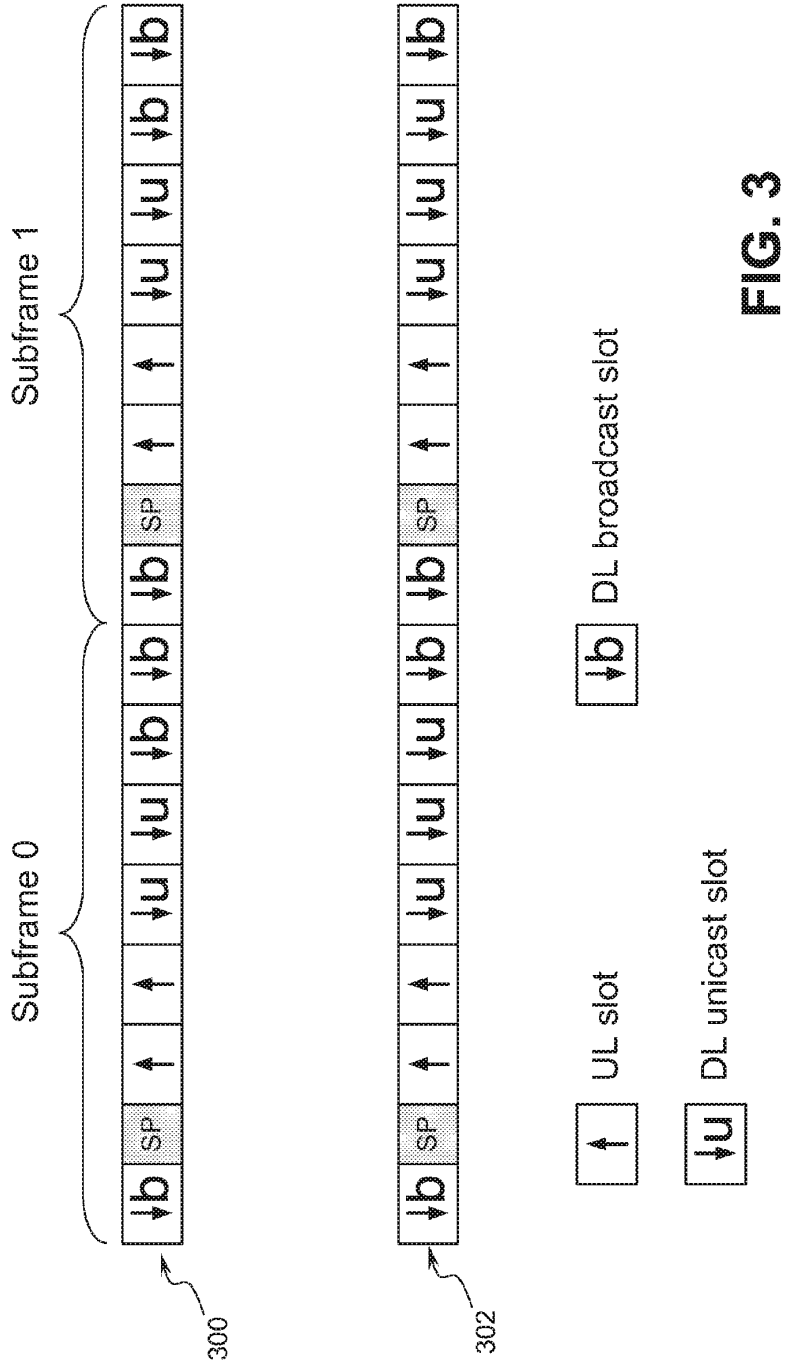

Subframe 0
Subframe 1
SP
300
302
UL slot
DL broadcast slot
DL unicast slot

FIG. 3

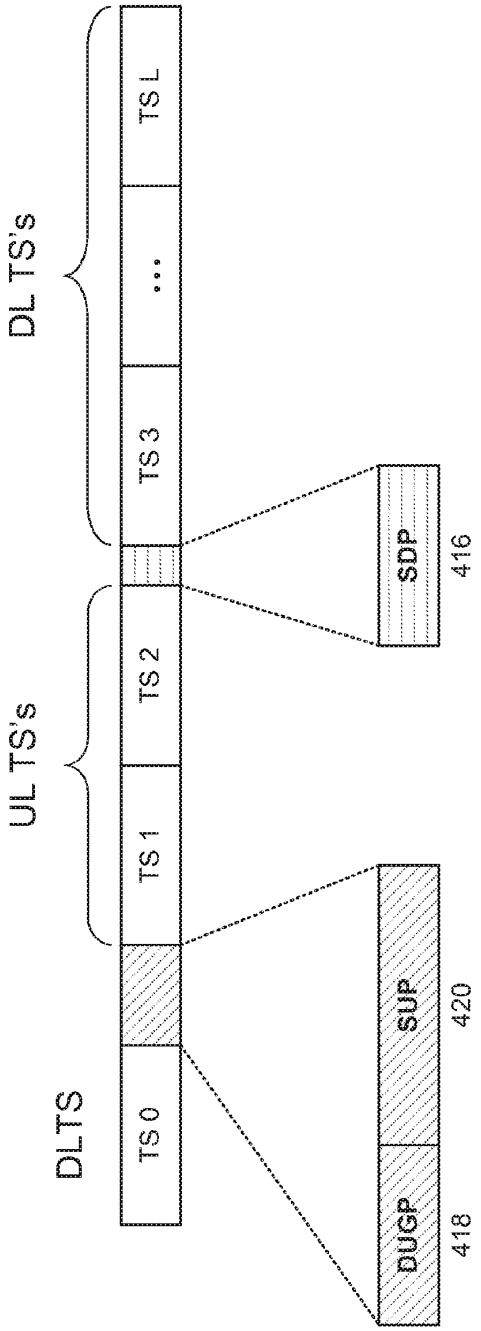


FIG. 4

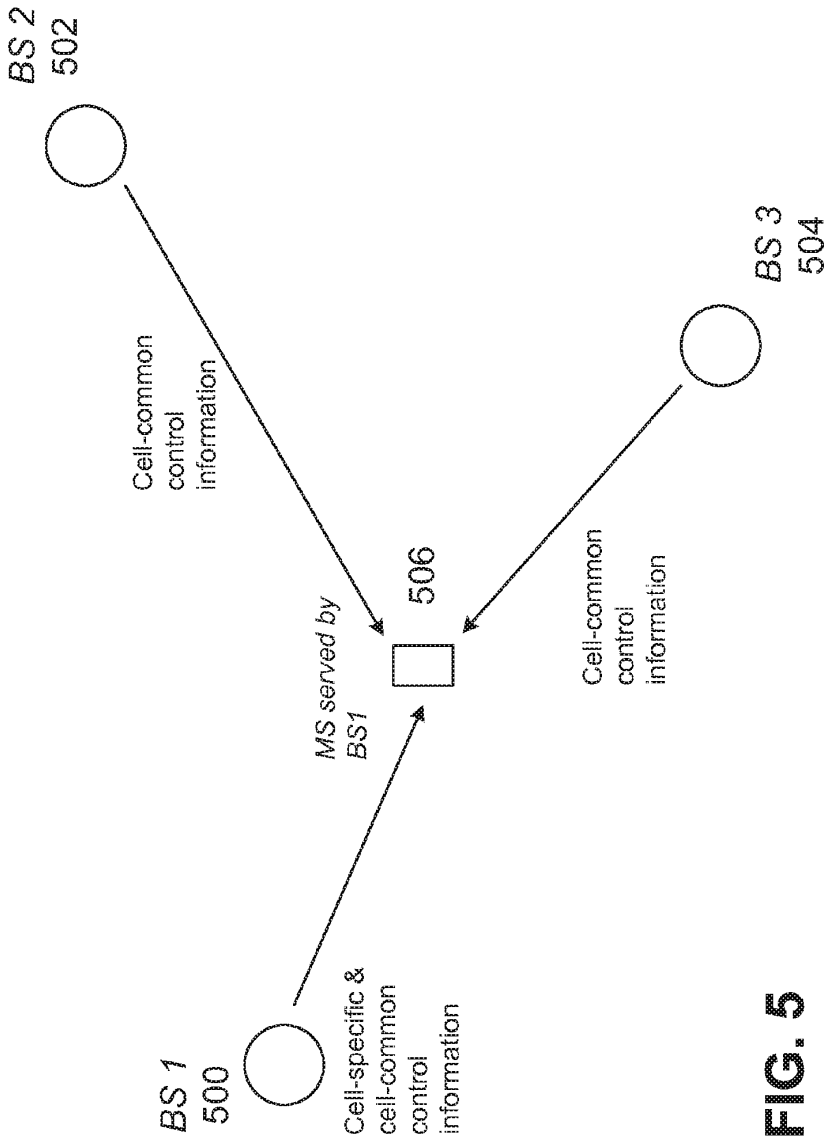

BS 2
502
BS 3
504
Cell-common control information
Cell-common control information
MS served by BS1
506
BS 1
500
Cell-specific & cell-common control information

FIG. 5

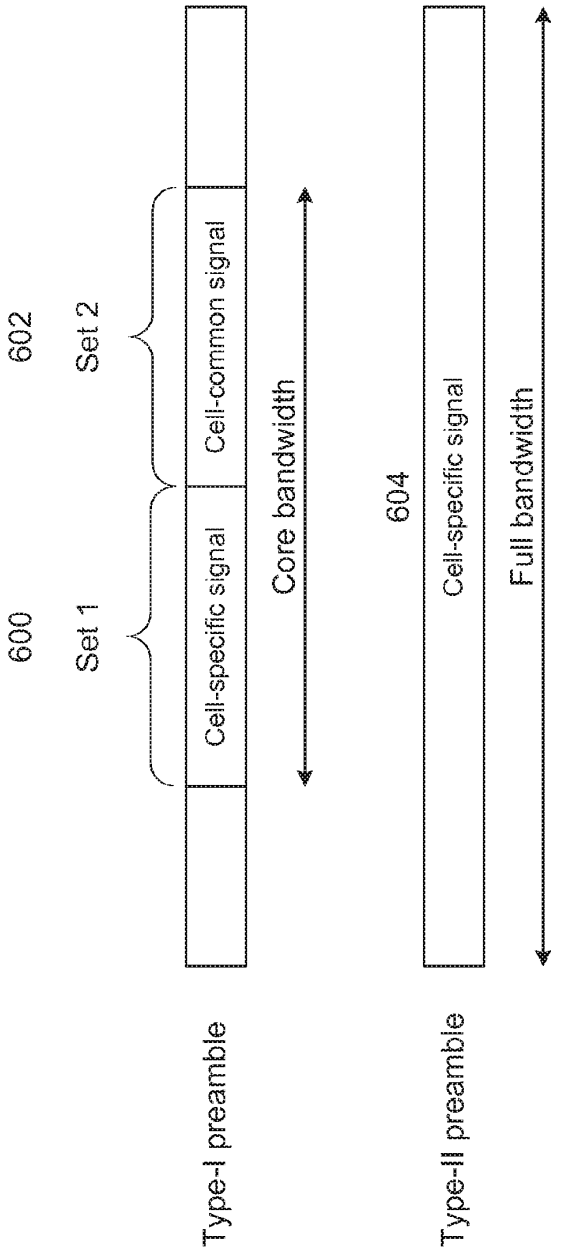

600
602
Set 1
Set 2
Cell-specific signal
Cell-common signal
Core bandwidth
Type-I preamble
604
Cell-specific signal
Full bandwidth
Type-II preamble

FIG. 6

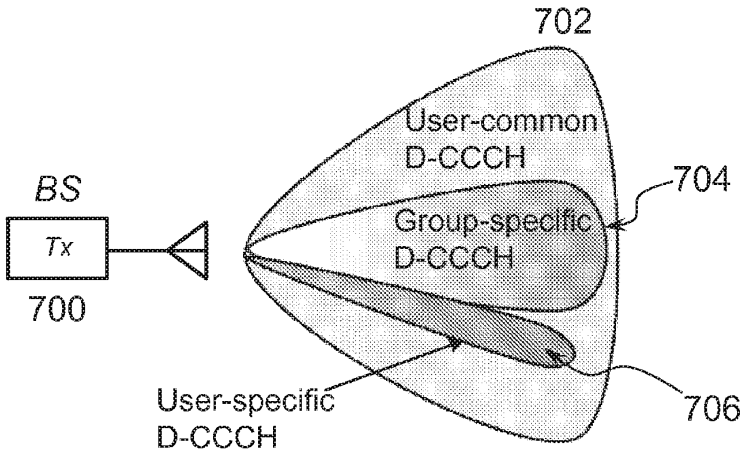

702
User-common
D-CCCH
704
BS
Tx
Group-specific
D-CCCH
700
User-specific
D-CCCH
706

FIG. 7

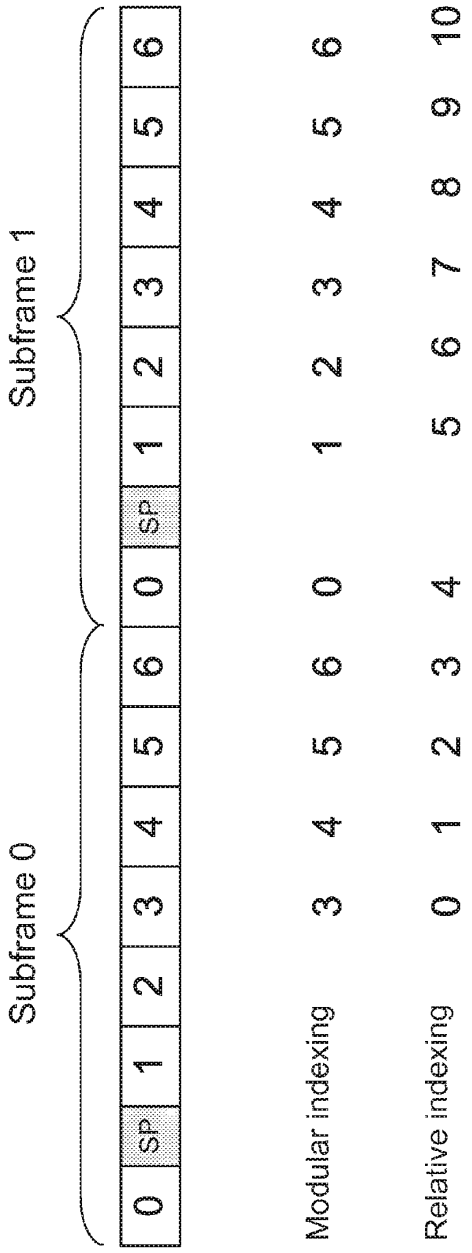

Subframe 0
Subframe 1
0 SP 1 2 3 4 5 6 0 SP 1 2 3 4 5 6
Modular indexing 3 4 5 6 0 1 2 3 4 5 6
Relative indexing 0 1 2 3 4 5 6 7 8 9 10

FIG. 8

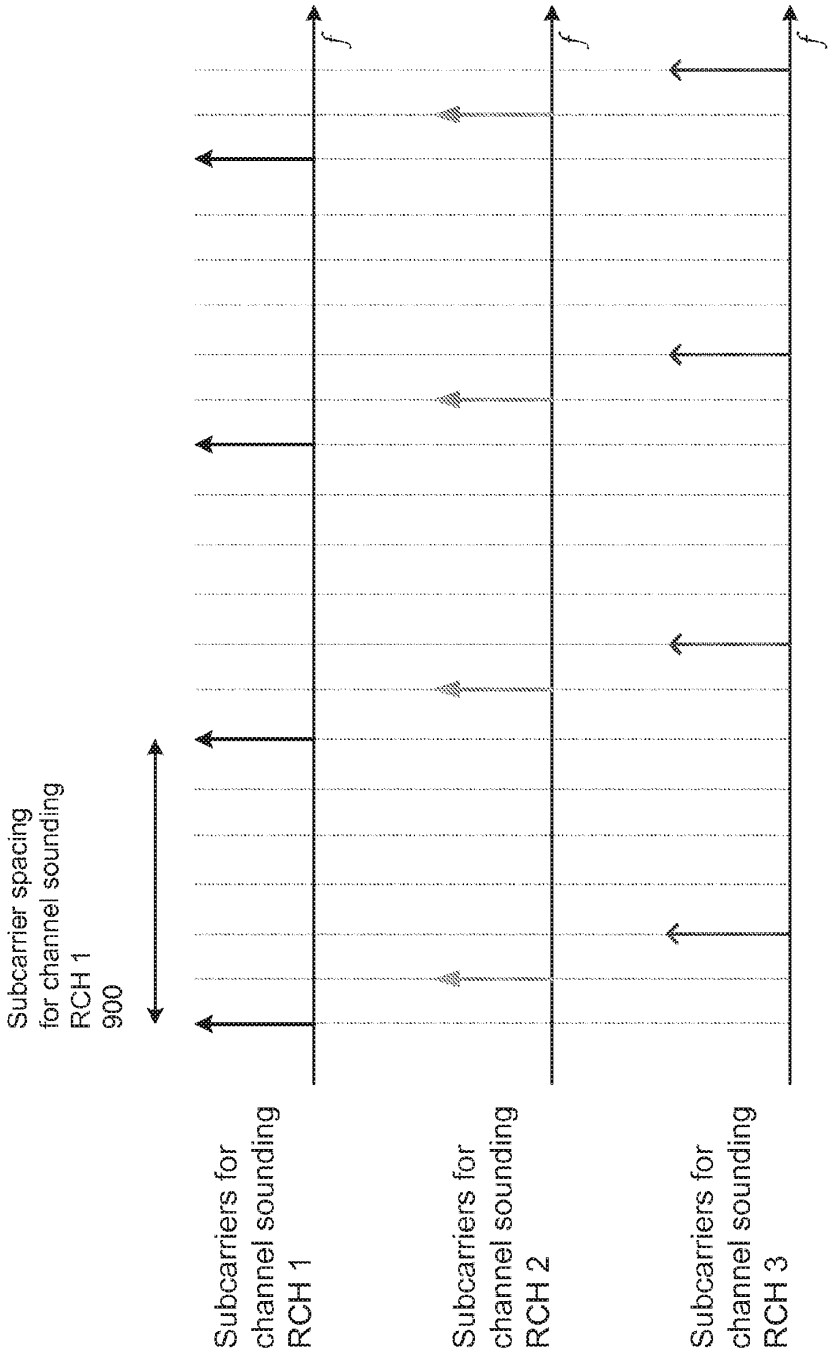

Subcarrier spacing
for channel sounding
RCH 1
900
Subcarriers for
channel sounding
RCH 1
Subcarriers for
channel sounding
RCH 2
Subcarriers for
channel sounding
RCH 3
f
f
f

FIG. 9

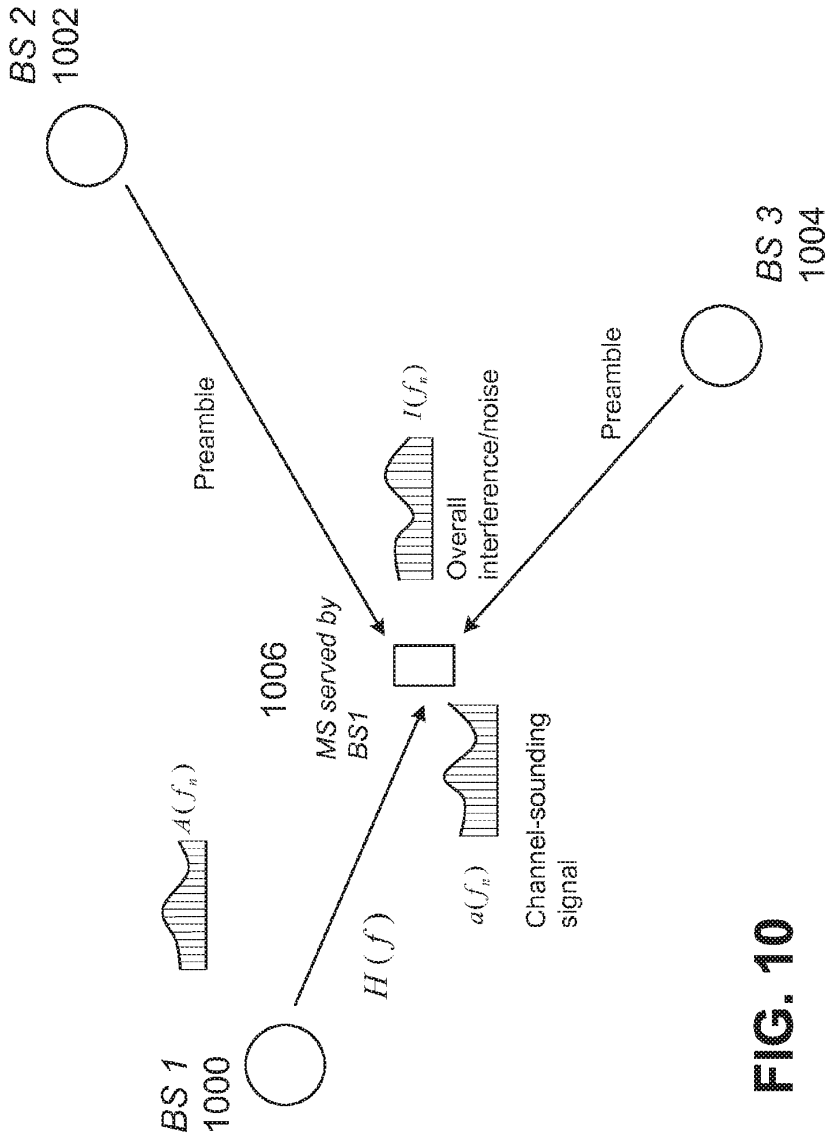

BS 2
1002
BS 3
1004
Preamble
Preamble
$I(f_n)$
Overall interference/noise
1006
MS served by BS1
$A(f_n)$
$H(f)$
$a(f_n)$
Channel-sounding signal
BS 1
1000

FIG. 10

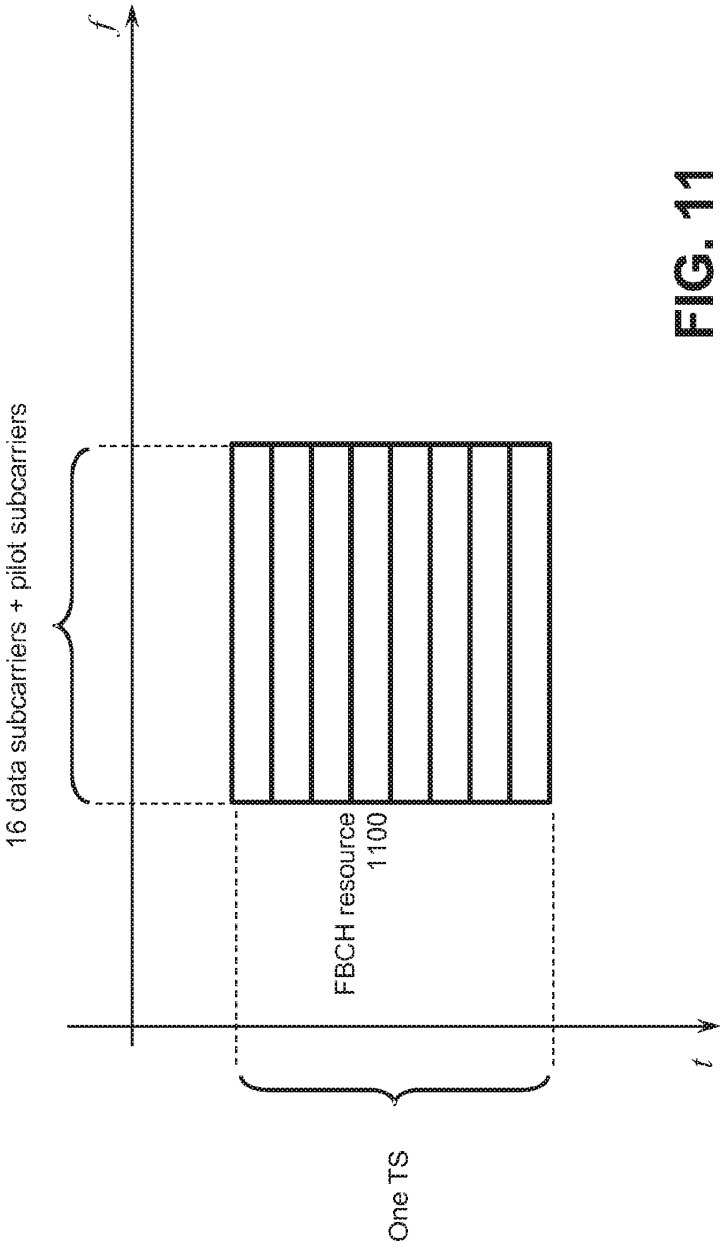

f
16 data subcarriers + pilot subcarriers
FBCH resource
1100
t
One TS

FIG. 11

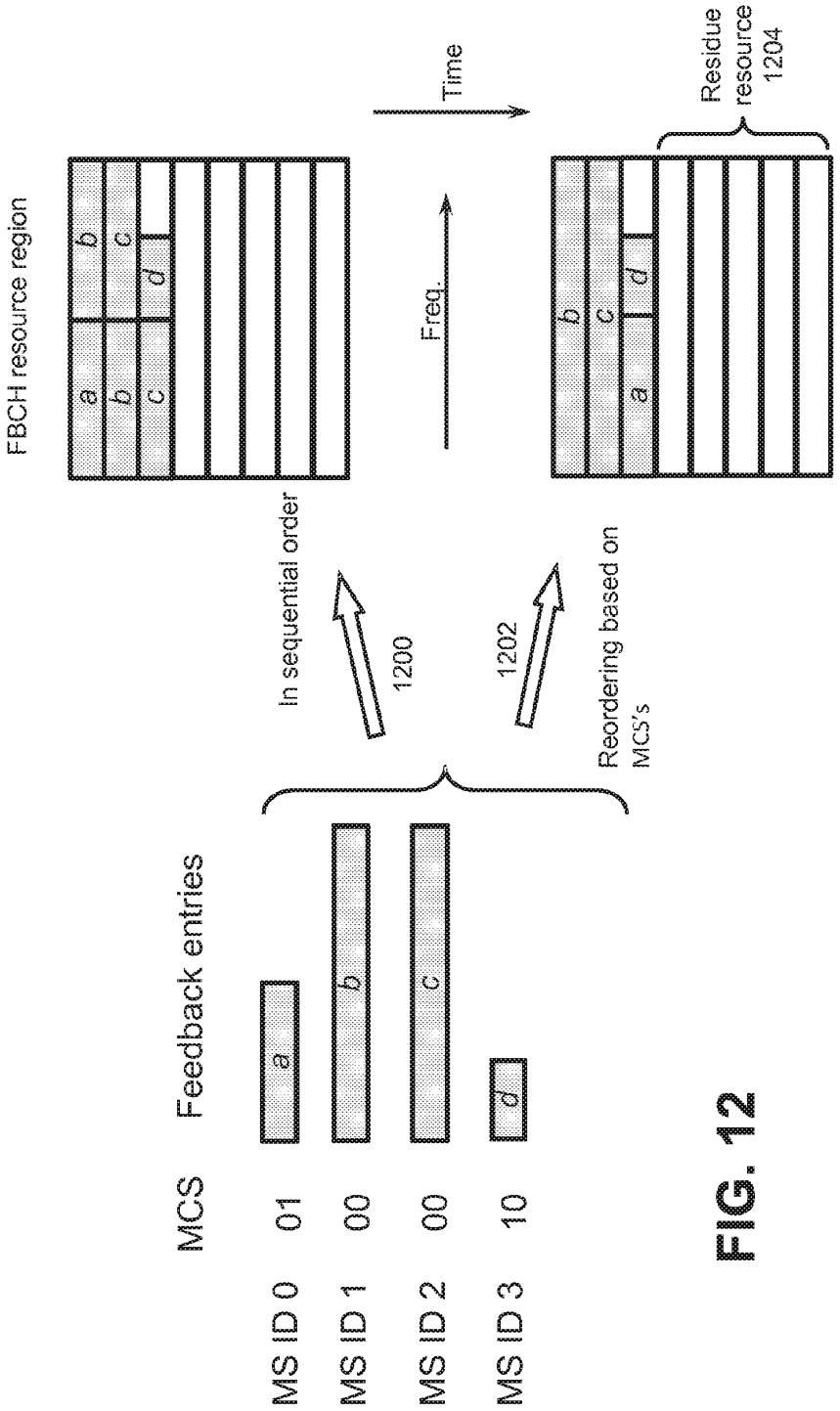

FBCH resource region
Time
Freq.
Residue resource 1204
In sequential order
1200
1202
Reordering based on MCS's
MCS
Feedback entries
MS ID 0
01
MS ID 1
00
MS ID 2
00
MS ID 3
10
a
b
c
d

FIG. 12

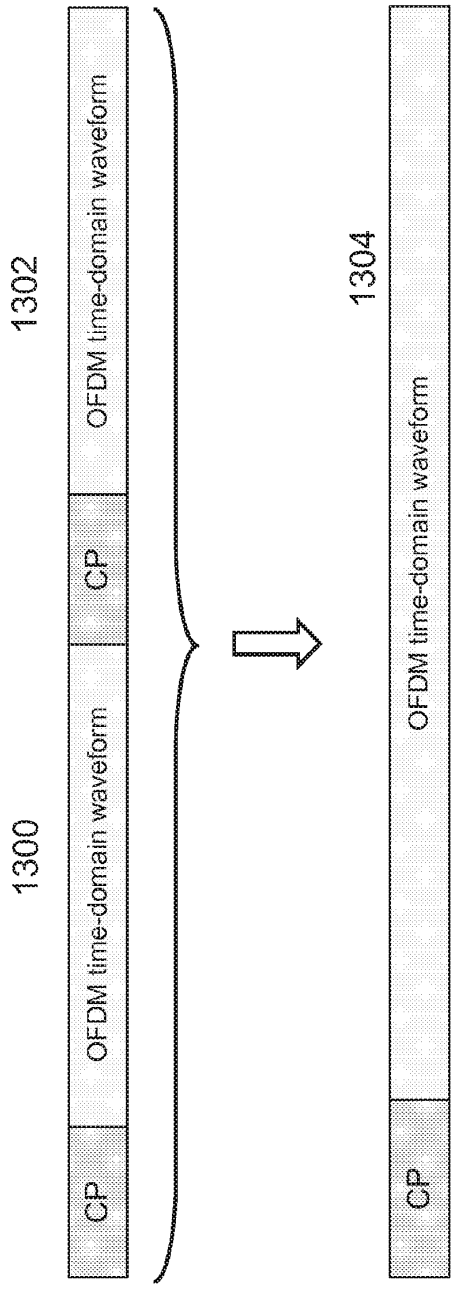

1300
CP
OFDM time-domain waveform
1302
CP
OFDM time-domain waveform
1304
CP
OFDM time-domain waveform

FIG. 13

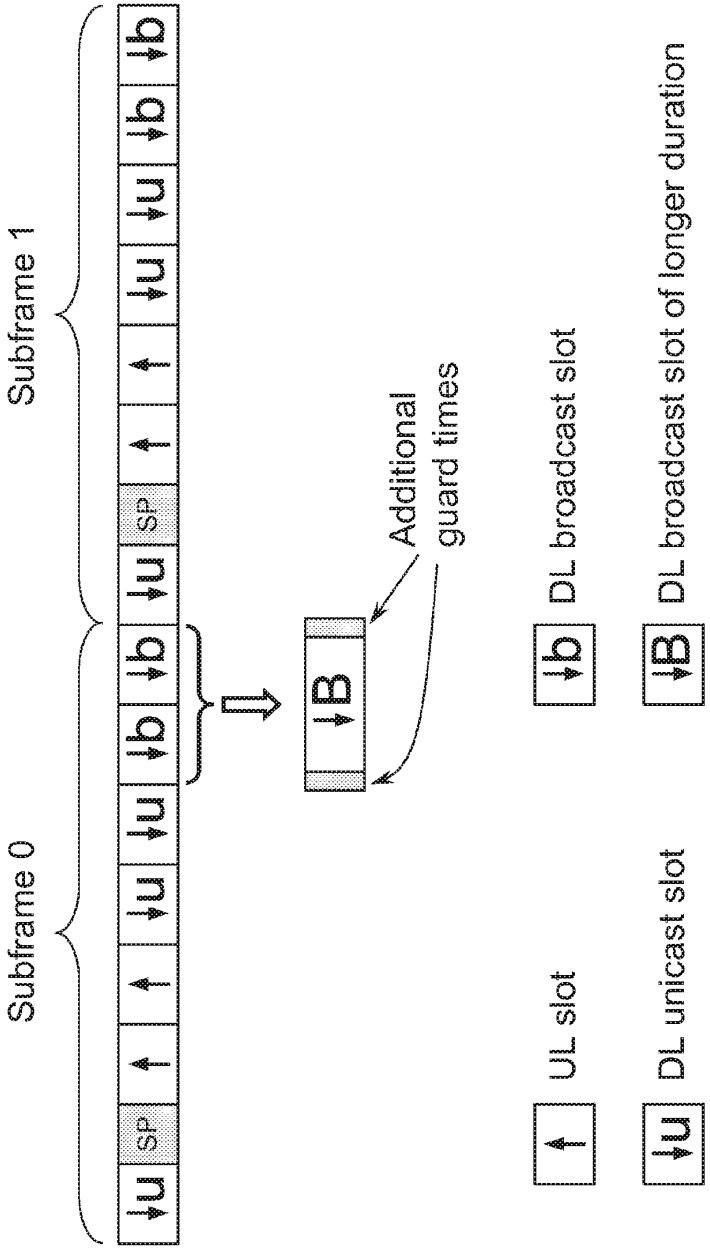

Subframe 0
Subframe 1
SP
SP
B
Additional guard times
UL slot
DL broadcast slot
DL unicast slot
DL broadcast slot of longer duration

FIG. 14

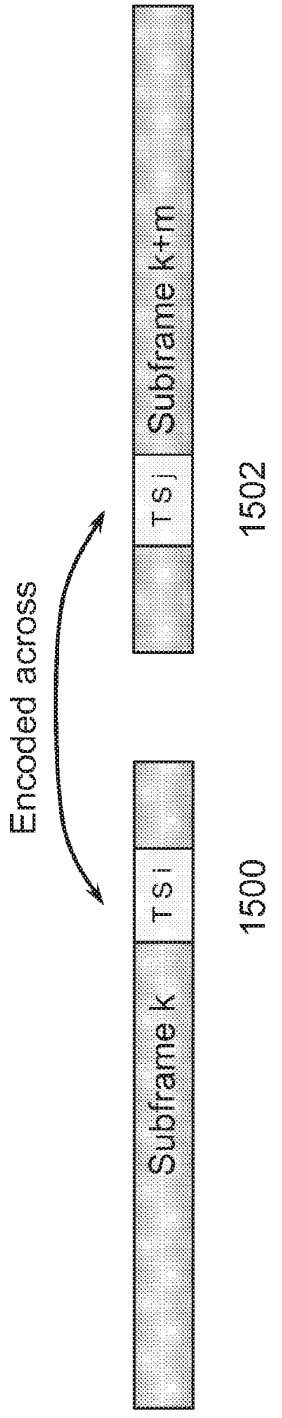


FIG. 15

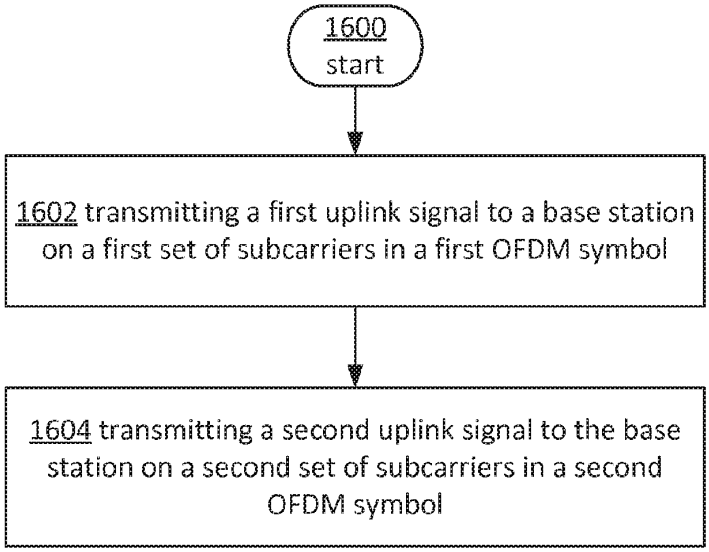

1600
start
1602 transmitting a first uplink signal to a base station on a first set of subcarriers in a first OFDM symbol
1604 transmitting a second uplink signal to the base station on a second set of subcarriers in a second OFDM symbol

FIG. 16

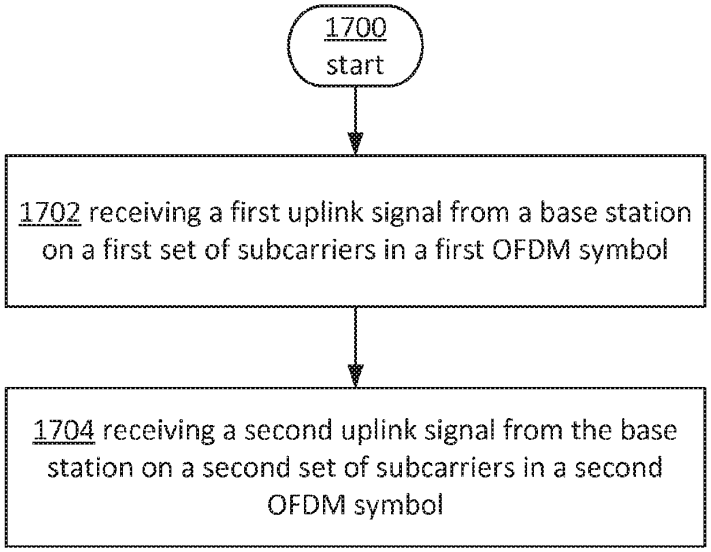

1700
start
1702 receiving a first uplink signal from a base station on a first set of subcarriers in a first OFDM symbol
1704 receiving a second uplink signal from the base station on a second set of subcarriers in a second OFDM symbol

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/024926

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04J 11/00 (2013.01)
USPC - 370/203
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H04J 11/00, H04W 72/04, H04L 27/26, H04J 1/00, H04L 5/00, H04B 7/005, H04B 7/04 (2013.01)
USPC - 370/203, 204, 205, 206, 208, 375/130, 148, 260, 261, 296

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - H04J 11/00, H04W 72/04, H04L 27/26, H04J 1/00, H04L 5/00, H04B 7/005, H04B 7/04 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patents, Proquest Dissertations & Theses: The Sciences and Engineering Collection; ProQuest Technology Collection, IEEE Xplore Digital Library, Elsevier Inc Engineering Village: Compendex, Inspec, NTIS, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/0020323 A1 (NOH et al) 26 January 2012 (26.01.2012) entire document	1-40
A	US 2009/0122771 A1 (CAI) 14 May 2009 (14.05.2009) entire document	1-40
A	US 2004/0228283 A1 (NAGUIB et al) 18 November 2004 (18.11.2004) entire document	1-40
A	US 2004/0037215 A1 (HWANG et al) 26 February 2004 (26.02.2004) entire document	1-40
A	US 2005/0002324 A1 (SUTIVONG et al) 06 January 2005 (06.01.2005) entire document	1-40
A	US 2009/0280866 A1 (LO et al) 12 November 2009 (12.11.2009) entire document	1-40
A	US 2011/0235590 A1 (LI et al) 29 September 2011 (29.09.2011) entire document	1-40

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 March 2013	15 APR 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

Espacenet

Bibliographic data: JP2013504248 (A) — 2013-02-04

METHOD AND APPARATUS FOR TRANSMITTING CONTROL INFORMATION IN WLAN SYSTEM

Inventor(s):

Applicant(s):

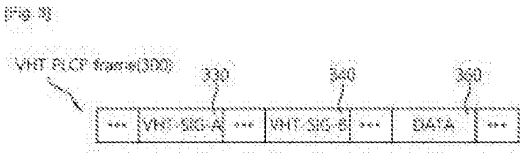
Classification: - international: ***H04B7/04; H04J99/00; H04W16/28; H04W72/04; H04W84/12***
- cooperative: **H04B7/0452; H04L5/001; H04L5/0023; H04L5/0053; H04W84/12;** H04B7/0671; H04L25/0226; H04L25/03343; H04L5/0048

Application number: JP20120527835 20100908 Global Dossier

Priority number(s): US20090240658P 20090909 ; US20090243160P 20090917 ; US20090259634P 20091109 ; US20100303684P 20100212 ; US20100307429P 20100223 ; KR20100022225 20100312 ; KR20100040588 20100430 ; KR20100040589 20100430 ; US20100349220P 20100528 ; WO2010KR06093 20100908

Also published as: AU2010293217 (A1) AU2010293217 (B2) CA2771605 (A1) CA2771605 (C) CN102484522 (A) more

Abstract not available for JP2013504248 (A)
Abstract of corresponding document: WO2011031058 (A2)



There is provided a method of transmitting control information in a Wireless Local Area Network (WLAN) system, comprising transmitting first control information by means of cyclic shift delay diversity beam-forming and transmitting second control information. The first control information comprises information necessary for each of a plurality of target stations of the second control information to receive the second control information. The second control information beamformed and transmitted to the plurality of target stations.

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特表2013-504248
(P2013-504248A)
(43)公表日　平成25年2月4日(2013.2.4)

(51)Int.Cl.		F I			テーマコード（参考）
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H04B 7/04	(2006.01)	H04B	7/04		5K159
H04W 84/12	(2009.01)	H04Q	7/00	630	
H04W 16/28	(2009.01)	H04Q	7/00	233	
H04W 72/04	(2009.01)	H04Q	7/00	551	

審査請求 有　予備審査請求 未請求　（全 72 頁）　最終頁に続く

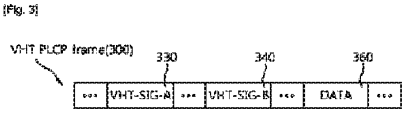
(21)出願番号　特願2012-527835 (P2012-527835)
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(54)【発明の名称】無線ＬＡＮシステムにおける制御情報送信方法及びこれをサポートする装置

(57)【要約】
【課題】無線ＬＡＮシステムにおいて制御情報を送信する方法を提供する。
【解決手段】前記制御情報を送信する方法は、第１の制御情報を循環シフト遅延ダイバーシティビーム形成により送信し、及び第２の制御情報を送信することを含み、前記第１の制御情報は、前記第２の制御情報の複数のターゲットステーションの各々が前記第２の制御情報の受信に必要な情報を含み、前記第２の制御情報は、ビーム形成され、前記複数のターゲットステーションに送信される。
【選択図】図３



【特許請求の範囲】
【請求項１】
無線ＬＡＮシステムにおける制御情報を送信する方法において、
第１の制御情報を循環シフト遅延ダイバーシティビーム形成により送信し；及び、
第２の制御情報を送信する；ことを含み、
前記第１の制御情報は、前記第２の制御情報の複数のターゲットステーションの各々が前記第２の制御情報の受信に必要な情報を含み、
前記第２の制御情報は、ビーム形成され、前記複数のターゲットステーションに送信されることを特徴とする方法。
【請求項２】
前記第１の制御情報は、前記複数のターゲットステーションに対して空間多重化されたＳＤＭＡ（ｓｐａｔａｉｌ ｄｉｖｉｓｉｏｎ ｍｕｌｔｉｐｌｅ ａｃｃｅｓｓ）データの送信に所要される送信時間情報をさらに含むことを特徴とする請求項１に記載の方法。
【請求項３】
前記第２の制御情報は、前記複数のターゲットステーションの各々に対する制御情報を含むことを特徴とする請求項１に記載の方法。
【請求項４】
前記複数のターゲットステーションの各々に対する前記制御情報は、ＭＣＳ（ｍｏｄｕｌａｔｉｏｎ ａｎｄ ｃｏｄｉｎｇ ｓｃｈｅｍｅ）情報、チャネル帯域幅情報、空間ストリーム（ｓｐａｔｉａｌ ｓｔｒｅａｍ）個数情報、送信パワー情報のうち少なくともいずれか一つであることを特徴とする請求項３に記載の方法。
【請求項５】
前記第１の制御情報及び前記第２の制御情報は、第１のフレームを介して送信され、
前記第２の制御情報は、前記第１のフレームの以後に送信される一つ以上の第２のフレーム送信に所要される送信時間情報をさらに含むことを特徴とする請求項１に記載の方法。
【請求項６】
前記第１の制御情報の送信に割り当てられるＯＦＤＭ（Ｏｒｔｈｏｇｏｎａｌ Ｆｒｅｑｕｅｎｃｙ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅｘｉｎｇ）シンボル当たり副搬送波の個数は、前記第２の制御情報の送信に割り当てられるＯＦＤＭシンボル当たり副搬送波の個数より小さい請求項１に記載の方法。
【請求項７】
前記共用制御情報の送信に割り当てられるＯＦＤＭシンボルの個数は、前記ＳＴＡ－特定制御情報の送信に割り当てられるＯＦＤＭシンボルの個数より多い請求項６に記載の方法。
【請求項８】
前記共用制御情報の以前のＯＦＤＭシンボルを介して前記共用制御情報の受信に使われるチャネル推定のための第１のＬＴＦ（Ｌｏｎｇ Ｔｒａｎｉｎｇ Ｆｉｅｌｄ）が送信されることをさらに含む請求項７に記載の方法。
【請求項９】
前記共用制御情報と前記ＳＴＡ－特定制御情報との間のＯＦＤＭシンボルを介して前記ＳＴＡ－特定制御情報の受信に使われるチャネル推定のための第２のＬＴＦが送信されることをさらに含む請求項７に記載の方法。
【請求項１０】
前記第２のＬＴＦと前記ＳＴＡ－特定制御情報は、同じプリコーディング行列を用いてビーム形成される請求項９に記載の方法。
【請求項１１】
前記第１の制御情報と前記第２の制御情報は、互いに異なる循環シフトが適用される請求項１に記載の方法。

【請求項１２】
プロセッサ；及び、
前記プロセッサと機能的に連結され、フレームを送信及び受信するトランシーバ；を含み、
前記プロセッサは、第１の制御情報を全方向（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎａｌ）に送信し、
第２の制御情報を送信するように設定され、
前記第１の制御情報は、前記第２の制御情報の複数のターゲットステーションの各々が前記第２の制御情報の受信に必要な情報を含み、
前記第２の制御情報は、ビーム形成され、前記複数のターゲットステーションに送信されることを特徴とする無線装置。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、無線通信に関し、より詳しくは、多重アンテナをサポートする無線ＬＡＮシステムにおける制御情報送信方法及びこれをサポートする装置に関する。
【背景技術】
【０００２】
最近、情報通信技術の発展とともに多様な無線通信技術が開発されている。このうち無線ＬＡＮ（ＷＬＡＮ）は、無線周波数技術に基づいて個人携帯用情報端末機（Ｐｅｒｓｏｎａｌ Ｄｉｇｉｔａｌ Ａｓｓｉｓｔａｎｔ；ＰＤＡ）、ラップトップコンピュータ、携帯型マルチメディアプレーヤ（Ｐｏｒｔａｂｌｅ Ｍｕｌｔｉｍｅｄｉａ Ｐｌａｙｅｒ；ＰＭＰ）などのような携帯型端末機を用いて家庭や企業または特定サービス提供地域で無線でインターネットに接続することができるようにする技術である。
【０００３】
ＷＬＡＮ技術の標準化機構であるＩＥＥＥ（Ｉｎｓｔｉｔｕｔｅ ｏｆ Ｅｌｅｃｔｒｉｃａｌ ａｎｄ Ｅｌｅｃｔｒｏｎｉｃｓ Ｅｎｇｉｎｅｅｒｓ）８０２が１９８０年２月に設立された以来、多くの標準化作業が実行されている。
【０００４】
初期のＷＬＡＮ技術は、ＩＥＥＥ８０２．１１を介して２．４ＧＨｚ周波数を使用して周波数ホッピング、帯域拡散、赤外線通信などで１～２Ｍｂｐｓの速度をサポートした以来、最近にはＯＦＤＭ（Ｏｒｔｈｏｇｏｎａｌ Ｆｒｅｑｕｅｎｃｙ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅｘ）を適用して最大５４Ｍｂｐｓの速度をサポートすることができる。その他、ＩＥＥＥ８０２．１１では、ＱｏＳ（Ｑｕａｌｉｔｙ ｆｏｒ Ｓｅｒｖｉｃｅ）の向上、アクセスポイント（Ａｃｃｅｓｓ Ｐｏｉｎｔ）プロトコル互換、セキュリティ強化（Ｓｅｃｕｒｉｔｙ Ｅｎｈａｎｃｅｍｅｎｔ）、無線リソース測定（Ｒａｄｉｏ Ｒｅｓｏｕｒｃｅ ｍｅａｓｕｒｅｍｅｎｔ）、車両環境のための無線接続（Ｗｉｒｅｌｅｓｓ Ａｃｃｅｓｓ Ｖｅｈｉｃｕｌａｒ Ｅｎｖｉｒｏｎｍｅｎｔ）、速いローミング（Ｆａｓｔ Ｒｏａｍｉｎｇ）、メッシュネットワーク（Ｍｅｓｈ Ｎｅｔｗｏｒｋ）、外部ネットワークとの相互作用（Ｉｎｔｅｒｗｏｒｋｉｎｇ ｗｉｔｈ Ｅｘｔｅｒｎａｌ Ｎｅｔｗｏｒｋ）、無線ネットワーク管理（Ｗｉｒｅｌｅｓｓ Ｎｅｔｗｏｒｋ Ｍａｎａｇｅｍｅｎｔ）等、多様な技術の標準を実用化または開発中である。
【０００５】
ＩＥＥＥ８０２．１１のうちＩＥＥＥ８０２．１１ｂは、２．４ＧＨｚ帯域の周波数を使用しつつ最高１１Ｍｂｓの通信速度をサポートする。ＩＥＥＥ８０２．１１ｂ以後に商用化されたＩＥＥＥ８０２．１１ａは、２．４ＧＨｚ帯域でない５ＧＨｚ帯域の周波数を使用することによって、相当混雑した２．４ＧＨｚ帯域の周波数に比べて干渉に対する影響を減らし、ＯＦＤＭ技術を使用して通信速度を最大５４Ｍｂｐｓまで向上させた。然しながら、ＩＥＥＥ８０２．１１ａは、ＩＥＥＥ８０２．１１ｂに比べて通信距離が短いという短所がある。また、ＩＥＥＥ８０２．１１ｇは、ＩＥＥＥ８０２．１１ｂと同様に２

．４ＧＨｚ帯域の周波数を使用して最大５４Ｍｂｐｓの通信速度を具現し、後方互換性（Ｂａｃｋｗａｒｄ　Ｃｏｍｐａｔｉｂｉｌｉｔｙ）を満たしているため相当な注目を浴びており、通信距離においてもＩＥＥＥ８０２．１１ａより優位にある。

【０００６】

また、無線ＬＡＮで脆弱点と指摘されてきた通信速度に対する限界を克服するために比較的最近に制定された技術規格としてＩＥＥＥ８０２．１１ｎがある。ＩＥＥＥ８０２．１１ｎは、ネットワークの速度と信頼性を増加させ、無線ネットワークの運営距離を拡張することを目的にする。より具体的に、ＩＥＥＥ８０２．１１ｎでは、データ処理速度が最大５４０Ｍｂｐｓ以上である高処理率（Ｈｉｇｈ　Ｔｈｒｏｕｇｈｐｕｔ；ＨＴ）をサポートし、また、送信エラーを最小化してデータ速度を最適化するために送信部と受信部の両方ともに多重アンテナを使用するＭＩＭＯ（Ｍｕｌｔｉｐｌｅ　Ｉｎｐｕｔｓ　ａｎｄ　Ｍｕｌｔｉｐｌｅ　Ｏｕｔｐｕｔｓ）技術に基づいている。また、この規格は、データ信頼性を高めるために重複する写本を複数個送信するコーディング方式を使用するだけでなく、速度を増加させるために直交周波数分割多重（Ｏｒｔｈｏｇｏｎａｌ　Ｆｒｅｑｕｅｎｃｙ　Ｄｉｖｉｓｉｏｎ　Ｍｕｌｔｉｐｌｅｘ；ＯＦＤＭ）を使用することもできる。

【０００７】

ＷＬＡＮの普及が活性化され、これを用いたアプリケーションが多様化されることによって、最近にはＩＥＥＥ８０２．１１ｎがサポートするデータ処理速度より高い処理率をサポートするための新たなＷＬＡＮシステムに対する必要性が台頭されている。超高処理率（Ｖｅｒｙ　Ｈｉｇｈ　Ｔｈｒｏｕｇｈｐｕｔ；ＶＨＴ）無線ＬＡＮシステムは、１Ｇｂｐｓ以上のデータ処理速度をサポートするために最近に新たに提案されているＩＥＥＥ８０２．１１無線ＬＡＮシステムのうち一つである。ＶＨＴ無線ＬＡＮシステムという名称は、任意であり、現在は１Ｇｂｐｓ以上のスループットを提供するために、４×４ＭＩＭＯ及び８０ＭＨｚまたはその以上のチャネル帯域幅を使用するシステムに対する実現可能性テスト（ｆｅａｓｉｂｉｌｉｔｙ　ｔｅｓｔ）が進行されている。

【０００８】

現在論議されているＶＨＴ無線ＬＡＮシステムは、その使用周波数帯域として６ＧＨｚ以下の帯域と６０ＧＨｚ帯域を用いる二つの方法が論議されている。６ＧＨｚ以下の周波数帯域を使用する場合、６ＧＨｚ以下の周波数帯域を使用している従来の無線ＬＡＮシステムとの共存可能性などが問題になることができる。

【０００９】

一方、ＩＥＥＥ８０２．１１の物理階層アーキテクチャ（ＰＨＹ　ｌａｙｅｒ　ａｒｃｈｉｔｅｃｔｕｒｅ）は、ＰＬＭＥ（ＰＨＹ　Ｌａｙｅｒ　Ｍａｎａｇｅｍｅｎｔ　Ｅｎｔｉｔｙ）、ＰＬＣＰ（Ｐｈｙｓｉｃａｌ　Ｌａｙｅｒ　Ｃｏｎｖｅｒｇｅｎｃｅ　Ｐｒｏｃｅｄｕｒｅ）副階層、ＰＭＤ（Ｐｈｙｓｉｃａｌ　Ｍｅｄｉｕｍ　Ｄｅｐｅｎｄｅｎｔ）副階層で構成される。ＰＬＭＥは、ＭＬＭＥ（ＭＡＣ　Ｌａｙｅｒ　Ｍａｎａｇｅｍｅｎｔ　Ｅｎｔｉｔｙ）と協調して物理階層の管理機能を提供する。ＰＬＣＰ副階層は、ＭＡＣ階層とＰＭＤ階層との間でＭＡＣ階層の指示によってＭＡＣ階層から受けたＭＰＤＵ（ＭＡＣ　Ｐｒｏｔｏｃｏｌ　Ｄａｔａ　Ｕｎｉｔ）をＰＭＤ副階層に伝達したり、或いはＰＭＤ副階層から来るフレームをＭＡＣ階層に伝達する。ＰＭＤ副階層は、ＰＬＣＰの後方階層であり、無線媒体を介する二つのステーション間物理階層エンティティ（ｅｎｔｉｔｙ）の送受信が可能にする。

【００１０】

ＰＬＣＰ副階層は、ＭＰＤＵをＭＡＣ階層から受けてＰＭＤ副階層に伝達する過程で物理階層送受信機により必要な情報を含む付加フィールドを加える。この時、付加されるフィールドは、ＭＰＤＵにＰＬＣＰプリアンブル（ｐｒｅａｍｂｌｅ）、ＰＬＣＰヘッダ（ｈｅａｄｅｒ）、データフィールド上に必要なテールビット（Ｔａｉｌ　Ｂｉｔｓ）などになることができる。ＰＬＣＰプリアンブルは、ＰＳＤＵ（ＰＬＣＰ　Ｓｅｒｖｉｃｅ　Ｄａｔａ　Ｕｎｉｔ＝ＭＰＤＵ）の送信前に受信機に同期化機能とアンテナダイバーシテ

ィを準備するようにする役割をする。ＰＬＣＰヘッダは、フレームに対する情報、例えば、ＰＳＤＵの長さ（ＰＳＤＵ　Ｌｅｎｇｔｈ　Ｗｏｒｄ；ＰＬＷ）、ＰＳＤＵ部分のデータ速度、ヘッダエラー検査（Ｈｅａｄｅｒ　Ｅｒｒｏｒ　Ｃｈｅｃｋ）情報を含む。

【００１１】

ＰＬＣＰ副階層ではＭＰＤＵに前述したフィールドを付加してＰＰＤＵ（ＰＬＣＰ　Ｐｒｏｔｏｃｏｌ　Ｄａｔａ　Ｕｎｉｔ）を生成し、ＰＭＤ副階層を経て受信ステーションに送信し、受信ステーションは、受信したＰＰＤＵのＰＬＣＰプリアンブル、ＰＬＣＰヘッダからデータ復元に必要な情報を得てデータを復元する。

【００１２】

ＩＥＥＥ８０２．１１ａ／ｂ／ｇ／ｎなど、多様なレガシステーションとＶＨＴステーションが共存する時、ＰＬＣＰフォーマットによってレガシステーションはこれを認識することができない、或いは間違って認識して誤動作することができる。このために、全ての送信データに全てのステーションが認識することができるように、レガシステーションが認識することができるＰＬＣＰフォーマットとＶＨＴステーションのためのフォーマットを加える場合、そのオーバーヘッドが大きくて無線リソースの効率的な活用を阻害する。また、ＭＵ－ＭＩＭＯをサポートする無線ＬＡＮシステムにおける無線フレームがマルチユーザに対する空間多重化（Ｓｐａｔｉａｌ　Ｍｕｌｔｉｐｌｅｘｉｎｇ）されて送信される時、送信対象でないステーションは、これを認識することができないという問題点が発生することができる。併せて、ＭＵ－ＭＩＭＯサポートによるデータ送信及び受信、復号に必要な制御情報の量も増加すると予想される。

【００１３】

ＭＵ－ＭＩＭＯをサポートする無線ＬＡＮシステムにおける制御情報の送信方法、及び増加する制御情報を受け入れ、後方互換性をサポートしてレガシステーションとの共存を保障することができるＶＨＴ無線ＬＡＮシステムのための新たなフレームフォーマットに対する考慮が必要である。

【発明の概要】

【発明が解決しようとする課題】

【００１４】

本発明が解決しようとする一つの課題は、ＭＵ－ＭＩＭＯをサポートする無線ＬＡＮシステムで制御情報の送信方法を提供することである。

【００１５】

本発明が解決しようとする一つの課題は、ＭＵ－ＭＩＭＯをサポートする無線ＬＡＮシステムで制御情報を受け入れてフレームの送信方法を提供することである。

【課題を解決するための手段】

【００１６】

一態様において、無線ＬＡＮシステムにおける制御情報を送信する方法は、第１の制御情報を循環シフト遅延ダイバーシティビーム形成により送信し、及び第２の制御情報を送信することを含み、前記第１の制御情報は、前記第２の制御情報の複数のターゲットステーションの各々が前記第２の制御情報の受信に必要な情報を含み、前記第２の制御情報は、ビーム形成され、前記複数のターゲットステーションに送信される。

【００１７】

前記第１の制御情報は、前記複数のターゲットステーションに対して空間多重化されたＳＤＭＡ（ｓｐａｔａｉｌ　ｄｉｖｉｓｉｏｎ　ｍｕｌｔｉｐｌｅ　ａｃｃｅｓｓ）データの送信に所要される送信時間情報をさらに含む。

【００１８】

前記第２の制御情報は、前記複数のターゲットステーションの各々に対する制御情報を含む。

【００１９】

前記複数のターゲットステーションの各々に対する前記制御情報は、ＭＣＳ（ｍｏｄｕｌａｔｉｏｎ　ａｎｄ　ｃｏｄｉｎｇ　ｓｃｈｅｍｅ）情報、チャネル帯域幅情報、空間

ストリーム（ｓｐａｔｉａｌ　ｓｔｒｅａｍ）個数情報、送信パワー情報のうち少なくともいずれか一つである。

【００２０】

前記第１の制御情報及び前記第２の制御情報は、第１のフレームを介して送信され、前記第２の制御情報は、前記第１のフレームの以後に送信される一つ以上の第２のフレーム送信に所要される送信時間情報をさらに含む。

【００２１】

前記第１の制御情報の送信に割り当てられるＯＦＤＭ（Ｏｒｔｈｏｇｏｎａｌ　Ｆｒｅｑｕｅｎｃｙ　Ｄｉｖｉｓｉｏｎ　Ｍｕｌｔｉｐｌｅｘｉｎｇ）シンボル当たり副搬送波の個数は、前記第２の制御情報の送信に割り当てられるＯＦＤＭシンボル当たり副搬送波の個数より小さい。

【００２２】

前記共用制御情報の送信に割り当てられるＯＦＤＭシンボルの個数は、前記ＳＴＡ－特定制御情報の送信に割り当てられるＯＦＤＭシンボルの個数より多い。

【００２３】

前記第１の制御情報と前記第２の制御情報は、互いに異なる循環シフトが適用される。

【発明の効果】

【００２４】

ＭＵ－ＭＩＭＯをサポートする無線ＬＡＮシステムに適用されることができる制御情報送信方法及びＰＬＣＰフレームフォーマットを提供し、後方互換性をサポートしてＶＨＴステーションとレガシステーションの共存を保障する。

【図面の簡単な説明】

【００２５】

【図１】本発明の実施例が適用されることができる無線ＬＡＮシステムの一例を示す。

【図２】既存ＰＬＣＰフレームフォーマットの例を示す。

【図３】本発明の実施例に係るＰＬＣＰフレームフォーマットの一例を示すブロック図である。

【図４】本発明によるＶＨＴシステムに適用されるＰＬＣＰフレームの一例を示す。

【図５】ＶＨＴＳＩＧ－ＡとＶＨＴＳＩＧ－Ｂの送信に使用するリソースの割当を示す。

【図６】ＶＨＴＳＩＧ－Ａのためのｂｐｓｋコンステレイションの一例を示す。

【図７】本発明の一実施例に係る制御情報送信方法を示すフローチャートである。

【図８】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図９】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１０】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１１】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１２】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１３】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１４】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１５】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１６】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。

【図１７】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロッ

ク図である。
【図１８】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図１９】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２０】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２１】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２２】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２３】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２４】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２５】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２６】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２７】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２８】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図２９】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３０】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３１】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３２】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３３】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３４】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３５】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３６】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３７】本発明の実施例に係るＰＬＣＰフレーム構造及び送信方法の一例を示すブロック図である。
【図３８】本発明の実施例が具現される無線装置の他の一例を示すブロック図である。
【発明を実施するための形態】
【００２６】
以下、図面を参照して本発明の実施例に対して詳細に説明する。
【００２７】
図１は、本発明の実施例が適用されることができる無線ＬＡＮシステムの一例を示す。
【００２８】
図１を参照すると、無線ＬＡＮシステムは、一つまたはその以上の基本サービスセット（Ｂａｓｉｃ　Ｓｅｒｖｉｃｅ　Ｓｅｔ；ＢＳＳ）を含む。ＢＳＳは、成功的に同期化を

行って互いに通信することができるステーション（Ｓｔａｔｉｏｎ；ＳＴＡ）の集合であり、特定領域を意味するものではない。また、本発明の実施例が適用されることができる無線ＬＡＮシステムのように、ＭＡＣ　ＳＡＰでＩＧＨｚ以上の超高速データ処理をサポートするＢＳＳをＶＨＴ（Ｖｅｒｙ　Ｈｉｇｈ　Ｔｈｒｏｕｇｈｐｕｔ）ＢＳＳという。

【００２９】

ＶＨＴ　ＢＳＳもインフラストラクチャＢＳＳ（ｉｎｆｒａｓｔｒｕｃｔｕｒｅ　ＢＳＳ）と独立ＢＳＳ（Ｉｎｄｅｐｅｎｄｅｎｔ　ＢＳＳ；ＩＢＳＳ）に区分し、図１にはインフラストラクチャＢＳＳが図示されている。インフラストラクチャＢＳＳ（ＢＳＳ１、ＢＳＳ２）は、一つまたはその以上のＮｏｎ－ＡＰ　ＳＴＡ（ＳＴＡ１、ＳＴＡ３、ＳＴＡ４）、分配サービス（Ｄｉｓｔｒｉｂｕｔｉｏｎ　Ｓｅｒｖｉｃｅ）を提供するステーションであるアクセスポイント（ＡＰ１（ＳＴＡ２）、ＡＰ２（ＳＴＡ５））、及び複数のアクセスポイント（ＡＰ１、ＡＰ２）を連結させる分配システム（Ｄｉｓｔｒｉｂｕｔｉｏｎ　Ｓｙｓｔｅｍ；ＤＳ）を含む。インフラストラクチャＢＳＳではＡＰ　ＳＴＡがＢＳＳのＮｏｎ－ＡＰ　ＳＴＡを管理する。

【００３０】

反面、独立ＢＳＳはアドホックモードに動作するＢＳＳである。ＩＢＳＳは、ＡＰ　ＶＨＴ　ＳＴＡを含まないため、中央で管理機能を遂行するエンティティ（Ｃｅｎｔｒａｌｉｚｅｄ　Ｍａｎａｇｅｍｅｎｔ　Ｅｎｔｉｔｙ）がない。即ち、ＩＢＳＳではＮｏｎ－ＡＰ　ＳＴＡが分散された方式（ｄｉｓｔｒｉｂｕｔｅｄ　ｍａｎｎｅｒ）に管理される。ＩＢＳＳでは全てのＳＴＡが移動ステーションからなることができ、ＤＳへの接続が許容されないため、自己完備的ネットワーク（ｓｅｌｆ－ｃｏｎｔａｉｎｅｄ　ｎｅｔｗｏｒｋ）を構築する。

【００３１】

ＳＴＡは、ＩＥＥＥ８０２．１１標準の規定による媒体接続制御（Ｍｅｄｉｕｍ　Ａｃｃｅｓｓ　Ｃｏｎｔｒｏｌ；ＭＡＣ）と無線媒体に対する物理層（Ｐｈｙｓｉｃａｌ　Ｌａｙｅｒ）インターフェースを含む任意の機能媒体であり、広義ではＡＰと非ＡＰステーション（Ｎｏｎ－ＡＰ　Ｓｔａｔｉｏｎ）を含む。また、後述のような多重チャネル環境でＩＧＨｚ以上の超高速データ処理をサポートするＳＴＡをＶＨＴ　ＳＴＡという。本発明の実施例が適用されることができるＶＨＴ無線ＬＡＮシステムでは、前記ＢＳＳに含まれるＳＴＡは全部ＶＨＴ　ＳＴＡであり、或いはＶＨＴ　ＳＴＡとレガシＳＴＡ（例えば、ＩＥＥＥ８０２．１１ａ／ｂ／ｇ／ｎによるＨＴ　ＳＴＡ）が共存することができる。

【００３２】

無線通信のためのＳＴＡは、プロセッサ（Ｐｒｏｃｅｓｓｏｒ）とトランシーバ（ｔｒａｎｓｃｅｉｖｅｒ）を含み、ユーザインターフェースとディスプレイ手段などを含むことができる。プロセッサは、無線ネットワークを介して送信するフレームを生成したり、或いは前記無線ネットワークを介して受信されたフレームを処理するように考案された機能ユニットであり、ＳＴＡを制御するための多様な機能を遂行する。また、トランシーバは、前記プロセッサと機能的に連結されており、ステーションのために無線ネットワークを介してフレームを送受信するように考案されたユニットである。

【００３３】

ＳＴＡのうちユーザが操作する携帯用端末は、Ｎｏｎ－ＡＰ　ＳＴＡ（ＳＴＡ１、ＳＴＡ３、ＳＴＡ４、ＳＴＡ５）であり、単にＳＴＡとする時はＮｏｎ－ＡＰ　ＳＴＡを意味する。Ｎｏｎ－ＡＰ　ＳＴＡは、端末（ｔｅｒｍｉｎａｌ）、無線送受信ユニット（Ｗｉｒｅｌｅｓｓ　Ｔｒａｎｓｍｉｔ／Ｒｅｃｅｉｖｅ　Ｕｎｉｔ；ＷＴＲＵ）、ユーザ装備（Ｕｓｅｒ　Ｅｑｕｉｐｍｅｎｔ；ＵＥ）、移動局（Ｍｏｂｉｌｅ　Ｓｔａｔｉｏｎ；ＭＳ）、携帯用端末（Ｍｏｂｉｌｅ　Ｔｅｒｍｉｎａｌ）、または移動スクライバユニット（Ｍｏｂｉｌｅ　Ｓｕｂｓｃｒｉｂｅｒ　Ｕｎｉｔ）など、他の名称と呼ばれることもある。また、後述のようなＭＵ－ＭＩＭＯ技術に基づいて超高速データ処理をサポートするＮｏｎ－ＡＰ　ＳＴＡをＮｏｎ－ＡＰ　ＶＨＴ　ＳＴＡまたは簡単にＶＨＴ　ＳＴＡという。

【００３４】
また、ＡＰ（ＡＰ１、ＡＰ２）は、自体に結合されたＳＴＡ（Ａｓｓｏｃｉａｔｅｄ Ｓｔａｔｉｏｎ）のために無線媒体を経由してＤＳに対する接続を提供する機能エンティティである。ＡＰを含むインフラストラクチャＢＳＳで非ＡＰ ＳＴＡ間の通信は、ＡＰを経由して行われることが原則であるが、ダイレクトリンク（ｄｉｒｅｃｔ ｌｉｎｋ）が設定された場合には非ＡＰ ＳＴＡ（ｎｏｎ－ＡＰ ＳＴＡ）間でも直接通信が可能である。ＡＰは、アクセスポイントという名称外に集中制御器、基地局（Ｂａｓｅ Ｓｔａｔｉｏｎ；ＢＳ）、ノードＢ、ＢＴＳ（Ｂａｓｅ Ｔｒａｎｓｃｅｉｖｅｒ Ｓｙｓｔｅｍ）、またはサイト制御器などと呼ばれることもある。また、後述のようなＭＵ－ＭＩＭＯ技術に基づいて超高速データ処理をサポートするＡＰをＶＨＴ ＡＰという。

【００３５】
複数のインフラストラクチャＢＳＳは、分配システム（Ｄｉｓｔｒｉｂｕｔｉｏｎ Ｓｙｓｔｅｍ；ＤＳ）を介して相互連結されることができる。ＤＳを介して連結された複数のＢＳＳを拡張サービスセット（Ｅｘｔｅｎｄｅｄ Ｓｅｒｖｉｃｅ Ｓｅｔ；ＥＳＳ）という。ＥＳＳに含まれるＳＴＡは互いに通信することができ、同じＥＳＳ内で非ＡＰ ＳＴＡはシームレス通信しつつ一つのＢＳＳから他のＢＳＳに移動することができる。

【００３６】
ＤＳは、一つのＡＰが他のＡＰと通信するためのメカニズムであり、これによると、ＡＰは、自体が管理するＢＳＳに結合されているＳＴＡのためにフレームを送信したり、或いはいずれか一つのＳＴＡが他のＢＳＳに移動した場合、フレームを伝達したり、有線ネットワークなどのような外部ネットワークとフレームを伝達することができる。このようなＤＳは、必ずネットワークである必要はなく、ＩＥＥＥ８０２．１１に規定された所定の分配サービスを提供することができれば、その形態に対しては何らの制限がない。例えば、ＤＳは、メッシュネットワークのような無線ネットワークであってもよく、ＡＰを互いに連結させる物理的な構造物であってもよい。

【００３７】
一方、ＶＨＴ無線ＬＡＮシステムは、複数のＳＴＡが効率的に同時に無線チャネルを使用するためにＭＵ－ＭＩＭＯを使用する。言い換えれば、同時に複数のＳＴＡがＡＰと送受信することを許容する。ＡＰは、空間多重化された無線フレームを複数のＳＴＡに同時に送信することができる。このためにチャネル状況を測定してビーム形成を実行し、複数の空間ストリーム（ｓｐａｔｉａｌ ｓｔｒｅａｍ）を用いてデータを送受信することができる。

【００３８】
以下、データを複数のＳＴＡに対して空間多重化して送信することをＭＵ－ＭＩＭＯ送信またはＳＤＭＡ送信という。ＭＵ－ＭＩＭＯ送信において送信対象となるＳＴＡの各々に対し、少なくとも一つの空間ストリーム（ｓｐａｔｉａｌ ｓｔｒｅａｍ）が割り当てられ、割り当てられた空間ストリームを用いてデータが送信されることができる。

【００３９】
以下、ＶＨＴ ＳＴＡを除いた従来のＳＴＡ（ｎｏｎ－ＶＨＴ ＳＴＡ）をレガシ（ｌｅｇａｃｙ）ＳＴＡという。レガシＳＴＡは、ＩＥＥＥ８０２．１１ａ／ｂ／ｇ標準をサポートするｎｏｎ－ＨＴ ＳＴＡ、ＩＥＥＥ８０２．１１ｎ標準をサポートするＨＴ ＳＴＡを含む。以下、本発明が提案する多様なＰＬＣＰフレームフォーマットで同じ名称で呼ばれる各フィールドの機能は、特別な言及がない場合には明細書の全範囲内で同じである。

【００４０】
本発明が提案するＰＬＣＰフレームフォーマットによるＰＬＣＰフレームは、ＳＴＡのＰＬＣＰ副階層で生成され、ＰＭＤ副階層を経て多重アンテナを用いて本発明が提案するＰＬＣＰフレーム送信方式に送信ターゲットＳＴＡに送信される。以下、図面を参照して記述されるＰＬＣＰフレームフォーマット及び構成するフィールドの送信方法は、本発明の多様な実施例の一例であり、フィールドの送信順序は図面に示されたことに限定されず

、以下の技術でその送信順序を特定しない限り、その順序を異なるようにすることができ、一部フィールドが省略されたり、或いは必要によって追加されることができる。以下のＰＬＣＰフレームフォーマット及びその送信方法は、ＢＳＳを構成するＳＴＡの種類及び数、送信すべきデータの量、優先順位などによって適応的に選択されて使われることができる。

【００４１】

図２は、既存ＰＬＣＰフレームフォーマットの例を示す。これは２００９年６月に開示されたＩＥＥＥ８０２．１１ｎ／Ｄ１１．０“Ｐａｒｔ １１：Ｗｉｒｅｌｅｓｓ ＬＡＮ Ｍｅｄｉｕｍ Ａｃｃｅｓｓ Ｃｏｎｔｒｏｌ（ＭＡＣ） ａｎｄ Ｐｈｙｓｉｃａｌ Ｌａｙｅｒ（ＰＨＹ） ｓｐｅｃｉｆｉｃａｔｉｏｎｓ；Ａｍｅｎｄｍｅｎｔ５：Ｅｎｈａｎｃｅｍｅｎｔｓ ｆｏｒ Ｈｉｇｈｅｒ Ｔｈｒｏｕｇｈｐｕｔ”の２０．３節を参照することができる。

【００４２】

ＩＥＥＥ８０２．１１ｎ標準は、Ｎｏｎ－ＨＴフォーマット、ＨＴ－ｍｉｘｅｄフォーマット、ＨＴ－ｇｒｅｅｎｆｉｅｌｄフォーマットという三つの類型のＰＬＣＰ（Ｐｈｙｓｉｃａｌ Ｌａｙｅｒ Ｃｏｎｖｅｒｇｅｎｃｅ Ｐｒｏｔｏｃｏｌ）フレームを提供する。ＰＬＣＰフレームは、ＰＰＤＵ（ＰＬＣＰ Ｐｒｏｔｏｃｏｌ Ｄａｔａ Ｕｎｉｔ）の送信に使われる。

【００４３】

ＰＬＣＰフレームに含まれる要素（ｅｌｅｍｅｎｔ）は、次の表のとおりである。

【００４４】

【表１】

要素	説明
Ｌ－ＳＴＦ(Ｎｏｎ－ＨＴ Ｓｈｏｒｔ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ)	フレームタイミング獲得(ｆｒａｍｅ ｔｉｍｉｎｇ ａｃｑｕｉｓｉｔｉｏｎ)、ＡＧＣ(ａｕｔｏｍａｔｉｃ ｇａｉｎ ｃｏｎｔｒｏｌ)コンバージェンスに使用
Ｌ－ＬＴＦ(Ｎｏｎ－ＨＴ Ｌｏｎｇ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ)	チャネル推定に使用
Ｌ－ＳＩＧ(Ｎｏｎ－ＨＴ ＳＩＧＮＡＬ ｆｉｅｌｄ)	Ｌ－ＳＴＡ用データを復調及びデコーディングするための情報を含む
ＨＴ－ＳＩＧ(ＨＴ ＳＩＧＮＡＬ ｆｉｅｌｄ)	ＨＴ－ＳＴＡがデータを復調及びデコーディングするための情報を含む
ＨＴ－ＳＴＦ(ＨＴ Ｓｈｏｒｔ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ)	フレームタイミング獲得(ｆｒａｍｅ ｔｉｍｉｎｇ ａｃｑｕｉｓｉｔｉｏｎ)、ＡＧＣ(ａｕｔｏｍａｔｉｃ ｇａｉｎ ｃｏｎｔｒｏｌ)コンバージェンスに使用
ＨＴ－ＧＦ－ＳＴＦ(ＨＴ－ｇｒｅｅｎｆｉｅｌｄ Ｓｈｏｒｔ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ)	フレームタイミング獲得(ｆｒａｍｅ ｔｉｍｉｎｇ ａｃｑｕｉｓｉｔｉｏｎ)、ＡＧＣ(ａｕｔｏｍａｔｉｃ ｇａｉｎ ｃｏｎｔｒｏｌ)コンバージェンスに使用(ＨＴ ＳＴＡのみが読み込むことができる)
ＨＴ－ＬＴＦ１(Ｆｉｒｓｔ ＨＴ Ｌｏｎｇ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ)	チャネル推定に使用
ＨＴ－ＬＴＦ(ＨＴ Ｌｏｎｇ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ)	ＨＴ－ＳＴＡ用データ復調のためのチャネル推定に使われるデータＨＴ－ＬＴＦとチャネルサウンディングに使われる拡張(ｅｘｔｅｎｓｉｏｎ)ＨＴ－ＬＴＦがある。
ｄａｔａ ｆｉｅｌｄ	ＰＳＤＵ(ＰＨＹ Ｓｅｒｖｉｃｅ Ｄａｔａ Ｕｎｉｔ)を含む

【００４５】

Ｎｏｎ－ＨＴフォーマットは、Ｌ－ＳＴＡにより使われ、Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧを含む。

【００４６】

ＨＴ－ｍｉｘｅｄフォーマットは、ＨＴ－ＳＴＡとＬ－ＳＴＡが共存する時に使われる。Ｌ－ＳＴＡに後方互換性を提供するために、Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、及びＬ－ＳＩＧが最初に順次送信される。ＨＴ－ＳＩＧは、ＨＴ－ＳＴＡがデータのデコーディングに使用する。

【００４７】

ＨＴ－ｇｒｅｅｎｆｉｅｌｄフォーマットは、ＨＴ－ＳＴＡのみで構成されたシステムで使われる。即ち、このフォーマットは、Ｌ－ＳＴＡが受信することができない。

【００４８】

Ｌ－ＳＴＦ、ＨＴ－ＳＴＦ、ＨＴ－ＧＦ－ＳＴＦのようなＳＴＦ（Ｓｈｏｒｔ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ）は、フレームタイミング獲得（ｆｒａｍｅ ｔｉｍｉｎｇ ａｃｑｕｉｓｉｔｉｏｎ）、ＡＧＣ（ａｕｔｏｍａｔｉｃ ｇａｉｎ ｃｏｎｔｒｏｌ）制御などに使われるため、同期信号または同期チャネルとも呼ばれる。即ち、ＳＴＦは、ＳＴＡ間またはＳＴＡとＡＰとの間の同期を合わせるために使われる。

【００４９】

Ｌ－ＬＴＦ、ＨＴ－ＬＴＦのようなＬＴＦ（Ｌｏｎｇ Ｔｒａｉｎｉｎｇ ｆｉｅｌｄ）は、データ及び／または制御情報の復調のためのチャネル推定に使われるため、基準信号、トレーニング信号（ｔｒａｉｎｉｎｇ ｓｉｇｎａｌ）またはプリアンブル（ｐｒｅａｍｂｌｅ）とも呼ばれる。

【００５０】

Ｌ－ＳＩＧ、ＨＴ－ＳＩＧは、データのデコーディングに必要な多様な情報を提供するため、制御情報とも呼ばれる。

【００５１】

図３は、本発明の実施例に係るＰＬＣＰフレームフォーマットの一例を示すブロック図である。

【００５２】

ＶＨＴ ＰＬＣＰフレーム３００は、ＶＨＴＳＩＧ－Ａフィールド３３０、ＶＨＴＳＩＧ－Ｂフィールド３４０、データフィールド３６０を含む。ＶＨＴＳＩＧ－Ａフィールド３３０、ＶＨＴＳＩＧ－Ｂフィールド３４０には受信ＳＴＡがデータフィールド３６０を復調（ｄｅｍｏｄｕｌａｔｉｏｎ）とデコーディング（ｄｅｃｏｄｉｎｇ）に必要な制御情報が含まれる。ＶＨＴＳＩＧ－Ａフィールド３３０、ＶＨＴＳＩＧ－Ｂフィールド３４０の名称は任意であり、各々、第１の制御情報と第２の制御情報、または第１の制御信号と第２の制御信号などで多様に表現されることができる。

【００５３】

ＶＨＴＳＩＧ－Ａフィールド３３０には、以後送信されるフィールドのＭＵ－ＭＩＭＯ送信に対する共通情報が含まれる。ＶＨＴＳＩＧ－Ａフィールド３３０には、ＢＳＳ内の全てのＳＴＡがこれを受信することができるように送信されることができる。ＶＨＴＳＩＧ－Ａフィールド３３０には、以後送信されるＶＨＴＳＩＧ－Ｂフィールド３４０のターゲットＳＴＡに関する情報、ＶＨＴＳＩＧ－Ｂフィールド３４０の受信に必要な情報が含まれることができる。ターゲットＳＴＡに対するデータ送信において共通情報がさらに含まれることができ、例えば、使われるチャネル帯域幅情報、変調及びコーディング情報、使われる空間ストリーム個数に関する情報とともにＳＤＭＡ送信時間（ＳＤＭＡ ｔｒａｎｓｍｉｓｓｉｏｎ ｔｉｍｅ）を指示する情報が含まれることができる。ＳＤＭＡ送信時間は、複数のステーションに対して空間多重化されたデータフレームであるＳＤＭＡ（Ｓｐａｔｉａｌ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅ Ａｃｃｅｓｓ）データが送信される時間であり、ＭＵ－ＭＩＭＯ送信時間といえる。送信対象以外のＳＴＡは、ＳＤＭＡ送信時間を指示する情報を受信し、該当送信期間中ネットワーク割当ベクトル（Ｎｅｔｗｏｒｋ Ａｌｌｏｃａｔｉｏｎ Ｖｅｃｔｏｒ；ＮＡＶ）を設定し、チャネル接近（ｃｈａｎｎｅｌ ａｃｃｅｓｓ）を延期（ｄｅｆｅｒ）することができる。

【００５４】

ＶＨＴ－ＳＩＧＢフィールド３４０には、各々の送信対象ＳＴＡ別にＳＤＭＡ送信のた

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めに使われるパラメータ値が含まれる。一例として使われたＭＣＳ（Ｍｏｄｕｌａｔｉｏｎ ａｎｄ Ｃｏｄｉｎｇ Ｓｃｈｅｍｅ）を指示するＭＣＳインデックス値、チャネルの帯域幅、空間ストリーム（ｓｐａｔｉａｌ ｓｔｒｅａｍ）の個数を指示する値など、個別ＳＴＡによって異なるように設定されることができるパラメータ値の情報が含まれることができる。

【００５５】

データフィールド３６０は、送信対象ＳＴＡに送信されるＳＤＭＡプリコーディングされたデータを含み、必要によってテールビット（ｔａｉｌ ｂｉｔｓ）及び／またはビットパディング（Ｂｉｔ Ｐａｄｄｉｎｇ）要素をさらに含むことができる。

【００５６】

ＶＨＴ ＰＬＣＰフレーム３００は、必要によって、フレームタイミング獲得とＡＧＣ（ａｕｔｏｍａｔｉｃ ｇａｉｎ ｃｏｎｔｒｏｌ）コンバージェンス（ｃｏｎｖｅｒｇｅｎｃｅ）、ダイバーシティ（ｄｉｖｅｒｓｉｔｙ）選択のための情報、チャネル推定（ｃｈａｎｎｅｌ ｅｓｔｉｍａｔｉｏｎ）のための情報を含んでいる一つまたは複数のフィールドをさらに含むことができる。前述した一つまたは複数のフィールドは、レガシＳＴＡ及びＨＴ ＳＴＡが認識することができるフォーマットであってもよく、レガシＳＴＡ及びＨＴ ＳＴＡが認識することができるフォーマットのフィールドがさらに付加されたものであってもよい。

【００５７】

ＶＨＴ ＰＬＣＰフレーム３００を送信する送信ステーションは、ＶＨＴＳＩＧ－Ａフィールド３３０をＳＤＭＡプリコーディング無しに全方向送信（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎａｌ ｔｒａｎｓｍｉｓｓｉｏｎ）し、ＶＨＴＳＩＧ－Ｂフィールド３４０と以後送信されるデータフィールド３６０などは、ＳＤＭＡプリコーディングを適用し、ビーム形成（ｂｅａｍｆｏｒｍｉｎｇ）して送信する。本発明において、全方向に信号を送信することは、時間領域で循環遅延ダイバーシティ（ｃｙｃｌｉｃ ｄｅｌａｙ ｄｉｖｅｒｓｉｔｙ）ビーム形成（ｂｅａｍ－ｆｏｒｍｉｎｇ）を用いた信号の送信である。この時、各々の送信アンテナに送信される信号は、他の送信アンテナのＯＦＤＭシンボル範囲内の時間領域循環シフトされた信号（ｔｉｍｅ ｄｏｍａｉｎ ｃｙｃｌｉｃ ｓｈｉｆｔｅｄ ｓｉｇｎａｌｓ）である。

【００５８】

ＢＳＳのＳＴＡは、ＳＤＭＡプリコーディング無しに全方向送信されるＶＨＴＳＩＧ－Ａフィールド３３０を受信し、送信対象に該当しないＳＴＡは、ＶＨＴＳＩＧ－Ａフィールド３３０に含まれたＳＤＭＡ送信時間情報が指示する期間中ＮＡＶを設定し、チャネル接近（ｃｈａｎｎｅｌ ａｃｃｅｓｓ）を延期（ｄｅｆｅｒ）することができる。送信対象に該当するＳＴＡは、ＶＨＴＳＩＧ－Ｂフィールド３４０で自体に個別化された情報を得て自体に送信されるデータを受信、復調（ｄｅｍｏｄｕｌａｔｉｏｎ）、デコーディング（ｄｅｃｏｄｉｎｇ）することができる。

【００５９】

図４は、本発明によるＶＨＴシステムに適用されるＰＬＣＰフレームの一例を示す。

【００６０】

ＰＬＣＰフレームは、Ｌ－ＳＴＦ４１０、Ｌ－ＬＴＦ４２０、Ｌ－ＳＩＧ４３０、ＶＨＴＳＩＧ－Ａ４４０、ＶＨＴ－ＳＴＦ４５０、ＶＨＴ－ＬＴＦ４６０、ＶＨＴＳＩＧ－Ｂ４７０、及びデータ４８０を含む。

【００６１】

Ｌ－ＳＴＦ４１０は、フレームタイミング獲得（ｆｒａｍｅ ｔｉｍｉｎｇ ａｃｑｕｉｓｉｔｉｏｎ）、ＡＧＣ（ａｕｔｏｍａｔｉｃ ｇａｉｎ ｃｏｎｔｒｏｌ）制御、粗い（ｃｏａｒｓｅ）周波数獲得などに使用する。

【００６２】

Ｌ－ＬＴＦ４２０は、Ｌ－ＳＩＧ４３０及びＶＨＴＳＩＧ－Ａ４４０の復調のためのチャネル推定に使用する。

【００６３】
ＶＨＴ－ＳＴＦ４５０は、ＭＩＭＯシステムでＶＨＴ－ＳＴＡがＡＧＣ推定を向上させるために使用する。
【００６４】
ＶＨＴ－ＬＴＦ４６０は、複数個で構成され、ＶＨＴＳＩＧ－Ｂ４７０とデータ４８０の復調のためのチャネル推定に使われる。これをデータＶＨＴ－ＬＴＦと呼ばれることもある。追加的に、チャネルサウンディングのための拡張ＶＨＴ－ＬＴＦが使われることができる。
【００６５】
Ｌ－ＳＴＦ４１０、Ｌ－ＬＴＦ４２０、Ｌ－ＳＩＧ４３０、及びＶＨＴＳＩＧ－Ａ４４０には、ビーム形成（ｂｅａｍ－ｆｏｒｍｉｎｇ）が適用されない。これに比べて、ＶＨＴ－ＳＴＦ４５０、ＶＨＴ－ＬＴＦ４６０、ＶＨＴＳＩＧ－Ｂ４７０、及びデータ４８０には、ＭＵ－ＭＩＭＯのためのビーム形成（ｂｅａｍ－ｆｏｒｍｉｎｇ）が適用される。ビーム形成は、各フィールドが同じプリコーディング行列（またはプリコーディングベクトル）を介して処理されることである。データ４８０とＶＨＴ－ＬＴＦ４６０が同じプリコーディング行列で処理されるため、ＶＨＴ－ＳＴＡは、プリコーディング行列を知っていなくてもＶＨＴ－ＬＴＦ４６０で推定したチャネルを介してデータ４８０を直接復調またはデコーディングすることができる。
【００６６】
ＰＬＣＰフレーム内でビーム形成されない領域とビーム形成される領域には、互いに異なる循環シフト（ｃｙｃｌｉｃ　ｓｈｉｆｔ）が適用されることができる。即ち、Ｌ－ＳＴＦ４１０、Ｌ－ＬＴＦ４２０、Ｌ－ＳＩＧ４３０、及びＶＨＴＳＩＧ－Ａ４４０には、第１の循環シフトが適用され、ＶＨＴ－ＳＴＦ４５０、ＶＨＴ－ＬＴＦ４６０、ＶＨＴＳＩＧ－Ｂ４７０には、第２の循環シフトが適用されることができる。
【００６７】
循環シフトは、各ＯＦＤＭシンボルに対して適用されることができる。また、循環シフトは、各送信チェーン別に与えられることができる。
【００６８】
例えば、循環シフト量（ａｍｏｕｎｔ）T_{cs}を区間$0 \leq t \leq T$の信号ｓ（ｔ）に適用するとする時、循環シフトされる信号s_{cs}（ｔ）は、次のように定義されることができる。
【００６９】
【数１】

$$s_{cs}(t;T_{cs})=\begin{cases} s(t-T_{cs}) & 0 \leq t < T+T_{cs} \\ s(t-T_{cs}-T) & T+T_{cs} \leq t \leq T \end{cases}$$

【００７０】
ビーム形成を介してデータ４８０に含まれる各ＰＳＤＵは、各ＳＴＡに送信される。
【００７１】
ＶＨＴ－ＳＴＡのためには、ＶＨＴＳＩＧ－Ａ４４０及びＶＨＴＳＩＧ－Ｂ４７０という２のの制御情報がＰＬＣＰフレームに含まれる。ＶＨＴＳＩＧ－Ａ４４０は、ＶＨＴＳＩＧ－Ｂ４７０を各ＳＴＡが受信することができるようにするための共用制御情報（または、第１の制御情報という）である。ＶＨＴＳＩＧ－Ｂ４７０は、各ＳＴＡが自体のデータ４８０を復調及び／またはデコーディングするためのＳＴＡ－特定（ＳＴＡ－ｓｐｅｃｉｆｉｃ）制御情報（または第２の制御情報という）である。
【００７２】
共用制御情報には、次のフィールドのうち少なくとも一つが含まれることができる。
【００７３】

【表２】

フィールド名	説明
ＳＩＧ－Ｂ長さ	ＶＨＴＳＩＧ－Ｂの長さを示す
ＭＵ－ＭＩＭＯ指示子	ＭＵ－ＭＩＭＯが使われかどうかを示す。または、ＳＵ－ＭＩＭＯ/ＭＵ－ＭＩＭＯをトグル（ｔｏｇｇｌｅ）することができる。
帯域幅	チャネルの帯域幅を示す
ＳＴＡ指示子	ＶＨＴＳＩＧ－Ｂを受信するＳＴＡを示す。ＳＴＡの住所を示したり、或いはＳＴＡのＩＤ、ＶＨＴＳＩＧ－Ｂのインデックスを示すことができる。
多重化個数	ＭＵ－ＭＩＭＯで多重化されるＳＴＡ（またはユーザ）の数
デコーディング指示子	ＶＨＴＳＩＧ－Ｂをデコーディングするための情報を示す。

【００７４】
ＳＴＡ－特定制御情報（または、ユーザ－特定制御情報という）には、次のフィールドのうち少なくとも一つが含まれることができる。
【００７５】
【表３】

フィールド名	説明
ＭＣＳ	データのデコーディングに必要なＭＣＳ（ｍｏｄｕｌａｔｉｏｎ ａｎｄ ｃｏｄｉｎｇ ｓｃｈｅｍｅ）情報を示す
ＳＴＡ ＩＤ	ＭＣＳを使用するＳＴＡを示す

【００７６】
前記表２及び表３でフィールド名は例示に過ぎず、他の名称が使われることができる。表２及び表３のフィールドは例示に過ぎず、あるフィールドは省略可能であり、他のフィールドがさらに追加されることができる。
【００７７】
図５は、ＶＨＴＳＩＧ－ＡとＶＨＴＳＩＧ－Ｂの送信に使用するリソースの割当を示す。
【００７８】
２０ＭＨｚの帯域幅を使用するとする時、ビーム形成が使われないＬ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧ、ＶＨＴＳＩＧ－Ａは、Ｌ－ＳＴＡをサポートするためにＯＦＤＭ（Ｏｒｔｈｏｇｏｎａｌ Ｆｒｅｑｕｅｎｃｙ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅｘｉｎｇ）シンボル当たり５２個の副搬送波（これを狭帯域（ｎａｒｒｏｗｂａｎｄ；ＮＢ）副搬送波という）を使用する。５２個のＮＢ副搬送波は、４８個のデータＮＢ副搬送波と４個のパイロットＮＢ副搬送波に分けられる。
【００７９】
ビーム形成が使われるＶＨＴ－ＬＴＦ、ＶＨＴＳＩＧ－Ｂは、ＯＦＤＭシンボル当たり５６個の副搬送波（これを広帯域（ｗｉｄｅｂａｎｄ；ＷＢ）副搬送波という）を使用する。５６個のＷＢ副搬送波は、５２個のデータＷＢ副搬送波と４個のパイロットＷＢ副搬送波に分けられる。
【００８０】
Ｌ－ＳＴＡは、２０ＭＨｚ帯域でＯＦＤＭシンボル当たり５２個の副搬送波を使用する。後方互換性を提供するために、ＶＨＴＳＩＧ－Ａは、Ｌ－ＳＴＦ及びＬ－ＬＴＦと同じ個数の副搬送波を使用する。
【００８１】
Ｌ－ＳＴＦは、ＱＰＳＫ（Ｑｕａｄｒａｔｕｒｅ Ｐｈａｓｅ Ｓｈｉｆｔ Ｋｅｙｉｎｇ）変調を使用し、一つのＯＦＤＭシンボルに次のような周波数領域のシーケンスＳで示すことができる。
【００８２】
$S_{-26,26} = K\{0, 0, 1+j, 0, 0, 0, -1-j, 0, 0, 0, 1+j,$

０，０，０，－１－ｊ，０，０，０，－１－ｊ，０，０，０，１＋ｊ，０，０，０，０，０，０，０，－１－ｊ，０，０，０，－１－ｊ，０，０，０，１＋ｊ，０，０，０，１＋ｊ，０，０，０，１＋ｊ，０，０，０，１＋ｊ，０，０｝

ここで、Ｋは、ＱＰＳＫ正規化（ｎｏｒｍａｌｉｚａｔｉｏｎ）ファクタであり、Ｋ＝

【００８３】

【化１】

$$\sqrt{1/2}$$

【００８４】

である。ＤＣ副搬送波は使われない。

【００８５】

Ｌ－ＬＴＦは、一つのＯＦＤＭシンボルに次のような周波数領域のシーケンスＴで示すことができる。

【００８６】

$T_{-26,26}$＝｛１，１，－１，－１，１，１，－１，１，－１，１，１，１，１，１，１，－１，－１，１，１，－１，１，－１，１，１，１，１，０，１，－１，－１，１，１，－１，１，－１，１，－１，－１，－１，－１，－１，１，１，－１，－１，１，－１，１，－１，１，１，１，１｝

Ｌ－ＳＩＧは、ＢＰＳＫ（Ｂｉｎａｒｙ　Ｐｈａｓｅ　Ｓｈｉｆｔ　Ｋｅｙｉｎｇ）変調を使用し、４８個のデータＮＢ副搬送波が割り当てられるため、４８ビットを有することができる。１／２コード率（ｃｏｄｅ　ｒａｔｅ）を有する時、Ｌ－ＳＩＧの情報ビットの数は２４である。

【００８７】

ＶＨＴＳＩＧ－ＡもＢＰＳＫ変調を使用し、４８個のデータＮＢ副搬送波が割り当てられるため、ＯＦＤＭシンボル当たり４８ビットを有することができる。１／２コード率（ｃｏｄｅ　ｒａｔｅ）を有し、２個のＯＦＤＭシンボルが割り当てられると、ＶＨＴＳＩＧ－Ａの情報ビットの数は４８になる。

【００８８】

ＶＨＴＳＩＧ－Ａの検出を容易にするために、ＶＨＴＳＩＧ－ＡのためのＢＰＳＫコンステレイション（ｃｏｎｓｔｅｌｌａｔｉｏｎ）は、Ｌ－ＳＩＧのためのＢＰＳＫコンステレイションを基準に回転されることができる。

【００８９】

図６は、ＶＨＴＳＩＧ－ＡのためのＢＰＳＫコンステレイションの一例を示す。

【００９０】

ＶＨＴＳＩＧ－ＡのためのＢＰＳＫコンステレイション（ｃｏｎｓｔｅｌｌａｔｉｏｎ）は、Ｌ－ＳＩＧのためのＢＰＳＫコンステレイションを基準に９０度ほど回転されたものである。これを回転された（ｒｏｔａｔｅｄ）コンステレイションという。これは例示に過ぎず、回転量は４５度、１８０度等に変わることができ、ＢＰＳＫだけでなく、ＱＰＳＫ、８－ＰＳＫ、１６－ＱＡＭにも同じに適用されることができる。

【００９１】

また、図４を参照すると、ビーム形成が使われるＶＨＴ－ＳＴＦ、ＶＨＴ－ＬＴＦ、ＶＨＴＳＩＧ－Ｂは、Ｌ－ＳＴＡと互換性を維持する必要がなく、周波数効率を上げるためにＯＦＤＭシンボル当たり５６個の副搬送波を使用する。

【００９２】

ＶＨＴ－ＳＴＦは、ＱＰＳＫ（Ｑｕａｄｒａｔｕｒｅ　Ｐｈａｓｅ　Ｓｈｉｆｔ　Ｋｅｙｉｎｇ）変調を使用し、一つのＯＦＤＭシンボルに次のようなシーケンスＶＨＴＳとして定義されることができる。

【００９３】

$VHTS_{-28,28}$＝Ｋ｛０，０，０，０，１＋ｊ，０，０，０，－１－ｊ，０，０，０，１＋ｊ，０，０，０，－１－ｊ，０，０，０，－１－ｊ，０，０，０，１＋ｊ，０

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，０，０，０，０，０，０，－１－ｊ，０，０，０，－１－ｊ，０，０，０，１＋ｊ，０，０，０，１＋ｊ，０，０，０，１＋ｊ，０，０，０，１＋ｊ，０，０，０｝

ここで、Ｋは、ＱＰＳＫ正規化（ｎｏｒｍａｌｉｚａｔｉｏｎ）ファクタであり、Ｋ＝

【００９４】

【化２】

$$\sqrt{1/2}$$

【００９５】

である。

【００９６】

ＶＨＴ－ＬＴＦは、一つのＯＦＤＭシンボルに次のような周波数領域のシーケンスＶＨＴＴで示すことができる。

【００９７】

$VHTT_{-28,28}$＝｛１，１，１，１，－１，－１，１，１，－１，１，－１，１，１，１，１，１，－１，－１，１，１，－１，１，－１，１，１，１，１，０，１，－１，－１，１，１，－１，１，－１，１，－１，－１，－１，－１，－１，１，１，－１，－１，１，－１，１，－１，１，１，１，１，－１，－１｝

ＶＨＴＳＩＧ－Ｂは、ＶＨＴＳＩＧ－Ａと同じ変調、即ち、回転されたＢＰＳＫコンステレイションにマッピングされ、一つのＯＦＤＭシンボルを使用する。ＯＦＤＭシンボル当たり５２個のデータ副搬送波があるため、１／２コード率を有する時、ＶＨＴＳＩＧ－Ｂの情報ビットの数は２６になる。

【００９８】

ＭＵ－ＭＩＭＯをサポートするために、データのデコーディングに必要な制御情報は、ＶＨＴＳＩＧ－ＡとＶＨＴＳＩＧ－Ｂに分けられる。ＶＨＴＳＩＧ－Ａは、チャネル特徴的（ｃｈａｎｎｅｌ　ｓｐｅｃｉｆｉｃ）ビーム形成が使われず、循環遅延シフトされたビーム形成（ｃｙｃｌｉｃ　ｄｅｌａｙ　ｓｈｉｆｔｅｄ　ｂｅａｍ－ｆｏｒｍｉｎｇ）が使われて全方向（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎ）に送信される。ＶＨＴＳＩＧ－Ｂは、ビーム形成されて送信される。

【００９９】

ＶＨＴＳＩＧ－Ａに割り当てられる副搬送波の個数（例、５２個）は、ＶＨＴＳＩＧ－Ｂに割り当てられる副搬送波の個数（例、５６個）より小さい。これはＶＨＴＳＩＧ－Ａに割り当てられる周波数領域リソースがＶＨＴＳＩＧ－Ｂに割り当てられる周波数領域リソースより小さいということを意味する。ＶＨＴＳＩＧ－Ａは、後方互換性を維持するためにＬ－ＬＴＦのチャネル推定を用いてデコーディングされるためである。

【０１００】

ＶＨＴＳＩＧ－Ａに割り当てられるＯＦＤＭシンボルの個数（例、２個）は、ＶＨＴＳＩＧ－Ｂに割り当てられるＯＦＤＭシンボルの個数（例、１個）より多い。これはＶＨＴＳＩＧ－Ａに割り当てられる時間領域リソースがＶＨＴＳＩＧ－Ｂに割り当てられる時間領域リソースより大きいということを意味する。より多いＳＴＡがＭＵ－ＭＩＭＯで多重化されると、一つのＯＦＤＭシンボルのみではＶＨＴＳＩＧ－Ａを送信するのが不十分であるためである。

【０１０１】

２０ＭＨｚ帯域幅でＬ－ＳＴＡとＶＨＴ－ＳＴＡが共存する時、後方互換性を提供する領域と後方互換性を提供しない領域に互いに異なる時間及び／または周波数リソースが割り当てられることができる。後方互換性を提供する領域で送信されるＳＴＦ、ＬＴＦ、及び共用制御情報には、ＢＳＳ内の全てのｎｏｎ－ＡＰ　ＳＴＡ、及びＡＰがサポートする時間／周波数領域が割り当てられる。後方互換性を提供しない領域で送信されるＳＴＦ、ＬＴＦ、及びＳＴＡ－特定制御情報には、ＶＨＴ－ＳＴＡまたはＶＨＴ－ＡＰのみがサポートする時間／周波数領域が割り当てられる。後方互換性を保障することができ、ＭＵ－ＭＩＭＯをサポートするＶＨＴ－ＳＴＡにもより高い周波数効率を提供することができる

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。

【０１０２】

前記構造で、ＶＨＴＳＩＧ－Ａに対する時間領域波形（ｔｉｍｅ　ｄｏｍａｉｎ　ｗａｖｅｆｏｒｍ）は、次の数式のように示すことができる。

【０１０３】

【数２】

$$r_{VHTSIG-A}^{i_{TX}}(t)=\frac{1}{\sqrt{N_{TX}\cdot N_{VHTSIG-A}^{Tone}}}\sum_{n=0}^{1}w_{T_{SYM}}(t-nT_{SYM})\cdot \sum_{k=-26}^{26}(\beta_n\cdot D_{k,n}+p_{n+1}P_k)\exp(j2\pi k\Delta_F(t-nT_{SYM}-T_{GI}-N_{CS}^{i_{TX}}))$$

【０１０４】

β_nは＋１または＋ｊのような位相回転値（ｐｈａｓｅ　ｒｏｔａｔｉｏｎ　ｖａｌｕｅ）である。ここでＶＨＴＳＩＧ－Ａ変調されたシンボルは、ＶＨＴプリアンブル検出を保障することができるように位相回転される。４０、８０、または１６０ＭＨｚのように広い帯域幅をサポートするために、時間領域での２０ＭＨｚ波形は、送信される信号の各２０ＭＨｚ帯域周波数単位に複製される。

【０１０５】

また、ＶＨＴＳＩＧ－Ｂに対する時間領域波形は、次の数式のように示すことができる。

【０１０６】

【数３】

$$r_{VHTSIG-B}^{i_{TX}}(t)=\frac{1}{\sqrt{N_{STS}\cdot N_{VHTSIG-B}^{Tone}}}\sum_{n=0}^{1}w_{T_{SYM}}(t-nT_{SYM})\cdot \sum_{k=-N_{SR}}^{N_{SR}}\sum_{i_{STS}=1}^{N_{STS}}[Q_k]_{i_{TX},i_{STS}}[P_{VHTLTF}]_{i_{STS},1}(D_{k,n}+p_{n+1}P_k)\exp(j2\pi k\Delta_F(t-nT_{SYM}-T_{GI}-N_{CS}^{i_{TX}}))$$

【０１０７】

N_{TX}：送信チェーン（ｔｒａｎｓｍｉｔ　ｃｈａｉｎ）の個数

N_{STS}：時空間ストリーム（ｓｐａｃｅ　ｔｉｍｅ　ｓｔｒｅａｍ）の個数

$N_{CS}^{i_{TX}}$：i_{TX}送信チェーンの循環シフト

$N_{CS}^{i_{STS}}$：i_{STS}時空間ストリームの循環シフト

$N_{VHT-SIGA}^{tone}$：ＶＨＴ－ＳＩＧＡに使われる副搬送波の個数

$N_{VHT-SIGB}^{tone}$：ＶＨＴ－ＳＩＧＢに使われる副搬送波の個数

N_{SR}：ＶＨＴＳＩＧ－Ｂのために使われる送信された信号帯域幅の半分にある副搬送波の個数

β_n：位相回転値（ｐｈａｓｅ　ｒｏｔａｔｉｏｎ　ｖａｌｕｅ）

T_{SYM}：シンボル長さ（ｓｙｍｂｏｌ　ｄｕｒａｔｉｏｎ）

T_{GI}：保護区間長さ（ｇｕａｒｄ　ｉｎｔｅｒｖａｌ　ｄｕｒａｔｉｏｎ）

P_{VHTLTF}：ＶＨＴ－ＬＴＦマッピング行列

$D_{k,n}$、P_n、P_k、Q_k：ＥＥＥ８０２．１１ｎ／Ｄ１１．０の２０．３節で与えられるパラメータ

図４には示していないが、ＰＬＣＰフレームにはＨＴ－ＳＩＧがさらに含まれることができる。ＨＴ－ＳＩＧは、Ｌ－ＳＩＧ以後、またはＶＨＴＳＩＧ－Ａ以後に配置されることができる。ＨＴ－ＳＩＧがさらに含まれると、ＨＴ－ＳＴＦとＨＴ－ＬＴＦもさらに含まれることができる。ＰＬＣＰフレームがＬ－ＳＴＡに後方互換性を提供しない場合、Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧは含まれない。これと関連し、本発明の実施例に係る多様なＰＬＣＰフレームフォーマットは、以後にブロック図と共に詳細に説明する。

【０１０８】
前記実施例では、２０ＭＨｚ帯域幅に対して記述しているが、これは例示に過ぎず、４０ＭＨｚ帯域幅またはその以上の帯域幅に対しても本発明の技術的思想は適用されることができる。また、２０ＭＨｚ帯域幅や４０ＭＨｚ帯域幅を複数個結合した構造にもそのまま適用されることができる。
【０１０９】
４０ＭＨｚ帯域幅でビーム形成が使われないＬ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧ、ＶＨＴＳＩＧ－Ａは、Ｌ－ＳＴＡをサポートするためにＯＦＤＭシンボル当たり１０４個の副搬送波を使用する。ビーム形成が使われるＶＨＴ－ＬＴＦ、ＶＨＴＳＩＧ－Ｂは、ＯＦＤＭシンボル当たり１１２個の副搬送波を使用する。
【０１１０】
４０ＭＨｚ帯域幅でＬ－ＬＴＦは、一つのＯＦＤＭシンボルに次のような周波数領域のシーケンスＴで示すことができる。
【０１１１】
$T_{-58,58}$＝{1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，1，1，－1，－1，1，1，－1，1，1，1，1，0，1，－1，－1，1，1，－1，1，－1，1，－1，－1，－1，－1，－1，1，1，－1，－1，1，－1，1，－1，1，1，1，1，0，0，0，0，0，0，0，0，0，0，0，1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，0，1，－1，－1，1，1，－1，1，－1，1，1，－1，－1，－1，－1，－1，1，1，－1，－1，1，－1，1，－1，1，1，1}
４０ＭＨｚ帯域幅でＶＨＴ－ＬＴＦは、一つのＯＦＤＭシンボルに次のような周波数領域のシーケンスＶＨＴＴで示すことができる。
【０１１２】
$VHTT_{-58,58}$＝{1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，1，1，－1，－1，1，1，－1，1，－1，1，－1，－1，－1，－1，－1，1，1，－1，－1，1，－1，1，－1，1，1，1，1，－1，－1，－1，1，0，0，0，－1，1，1，－1，1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，1，1，－1，－1，1，1，－1，1，－1，1，1，1，1，1，1，－1，－1，1，1，－1，1，－1，1，－1，－1，－1，－1，1，1，－1，1，1，1，1}
図７は、本発明の一実施例に係る制御情報送信方法を示すフローチャートである。
【０１１３】
ＳＴＡまたはＡＰは、共用制御情報を送信する（Ｓ７１０）。共用制御情報は、ビーム形成を使用せずに全方向に送信される。共用制御情報は、以前のＯＦＤＭシンボルで送信されるＬ－ＬＴＦを介して推定されるチャネルを用いてデコーディングされる。
【０１１４】
共用制御情報が送信された後、ＳＴＡまたはＡＰは、ＳＴＡ－特定制御情報を送信する（Ｓ７２０）。ＳＴＡ－特定制御情報は、ビーム形成を用いて特定ＳＴＡ（または、特定ユーザ）に送信される。特定ＳＴＡは、共用制御情報を受信し、ＳＴＡ－特定制御情報を受信するための情報を獲得した後、ビーム形成されて送信されるＳＴＡ－特定制御情報を受信する。ＳＴＡ－特定制御情報は、共用制御情報とＳＴＡ－特定制御情報との間のＯＦＤＭシンボルで送信されるＶＨＴ－ＬＴＦを介して推定されるチャネルを用いてデコーディングされる。
【０１１５】
共用制御情報は、ＢＳＳ内のｎｏｎ－ＡＰ　ＳＴＡ及びＡＰの両方ともが受信すべきであるため、ＢＳＳ内の全てのｎｏｎ－ＡＰ　ＳＴＡ及びＡＰがサポートする時間／周波数領域が割り当てられる。これと比較し、ＳＴＡ－特定制御情報は、特定ＳＴＡまたは特定

ＡＰのみが受信する情報であるため、特定ＳＴＡまたは特定ＡＰがサポートする時間／周波数領域が割り当てられる。従って、後方互換性（ｂａｃｋｗｏｒｄ　ｃｏｍｐａｔｉｂｉｌｔｙ）を保障することができ、ＭＵ－ＭＩＭＯをサポートするＶＨＴ－ＳＴＡにもより高い周波数効率を提供することができる。

【０１１６】

周波数領域で共用制御情報の周波数リソースの大きさは、ＳＴＡ－特定制御情報の周波数リソースの大きさより小さい。例えば、共用制御情報に割り当てられる副搬送波の個数は、ＳＴＡ－特定制御情報に割り当てられる副搬送波の個数より小さい。

【０１１７】

時間領域で共用制御情報の時間リソースの大きさは、ＳＴＡ－特定（ＳＴＡ－ｓｐｅｃｉｆｉｃ）制御情報の時間リソースの大きさより大きい。例えば、共用制御情報に割り当てられるＯＦＤＭシンボルの個数は、ＳＴＡ－特定制御情報に割り当てられるＯＦＤＭシンボルの個数より大きい。

【０１１８】

共用制御情報とＳＴＡ－特定制御情報は、互いに異なる量の循環シフトが適用されることができる。

【０１１９】

前述した制御情報に対する周波数リソースの割当方法、変調方法、送信方法、及び循環シフト（ｃｙｃｌｉｃ　ｓｈｉｆｔ）適用方法は、以下の本発明が提案する多様なＰＬＣＰフレームフォーマットにも同じに適用されることができる。

【０１２０】

図８は、ＰＬＣＰフレーム構造の一例を示す。これは図４のＰＬＣＰフレームでデータが送信される中間部分に中間ＶＨＴ－ＬＴＦを追加することを提案するものである。

【０１２１】

一般的なＷＬＡＮシステムは、インドア（ｉｎｄｏｏｒ）環境を仮定しているが、アウトドア（ｏｕｔｄｏｏｒ）環境で使用する可能性を排除することができない。例えば、大学キャンパス或いは室外駐車場等で無線ＬＡＮを使用することができる。アウトドア環境は、インドア環境よりチャネル変化が激しい。

【０１２２】

ドップラ効果（Ｄｏｐｐｌｅｒ　ｅｆｆｅｃｔ）のみを考慮しても、データの量が多くてデータの送信区間が長くなると、途中にチャネルの変化する可能性があるため、性能の劣化が予想される。

【０１２３】

データを分割して送ることもできるが、これはＰＣＬＰフレームのフォーマットによって、ＳＴＦ、ＬＴＦのオーバーヘッドが発生することができる。従って、データの中間部分にチャネル推定のための中間ＶＨＴ－ＬＴＦを追加し、チャネル環境の変化にもチャネル推定性能が悪化しないようにすることができる。

【０１２４】

中間ＶＨＴ－ＬＴＦの送信可否は、ＶＨＴＳＩＧ－ＡまたはＶＨＴＳＩＧ－Ｂを介して知らせることができる。

【０１２５】

図９は、ＰＬＣＰフレーム構造の他の例を示す。これは図４のＰＬＣＰフレームの最後にＶＨＴ－ＬＴＦを追加することを提案するものである。

【０１２６】

図１０は、本発明が提案するＶＨＴ－ＧＦ　ＰＬＣＰフレームフォーマットの一例を示すブロック図である。

【０１２７】

本発明が提案するＶＨＴ－ＧＦ　ＰＬＣＰフレームは、ＶＨＴ－ＧＦ－ＳＴＦ（ＶＨＴ　Ｇｒｅｅｎ　Ｆｉｅｌｄ　Ｓｈｏｒｔ　Ｔｒａｉｎｉｎｇ　Ｆｉｅｌｄ）、ＶＨＴ－ＬＴＦ１（ＶＨＴ　Ｌｏｎｇ　Ｔｒａｉｎｉｎｇ　Ｆｉｅｌｄ　１）、ＶＨＴＳＩＧ－Ａ１

０５０の順に送信される。ＶＨＴ－ＧＦ－ＳＴＦ、ＶＨＴ－ＬＴＦ１は、フレームのタイミング獲得、ＡＧＣ（ａｕｔｏｍａｔｉｃ　ｇａｉｎ　ｃｏｎｔｒｏｌ）コンバージェンス、チャネル推定のための制御信号を含んでいる。ＶＨＴ－ＧＦ－ＳＴＦ、ＶＨＴ－ＬＴＦ１、ＶＨＴＳＩＧ－Ａ１０５０は、全方向（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎａｌ）送信される。ＢＳＳ（Ｂａｓｉｃ　Ｓｅｒｖｉｃｅ　Ｓｅｔ）のＶＨＴ　ＳＴＡが全方向送信されるＶＨＴ－ＧＦ－ＳＴＦ、ＶＨＴ－ＬＴＦ１、ＶＨＴＳＩＧ－Ａ１０５０を受信してチャネルが使用中であることを知ることができる。

【０１２８】

ＶＨＴＳＩＧ－Ａ１０５０の以後に送信されるＶＨＴＳＩＧ－Ｂ１０６０、ＶＨＴ－ＬＴＦ、データフィールドは、ＳＤＭＡプリコーディングされてビーム形成送信される。ＶＨＴＳＩＧ－Ｂ１０６０、ＶＨＴ－ＬＴＦ、データフィールドは、ＭＵ－ＭＩＭＯを介して複数のターゲットＳＴＡに送信されるため、ターゲットＳＴＡ別に個別化された情報を送信することができる。

【０１２９】

図１０において、ＶＨＴＳＩＧ－Ａ１０５０までは循環シフトＣＳＤ１が使われ、ＶＨＴＳＩＧ－Ａ１０５０の以後からは循環シフトＣＳＤ２が使われ、互いに異なる循環シフトが使われることができることを例示している。

【０１３０】

図１１は、本発明が提案するＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１３１】

図１１のＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットは、図１０のＶＨＴ－ＧＦ－ＰＬＣＰフレームでＶＨＴＳＩＧ－ＡとＶＨＴＳＩＧ－Ｂとの間にＶＨＴ－ＬＴＦ２をさらに送信する一例を示す。ＶＨＴ－ＬＴＦ２は、ＶＨＴＳＩＧ－Ｂ前に送信され、受信ＳＴＡが以後に送信されるＶＨＴＳＩＧ－Ｂを受信するためのチャネル推定に使用する制御情報を提供する。

【０１３２】

図１２は、本発明が提案するＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１３３】

図１２のＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットは、図１１のＶＨＴ－ＧＦ－ＰＬＣＰフレームでＶＨＴＳＩＧ－ＡとＶＨＴ－ＬＴＦ２との間にＶＨＴ－ＳＴＦ１２５２をさらに送信する一例を示す。ＶＨＴ－ＳＴＦ１２５２をさらに送信することは、受信ＳＴＡが全方向送信からビーム形成送信に送信方式が変更されることによって変化することができる送信パワーをＡＧＣで適切に補償することができるようにする制御信号を送信するためである。

【０１３４】

図１３は、本発明が提案するＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１３５】

ＶＨＴ－ＧＦ－ＳＴＦ、ＶＨＴ－ＬＴＦ１、一つのＶＨＴＳＩＧ１３５０を全方向に送信し、ＢＳＳの全てのＳＴＡが受信することができるようにし、以後プリコーディングを実行してビーム形成送信されるＶＨＴ－ＳＴＦ、ＶＨＴ－ＬＴＦ、データフィールドを送信する。

【０１３６】

図１４は、本発明が提案するＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１３７】

図１４のＶＨＴ－ＧＦ－ＰＬＣＰフレームは、図１３のＶＨＴ－ＧＦ－ＰＬＣＰフレームと同様にＶＨＴ－ＧＦ－ＳＴＦ、ＶＨＴ－ＬＴＦ１、ＶＨＴＳＩＧ－Ａ１４５０、ＶＨ

ＴＳＩＧ－Ｂ１４６０を全方向に送信してＢＳＳの全てのＳＴＡが受信することができるようにし、以後プリコーディングを実行してビーム形成送信されるＶＨＴ－ＳＴＦ、ＶＨＴ－ＬＴＦ、データフィールドを送信する。この時、複数のターゲットＳＴＡに対して空間多重化されたデータを送信する時、ＭＵ－ＭＩＭＯを介するストリームの個数が可変的（ｖａｒｉａｂｌｅ）であるため、これによって制御情報も可変的である。図１４のＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットは、図１３のＶＨＴ－ＳＩＧ１３５０をＶＨＴＳＩＧ－Ａ１４５０、ＶＨＴＳＩＧ－Ｂ１４６０に分け、可変的な個別ターゲットＳＴＡに対する制御情報を含むＶＨＴＳＩＧ－Ｂ１４６０の大きさに対する情報をＶＨＴＳＩＧ－Ａ１４５０が指示することができるようにする。

【０１３８】

図１５は、本発明が提案するＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１３９】

図１５のＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットは、ＶＨＴ－ＧＦ－ＳＴＦ、ＶＨＴ－ＬＴＦ１、ＶＨＴＳＩＧ－Ａ、及びＶＨＴＳＩＧ－Ｂを全方向送信し、以後ＶＨＴ－ＳＴＦ、ＶＨＴ－ＬＴＦ、及びデータフィールドをプリコーディングした後にビーム形成送信する一例である。図１５のＶＨＴ－ＧＦ－ＰＬＣＰフレームは、ＭＵ－ＭＩＭＯ送信をする図１０乃至図１４のＶＨＴ－ＧＦ－ＰＬＣＰフレームの場合とは違って、ＳＵ－ＭＩＭＯ送信をする場合に使われることができるＰＬＣＰフレームの一例である。二つのＶＨＴ－ＳＩＧ（ＶＨＴＳＩＧ－Ａ、ＶＨＴＳＩＧ－Ｂ）を全方向送信することは、ＭＵ－ＭＩＭＯ送信の場合とは違って、ＳＤＭＡ送信が行われないため、互いに異なるＳＴＡへ向かうＰＬＣＰフレームの衝突、干渉問題が発生しないためである。

【０１４０】

ＶＨＴＳＩＧ－Ａ１５５０、ＶＨＴＳＩＧ－Ｂ１５６０には、ＶＨＴ－ＧＦ－ＰＬＣＰフレームがＭＵ－ＭＩＭＯのＶＨＴ－ＧＦ－ＰＬＣＰフレームであるか、或いはＳＵ－ＭＩＭＯのＶＨＴ－ＧＦ－ＰＬＣＰフレームであるかを識別することができるようにする指示子（ｉｎｄｉｃａｔｏｒ）をサブフィールド形態に含まれることができる。例えば、ＶＨＴ－ＧＦ－ＰＬＣＰフレームの類型を指示する情報を含めた類型サブフィールド（ｔｙｐｅ　ｓｕｂｆｉｅｌｄ）が０に設定されて送信される場合、受信ＳＴＡは、ＳＵ－ＭＩＭＯ　ＶＨＴ－ＧＦ－ＰＬＣＰフレームであると認識し、類型サブフィールド（ｔｙｐｅ　ｓｕｂｆｉｅｌｄ）が１に設定されて送信される場合、受信ＳＴＡは、ＭＵ－ＭＩＭＯ　ＶＨＴ－ＧＦ－ＰＬＣＰフレームであると認識することができる。

【０１４１】

ＶＨＴＳＩＧ－Ｂ１５６０の以後の送信方式の変化によるＡＧＣでの補償のための制御信号を含めたＶＨＴ－ＳＴＦを送信し、ＶＨＴ－ＳＴＦからプリコーディングしてビーム形成送信する。

【０１４２】

図１６は、本発明が提案するＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１４３】

図１６は、ＳＵ－ＭＩＭＯで使用することができるＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットであり、ＢＳＳの他のＳＴＡにＶＨＴＳＩＧ－Ａさえ送信する必要がない場合に使われることができる。図１６のＶＨＴ－ＧＦ－ＰＬＣＰフレームは、図１５の例と違って、全てのフィールドがＳＤＭＡプリコーディングされて送信される。フレーム送信で送信方式の変化がないため、図１５のＰＬＣＰフレームフォーマットと違ってＶＨＴ－ＳＴＦが省略されることができる。

【０１４４】

図１７は、本発明が提案するＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットの一例を示すブロック図である。

【０１４５】

本発明が提案するＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームは、レガシＳＴＡのためのトレーニングフィールド（ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）と、シグナルフィールド（ＳＩＧ　ｆｉｅｌｄ）を含む。レガシＳＴＡのためのトレーニングフィールドとシグナルフィールドは、ＶＨＴ　ＳＴＡのためのトレーニングフィールドとシグナルフィールドの送信以前に送信され、レガシＳＴＡがこれを受信し、チャネルが使われていることを知ることができるようにする。

【０１４６】

図１７を参照すると、まず、レガシＳＴＡのためのトレーニングフィールドであるＬ－ＳＴＦ（ｌｅｇａｃｙ　ｓｈｏｒｔ　ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）、Ｌ－ＬＴＦ（ｌｅｇａｃｙ　ｌｏｎｇ　ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）が送信される。Ｌ－ＳＴＦは、フレームのタイミング獲得（ｆｒａｍｅ　ｔｉｍｉｎｇ　ａｃｑｕｉｓｉｔｉｏｎ）とＡＧＣ（ａｕｔｏｍａｔｉｃ　ｇａｉｎ　ｃｏｎｔｒｏｌ）コンバージェンス（ｃｏｎｖｅｒｇｅｎｃｅ）のために使われ、Ｌ－ＬＴＦは、シグナルフィールド（ＳＩＧ　ｆｉｅｌｄ）とデータを復調するためのチャネル推定（ｃｈａｎｎｅｌ　ｅｓｔｉｍａｔｉｏｎ）に使われる。

【０１４７】

トレーニングフィールドの次にシグナルフィールドが送信され、ｎｏｎ－ＨＴ　ＳＴＡのためのＬ－ＳＩＧ、ＨＴ　ＳＴＡのためのＨＴ－ＳＩＧが送信されることができる。ＨＴ－ＳＩＧは、図１０の例と同様に、Ｌ－ＳＩＧの次に一つのフィールド形態で送信されたり、或いは必要によってＬ－ＳＩＧに含まれて送信されることができる。Ｌ－ＳＩＧ、ＨＴ－ＳＩＧには、以後に送信されるデータフィールドを復調してデコーディング（ｄｅｃｏｄｉｎｇ）に必要なＭＣＳ（ｍｏｄｕｌａｔｉｏｎ　ａｎｄ　ｃｏｄｉｎｇ　ｓｃｈｅｍｅ）情報が含まれている。

【０１４８】

レガシＳＴＡのためのトレーニングフィールドとシグナルフィールドが送信され、以後ＶＨＴ　ＳＴＡのためのフィールドが送信される。ＶＨＴ　ＳＴＡのためのフィールドとして、ＶＨＴ－ＳＴＦ、ＶＨＴ－ＬＴＦ１、ＶＨＴ－ＳＩＧ、個別ＳＴＡとのチャネル推定のためのＶＨＴ－ＬＴＦ、及び拡張ＶＨＴ－ＬＴＦが送信されることができる。ＶＨＴ　ＳＴＡのためのトレーニングフィールドとシグナルフィールドが送信された以後にデータフィールドが送信される。

【０１４９】

図１７の例で、レガシＳＴＡのためのトレーニングフィールドとシグナルフィールドは、レガシＳＴＡが認識することができるようにプリコーディング無しにＣＳＤ（ｃｙｃｌｉｃ　ｓｈｉｆｔ　ｄｅｌａｙ）のみを実行して全方向に送信される。ＣＳＤは、信号送信過程で逆離散フーリエ変換（Ｉｎｖｅｒｓｅ　ｄｉｓｃｒｅｔｅ　Ｆｏｕｒｉｅｒ　ｔｒａｎｓｆｏｒｍ；ＩＤＦＴ）前または後に実行されることができ、これは意図しないビーム形成が生成されることを防止する役割をする。ＣＳＤは、送信機チェーン（ｔｒａｎｓｍｉｔｔｅｒ　ｃｈａｉｎ）別に実行されたり、或いは時空間ストリーム（ｓｐａｃｅ　ｔｉｍｅ　ｓｔｒｅａｍ）別に実行されることができ、空間マッパ（ｓｐａｔｉａｌ　ｍａｐｐｅｒ）の一部として適用されることができる。以後、ＶＨＴ　ＳＴＡのためのトレーニングフィールド、シグナルフィールド、及びデータフィールドは、ＣＳＤとプリコーディングしてビーム形成されて送信されることができる。

【０１５０】

図１８及び図１９は、本発明が提案するＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１５１】

図１８と図１９のＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームは、図８のＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームと同じフィールドと同じ送信順序を有する。ただし、図１８のＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームは、ＶＨＴＳＩＧ－Ａまで全方向送信し、以後ＶＨＴＳＩＧ－ＢからＳＤＭＡプリコーディングして送信する。図１９のＶＨＴ－ｍｉｘｅｄ

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ＰＬＣＰフレームは、図１８の例でＶＨＴ－ＳＴＦからＶＨＴＳＩＧ－Ａまでプリコーディングして送信するという点が異なる。

【０１５２】

図２０は、本発明が提案するＶＨＴ－ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１５３】

図２０を参照すると、レガシＳＴＡのためのトレーニングフィールドとシグナルフィールド、及びＶＨＴ　ＳＴＡのためのシグナルフィールドＶＨＴ－ＳＩＧを全方向送信される。以後、ＶＨＴ－ＳＴＦからデータフィールドまでＳＤＭＡプリコーディングされて送信される。ここで、ＶＨＴ－ＳＩＧフィールドには、受信ＳＴＡが受信したデータを復調し、デコーディングするための制御情報が含まれる。

【０１５４】

図２１は、本発明が提案するＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームフォーマットの一例を示すブロック図である。

【０１５５】

図２１のＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフォーマットは、ＩＥＥＥ８０２．１１ｎＨＴ　ＳＴＡとＶＨＴ　ＳＴＡのみで構成された無線ＬＡＮシステムまたはｎｏｎ－ＨＴ　ＳＴＡに対する考慮が必要でない場合に効果的なＰＬＣＰフレームフォーマットである。ＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームは、ｎｏｎ－ＨＴ　ＳＴＡに対する考慮が必要でないため、Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧを送信しない。ただし、ＨＴ　ＳＴＡがＰＬＣＰフレームを認識することができるようにＨＴ－ＧＦ－ＳＴＦ、ＨＴ－ＬＴＦ１、ＨＴ－ＳＩＧを送信し、以後にＶＨＴ　ＳＴＡのためのＶＨＴＳＩＧ、ＶＨＴ－ＬＴＦ、及びデータフィールドを送信する。

【０１５６】

図２１のＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームは、全てのフィールドがプリコーディングされ、プリコーディングされた値が全てのフィールドに適用されるため、ＶＨＴ－ＳＴＦ無しにＨＴ－ＳＩＧ、ＶＨＴ－ＳＩＧ以後にＶＨＴ－ＬＴＦ及びデータフィールドが続けて送信される。

【０１５７】

図２２は、本発明が提案するＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１５８】

図２１の例と違って、ＶＨＴ－ＳＩＧまで全方向送信し、ＢＳＳ内の全てのＨＴ　ＳＴＡとＶＨＴ　ＳＴＡがＨＴ－ＳＩＧとＶＨＴ－ＳＩＧを受信することができるようにする。その以後に送信されるフィールドは、プリコーディングをして送信するため、ＶＨＴ－ＳＴＦが送信された後、ＶＨＴ－ＬＴＦとデータフィールドが送信される。

【０１５９】

図２３は、本発明が提案するＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームフォーマットの他の一例を示すブロック図である。

【０１６０】

図２３のＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームは、ＨＴ－ＧＦ－ＳＴＦ、ＨＴ－ＬＴＦ１、ＨＴ－ＳＩＧ、ＶＨＴＳＩＧ－Ａまで全方向（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎａｌ）に送信され、次に送信されるフィールドは、全部プリコーディングされ、ＶＨＴ－ＳＴＦ、ＶＨＴ－ＬＴＦ、ＶＨＴＳＩＧ－Ｂ、ＶＨＴ－ＬＴＦ、及びデータフィールドの順に順次送信される。追加的に、ＶＨＴＳＩＧ－Ａは送信されず、データの復調とデコーディングのためのパラメータは、ＶＨＴＳＩＧ－Ｂに送信されることができる。この場合、ＨＴ－ＳＩＧに送信されたサブフィールドの情報が再使用されることができる。受信ＳＴＡは、ＶＨＴＳＩＧ－Ｂの情報に基づいてデータフィールドの復調とデコーディングを実行することができる。図２３のＰＬＣＰフレームフォーマットの一部フィールドは、必要によって省略されることができ、図２４と図２５はその一例を示す。

【０１６１】
図２４及び図２５は、図２３の例で、各々ＶＨＴ－ＳＴＦまたはＶＨＴ－ＬＴＦ１が省略された形態であり、ＳＴＡの具現によって変形されることができるＶＨＴ－ｍｉｘｅｄ－ＧＦ　ＰＬＣＰフレームフォーマットの一例である。
【０１６２】
図２６は、本発明の実施例に係るＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレームフォーマット及びフレーム送信の一例である。
【０１６３】
ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０は、レガシＳＴＡのための（レガシＳＴＡが認識することができる）ＴＦ（ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）及びＳＩＧ、ＶＨＴ　ＳＴＡのためのＴＦ及びＳＩＧ、データフィールドを含む。レガシＳＴＡのためのＴＦ（ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）及びＳＩＧの一例として、図２６のＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０は、Ｌ－ＳＴＦ（Ｎｏｎ－ＨＴ　ｓｈｏｒｔ　Ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）２６１２、Ｌ－ＬＴＦ（Ｎｏｎ－ＨＴ　Ｌｏｎｇ　Ｔｒａｉｎｉｎｇ　ｆｉｅｌｄ）２６１４、Ｌ－ＳＩＧ（Ｎｏｎ－ＨＴ　ＳＩＧＮＡＬ　ｆｉｅｌｄ）２６１６、ＨＴ－ＳＩＧ（ＨＴ　ＳＩＧＮＡＬ　ｆｉｅｌｄ）２６１８を含む。
【０１６４】
Ｌ－ＳＴＦ２６１２は、フレームタイミング獲得（ｆｒａｍｅ　ｔｉｍｉｎｇ　ａｃｑｕｉｓｉｔｉｏｎ）と自動利得制御（ａｕｔｏｍａｔｉｃ　ｇａｉｎ　ｃｏｎｔｒｏｌ；ＡＧＣ）コンバージェンス（ｃｏｎｖｅｒｇｅｎｃｅ）のために使われ、Ｌ－ＬＴＦ２６１４は、Ｌ－ＳＩＧ２６１６とデータを復調（ｄｅｍｏｄｕｌａｔｉｏｎ）するためのチャネル推定（ｃｈａｎｎｅｌ　ｅｓｔｉｍａｔｉｏｎ）に使われる。Ｌ－ＳＩＧ２６１６には、その以後のデータを復調してデコーディング（ｄｅｃｏｄｉｎｇ）するための情報が含まれる。ＨＴ－ＳＩＧ２６１８は、ＨＴ　ＳＴＡのためのＳＩＧフィールドであり、Ｌ－ＳＩＧ２６１６に含まれて送信されることができる。Ｌ－ＳＴＦ２６１２、Ｌ－ＬＴＦ２６１４、Ｌ－ＳＩＧ２６１６は、他のフィールド以前に送信され、レガシＳＴＡがこれらを認識し、チャネルが使われていることを知ることができるようにする。
【０１６５】
本発明の実施例によるＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０は、ＶＨＴ　ＳＴＡのためのＶＨＴ－ＳＴＦ２６２２、ＶＨＴ－ＬＴＦ１、二つのＶＨＴ－ＳＩＧ（ＶＨＴＳＩＧ－Ａ２６３０、ＶＨＴＳＩＧ－Ｂ２６４０）、及びＶＨＴ－ＬＴＦ２６５０－１，．．．，２６５０－Ｌを含む。ＶＨＴＳＩＧ－Ａ２６３０は、以後送信されるフィールド及びＰＬＣＰフレームに対する共通情報を含み、ＶＨＴＳＩＧ－Ｂ２６４０は、データを送信するターゲットＳＴＡ別に個別化された情報を含むことができる。
【０１６６】
本発明の実施例によるフレームの送信方法は、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０が送信され、以後、Ｎ個のＧＦ－ＰＬＣＰフレーム２６９０－１，．．．，２６９０－Ｎが送信される。ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０には、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０とＮ個のＶＨＴ　ＧＦ－ＰＬＣＰフレーム２６９０－１，．．．，２６９０－Ｎの送信時間情報が含まれる。レガシＳＴＡと送信ターゲットＳＴＡでないＶＨＴ　ＳＴＡは、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０を介してチャネルが使われていることを認識し、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０に含まれた送信時間情報に基づいてチャネルが使われる時間中ＮＡＶを設定し、チャネル接近を保留する。このために、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０で、ＶＨＴＳＩＧ－Ａ２６３０前まではレガシＳＴＡを含んだ全てのＳＴＡが受信することができるようにＳＤＭＡプリコーディング無しに送信され、ＶＨＴＳＩＧ－Ａ２６３０以後に送信されるフィールドに対するのみでＳＤＭＡプリコーディングして送信する。
【０１６７】
レガシＳＴＡと送信ターゲットＳＴＡでないＶＨＴ　ＳＴＡは、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０以後に送信されるＮ個のＧＦ－ＰＬＣＰフレーム２６９０－１

，．．．，２６９０－Ｎを認識することができないが、ＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０に含まれた送信期間情報に基づいてＶＨＴ－Ｍｉｘｅｄ－ＰＬＣＰフレーム２６１０とＮ個のＧＦ－ＰＬＣＰフレーム２６９０－１，．．．，２６９０－Ｎの送信に所要される時間中ＮＡＶを設定し、チャネル接近を保留するため、誤作動を防止することができる。

【０１６８】

図２７は、本発明の実施例に係るＶＨＴ－ＧＦ－ＰＬＣＰフレームフォーマットを示すブロック図である。

【０１６９】

ＶＨＴ－ＧＦ－ＰＬＣＰフレーム２７００は、ＶＨＴ－ＧＦ－ＳＴＦ２７１０、ＶＨＴ－ＬＴＦ１、２個のＶＨＴ－ＳＩＧフィールド（ＶＨＴＳＩＧ－Ａ２７３０、ＶＨＴＳＩＧ－Ｂ２７４０）、Ｎ個のＶＨＴ－ＬＴＦ２７５０－１，．．．，２７５０－Ｎ、及びデータフィールドを含む。図２７の例で、ＶＨＴＳＩＧ－Ａ２７３０、ＶＨＴＳＩＧ－Ｂ２７４０は、連続送信されるが、これは一例に過ぎず、ＶＨＴＳＩＧ－Ｂ２７４０は、ＶＨＴＳＩＧ－Ａ２７３０が送信され次第に、又はその以後に送信されることができる。本発明によるＶＨＴ－ＧＦ－ＰＬＣＰフレーム２７００は、ＶＨＴ－ＧＦ－ＳＴＦ２７１０、ＶＨＴ－ＬＴＦ１、ＶＨＴＳＩＧ－Ａ２７３０フィールドは、全てのＶＨＴ　ＳＴＡが聞こえるように全方向（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎａｌ）に送信される。ＶＨＴＳＩＧ－Ｂ２７４０フィールドと以後送信されるデータは、ＳＤＭＡプリコーディングしてビーム形成されて送信されることができる。ＶＨＴＳＩＧ－Ａ２７３０には次に送信されるＳＤＭＡ送信に対する共通された情報が含まれる。その一例として、ＳＤＭＡ送信期間が含まれ、送信ターゲットＳＴＡでない第３のＳＴＡが送信期間中ＮＡＶを設定することができるようにすることができる。ＶＨＴＳＩＧ－Ｂ２７４０には、送信ターゲットＳＴＡ別にＳＤＭＡ送信のために使われるパラメータ値が設定／含まれる。その一例として、ＭＣＳインデックス、チャネル帯域幅、空間ストリームの数などがＳＴＡ別に設定／含まれて送信されることができる。

【０１７０】

ＶＨＴＳＩＧ－Ｂ２７４０フィールドと以後送信されるデータは、ＳＤＭＡプリコーディングしてビーム形成されて送信されるため、送信ターゲットＳＴＡでない第３のＳＴＡは、ＶＨＴＳＩＧ－Ｂ２７４０フィールドと以後送信されるデータを受信することができないが、ＶＨＴＳＩＧ－Ａ２７３０フィールドまで受信して該当プリアンブルを認識することができる。

【０１７１】

ＳＵ（Ｓｉｎｇｌｅ　Ｕｓｅｒ）－ＭＩＭＯでＧＦ－ＰＬＣＰフレームは、一つのＶＨＴＳＩＧを使用することができる。ＳＵ－ＭＩＭＯではＳＤＭＡ送信が行われなくて、互いに異なるＳＴＡへ向かうＰＬＣＰフレーム間に衝突、干渉問題が発生しないためである。ＳＵ－ＭＩＭＯ、ＭＵ－ＭＩＭＯでＧＦ－ＰＬＣＰフレーム識別のために、ＶＨＴＳＩＧ－Ａ２７３０、ＶＨＴＳＩＧ－Ｂ２７４０には、その送信類型を指示する類型サブフィールドが含まれることができる。類型サブフィールドの設定値がＳＵ－ＭＩＭＯ方式の送信を指示する場合、一つのＶＨＴＳＩＧフィールドのみが使われる。類型サブフィールドの設定値がＭＵ－ＭＩＭＯ方式の送信を指示する場合、二つのＶＨＴＳＩＧ（ＶＨＴＳＩＧ－Ａ　、ＶＨＴＳＩＧ－Ｂ）が使われる。二つのＶＨＴＳＩＧは、前述した通り、ＶＨＴＳＩＧ－Ａは、全方向送信され、ＢＳＳ内のＳＴＡが送信中であるＰＬＣＰフレームのプリアンブルを検出／認識することができるようにし、ＶＨＴＳＩＧ－Ｂは、各々の送信ターゲットＳＴＡへ向かう空間ストリームに対するＭＣＳインデックス値、チャネル帯域幅、空間ストリームの個数などの情報を有する。

【０１７２】

図２８は、本発明の実施例に係るＰＬＣＰフレームフォーマットの一例を示す。

【０１７３】

図２８のＰＬＣＰフレームは、ＶＨＴ　ｍｉｘｅｄフレームフォーマットであり、レガ

システーションのためのＬ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧ、及びＨＴ－ＳＩＧフィールドを含む。Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧ、及びＨＴ－ＳＩＧフィールドの機能は前述の通りである。

【０１７４】

図２８の例は、ＡＰが５個の空間ストリームを２個のＳＴＡに対してＭＵ－ＭＩＭＯ方式に送信し、１番目のＳＴＡは空間ストリーム３個を受信し、２番目のＳＴＡは空間ストリーム２個を受信する場合を例示している。ここで、ＭＵ－ＭＩＭＯ送信の対象となるＳＴＡの数及び各ＳＴＡに対して送信する空間ストリームの個数は例示であり、本発明はこれに限定されるものではない。

【０１７５】

図２８のＰＬＣＰフレームは、ＭＵ－ＭＩＭＯ送信の対象となるＳＴＡの各々に対する制御情報を含む複数のＶＨＴＳＩＧフィールドを含む。即ち、ＶＨＴＳＩＧフィールドの個数は、ＭＵ－ＭＩＭＯ送信の対象となるＳＴＡの数の同じ、或いは多い。

【０１７６】

図２８の例で、ＶＨＴＳＩＧ１は、ＭＵ－ＭＩＭＯ送信の対象であるＳＴＡ１に対する制御情報を含み、ＶＨＴＳＩＧ２は、ＭＵ－ＭＩＭＯ送信の対象であるＳＴＡ２に対する制御情報を含む。

【０１７７】

各ＳＴＡに割り当てられるＶＨＴ－ＳＩＧは、ＶＨＴＳＩＧ１，．．．，ＶＨＴＳＩＧＮの複数個のＶＨＴＳＩＧで構成されることができる。例えば、ＩＥＥＥ８０２．１１ｎ標準のＨＴ－ＳＩＧフィールドは、２個のＨＴ－ＳＩＧで構成されており、２個のＯＦＤＭシンボルで送信される。送信すべきＶＨＴＳＩＧのＯＦＤＭシンボル個数は、ＭＵ－ＭＩＭＯで空間多重化（ｓｐａｔｉａｌ　ｍｕｌｔｉｐｌｅｘｉｎｇ）されたＳＴＡの数、空間多重化されたストリームの個数の関数で表されることができる。

【０１７８】

図２８の例ではＶＨＴＳＩＧフィールドが２個存在するが、ＭＵ－ＭＩＭＯ送信の対象ＳＴＡ数が増えることによってＶＨＴＳＩＧを送信する期間（ｄｕｒａｔｉｏｎ）が長くなる。８個のストリームを送信するＡＰが８個のＩＲｘ－ＳＴＡとＭＵ－ＭＩＭＯで動作する場合、８個のＶＨＴＳＩＧフィールド（ＶＨＴＳＩＧ１乃至ＶＨＴＳＩＧ８）が続けて送信されなければならない。

【０１７９】

この時、ＭＵ－ＭＩＭＯ送信の対象ＳＴＡに対して自体に送信されるストリームが何であるかを知らせる階層インデックス指示（ｌａｙｅｒ　ｉｎｄｅｘ　ｉｎｄｉｃａｔｉｏｎ）が必要である。このために、ＶＨＴＳＩＧフィールドは、複数のＭＵ－ＭＩＭＯ送信対象ＳＴＡのうちいずれのＳＴＡに対する制御情報であるかを指示する指示ビット（ｉｎｄｉｃａｔｉｏｎ　ｂｉｔ）を含むことができる。

【０１８０】

ＬＴＦは、符号多重化（ｃｏｄｅ　ｍｕｌｔｉｐｌｅｘｉｎｇ）されて複数の空間ストリームを介して同時に送信される。ＬＴＦの個数はＬＴＦ直交性（ｏｒｔｈｏｇｏｎａｌｉｔｙ）を与えるために送信するＬＴＦ個数が変わることができるため、図２８の例でＬＴＦｘで表現した。

【０１８１】

複数のＭＵ－ＭＩＭＯ送信対象ＳＴＡの各々に対して自体のための制御情報がいずれのＶＨＴＳＩＧフィールドに含まれているかを指示するための方法として、ＶＨＴＳＩＧに各ＳＴＡに対する制御情報別に区分可能な識別信号（ｉｄｅｎｔｉｆｉｃａｔｉｏｎ　ｓｉｇｎａｌ）を追加したり、或いはＶＨＴＳＩＧのＣＲＣパリティビット（ｐａｒｉｔｙ　ｂｉｔ）にＳＴＡを区分可能な識別値（ｉｄｅｎｔｉｆｉｃａｔｉｏｎ　ｖａｌｕｅ）をビットパターンマスキング（ｂｉｔ　ｐａｔｔｅｒｎ　ｍａｓｋｉｎｇ）（例えば、ｅｘｃｌｕｓｉｖｅ　ＯＲ　ｔｏ　ｐａｒｉｔｙ　ｂｉｔｓ）する方法が使われることができる。この時、識別値／信号は、対象ＳＴＡのＭＡＣ住所（ａｄｄｒｅｓｓ）または結合

（ａｓｓｏｃｉａｔｉｏｎ）ＩＤになることができる。

【０１８２】

ＶＨＴＳＩＧフィールドまで使われる循環シフトと以後に使われる循環シフトは異なるようにすることができ、ＶＨＴＳＩＧフィールド以後に送信されるフィールドは、プリコーディング後にビーム形成して送信することができる。

【０１８３】

図２９は、本発明の実施例に係るＰＬＣＰフレームフォーマットの一例である。図２９のＰＬＣＰフレームフォーマットは、ＶＨＴ　ＧＦ　ＰＬＣＰフォーマットであり、基本的に図２８と同様である。ただし、レガシＳＴＡに対して考慮する必要がないため、レガシＳＴＡのためのフィールド（Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧ、及びＨＴ－ＳＩＧ）は省略されることができ、全てのフィールドがビーム形成されて送信されることができる。

【０１８４】

図３０及び図３１は、本発明の実施例に係るＰＬＣＰフレームフォーマットの他の一例を示す。

【０１８５】

図３０は、ＶＨＴ　ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットを示し、図３１は、ＶＨＴ　ＧＦ　ＰＬＣＰフレームフォーマットを示す。

【０１８６】

図３０のＰＬＣＰフレームは、レガシＳＴＡのためのフィールド（Ｌ－ＳＴＦ、Ｌ－ＬＴＦ、Ｌ－ＳＩＧ、及びＨＴ－ＳＩＧ）は、全方向送信され、以後各ＳＴＡに対する制御情報を含むＶＨＴＳＩＧフィールドからはＳＴＡ別にビーム形成されて送信されることができる。従って、図３０のＶＨＴ　ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットでＶＨＴＳＩＧは、ＡＧＣ利得（ｇａｉｎ）を考慮したＶＨＴ－ＳＴＦ送信後に送信される。即ち、ＨＴ－ＳＩＧとＶＨＴ－ＳＩＧが続けて送信されないという特徴がある。

【０１８７】

図２８及び図２９のＶＨＴＳＩＧフィールドがオーバーラップ（Ｏｖｅｒｌａｐｐｉｎｇ）されたフォーマットとは違ってＭＵ－ＭＩＭＯをサポートする時、ＳＴＡの個数によってＶＨＴＳＩＧフィールドの送信期間（ｄｕｒａｔｉｏｎ）が変わらない。また、ＭＵ－ＭＩＭＯ送信対象である各ＳＴＡに対してＡＰがビーム（ｂｅａｍ）（例えば、Ｂｌｏｃｋ　ｄｉａｇｏｎａｌｉｚａｔｉｏｎ技法を利用）を形成すると、総ストリームの個数とは関係無しに自体のストリームのみ認識することができるため、他のＳＴＡに干渉（ｉｎｔｅｒｆｅｒｅｎｃｅ）を受けない。その結果、各々のＳＴＡは、ＭＵ－ＭＩＭＯにより動作しているという事実を知ることができず、単純に少ない数の空間ストリームを用いたＳＵ－ＭＩＭＯにより動作すると判断する。

【０１８８】

図３０及び図３１の例では、ＭＵ－ＭＩＭＯのためにＡＰが２個のＳＴＡをペアリング（ｐａｉｒｉｎｇ）した一例である。ＳＴＡ１は、ストリーム３個を受信し、チャネル測定（ｃｈａｎｎｅｌ　ｍｅａｓｕｒｅｍｅｎｔ）のために４個のＶＨＴ－ＬＴＦを受信する。ＳＴＡ２は、ストリーム２個を受信し、チャネル測定（ｃｈａｎｎｅｌ　ｍｅａｓｕｒｅｍｅｎｔ）のために２個のＶＨＴ－ＬＴＦを受信する。

【０１８９】

この時、ＬＴＦマッピング行列（ｍａｐｐｉｎｇ　ｍａｔｒｉｘ）Ｐは、数式５乃至数式６のように示すことができる。

【０１９０】

数式４は、２個のＬＴＦを測定する時、数式５は、３個のＬＴＦを測定する時、数式６は、４個のＬＴＦを測定する時に使われることができるＬＴＦマッピング行列の一例である。

【０１９１】

【数４】

$$P=\begin{bmatrix}1 & -1\\ 1 & 1\end{bmatrix}$$

【０１９２】

【数５】

$$P=\begin{bmatrix}1 & -1 & 1 & 1\\ 1 & 1 & -1 & 1\\ 1 & 1 & 1 & -1\end{bmatrix}$$

【０１９３】

【数６】

$$P=\begin{bmatrix}1 & -1 & 1 & 1\\ 1 & 1 & -1 & 1\\ 1 & 1 & 1 & -1\\ -1 & 1 & 1 & 1\end{bmatrix}$$

【０１９４】

図３１は、ＶＨＴ　ＧＦ　ＰＬＣＰフレームフォーマットであり、図３０の例でオーバーラップされない（ｎｏｎ－ｏｖｅｒｌａｐｐｉｎｇ）部分であるレガシステーションのためのフィールドが省略される。また、全てのフィールドがプリコーディングされてビーム形成送信されるため、ＡＣＧ利得調整のためのＶＨＴＳＴＦフィールドの送信が省略されることができる。

【０１９５】

図３０及び図３１の例で、ＡＰが５個以上のストリームを送信することができると、各ＳＴＡに対するビームが相互に対する干渉無しに送信されることができる。然しながら、ＭＵ－ＭＩＭＯ送信の対象ＳＴＡの総ＲＸの数字が受けることができるストリームの個数より大きくなるようになると、ビームが形成されないため、性能損失（ｐｅｒｆｏｒｍａｎｃｅ　ｌｏｓｓ）が発生することができる。一例として、ＡＰが４個のストリームの送信時、ＳＴＡ１が３個のＲｘアンテナを有し、ＳＴＡ２が２個のＲｘアンテナを有している状況を仮定する。ＡＰが各ＳＴＡに対して２個のストリームを送信するためにビームを形成するとする時、ＳＴＡ１は性能損失が発生するようになる。

【０１９６】

ここでの性能損失は多様な要因により発生することができる。ＡＰで使用した干渉無効化ビーム形成（ｉｎｔｅｒｆｅｒｅｎｃｅ　ｚｅｒｏ　ｆｏｒｃｉｎｇ　ｂｅａｍｆｏｒｍｉｎｇ）を実行する当時の限定されたワード長さ精密性（ｆｉｎｉｔｅ　ｗｏｒｄ　ｌｅｎｇｔｈ　ｐｒｅｃｉｓｉｏｎ）の限界とチャネル係数推定エラー（ｃｈａｎｎｅｌ　ｃｏｅｆｆｉｃｉｅｎｔ　ｅｓｔｉｍａｔｉｏｎ　ｅｒｒｏｒ）により正確に各ＳＴＡに送信信号が相互干渉されないように送信されない（ここで限定されたワード長さ精密性（Ｆｉｎｉｔｅ　ｗｏｒｄ　ｌｅｎｇｔｈ　ｐｒｅｃｉｓｉｏｎ）問題は、現代無線モデムで信号情報をデジタルに量子化する時に失われる情報により発生する問題である）。また、空間干渉漏洩（ｓｐａｔｉａｌ　ｉｎｔｅｒｆｅｒｅｎｃｅ　ｌｅａｋａｇｅ）がある状態では同じシーケンス（ｓｅｑｕｅｎｃｅ）で構成されている互いに異なるＳＴＡのためのＬＴＦによりチャネル推定（ｃｈａｎｎｅｌ　ｅｓｔｉｍａｔｉｏｎ）が誤ることがあり、これによってデータ復調（ｄａｔａ　ｄｅｍｏｄｕｌａｔｉｏｎ）が正常にされないため、性能損失が発生することができる。

【０１９７】

一方、互いに異なるＳＴＡから干渉が入ってくるとしても他のＳＴＡのストリームに対するＬＴＦ指示（ｉｎｄｉｃａｔｉｏｎ）を自体のＶＨＴＳＩＧフィールドに含んでいる場合（或いは、自体のＬＴＦに対する指示をＶＨＴＳＩＧフィールドに含んでいる場合）

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、適当な受信機（例えば、ＭＭＳＥ受信機）を用いて干渉を無効化することができる。本発明は、このように自体を除いた他のＳＴＡのＬＴＦ指示をＶＨＴＳＩＧフィールドに含ませる方法を提案する。

【０１９８】

また、互いに異なるＳＴＡのための信号によって互いに干渉が発生する状況でチャネル推定性能を向上させるために、ＬＴＦとその他の信号（例えば、ＳＴＦ、ＶＨＴＳＩＧ、等）にＳＴＡ特定的スクランブリング（ｓｃｒａｍｂｌｉｎｇ）を介して送信するシーケンスを互いに異なるようにすることができるようにする送信方法を提案する。

【０１９９】

具体的な実施例として、ＳＴＡの結合ＩＤ（ａｓｓｏｃｉａｔｉｏｎ　ＩＤ）を活用してスクランブリングコード（ｓｃｒａｍｂｌｉｎｇ　ｃｏｄｅ）を生成することができる。この時、ＳＴＡ特定的スクランブリングは、必ず全てのＳＴＡ毎に異なる特定的スクランブリングである必要はなく、ＭＵ－ＭＩＭＯでペアリングされ、同時に空間多重化された互いに異なるＳＴＡのための信号をスクランブリングするために識別可能な程度のみあればよい。

【０２００】

これはオーバーラッピング（ｏｖｅｒｌａｐｐｉｎｇ）により構成される全ての技法（ｓｃｈｅｍｅ）に応用が可能であるため、以後に提案される全てのＰＬＣＰフレームフォーマットでオーバーラッピング技法（ｏｖｅｒｌａｐｐｉｎｇ　ｓｃｈｅｍｅ）が含まれる場合、特別な言及がなくても必要によりＶＨＴＳＩＧフィールドに関連指示（ｉｎｄｉｃａｔｉｏｎ）が含まれることができ、ＬＴＦ、ＳＴＦ、及びＳＩＧの組合せはスクランブリングされることができる。

【０２０１】

オーバーラッピング技法は、ＶＨＴＳＩＧのシンボル期間（ｄｕｒａｔｉｏｎ）がＳＴＡの数によって可変されないため、適当なオーバーヘッド（ｏｖｅｒｈｅａｄ）を維持することができ、非オーバーラッピング技法（ｎｏｎ－ｏｖｅｒｌａｐｐｉｎｇ　ｓｃｈｅｍｅ）は、ＭＵ－ＭＩＭＯのためにペアリングされたＳＴＡが自体で割り当てられたストリームを知ることができるという仮定下に送信された全てのＶＨＴ－ＬＴＦを用いて必要な空間ストリームを検出することができるという長所がある。この長所を最大限生かし、ＶＨＴＳＩＧはオーバーラッピングで送信し、ＶＨＴ－ＬＴＦは非オーバーラッピング（ｎｏｎ－ｏｖｅｒｌａｐｐｉｎｇ）で送信するＰＬＣＰフレームフォーマットを提案する。

【０２０２】

図３２乃至図３５は、ＶＨＴＳＩＧはオーバーラッピングで送信し、ＶＨＴ－ＬＴＦは非オーバーラッピングで送信するＰＬＣＰフレームフォーマットの一例である。図３２及び図３３は、ＶＨＴＳＩＧにかけられるビーム形成行列とＶＨＴ－ＬＦＴにかけられるビーム形成行列が異なる時、ＡＧＣ利得調整のためのＶＨＴ－ＳＴＦがＶＨＴ－ＬＴＦ前に必要な場合の例示である。図３４及び図３５は、ＶＨＴＳＩＧとＶＨＴ－ＬＴＦが同じビーム形成行列によりビーム形成されて送信される場合であり、ＶＨＴ－ＬＴＦ送信前にＶＨＴ－ＳＴＦが必要ない場合である。図３２及び図３４は、ＶＨＴ　ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットの一例であり、図３３及び図３５は、ＶＨＴ　ＧＦ　ＰＬＣＰフレームフォーマットの一例である。

【０２０３】

図３２乃至図３５の例では受信ＳＴＡがＶＨＴＳＩＧフィールドを検出する前までＲＸアンテナ一個がつけられていると仮定する。受信ＳＴＡは、ＶＨＴ－ＬＴＦでＶＨＴＳＩＧを測定し、ＶＨＴ－ＳＩＧフィールドを読み込んで自体が使用するストリームが何であるか或いは総ストリーム個数がいくつであるか等に対する情報を知ることができる。一方、ＶＨＴ－ＳＩＧを読み込む前までは一つのアンテナであると仮定されているため、Ｒｘの個数が増加することによって得ることができるダイバーシティ利得（ｄｉｖｅｒｓｉｔｙ　ｇａｉｎ）を得ることができない。

【０２０４】
図３６及び図３７は、共用ＶＨＴＳＩＧフィールドを導入したＰＬＣＰフレームフォーマットを示す。
【０２０５】
図３６は、ＶＨＴ　ｍｉｘｅｄ　ＰＬＣＰフレームフォーマットの一例を示し、図３７は、ＶＨＴ　ＧＦ　ＰＬＣＰフレームフォーマットの一例を示す。
【０２０６】
図３６及び図３７のＰＣＬＰフレームは、共通制御情報を含んでいるＶＨＴＳＩＧｃフィールドを含む。ＶＨＴＳＩＧｃは、共用ＶＨＴＳＩＧフィールドであり、ＳＴＡ１、ＳＴＡ２に対する共通制御情報を含む。ＶＨＴＳＩＧｃフィールドは、全方向送信され、全てのＳＴＡがＶＨＴＳＩＧｃフィールドの情報を獲得することができる。ＶＨＴＳＩＧｃフィールドには、各ＳＴＡに割り当てられたストリームを指示する情報、総ストリーム数など、全てのＳＴＡに共通的に知らせる情報が含まれて各ＳＴＡに伝達される。ＶＨＴＳＩＧｃとＶＨＴ－ＬＴＦを非オーバーラッピング方式に送信する。次に、各ＳＴＡに対する個別化された制御情報を含んでおり、ＶＨＴＳＩＧ１、ＶＨＴＳＩＧ２フィールドをオーバーラッピング方式に送信する。
【０２０７】
前述した多様な実施例でオーバーラッピング方法にフィールドを構成し、各々のＳＴＡに同時に送信する時、正常な動作のためには各ＳＴＡ方向にビームがよく形成され、ＳＴＡ立場ではＳＵ－ＭＩＭＯと認識するようにしなければならない。即ち、あるＳＴＡ立場では、他のＳＴＡでのＬＴＦなどが干渉として作用しないため、他のＳＴＡに対する存在可否を考慮する必要がない。
【０２０８】
然しながら、理由が何であれ、他のＳＴＡにより干渉を受けるようになると、自体に割り当てられたフィールドと他のＳＴＡ野に割り当てられたフィールドの区分が容易ではない。例えば、図３２乃至図３５のＰＬＣＰフレームフォーマットによる場合、ＳＴＡ１にはＶＨＴ－ＬＴＦがＰ行列により３個のＶＨＴ－ＬＴＦがオーバーラッピングされて送信され、ＳＴＡ２にはＶＨＴ－ＬＴＦがｐ行列により２個のＶＨＴ－ＬＴＦがオーバーラッピングされて送信される。この時、ＳＵ－ＭＩＭＯのみをサポートする８０２．１１ｎシステムでＬＴＦ　ＯＦＤＭシンボルは、｛－１，１｝で構成された固定パターン（ｆｉｘｅｄ　ｐａｔｔｅｒｎ）に与えられるため、ＳＴＡ１のＶＨＴ－ＬＴＦとＳＴＡ２のＶＨＴ－ＬＦＴは、同じパターンのＯＦＤＭシンボルを有するようになる。理想的なビームが形成されると、ＳＴＡ１では３個のＶＨＴ－ＬＴＦを認識し、ＳＴＡ２では２個のＶＨＴ－ＬＴＦを認識すべきであるが、何らかの理由で、ＳＴＡ１でＳＴＡ２のＶＨＴ－ＬＦＴが検出されることができる。例えば、ＳＴＡ１で５個のＶＨＴ－ＬＴＦを認識することができるが、このような場合、ＳＴＡ１立場では特別な指示方法がサポートされない限り、干渉として入ってきたＶＨＴ－ＬＴＦを区分する方法がない。このような問題点を解決するために、ＳＴＡが自体のためのＶＨＴ－ＬＴＦを区別するための方法を提案する。
【０２０９】
本発明の実施例によると、ＭＵ－ＭＩＭＯをサポートするために、各々のＳＴＡに送信されるＬＴＦ／ＶＨＴＳＩＧなど、フィールドにスクランブリングコードが適用されることができる。この時、各ＳＴＡに使われるシーケンスは互いに直交（ｏｒｔｈｏｇｏｎａｌ）したり、或いは少なくとも良い相関（ｃｏｒｒｅｌａｔｉｏｎ）特性を有するようにする。このような場合、ＳＴＡは、干渉として作用する他のＳＴＡのためのＬＴＦまたはＶＨＴＳＩＧを受信しても、自体のためのＬＴＦまたはＶＨＴＳＩＧと区分することができ、干渉抑制効果を得ることができる。スクランブリングシーケンスを初期化する時、ＳＴＡ　ＩＤまたはＳＴＡ　ＩＤと代替可能なＩＤ（例えば、結合ＩＤ（ＡＩＤ））を用いたり、或いはＳＴＡ臨時ナンバリング（ｔｅｍｐｏｒａｒｙ　ｎｕｍｂｅｒｉｎｇ）などを用いることができる。ＳＴＡ臨時ナンバリングを用いる方法が使われる場合、各ＳＴＡにナンバリングをし、その値でスクランブリングシーケンスを初期化した後、オーバーラ

ッピングされるフィールドに適用することができる。

【０２１０】

図３８は、本発明の実施例が具現される無線装置の他の一例を示すブロック図である。無線装置３８００は、ＡＰまたはｎｏｎ－ＡＰステーションである。

【０２１１】

無線装置３８００は、プロセッサ３８１０、メモリ３８２０、及び送受信機３８３０を含む。送受信機３８３０は、無線信号を送信／受信し、ＩＥＥＥ８０２．１１の物理階層が具現される。送受信機３８３０は、多重アンテナを介してＭＩＭＯ送信をサポートする。プロセッサ３８１０は、送受信機３８３０と連結され、ＩＥＥＥ８０２．１１のＭＡＣ階層及び物理階層を具現する。プロセッサ３８１０が前述した方法のうち送信ステーションの動作を処理する時、無線装置３８００は、送信ステーションになる。プロセッサ３８１０が前述した方法のうち受信ステーションの動作を処理する時、無線装置３８００は、受信ステーションになる。

【０２１２】

プロセッサ３８１０に具現された送信ステーションのＰＬＣＰ副階層では前述したＰＬＣＰフレームフォーマットに基づいてＭＡＣ階層で送信されたＰＳＤＵにＰＬＣＰプリアンブルを付けてプロセッサ３８１０または送受信機３８３０に具現されたＰＭＤ副階層に送る。ＰＭＤ副階層では、多重アンテナシステムを用いてＰＬＣＰフレームを、前述したＰＬＣＰフレームフォーマットのフィールド別送信方法に基づいて送受信機３８３０を介してＰＬＣＰフレームを送信する。受信ステーションのプロセッサ３８１０に具現された受信ステーションのＰＬＣＰ副階層では、前述したＰＬＣＰフレームフォーマットに基づいてＰＬＣＰプリアンブルを除去し、ＰＳＤＵを受信ステーションのプロセッサ３８１０に具現されたＭＡＣ階層に送る。

【０２１３】

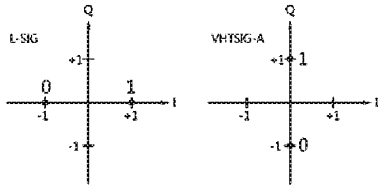
プロセッサ３８１０及び／または送受信機３８３０は、ＡＳＩＣ（ａｐｐｌｉｃａｔｉｏｎ－ｓｐｅｃｉｆｉｃ　ｉｎｔｅｇｒａｔｅｄ　ｃｉｒｃｕｉｔ）、他のチップセット、論理回路及び／またはデータ処理装置を含むことができる。メモリ３８２０は、ＲＯＭ（ｒｅａｄ－ｏｎｌｙ　ｍｅｍｏｒｙ）、ＲＡＭ（ｒａｎｄｏｍ　ａｃｃｅｓｓ　ｍｅｍｏｒｙ）、フラッシュメモリ、メモリカード、格納媒体及び／または他の格納装置を含むことができる。実施例がソフトウェアで具現される時、前述した技法は前述した機能を遂行するモジュール（過程、機能など）で具現されることができる。モジュールは、メモリ３８２０に格納され、プロセッサ３８１０により実行されることができる。メモリ３８２０は、プロセッサ３８１０の内部または外部にあり、よく知られた多様な手段でプロセッサ３８１０と連結されることができる。

【０２１４】

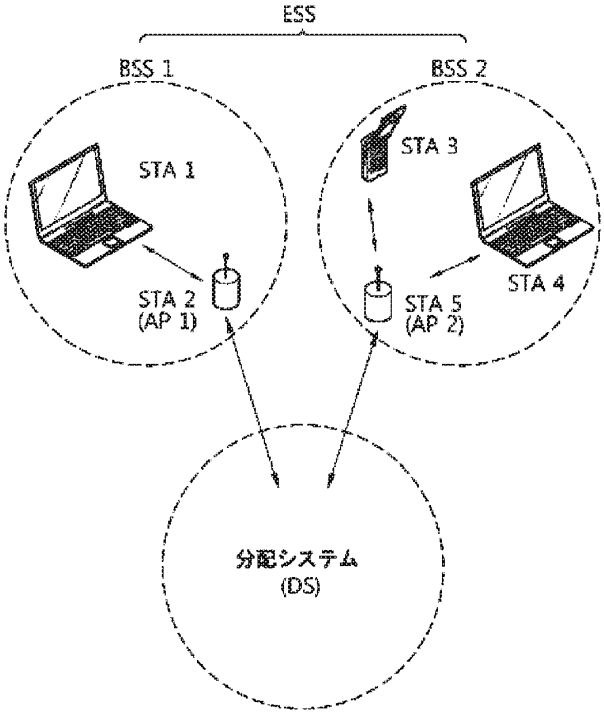
前述した実施例は多様な態様の例示を含む。多様な態様を示すための全ての可能な組合せを記述することはできないが、該当技術分野の通常の知識を有する者は、他の組合せが可能であることを認識することができる。従って、本発明は、特許請求の範囲に属する全ての交替、修正及び変更を含む。

【図６】

[Fig. 6]

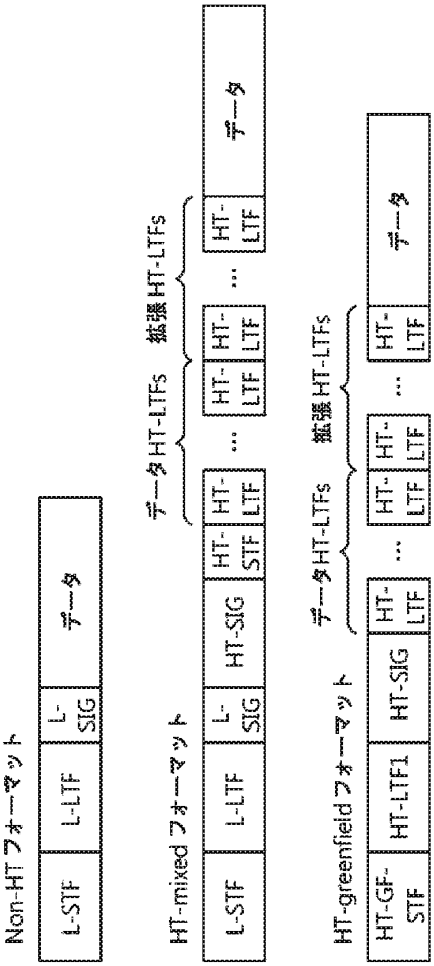

L-SIG
Q
I
+1
-1
0
1
VHTSIG-A
Q
I
+1
-1
1
0

【図１】


ESS
BSS 1
BSS 2
STA 1
STA 2
(AP 1)
STA 3
STA 4
STA 5
(AP 2)
分配システム
(DS)

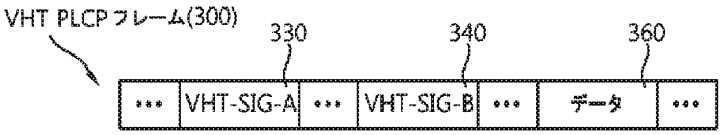
【図２】

【図２】


Non-HT フォーマット
L-STF
L-LTF
L-SIG
データ
HT-mixed フォーマット
L-STF
L-LTF
L-SIG
HT-SIG
HT-STF
HT-LTF
データ HT-LTFs
...
HT-LTF
拡張 HT-LTFs
HT-LTF
データ
HT-greenfield フォーマット
HT-GF-STF
HT-LTF1
HT-SIG
HT-LTF
データ HT-LTFs
...
HT-LTF
拡張 HT-LTFs
HT-LTF
データ

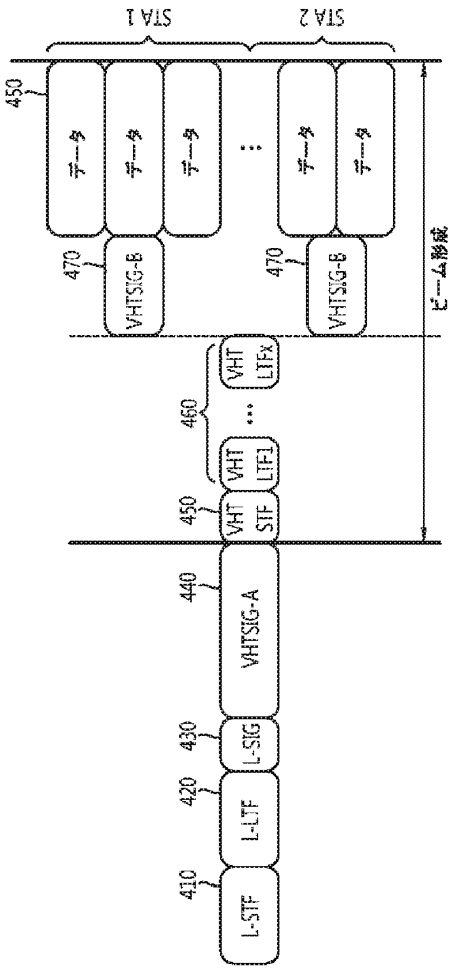
【図３】

【図３】


VHT PLCP フレーム(300)
330
340
360
...
VHT-SIG-A
...
VHT-SIG-B
...
データ
...

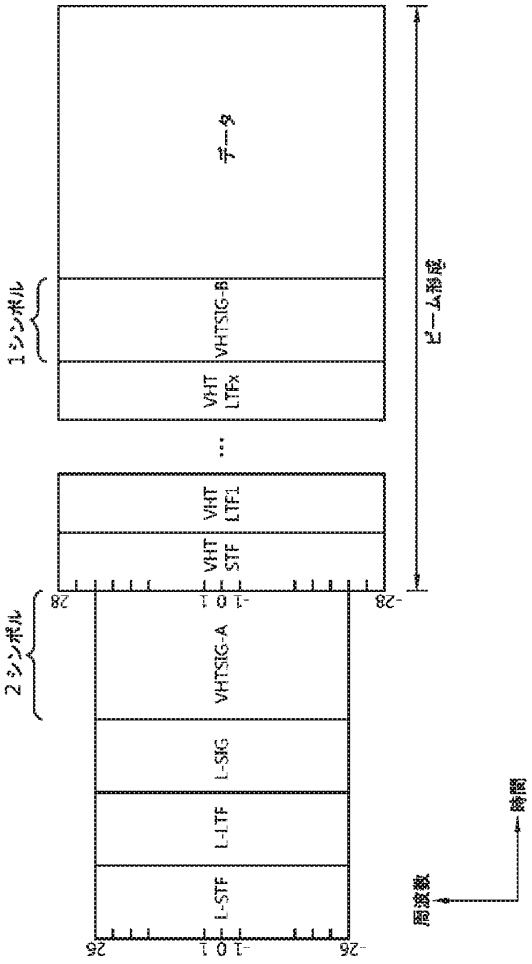
【図４】

【図４】


STA 1
STA 2
450
データ
データ
データ
データ
データ
470
VHTSIG-B
470
VHTSIG-B
ビーム形成
460
VHT LTFx
VHT LTF1
450
VHT STF
440
VHTSIG-A
430
L-SIG
420
L-LTF
410
L-STF

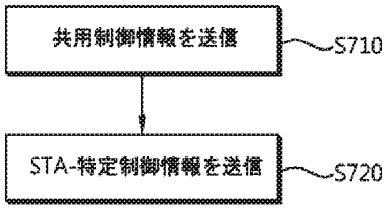
【図５】

【図５】


データ
VHTSIG-B
VHT LTFx
VHT LTF1
VHT STF
ビームforming
1シンボル
2シンボル
VHTSIG-A
L-SIG
L-LTF
L-STF
28
-28
26
-26
0
1
-1
時間
周波数

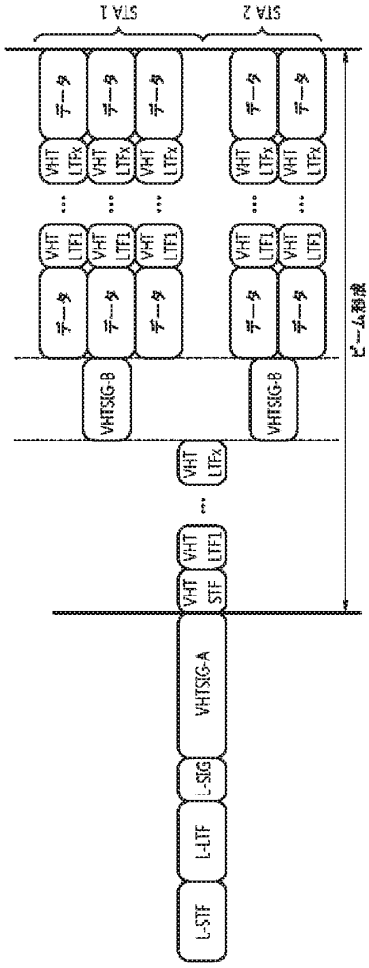
【図７】

【図７】


共用制御情報を送信
S710
STA-特定制御情報を送信
S720

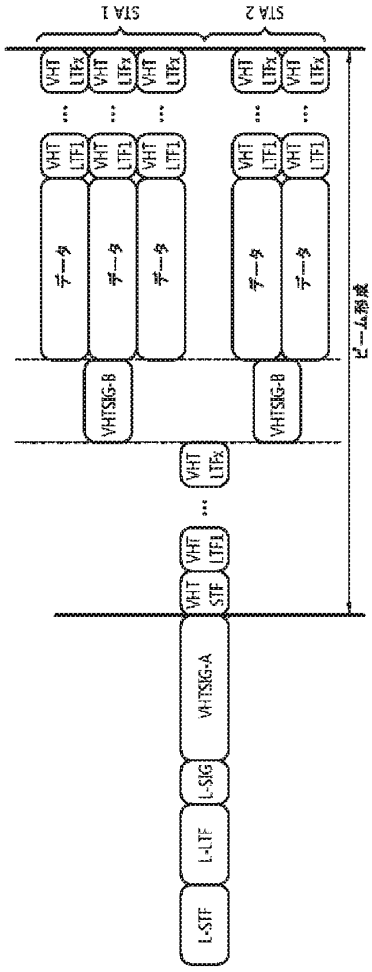
【図８】

【図８】


STA 1
STA 2
データ
VHT LTFx
VHT LTF1
VHTSIG-B
VHT LTFx
VHT LTF1
VHT STF
VHTSIG-A
L-SIG
L-LTF
L-STF
ビームフォーミング

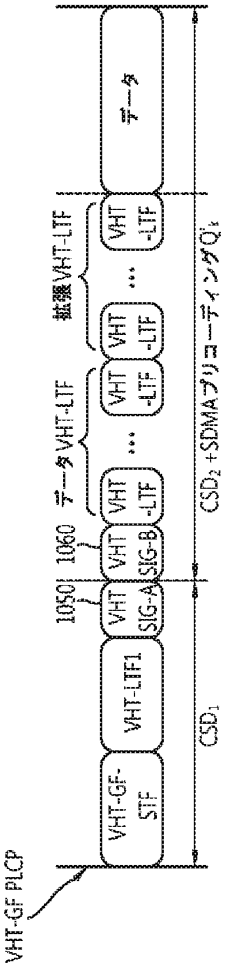
【図９】

【図９】


STA 1
STA 2
VHT LTFx
VHT LTF1
データ
VHTSIG-B
ビーム形成
VHT STF
VHTSIG-A
L-SIG
L-LTF
L-STF

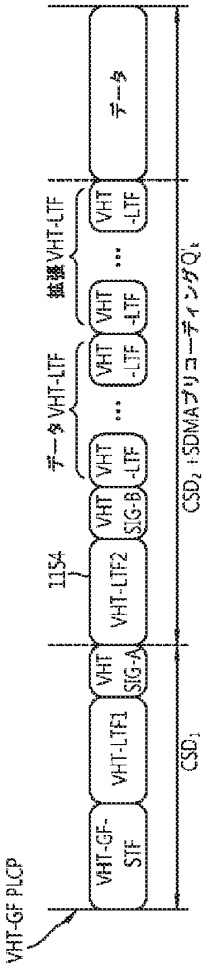
【図１０】

【図１０】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT-SIG-A
VHT-SIG-B
データVHT-LTF
VHT-LTF
拡張VHT-LTF
データ
1050
1060
CSD1
CSD2+SDMAプリコーディングQ1

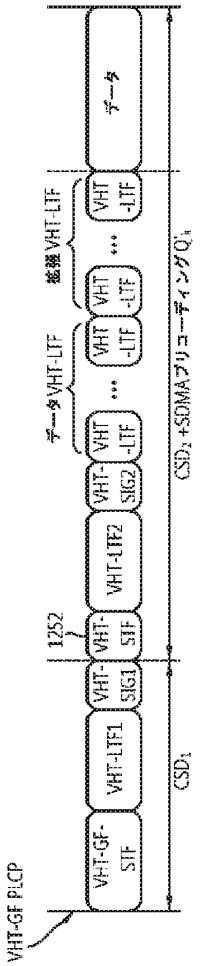
【図１１】

【図１１】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT SIG-A
1154
VHT-LTF2
VHT SIG-B
データVHT-LTF
VHT -LTF
拡張VHT-LTF
VHT -LTF
データ
CSD1
CSD2：SDMAプリコーディングQ1

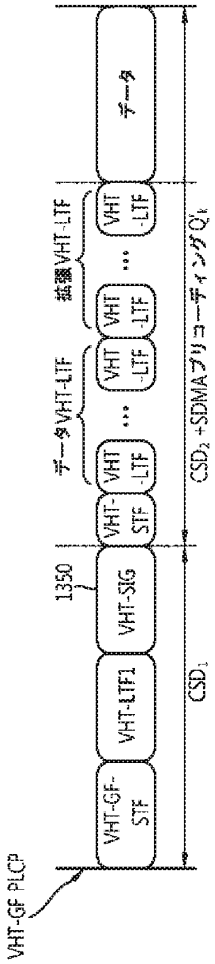
【図１２】

【図１２】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT-SIG1
VHT-STF
VHT-LTF2
VHT-SIG2
データVHT-LTF
VHT-LTF
拡張VHT-LTF
VHT-LTF
データ
1252
CSD1
CSD2+SDMAプリコーディングQ1

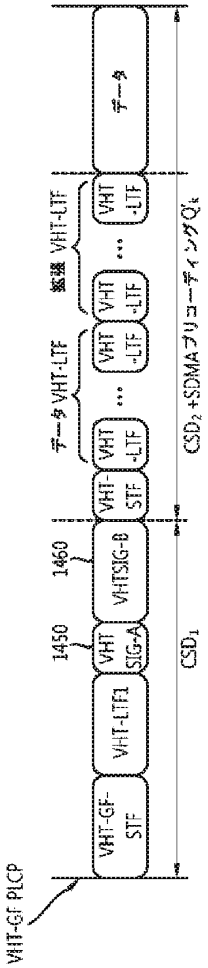
【図１３】

【図１３】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT-SIG
1350
VHT-STF
VHT-LTF
データVHT-LTF
VHT-LTF
拡張VHT-LTF
VHT-LTF
データ
CSD1
CSD2+SDMAプリコーディングQ1

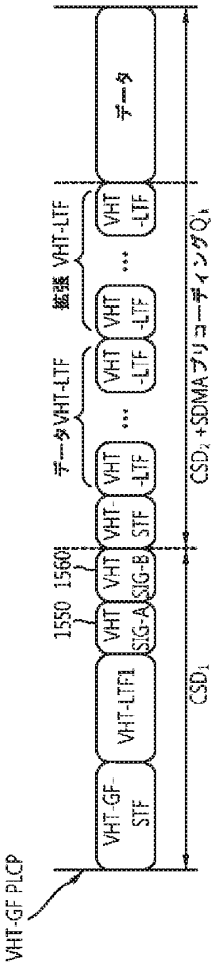
【図１４】

【図１４】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT-SIG-A
1450
VHTSIG-B
1460
VHT-STF
VHT-LTF
データ VHT-LTF
VHT-LTF
拡張 VHT-LTF
VHT-LTF
データ
CSD1
CSD2+SDMAプリコーディングQk

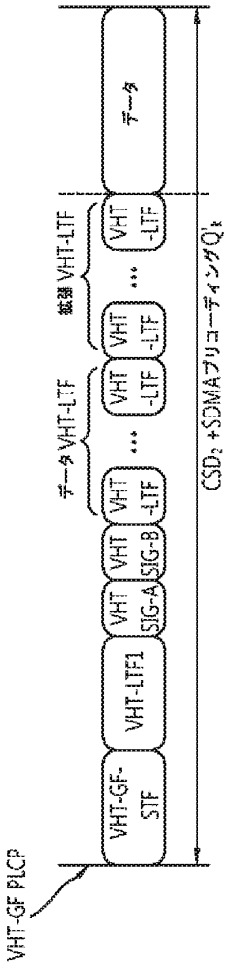
【図１５】

【図１５】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT-SIG-A
1550
VHT-SIG-B
1560
VHT-STF
データVHT-LTF
VHT-LTF
拡張VHT-LTF
データ
CSD1
CSD2+SDMAプリコーディングQ1

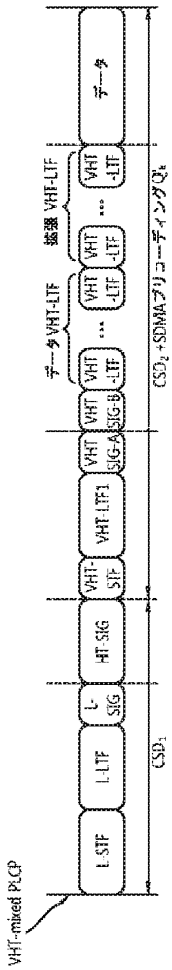
【図１６】

【図１６】


VHT-GF PLCP
VHT-GF-STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
データVHT-LTF
VHT -LTF
…
VHT -LTF
拡張VHT-LTF
VHT -LTF
…
VHT -LTF
データ
CSD₁ +SDMAプリコーディングQ₁

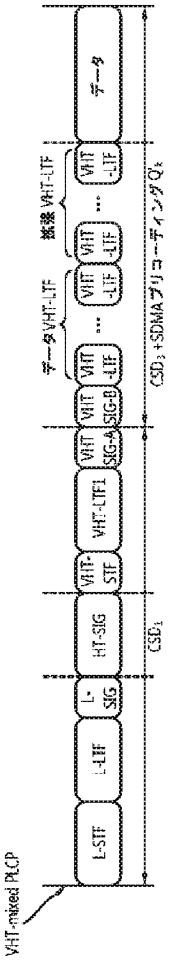
【図１７】

【図１７】


VHT-mixed PLCP
L-STF
L-LTF
L-SIG
HT-SIG
VHT-STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
データVHT-LTF
VHT LTF
拡張 VHT-LTF
VHT LTF
データ
CSD_1
CSD_2 +SDMAプリコーディングQ_k

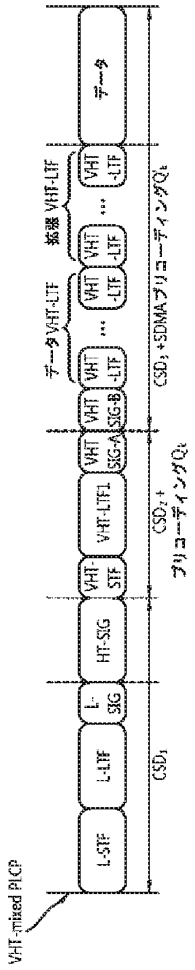
【図１８】

【図１８】


VHT-mixed PLCP
L-STF
L-LTF
L-SIG
HT-SIG
VHT-STF
VHT-LTF1
VHT-SIG-A
VHT-SIG-B
データVHT-LTF
VHT-LTF
VHT-LTF
拡張 VHT-LTF
VHT-LTF
VHT-LTF
データ
CSD1
CSD2+SDMAプリコーディングQ1

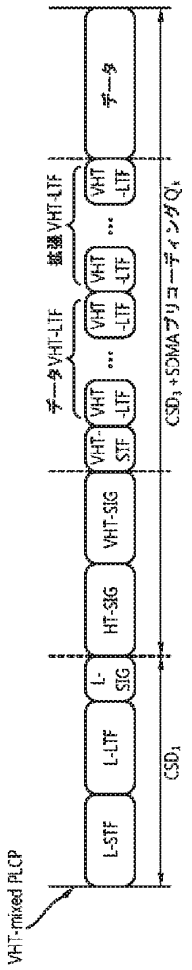
【図１９】

【図１９】


VHT-mixed PLCP
L-STF
L-LTF
L-SIG
HT-SIG
VHT STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
VHT -LTF
データVHT-LTF
VHT -LTF
…
拡張 VHT-LTF
VHT -LTF
データ
CSD1
CSD2+ プリコーディングQ1
CSD3+SDMAプリコーディングQ1

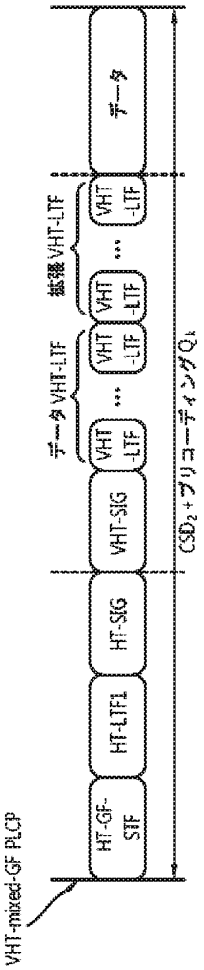
【図２０】

【図２０】


VHT-mixed PLCP
L-STF
L-LTF
L-SIG
HT-SIG
VHT-SIG
VHT-STF
VHT-LTF
データVHT-LTF
最後VHT-LTF
データ
CSD1
CSD2+SDMAプリコーディングQ1

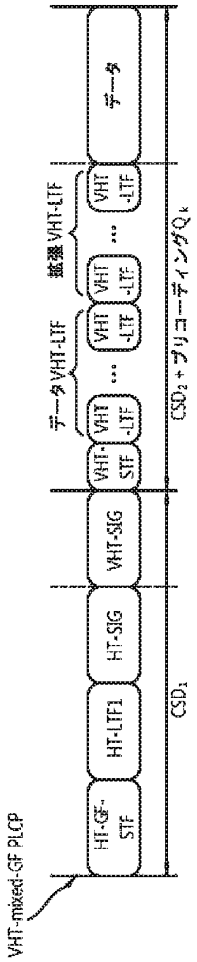
【図２１】

【図２１】


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG
データVHT-LTF
VHT-LTF
VHT-LTF
基礎VHT-LTF
VHT-LTF
VHT-LTF
データ
CSD₂+プリコーディングQ₁

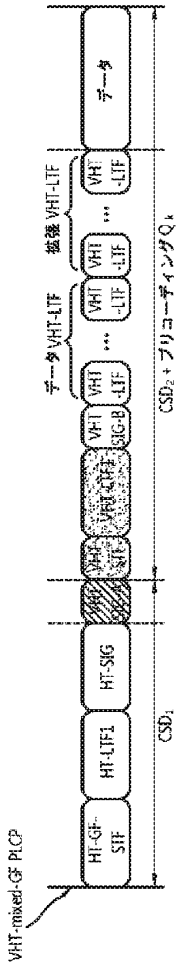
【図２２】

【図２２】


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG
VHT-STF
VHT-LTF
データVHT-LTF
拡張VHT-LTF
データ
CSD1
CSD2+プリコーディングQk

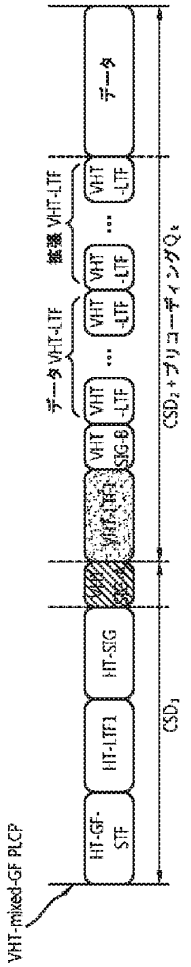
【図２３】

【図２３】


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-STF
VHT-LTF
VHT-SIG-B
データVHT-LTF
拡張VHT-LTF
データ
CSD_1
CSD_2＋プリコーディングQ_1

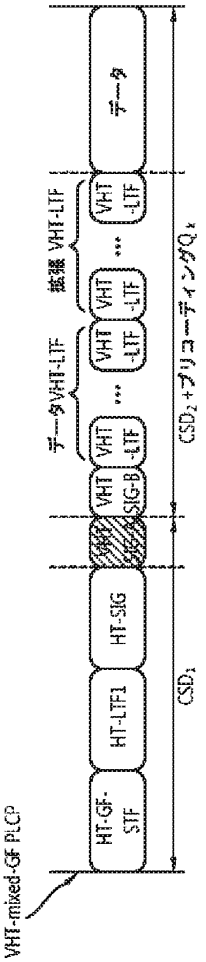
【図２４】

【図２４】


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG-A
VHT-SIG-B
VHT-LTF
VHT-LTF
VHT-LTF
データ
データVHT-LTF
拡張VHT-LTF
CSD1
CSDn+プリコーディングQn

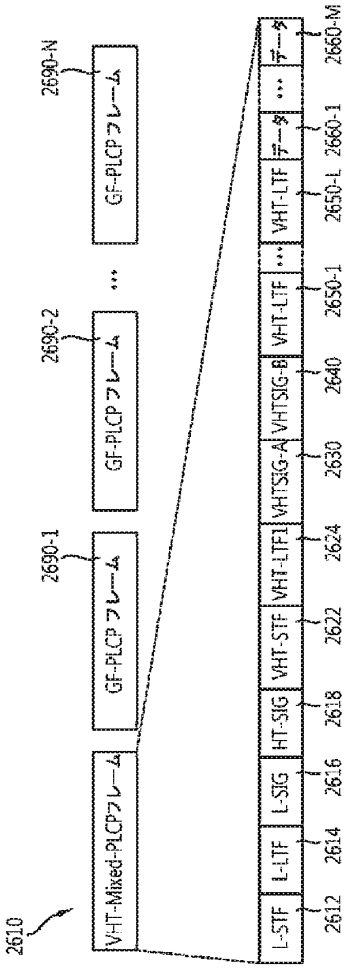
【図２５】

【図２５】


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG-B
VHT-LTF
データVHT-LTF
拡張VHT-LTF
データ
CSD1
CSD2+プリコーディングQ1

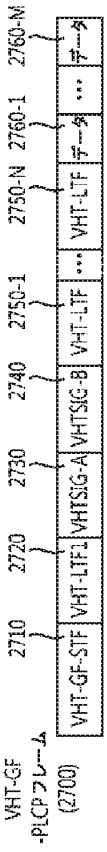
【図２６】

【図２６】


2610
V-HT-Mixed-PLCPフレーム
GF-PLCP フレーム
GF-PLCP フレーム
GF-PLCP フレーム
2690-1
2690-2
2690-N
L-STF
L-LTF
L-SIG
HT-SIG
VHT-STF
VHT-LTF1
VHTSIG-A
VHTSIG-B
VHT-LTF
VHT-LTF
VHT-LTF
データ
データ
2612
2614
2616
2618
2622
2624
2630
2640
2650-1
2650-L
2660-1
2660-M

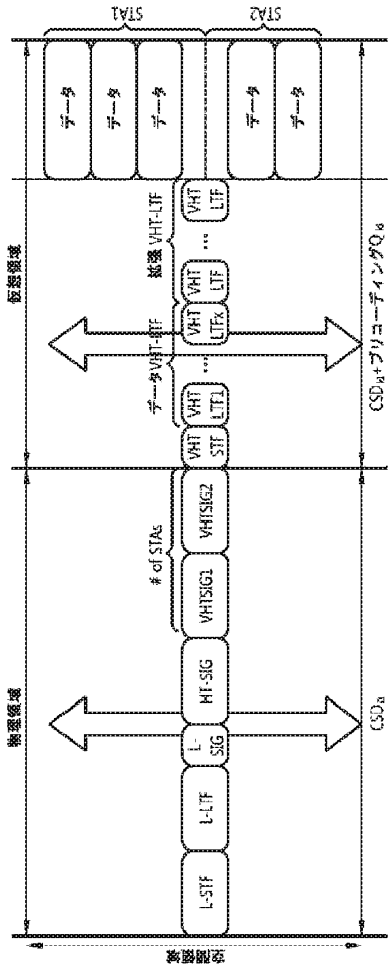
【図２７】

【図２７】


VHT-GF
-PLCPフレーム
(2700)
2710
2720
2730
2740
2750-1
2750-N
2760-1
2760-M
VHT-GF-STF
VHT-LTF1
VHTSIG-A
VHTSIG-B
VHT-LTF
VHT-LTF
VHT-LTF
データ
データ
…

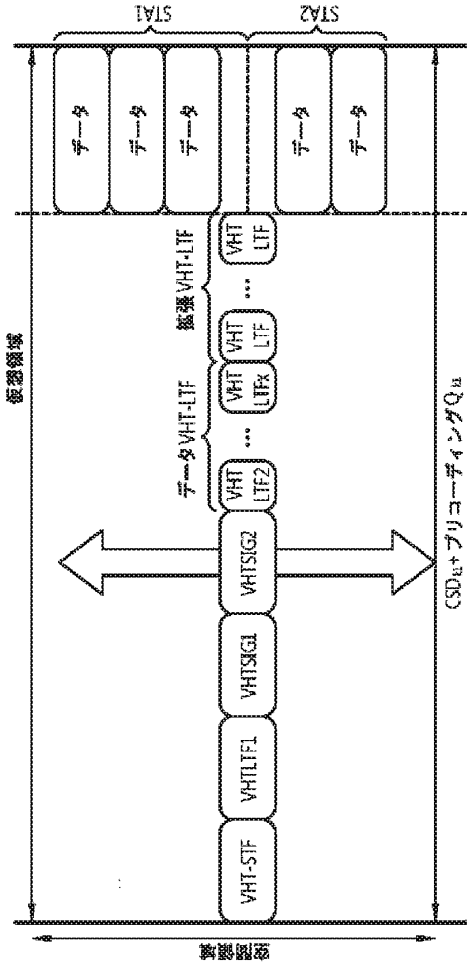
【図２８】

【図２８】


STA1
STA2
データ
データ
データ
データ
データ
仮想領域
拡張 VHT-LTF
VHT LTF
VHT LTFx
データ VHT-LTF
VHT LTF1
VHT STF
CSD$_M$+プリコーディングQ_M
of STAs
VHTSIG2
VHTSIG1
HT-SIG
L SIG
L-LTF
L-STF
物理領域
CSD$_n$
時間

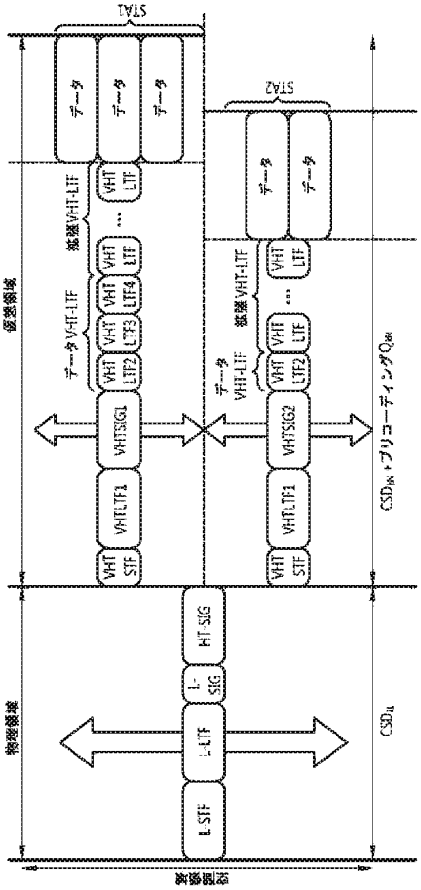
【図２９】

【図２９】


STA1
STA2
データ
データ
データ
データ
データ
拡張VHT-LTF
VHT LTF
VHT LTF
VHT LTFx
データVHT-LTF
VHT LTF2
VHTSIG2
VHTSIG1
VHTLTF1
VHT-STF
CSD+プリコーディングQ

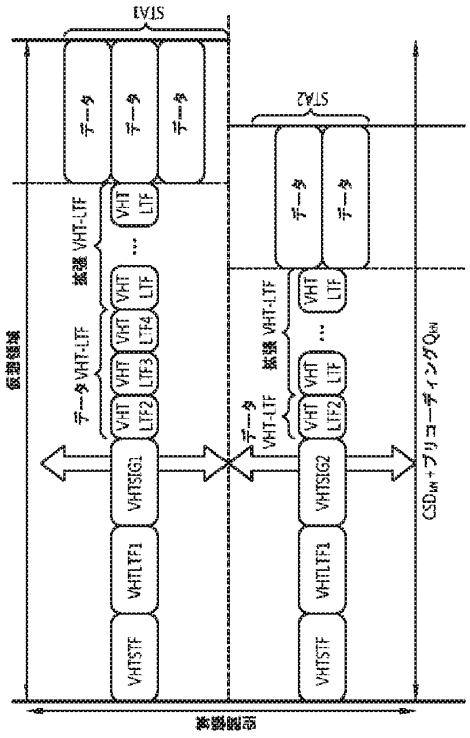
【図３０】

【図３０】


STA1
STA2
データ
VHT LTF
拡張VHT-LTF
データVHT-LTF
VHT LTF2
VHT LTF3
VHT LTF4
VHTSIG1
VHTSIG2
VHT-LTF1
VHT STF
データ VHT-LTF
送信領域
CSD$_{VHT}$+プリコーディングQ_{VHT}
物理領域
HT SIG
L-SIG
L-LTF
L-STF
CSD$_{L}$
送信装置

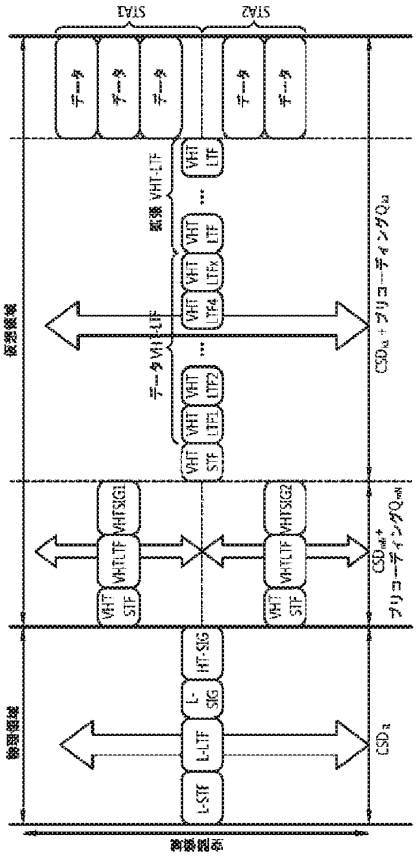
【図３１】

【図３１】


STA1
STA2
データ
VHT-LTF
VHT LTF
VHT LTF4
VHT LTF3
VHT LTF2
拡張 VHT-LTF
データ VHT-LTF
VHTSIG1
VHTSIG2
VHTLTF1
VHTSTF
仮想領域
送信機部
CSD$_M$+プリコーディングQ_M

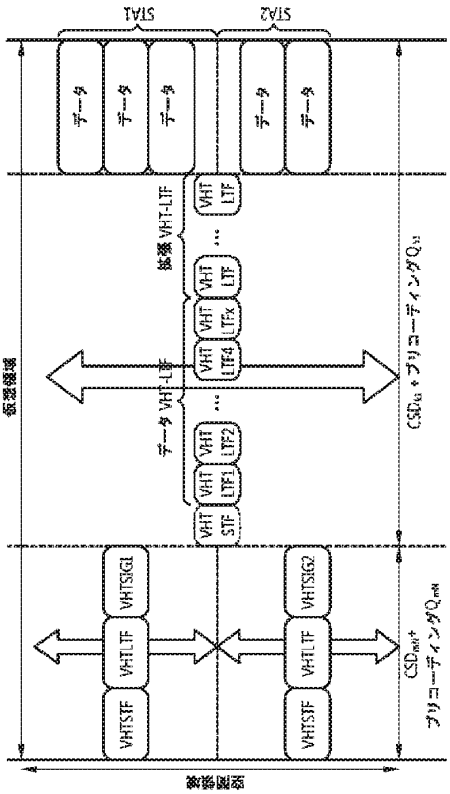
【図３２】

【図３２】


STA1
STA2
データ
VHT-LTF
VHT LTF
VHT LTF1
VHT LTF2
VHT LTF4
VHT STF
VHT-SIGA1
VHT-SIGA2
VHT-LTF
L-STF
L-LTF
L-SIG
HT-SIG
CSD
プリコーディング
周波数

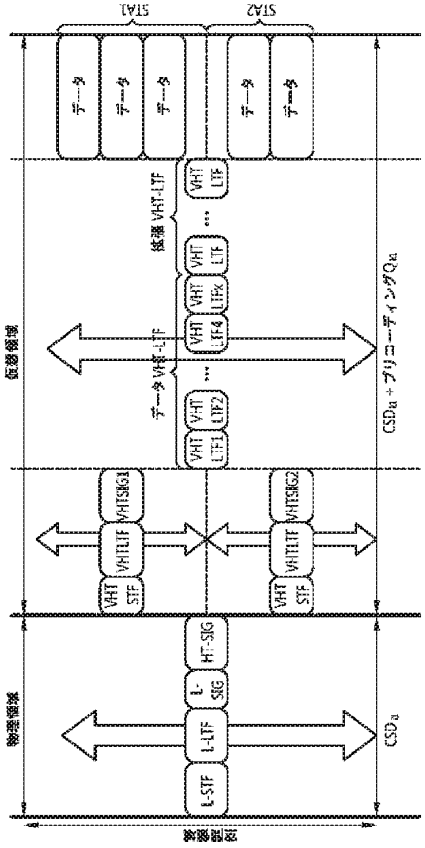
【図３３】

【図３３】


STA1
STA2
データ
データ
データ
データ
データ
VHT LTF
VHT LTF
VHT LTFx
VHT LTF4
VHT LTF2
VHT LTF1
VHT STF
拡張 VHT-LTF
データ VHT-LTF
VHTSIG1
VHTSIG2
VHTLTF
VHTSTF
VHTLTF
VHTSTF

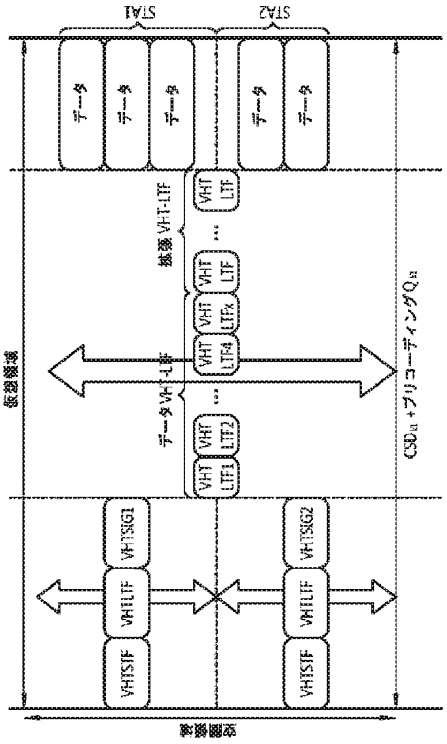
【図３４】

【図３４】


STA1
STA2
データ
データ
データ
データ
データ
VHT LTF
VHT LTF
VHT LTFs
VHT LTF4
VHT LTF2
VHT LTF1
VHT SIG3
VHT SIG2
VHT STF
VHT LTF
VHT STF
HT-SIG
L-SIG
L-LTF
L-STF

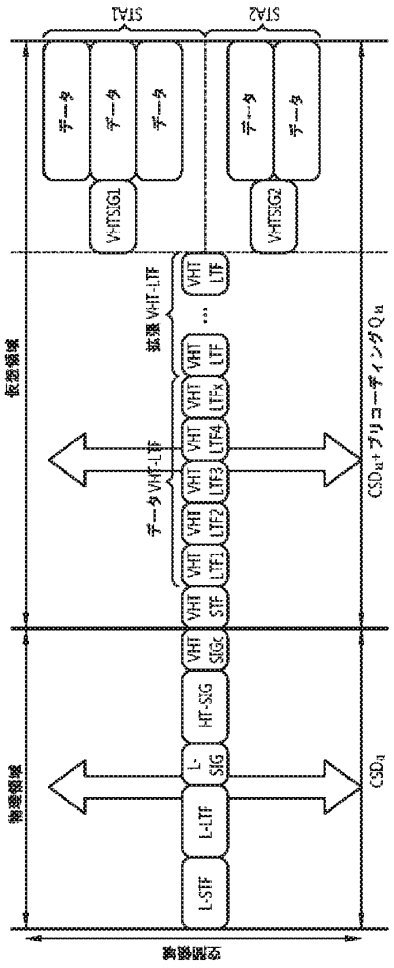
【図３５】

【図３５】


STA1
STA2
データ
データ
データ
データ
データ
VHT LTF
VHT LTF
VHT LTF6
VHT LTF4
VHT LTF2
VHT LTF1
VHT-SIG1
VHT-LTF
VHT-SIG2
VHT-LTF
VHT-STF
VHT-STF

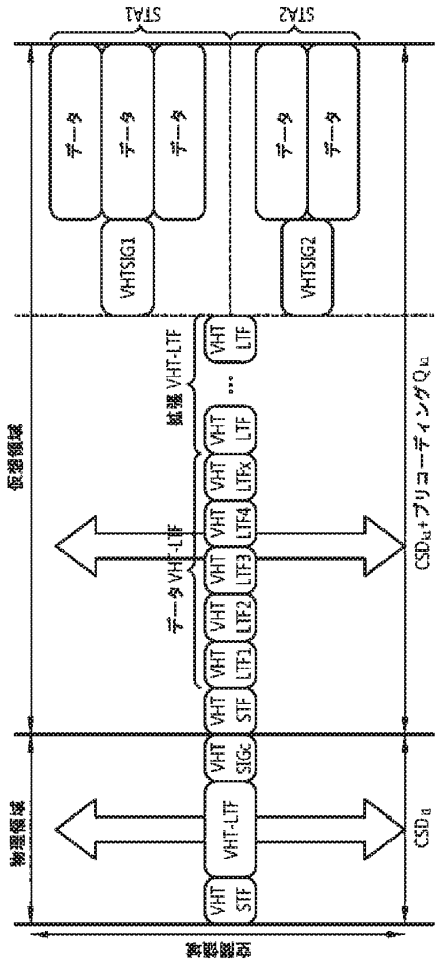
【図３６】

【図３６】


STA1
STA2
データ
データ
データ
データ
データ
VHT-SIG1
VHT-SIG2
拡張 VHT-LTF
VHT LTF
VHT LTFx
VHT LTF4
VHT LTF3
VHT LTF2
VHT LTF1
データ VHT-LTF
VHT STF
VHT SIGc
HT-SIG
L-SIG
L-LTF
L-STF
仮想領域
物理領域
CSD(4)+プリコーディングQ4
CSD1
空間領域

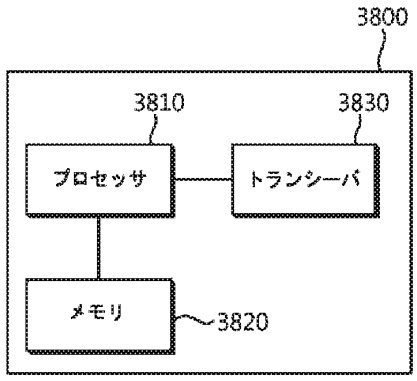
【図３７】

【図３７】



【図３８】

【図３８】



【手続補正書】
【提出日】平成24年3月1日(2012.3.1)

【手続補正１】
【補正対象書類名】特許請求の範囲
【補正対象項目名】全文
【補正方法】変更
【補正の内容】
【特許請求の範囲】
【請求項１】
無線ローカルエリアネットワーク（ＷＬＡＮ）システムにおいてアクセスポイントによって制御情報を送信する方法であって、前記方法は、
前記アクセスポイントによって、複数のターゲットステーションによって共通に受信される制御情報を含む第１の超高処理率制御信号（ＶＨＴＳＩＧ－Ａ）を含む第１の制御シーケンスを生成することと、
前記アクセスポイントによって、前記複数のターゲットステーションの各々によって特異的に受信される制御情報を含む第２の超高処理率制御信号（ＶＨＴＳＩＧ－Ｂ）を含む第２の制御シーケンスを生成することと、
前記第１の制御シーケンスを変調させることによって、前記アクセスポイントによって、第１の時間領域の信号を生成することと、
前記第２の制御シーケンスを変調させることによって、前記アクセスポイントによって、第２の時間領域の信号を生成することと、
前記アクセスポイントによって、前記第１の時間領域の信号と前記第２の時間領域の信号とを前記複数のステーションに送信することと
を含む、方法。
【請求項２】
前記第２の制御シーケンスを変調させるステップの前に、プリコード化された第２の制御信号を形成するために、マルチユーザの複数の入力および複数の出力（ＭＵ－ＭＩＭＯ）のステアリング行列を前記第２の制御シーケンスに適用することをさらに含む、請求項１に記載の方法。
【請求項３】
前記ＶＨＴＳＩＧ－Ｂは、変調およびコーディング方式（ＭＣＳ）のインデックスを含み、前記ＭＣＳインデックスは、前記送信するステップにおいて使用されたＭＣＳを指示する、請求項１に記載の方法。
【請求項４】
前記ＶＨＴＳＩＧ－Ａは、前記送信するステップにおいて使用されたチャネル幅を指示するチャネル帯域幅識別子と、前記送信するステップにおいて使用された、前記複数のターゲットステーションの各々のための空間ストリームの数を指示する空間ストリーム識別子とを含む、請求項１に記載の方法。
【請求項５】
前記ＶＨＴＳＩＧ－Ａは、第１の数の情報ビット／シンボルからなり、前記ＶＨＴＳＩＧ－Ｂは、前記第１の数のビット／シンボルより多い第２の数の情報ビット／シンボルからなる、請求項１に記載の方法。
【請求項６】
前記第１の数の情報ビット／シンボルは、２４であり、前記第２の数の情報ビット／シンボルは、少なくとも２６である、請求項５に記載の方法。
【請求項７】
無線ローカルエリアネットワーク（ＷＬＡＮ）システムにおいて制御情報を送信する無線装置であって、前記装置は、プロセッサを含み、前記プロセッサは、
複数のターゲットステーションによって共通に受信される制御情報を含む第１の超高処理率制御信号（ＶＨＴＳＩＧ－Ａ）を含む第１の制御シーケンスを生成することと、
前記複数のターゲットステーションの各々によって特異的に受信される制御情報を含む第２の超高処理率制御信号（ＶＨＴＳＩＧ－Ｂ）を含む第２の制御シーケンスを生成する

こと、
前記第１の制御シーケンスを変調させることによって、第１の時間領域の信号を生成することと、
前記第２の制御シーケンスを変調させることによって、第２の時間領域の信号を生成することと、
前記第１の時間領域の信号と前記第２の時間領域の信号とを前記複数のステーションに送信することと
を行うように構成されている、装置。
【請求項８】
前記プロセッサは、前記第２の制御シーケンスを変調させるステップの前に、プリコード化された第２の制御信号を形成するために、マルチユーザの複数の入力および複数の出力（ＭＵ－ＭＩＭＯ）のステアリング行列を前記第２の制御シーケンスに適用するようにさらに構成されている、請求項７に記載の装置。
【請求項９】
前記ＶＨＴＳＩＧ－Ｂは、変調およびコーディング方式（ＭＣＳ）のインデックスとを含み、前記ＭＣＳインデックスは、前記送信するステップにおいて使用されたＭＣＳを指示する、請求項７に記載の装置。
【請求項１０】
前記ＶＨＴＳＩＧ－Ａは、前記送信するステップにおいて使用されたチャネル幅を指示するチャネル帯域幅識別子と、前記送信するステップにおいて使用された、前記複数のターゲットステーションの各々のための空間ストリームの数を指示する空間ストリーム識別子とを含む、請求項７に記載の装置。
【請求項１１】
前記ＶＨＴＳＩＧ－Ａは、第１の数の情報ビット／シンボルからなり、前記ＶＨＴＳＩＧ－Ｂは、前記第１の数のビット／シンボルより多い第２の数の情報ビット／シンボルからなる、請求項７に記載の装置。
【請求項１２】
前記第１の数の情報ビット／シンボルは、２４であり、前記第２の数の情報ビット／シンボルは、少なくとも２６である、請求項１１に記載の装置。

【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】００２３
【補正方法】変更
【補正の内容】
【００２３】
前記第１の制御情報と前記第２の制御情報は、互いに異なる循環シフトが適用される。本発明は、例えば以下の項目を提供する。
（項目１）
無線ＬＡＮシステムにおける制御情報を送信する方法において、
第１の制御情報を循環シフト遅延ダイバーシティビーム形成により送信し；及び、
第２の制御情報を送信する；ことを含み、
前記第１の制御情報は、前記第２の制御情報の複数のターゲットステーションの各々が前記第２の制御情報の受信に必要な情報を含み、
前記第２の制御情報は、ビーム形成され、前記複数のターゲットステーションに送信されることを特徴とする方法。
（項目２）
前記第１の制御情報は、前記複数のターゲットステーションに対して空間多重化されたＳＤＭＡ（ｓｐａｔａｉｌ ｄｉｖｉｓｉｏｎ ｍｕｌｔｉｐｌｅ ａｃｃｅｓｓ）データの送信に所要される送信時間情報をさらに含むことを特徴とする項目１に記載の方法。

（項目３）
前記第２の制御情報は、前記複数のターゲットステーションの各々に対する制御情報を含むことを特徴とする項目１に記載の方法。
（項目４）
前記複数のターゲットステーションの各々に対する前記制御情報は、ＭＣＳ（ｍｏｄｕｌａｔｉｏｎ ａｎｄ ｃｏｄｉｎｇ ｓｃｈｅｍｅ）情報、チャネル帯域幅情報、空間ストリーム（ｓｐａｔｉａｌ ｓｔｒｅａｍ）個数情報、送信パワー情報のうち少なくともいずれか一つであることを特徴とする項目３に記載の方法。
（項目５）
前記第１の制御情報及び前記第２の制御情報は、第１のフレームを介して送信され、
前記第２の制御情報は、前記第１のフレームの以後に送信される一つ以上の第２のフレーム送信に所要される送信時間情報をさらに含むことを特徴とする項目１に記載の方法。
（項目６）
前記第１の制御情報の送信に割り当てられるＯＦＤＭ（Ｏｒｔｈｏｇｏｎａｌ Ｆｒｅｑｕｅｎｃｙ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅｘｉｎｇ）シンボル当たり副搬送波の個数は、前記第２の制御情報の送信に割り当てられるＯＦＤＭシンボル当たり副搬送波の個数より小さい項目１に記載の方法。
（項目７）
前記共用制御情報の送信に割り当てられるＯＦＤＭシンボルの個数は、前記ＳＴＡ－特定制御情報の送信に割り当てられるＯＦＤＭシンボルの個数より多い項目６に記載の方法。
（項目８）
前記共用制御情報の以前のＯＦＤＭシンボルを介して前記共用制御情報の受信に使われるチャネル推定のための第１のＬＴＦ（Ｌｏｎｇ Ｔｒａｎｉｎｇ Ｆｉｅｌｄ）が送信されることをさらに含む項目７に記載の方法。
（項目９）
前記共用制御情報と前記ＳＴＡ－特定制御情報との間のＯＦＤＭシンボルを介して前記ＳＴＡ－特定制御情報の受信に使われるチャネル推定のための第２のＬＴＦが送信されることをさらに含む項目７に記載の方法。
（項目１０）
前記第２のＬＴＦと前記ＳＴＡ－特定制御情報は、同じプリコーディング行列を用いてビーム形成される項目９に記載の方法。
（項目１１）
前記第１の制御情報と前記第２の制御情報は、互いに異なる循環シフトが適用される項目１に記載の方法。
（項目１２）
プロセッサ；及び、
前記プロセッサと機能的に連結され、フレームを送信及び受信するトランシーバ；を含み、
前記プロセッサは、第１の制御情報を全方向（ｏｍｎｉ－ｄｉｒｅｃｔｉｏｎａｌ）に送信し、
第２の制御情報を送信するように設定され、
前記第１の制御情報は、前記第２の制御情報の複数のターゲットステーションの各々が前記第２の制御情報の受信に必要な情報を含み、
前記第２の制御情報は、ビーム形成され、前記複数のターゲットステーションに送信されることを特徴とする無線装置。

【国際調査報告】

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2010/006093

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/06(2006.01)i, H04L 27/26(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B 7/06; H04B 7/04; H04L 27/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: control information , CDD , SDMA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008-100093 A1 (SAMSUNG ELECTRONICS CO., LTD.) 21 August 2008 See abstract; claims 1,2,4-8; Fig.8	1-12
A	WO 2008-032979 A1 (SAMSUNG ELECTRONICS CO., LTD.) 20 March 2008 See abstract; claims 2,3	1-12

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 MAY 2011 (20.05.2011)	**23 MAY 2011 (23.05.2011)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 189 Cheongsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer KIM Byeong Gyun Telephone No. 82-42-481-8300

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008-100093 A1	21.08.2008	AU 2008-215225 A1	21.08.2008
		CA 2677032 A1	21.08.2008
		CN 101611566 A	23.12.2009
		EP 1959585 A2	20.08.2008
		JP 2010-516215 A	13.05.2010
		KR 10-2008-0076682 A	20.08.2008
		US 2008-0225984 A1	18.09.2008
WO 2008-032979 A1	20.03.2008	KR 10-0899744 B1	27.05.2009
		US 2008-0080421 A1	03.04.2008

Form PCT/ISA/210 (patent family annex) (July 2009)

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FF05 GG01 KK02
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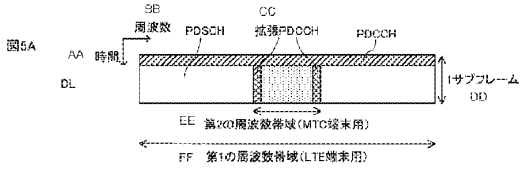
(81) 指定国 (表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

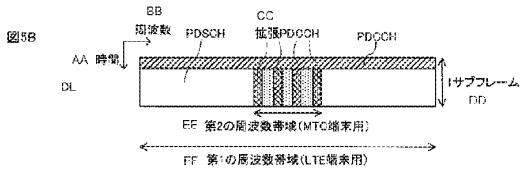
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[続葉有]

(54) Title: BASE STATION DEVICE, WIRELESS COMMUNICATIONS TERMINAL, WIRELESS COMMUNICATIONS SYSTEM, AND WIRELESS COMMUNICATIONS METHOD

(54) 発明の名称 : 基地局装置、無線通信端末、無線通信システム及び無線通信方法





AA Time
BB Frequency
CC Expanded PDCCH
DD 1 sub-frame
EE Second frequency band (for MTC terminals)
FF First frequency band (for LTE terminals)

(57) **Abstract**: The purpose of the present invention is to provide a base station device, a wireless communications terminal, a wireless communications system, and a wireless communications method whereby the costs required for an MTC terminal can be reduced, when adopting an LTE system in a network domain for a machine-to-machine communications system. The base station device communicates with a first communications terminal by using a first frequency band and communicates with second communications terminals by using a second frequency band that has a narrower bandwidth than the first frequency band. Provided in a prescribed frequency area of the second frequency band are: an allocation control unit that arranges expanded downlink control channels that frequency-division multiplex with downlink shared data channels; and a mapping unit that maps shared control signals shared between at least the second communications terminals, to a shared search space for the expanded downlink control channels.

(57) 要約: マシン通信システムのネットワークドメインにＬＴＥシステムを採用する場合に、ＭＴＣ端末に要求されるコストを低減可能な基地局装置、無線通信端末、無線通信システム及び無線通信方法を提供すること。第１の周波数帯域で第１の通信端末と通信を行うと共に、第１の周波数帯域より帯域幅が狭い第２の周波数帯域で第２の通信端末と通信を行う基地局装置であって、第２の周波数帯域の所定の周波数領域に、下り共有データチャネルと周波数分割多重する拡張下り制御チャネルを配置する割当て制御部と、拡張下り制御チャネルの共通サーチスペースに、少なくとも第２の通信端末間で共有する共通制御信号をマッピングするマッピング部とを設ける。

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NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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明 細 書

発明の名称 :

基地局装置、無線通信端末、無線通信システム及び無線通信方法

技術分野

[0001] 本発明は、マシン通信システムに適用可能な基地局装置、無線通信端末、無線通信システム及び無線通信方法に関する。

背景技術

[0002] 近年、機器間の自律的なコミュニケーションによりサービスを提供するマシン通信（Machine-to-Machine Communication）に関する技術開発が進められている。欧州電気通信標準化機構（ＥＴＳＩ）は、マシン通信システムの参照モデルとして、アプリケーションドメイン（Application Domain）、ネットワークドメイン（Network Domain）、デバイスドメイン（Device Domain）の３つのドメインを定義している。このうち、デバイスドメインにおいて、既に、電気、ガス、水道といったライフライン制御、高速道路交通システム（Intelligent Transport System（ＩＴＳ））などのアプリケーションの実用化が検討されている。

[0003] ネットワークドメインにおいては、３ＧＰＰ（Third Generation Partnership Project）の規定に基づくセルラーシステムの採用が有力視されている。このため、３ＧＰＰにおいても、ＭＴＣ（Machine Type Communication）として定義されるマシン通信の標準化活動が開始されている（非特許文献１）。

先行技術文献

非特許文献

[0004] 非特許文献1：3GPP, TS22.368 (V10.5.0), “MTC communication aspects”, Jun. 2011

発明の概要

発明が解決しようとする課題

[0005] ところで、３ＧＰＰにおいて合意されたＬＴＥ（Long Term Evolution）においては、１．４ＭＨｚ～２０ＭＨｚの可変帯域を用いて、下りで最大３００Ｍｂｐｓ及び上りで７５Ｍｂｐｓ程度の伝送レートが実現される。しかし、ＭＴＣは、比較的低速な通信環境を前提として検討されており、ＬＴＥシステム（Ｒｅｌ．８／９／１０及びそれ以降のバージョンを含む）をそのままＭＴＣに適用すると不都合が生じてしまう。例えば、ＭＴＣシステムに対する条件は、下りが１１８．４ｋｂｐｓ、上りが５９．２ｋｂｐｓというように、ＬＴＥシステムほどには高くない。このため、ＭＴＣシステムに適合させた無線通信端末（以下、ＭＴＣ端末）にＬＴＥシステムの要求条件を満足させようとするとオーバースペックとなり、製造コストが増大してしまう。

[0006] 本発明はかかる点に鑑みてなされたものであり、マシン通信システムのネットワークドメインにＬＴＥシステムを採用する場合に、ＭＴＣ端末に要求されるコストを低減可能な無線通信端末、基地局装置、無線通信システム及び無線通信方法を提供することを目的とする。

課題を解決するための手段

[0007] 本発明の基地局装置は、第１の周波数帯域で第１の通信端末と通信を行うと共に、前記第１の周波数帯域より帯域幅が狭い第２の周波数帯域で第２の通信端末と通信を行う基地局装置であって、前記第２の周波数帯域の所定の周波数領域に、下り共有データチャネルと周波数分割多重する拡張下り制御チャネルを配置する割当て制御部と、前記拡張下り制御チャネルの共通サーチスペースに、少なくとも前記第２の通信端末間で共有する共通制御信号をマッピングするマッピング部と、を有することを特徴とする。

発明の効果

[0008] 本発明によれば、マシン通信システムのネットワークドメインにＬＴＥシステムを採用する場合に、ＭＴＣ端末に要求されるコストを低減できる。

図面の簡単な説明

[0009] [図1]本実施の形態に係る無線通信システムのシステム構成を説明するための

図である。

[図2]既存ＰＤＣＣＨが配置される場合のサブフレーム構成の説明図である。

[図3]拡張ＰＤＣＣＨが配置される場合のサブフレーム構成の説明図である。

[図4]ＬＴＥ端末とＭＴＣ端末の周波数帯域の関係の一例を説明する図である。

[図5]本実施の形態に係る拡張ＰＤＣＣＨを配置する場合のサブフレーム構成の一例を示す図である。

[図6]本実施の形態に係る拡張ＰＤＣＣＨを配置する場合のサブフレーム構成の他の一例を示す図である。

[図7]本実施の形態に係る基地局装置の全体構成を示すブロック図である。

[図8]本実施の形態に係る無線通信端末の全体構成を示すブロック図である。

[図9]ＭＴＣ端末の送受信ポートの構成例について説明する回路図である。

[図10]本実施の形態に係る基地局装置のベースバンド処理部の構成を示すブロック図である。

[図11]本実施の形態に係る無線通信端末のベースバンド処理部の構成を示すブロック図である。

発明を実施するための形態

[0010] まず、図１を参照して、本実施の形態に係る無線通信システムについて説明する。図１に示す無線通信システムは、マシン通信システムのネットワークドメインにＬＴＥシステムを採用した一例である。ＬＴＥ－Ａｄｖａｎｃｅｄ（Ｒｅｌ．１０及びそれ以降のバージョンを含む）をサポートする無線通信システムでは、最大２０ＭＨｚを１単位とする基本周波数ブロック（コンポーネントキャリア）を複数使用して、システム帯域を最大で１００ＭＨｚまで拡張するキャリアアグリゲーション（ＣＡ）が採用されている。以下の説明では、一例として、ＬＴＥシステムが下りリンク及び上りリンク共に最大２０ＭＨｚのシステム帯域に設定されるものとする。

[0011] 図１に示すように、無線通信システム１は、基地局装置２０と、無線通信のために基地局装置２０に無線接続する複数の無線通信端末１０Ａ、１０Ｂ

、１０Ｃとを含んで構成されている。例えば、無線通信端末１０Ａ（第１の通信端末）は、ＬＴＥ（Ｒｅｌ．１０）又はＬＴＥ－Ａｄｖａｎｃｅｄ（Ｒｅｌ．１０以降も含む）をサポートするユーザ端末（以下、ＬＴＥ端末）であり、他の無線通信端末１０Ｂ、１０Ｃは、マシン通信システムにおける通信デバイスとなるＭＴＣ端末（第２の通信端末）である。

[0012] 基地局装置２０は、上位局装置３０と接続され、この上位局装置３０は、コアネットワーク４０と接続される。複数の無線通信端末１０Ａ、１０Ｂ、１０Ｃは、セル５０において基地局装置２０と通信を行うことができる。なお、上位局装置３０には、例えば、アクセスゲートウェイ装置、無線ネットワークコントローラ（ＲＮＣ）、モビリティマネジメントエンティティ（ＭＭＥ）などが含まれるが、これに限定されない。

[0013] 無線通信システム１は、無線アクセス方式として、下りリンクについてはＯＦＤＭＡ（直交周波数分割多元接続）、上りリンクについてはＳＣ－ＦＤＭＡ（シングルキャリアー周波数分割多元接続）をサポートすることができる。なお、無線アクセス方式はこれに限定されない。ＯＦＤＭＡは、周波数帯域を複数の狭い周波数帯域（サブキャリア）に分割し、各サブキャリアにデータをマッピングして通信を行うマルチキャリア伝送方式である。ＳＣ－ＦＤＭＡは、システム帯域を１つ又は連続したリソースブロックからなる帯域に分割し、複数の端末が互いに異なる帯域を用いることで、端末間の干渉を低減するシングルキャリア伝送方式である。ＬＴＥ端末は、下りリンク及び上りリンク共に最大で２０ＭＨｚの帯域幅に対応可能な通信性能を有する。

[0014] ここで、ＬＴＥシステムにおけるチャネル構成について説明する。図２は、下りリンク伝送が適用される無線フレーム（例えば、１サブフレーム）の一例を示す図である。図２に示すように、ＬＴＥシステムでは、各サブフレームにおいて先頭から所定のＯＦＤＭシンボル（１～３ＯＦＤＭシンボル）まで、下り制御チャネル（ＰＤＣＣＨ：Physical Downlink Control Channel）用のリソース領域（ＰＤＣＣＨ領域）として確保される。また、サブフ

レームの先頭から所定のシンボルより後の無線リソースに、下り共有データチャネル（ＰＤＳＣＨ：Physical Downlink Shared Channel）用のリソース領域（ＰＤＳＣＨ領域）が確保される。

[0015] ＰＤＣＣＨ領域には、ユーザ端末に対する下り制御情報（ＤＣＩ：Downlink Control Information）が割当てられる。下り制御情報（ＤＣＩ）には、ＰＤＳＣＨ領域における割当て情報等が含まれており、ユーザ端末は下り制御情報に基づいてＰＤＳＣＨに割当てられたデータや報知情報（例えば、ＳＩＢ（システム情報ブロック）等のシステム情報）を復調する。このように、各サブフレームにおいて、ユーザ端末に対する下りデータ用の信号と、当該下りデータを受信するための下り制御情報用の信号とは時分割多重されて送信される。

[0016] また、ＬＴＥ－Ａシステムにおいては、例えば、異なる送信アンテナから同時に異なるユーザに送信情報系列を送信するマルチユーザＭＩＭＯ（ＭＵ－ＭＩＭＯ：Multiple User MIMO）伝送が規定されている。ＭＵ－ＭＩＭＯ伝送においては、同一時間及び同一周波数で複数のユーザ端末ＵＥに対するデータ送信が可能となる。このように多くのユーザ端末ＵＥの下り制御情報をＰＤＣＣＨ領域に割当てる場合、下り制御情報を伝送するためのＰＤＣＣＨ領域が足りなくなる場合がある。この場合には、ＰＤＳＣＨ領域に多重できるユーザ端末ＵＥの数が制限されてしまう。

[0017] このようなＰＤＣＣＨ領域の不足を解決する方法として、サブフレームの先頭から最大３ＯＦＤＭシンボルの制御領域以外にＰＤＣＣＨの割当て領域を拡張する（既存のＰＤＳＣＨ領域に加えて新たにＰＤＣＣＨ領域を拡張する）ことが考えられる。例えば、ＰＤＳＣＨ領域においてＰＤＳＣＨと拡張するＰＤＣＣＨとを周波数分割多重する方法（周波数分割（ＦＤＭ）アプローチ）が考えられる。このようなＰＤＳＣＨと周波数分割多重されるＰＤＣＣＨは、既存のＰＤＣＣＨと区別するために、拡張ＰＤＣＣＨと呼ぶ（拡張下り制御チャネル、Ｅ－ＰＤＣＣＨ、Enhanced ＰＤＣＣＨ、ＦＤＭ型ＰＤＣＣＨ、ＵＥ－ＰＤＣＣＨ等とも呼ぶ）。

[0018] 図３に、周波数分割アプローチを適用する場合のフレーム構成の一例を示す。図３Ａに示すフレーム構成では、既存のＰＤＣＣＨと拡張ＰＤＣＣＨが配置されている。送信時間間隔となるフレーム（以下、「サブフレーム」と記す）の先頭から所定のＯＦＤＭシンボル（最大３ＯＦＤＭシンボル）まではシステム帯域全体にわたり既存のＰＤＣＣＨが配置される。既存のＰＤＣＣＨが配置されたＯＦＤＭシンボルより後の無線リソースに、拡張ＰＤＣＣＨがＰＤＳＣＨと周波数分割多重するように配置されている。

[0019] また、図３Ｂに示すように、システム帯域は所定の周波数領域単位で構成される。この所定の周波数領域単位としては、例えば、物理リソースブロック（ＰＲＢ）（単に、リソースブロック（ＲＢ）ともいう）や、複数の連続する物理リソースブロックからなるリソースブロックグループ（ＲＢＧ）等がある。図３Ｂでは、所定の周波数領域単位としてリソースブロックが用いられており、システム帯域の一部のリソースブロックが拡張ＰＤＣＣＨに割り当てられる場合を示している。

[0020] また、Ｒｅｌ．１１以降のフレーム構成として、サブフレームの先頭から所定のＯＦＤＭシンボル（最大３ＯＦＤＭシンボル）までの既存ＰＤＣＣＨを持たないニューキャリアタイプ（Extension carrierタイプ）が検討されている。このExtension carrierタイプが適用されるサブフレームでは、下り制御チャネルとして、既存ＰＤＣＣＨを配置せず、拡張ＰＤＣＣＨのみを割り当てることができる。また、Extension carrierタイプが適用されるサブフレームでは、先頭から最大３ＯＦＤＭシンボルに対しても拡張ＰＤＣＣＨを割当てることができる（図３Ｃ参照）。

[0021] ところで、上述したように、ＭＴＣは比較的低速な通信環境を前提として検討されており、ＬＴＥシステムをそのままＭＴＣに適用すると製造コストが増加する等の不都合が生じてしまう。そこで、本発明者等は、上記のようなフレーム構成を有するＬＴＥシステムにＭＴＣ端末を無線接続する構成を設計するに当たり、ＭＴＣ端末のコスト低減の観点から、ＭＴＣ端末に対しては、ＬＴＥ端末に比べて狭い周波数帯域のみに対応可能とすることが有効

であることを見出した（図４参照）。

[0022] 但し、ＭＴＣ端末がＬＴＥシステムに無線接続する場合、ＭＴＣ端末はＬＴＥ端末と同様に、下り共用チャネル（ＤＬ－ＳＣＨ：Downlink Shared Channel）等を用いて、基地局装置に対して初期アクセス（初期接続）処理等を行う必要がある。ここで、初期接続処理とは、ユーザデータの送受信前に行う接続処理（システム情報（例えば、ＳＩＢ）の受信、ランダムアクセス処理等）をいう。

[0023] しかし、図４に示すように、ＭＴＣ端末がサポートする帯域幅をＬＴＥ端末がサポートする帯域幅より狭帯域化する場合、ＭＴＣ端末はＬＴＥ端末がサポートする周波数帯域に亘って配置されるＰＤＣＣＨに割当てられた制御信号を復調することができない。つまり、基地局装置は、ＬＴＥ端末に対しては既存のＰＤＣＣＨを用いて初期接続処理を行うことができるが、ＭＴＣ端末に対しては既存のＰＤＣＣＨを用いて初期接続処理を行うことが困難となる。そこで、本発明者等は、所定の周波数領域（例えば、所定のＰＲＢ）に対して選択的に配置することができる拡張ＰＤＣＣＨを用いることにより、ＭＴＣ端末が初期接続処理を行うことができることに着目した。

[0024] 一方で、ＬＴＥシステムにおいて検討されている拡張ＰＤＣＣＨでは、基地局装置が既存のＰＤＣＣＨを用いてＬＴＥ端末と初期接続を行うことによりユーザ端末情報（ＵＥ ｃａｐａｂｉｌｉｔｙ）を取得した後、当該取得したユーザ端末情報に基づいて拡張ＰＤＣＣＨのパラメータ（割当て位置等）を設定することが検討されている。つまり、拡張ＰＤＣＣＨを配置する場合であっても、初期接続処理は既存のＰＤＣＣＨを用いて行う必要があった。

[0025] そのため、本発明者等は、無線通信端末（ＭＴＣ端末及び／又はＬＴＥ端末）が拡張ＰＤＣＣＨを用いて基地局装置に初期接続できるように、当該拡張ＰＤＣＣＨの構成を設計することを着想して本願発明に至った。

[0026] 以下に本実施の形態について、図面を参照して詳細に説明する。なお、本実施の形態では、無線通信端末として異なる周波数帯域をサポートするＬＴ

Ｅ端末とＭＴＣ端末を例に挙げて説明しているが、本実施の形態が適用できる端末はこれらに限られない。また、ＬＴＥ端末とＭＴＣ端末のいずれか一方の端末の無線通信に対しても本実施の形態を適用することができる。

[0027] （第１の態様）

第１の態様に係る拡張ＰＤＣＣＨの構成について、図５を参照して説明する。以下の説明では、基地局装置が、第１の周波数帯域（例えば、帯域幅２０ＭＨｚ）で第１の通信端末（例えば、ＬＴＥ端末）と通信を行うと共に、第１の周波数帯域よりも帯域幅が狭い第２の周波数帯域で第２の通信端末（例えば、ＭＴＣ端末）とマシン通信する場合を例に挙げて説明する。

[0028] 図５Ａ、Ｂは、ＬＴＥ端末及びＭＴＣ端末に適用するフレーム構成の一例である。図５に示すフレーム構成では、ＰＤＳＣＨと時間分割多重するＰＤＣＣＨ（既存ＰＤＣＣＨ）と、ＰＤＳＣＨと周波数分割多重する拡張ＰＤＣＣＨとが配置されている。既存ＰＤＣＣＨは、第１の周波数帯域の全体に亘って送信時間間隔となるサブフレームの先頭から所定のＯＦＤＭシンボル（最大３ＯＦＤＭシンボル）まで配置される。拡張ＰＤＣＣＨは、所定のＯＦＤＭシンボルより後の無線リソースに配置される。

[0029] ＬＴＥ端末は、第１の周波数帯域に亘って配置されたＰＤＣＣＨを受信して復号し、ＰＤＣＣＨに含まれる下り制御情報（ＤＣＩ）に基づいてＰＤＳＣＨを受信する。ＬＴＥ端末の初期接続処理時には、基地局装置が、ＰＤＣＣＨの共通サーチスペース（ＣＳＳ：Common Search Space）にＬＴＥ端末間で共有する共通制御信号をマッピングする。例えば、ＬＴＥ端末は、ブラインド復号（ブラインドデコーディング）により得られた共通制御情報に基づいて、ＰＤＳＣＨに割当てられたシステム情報（例えば、ＳＩＢ）を受信する。なお、共通サーチスペースとは、セル内の無線通信端末ＵＥが共通制御情報をブラインドデコーディングすべき範囲を示すものである。

[0030] ＭＴＣ端末は、上述したように、上り及び下りリンクで対応可能な帯域幅が、ＬＴＥ端末がサポートする帯域幅（例えば、２０ＭＨｚ）と比較して、より狭い帯域幅に制限されている。つまり、第２の周波数帯域はＭＴＣ端末

及びＬＴＥ端末が利用可能であり、第２の周波数帯域以外の第１の周波数帯域はＭＴＣ端末が利用できずＬＴＥ端末のみが利用可能となっている。なお、図５では、第２の周波数帯域が第１の周波数帯域内に含まれる場合を示しているが、これに限られない。

[0031] また、ＭＴＣ端末の初期接続処理時には、基地局装置が、第２の周波数帯域の所定の周波数領域（例えば、ＰＲＢ）に拡張ＰＤＣＣＨを配置すると共に、拡張ＰＤＣＣＨの共通サーチスペース（Ｃｏｍｍｏｎ　ＳＳ）にＭＴＣ端末間で共有する共通制御信号をマッピングする。例えば、ＭＴＣ端末は、拡張ＰＤＣＣＨのブラインド復号により得られた共通制御情報に基づいて、ＰＤＳＣＨに割当てられたシステム情報（例えば、ＳＩＢ）を受信することができる。

[0032] このように、基地局装置は、ＭＴＣ端末との通信時において、少なくともＭＴＣ端末がサポートする第２の周波数帯域に拡張ＰＤＣＣＨを配置し、ＭＴＣ端末は当該拡張ＰＤＣＣＨの共通サーチスペースに割当てられた共通制御情報を用いて基地局装置と初期接続処理を行う。

[0033] 第２の周波数帯域に配置する拡張ＰＤＣＣＨの位置としては、例えば、図５Ａ、Ｂに示す構成とすることができる。図５Ａは、周波数軸方向において、第２の周波数帯域の両端に拡張ＰＤＣＣＨを配置する場合を示している。例えば、第２の周波数帯域の両端に１ＰＲＢペアずつ拡張ＰＤＣＣＨを配置し、当該拡張ＰＤＣＣＨの共通サーチスペースにシステム情報等を受信するための共通制御情報を割当てる。また、この場合、基地局装置は、第２の周波数帯域に配置されるＰＤＳＣＨに当該共通制御信号により復調されるシステム情報等を割当てる。

[0034] このように、第２の周波数帯域の両端に配置された拡張ＰＤＣＣＨを配置することにより、共通制御信号を第２の周波数帯域の両端にマッピングすることができるため、周波数ダイバーシチ効果を得ることができる。もちろん、拡張ＰＤＣＣＨの割当て単位は１ＰＲＢペアに限られない。また、通信環境に応じて拡張ＰＤＣＣＨの割当て単位を動的に変化させることも可能であ

る。

[0035] 図５Ｂは、周波数軸方向において、第２の周波数帯域の複数の周波数領域に拡張ＰＤＣＣＨを分散して配置する場合を示している。この場合、共通制御信号を複数の拡張ＰＤＣＣＨに分散してマッピング（Distributed mapping）することができるため、周波数ダイバーシチ効果をより効果的に得ることが可能となる。

[0036] なお、ＭＴＣ端末は、第２の周波数帯域に配置された拡張ＰＤＣＣＨを利用して初期接続処理を行う場合、拡張ＰＤＣＣＨが配置されるリソースの位置（例えば、拡張ＰＤＣＣＨの共通サーチスペース）を把握する必要がある。そのため、本実施の形態では、基地局装置が、拡張ＰＤＣＣＨが割当てられるリソースの位置に関する情報を報知信号に含めて、物理報知チャネル（ＰＢＣＨ）を介してＭＴＣ端末に通知する構成とすることができる。

[0037] 他にも、初期接続処理用に用いる拡張ＰＤＣＣＨが配置される位置（拡張ＰＤＣＣＨの共通サーチスペース）をあらかじめ定めておく構成としてもよい。この場合、基地局装置からＭＴＣ端末に対して拡張ＰＤＣＣＨの位置に関する情報を通知する処理を省略することができる。

[0038] また、初期接続処理用に用いる拡張ＰＤＣＣＨ（拡張ＰＤＣＣＨの共通サーチスペース）を拡張ＰＤＣＣＨのＵＥ固有サーチスペース（ＵＥ－ＳＳ：UE-specific Search Space）に用いても良い。

[0039] また、ＭＴＣ端末における初期接続処理が終了した後は、基地局装置は、第２の周波数帯域の任意の周波数領域（例えば、ＰＲＢ）に拡張ＰＤＣＣＨを配置すると共に、拡張ＰＤＣＣＨのＵＥ固有サーチスペース（ＵＥ－ＳＳ：UE-specific Search Space）に各ＭＴＣ端末のＵＥ固有の制御情報をマッピングする。各ＭＴＣ端末は、拡張ＰＤＣＣＨのブラインド復号により得られたＵＥ固有の制御情報に基づいて、ＰＤＳＣＨに割当てられたデータを受信することができる。

[0040] なお、ＵＥ固有サーチスペースとは、各無線通信端末が固有制御情報をブラインドデコーディングすべき範囲を示すものである。また、ＵＥ固有の制

御情報とは、例えば、ＰＤＳＣＨの割り当て情報（DL Assignment）や、ＰＵＣＣＨのスケジューリング情報（UL grant）等が含まれる。

[0041] 初期接続処理後のデータ送信用に用いる拡張ＰＤＣＣＨが配置される位置（ＵＥ固有サーチスペース）は、ＲＲＣの接続（RRC connection）が確立された後に、上位レイヤシグナリングを用いてＭＴＣ端末に通知する構成とすることができる。また、初期接続処理に用いる拡張ＰＤＣＣＨ（共通サーチスペース）と同様に、報知信号により物理報知チャネル（ＰＢＣＨ）を介してＭＴＣ端末に通知する構成としてもよいし、あらかじめ定めておく構成としてもよい。なお、この場合の拡張ＰＤＣＣＨについても図５Ａ、Ｂに示した領域に配置することができる。

[0042] また、基地局装置は、ＭＴＣ端末に対して下り制御情報の送信を行わない場合（第２の周波数領域に拡張ＰＤＣＣＨを配置しない場合）に、第２の周波数帯域にＬＴＥ端末用の下り共有データチャネル（ＰＤＳＣＨ）を配置し、ＬＴＥ端末用のデータを割当てることができる。これにより、ＭＴＣ端末が通信を行わない場合であっても、第２の周波数帯域の無線リソースを有効に活用することが可能となる。

[0043] （第２の態様）

上述したように、Ｒｅｌ．１１以降のフレーム構成として、サブフレームの先頭から所定のＯＦＤＭシンボル（最大３ＯＦＤＭシンボル）までの既存ＰＤＣＣＨを持たないニューキャリアタイプ（Extension carrierタイプ）が検討されている（図３Ｃ参照）。そこで、第２の態様では、ＬＴＥ端末及び／又はＭＴＣ端末に対して、Extension carrierタイプを適用する場合について説明する。

[0044] 図６Ａは、Extension carrierタイプが適用されるサブフレーム構成の一例である。図６Ａに示すフレーム構成では、基地局装置が、第２の周波数帯域の所定の周波数領域において、サブフレームの先頭から最終シンボルまでに亘って拡張下り制御チャネルを割当てる場合を示している。

[0045] ＭＴＣ端末の初期接続処理時には、基地局装置が、第２の周波数帯域の所

定の周波数領域（例えば、ＰＲＢ）に拡張ＰＤＣＣＨを配置すると共に、拡張ＰＤＣＣＨの共通サーチスペース（Ｃｏｍｍｏｎ　ＳＳ）にＭＴＣ端末間で共有する共通制御信号をマッピングする。例えば、ＭＴＣ端末は、拡張ＰＤＣＣＨのブラインド復号により得られた共通制御情報に基づいて、ＰＤＳＣＨに割当てられたシステム情報（例えば、ＳＩＢ）を受信することができる。

[0046] 一方で、Extension carrierタイプを適用する場合（キャリアアグリゲーション適用時にＰＣｅｌｌで適用する場合）、ＬＴＥ端末も拡張ＰＤＣＣＨを用いて初期接続処理を行う必要がある。したがって、ＬＴＥ端末の初期接続処理時にも、ＭＴＣ端末と同様に、拡張ＰＤＣＣＨの共通サーチスペースに割当てられた共通制御信号に基づいて、ＰＤＳＣＨに割当てられたシステム情報（例えば、ＳＩＢ）等を受信することができる。

[0047] また、第２の周波数帯域に配置する拡張ＰＤＣＣＨの位置としては、例えば、周波数軸方向において、第２の周波数帯域の両端に拡張ＰＤＣＣＨを配置する構成（図６Ａ参照）とすることができる。また、上記図５Ｂに示すように、周波数軸方向において、第２の周波数帯域の複数の周波数領域に拡張ＰＤＣＣＨを分散して配置する構成とすることもできる。

[0048] 上述したように、初期接続処理時において、ＬＴＥ端末及びＭＴＣ端末は、拡張ＰＤＣＣＨの共通サーチスペースをブラインド復号することにより得られる共通制御信号に基づいて、ＰＤＳＣＨに割当てられたシステム情報（例えば、ＳＩＢ）等を受信する。この際、ＬＴＥ端末とＭＴＣ端末に送信されるシステム情報が共通する場合には、図６Ａに示すように、ＬＴＥ端末とＭＴＣ端末は、拡張ＰＤＣＣＨ（拡張ＰＤＣＣＨの共通サーチスペース）を共有することができる。これにより、無線リソースの利用効率を向上することができる。

[0049] なお、第２の周波数帯域に配置された拡張ＰＤＣＣＨを利用して初期接続処理を行う場合、ＬＴＥ端末及びＭＴＣ端末は、拡張ＰＤＣＣＨが配置されるリソースの位置（例えば、拡張ＰＤＣＣＨの共通サーチスペース）を把握

する必要がある。そのため、基地局装置が、拡張ＰＤＣＣＨが割当てられるリソースの位置に関する情報を報知信号に含めて、物理報知チャネル（ＰＢＣＨ）を介してＬＴＥ端末及びＭＴＣ端末に通知する構成とすることができる。

[0050] 他にも、初期接続処理用に用いる拡張ＰＤＣＣＨが配置される位置（共通サーチスペース）をあらかじめ定めておく構成としてもよい。この場合、基地局装置からＬＴＥ端末及びＭＴＣ端末に対して拡張ＰＤＣＣＨの位置に関する情報を通知する処理を省略することができる。

[0051] また、初期接続処理用に用いる拡張ＰＤＣＣＨ（拡張ＰＤＣＣＨの共通サーチスペース）を拡張ＰＤＣＣＨのＵＥ固有サーチスペース（ＵＥ－ＳＳ：UE-specific Search Space）に用いても良い。

[0052] また、ＬＴＥ端末及び／又はＭＴＣ端末における初期接続処理が終了した後は、基地局装置は、第２の周波数帯域の任意の周波数領域（例えば、ＰＲＢ）に拡張ＰＤＣＣＨを配置すると共に、拡張ＰＤＣＣＨのＵＥ固有サーチスペースに各ＬＴＥ端末、各ＭＴＣ端末のＵＥ固有の制御情報をマッピングする。各ＬＴＥ端末、各ＭＴＣ端末は、拡張ＰＤＣＣＨのブラインド復号により得られたＵＥ固有の制御情報に基づいて、ＰＤＳＣＨに割当てられたデータを受信することができる。

[0053] 初期接続処理後のデータ送信用に用いる拡張ＰＤＣＣＨが配置される位置は、ＲＲＣの接続（RRC connection）が確立された後に、上位レイヤシグナリングを用いてＬＴＥ端末及びＭＴＣ端末に通知する構成とすることができる。また、初期接続処理に用いる拡張ＰＤＣＣＨ（共通サーチスペース）と同様に、報知信号により物理報知チャネル（ＰＢＣＨ）を介してＬＴＥ端末及びＭＴＣ端末に通知する構成としてもよいし、あらかじめ定めておく構成としてもよい。

[0054] なお、上記図６Ａでは、初期接続処理に用いる拡張ＰＤＣＣＨ（ＬＴＥ端末用の拡張ＰＤＣＣＨとＭＴＣ端末用の拡張ＰＤＣＣＨ）を第２の周波数帯域に共有して設ける場合を示したが、それぞれ異なる周波数帯域に設けても

よい。特に、ＬＴＥ端末とＭＴＣ端末でシステム情報（例えば、ＳＩＢ）が異なる場合には、第１の周波数帯域にＬＴＥ端末用の拡張ＰＤＣＣＨを配置し、第２の周波数帯域にＭＴＣ端末用の拡張ＰＤＣＣＨを割当てることが好ましい。

[0055] 具体的には、図６Ｂに示すように、周波数軸方向において、ＬＴＥ端末用の拡張ＰＤＣＣＨを第１の周波数帯域の両端に配置すると共に、ＭＴＣ端末用の拡張ＰＤＣＣＨを第２の周波数帯域の両端に割当てることができる。この場合、ＬＴＥ端末は第１の周波数領域の両端に配置された拡張ＰＤＣＣＨを用いて初期接続処理を行い、ＭＴＣ端末は第２の周波数領域の両端に配置された拡張ＰＤＣＣＨを用いて初期接続処理を行う。また、第１の周波数領域と第２の周波数領域の両端に拡張ＰＤＣＣＨを配置することにより、周波数ダイバーシチ効果を得ることができる。

[0056] 他にも、周波数軸方向において、第１の周波数帯域及び／又は第２の周波数帯域の複数の周波数領域に拡張ＰＤＣＣＨを分散して配置してもよい。この場合、共通制御信号を複数の拡張ＰＤＣＣＨに分散してマッピング（Distributed mapping）することができるため、周波数ダイバーシチ効果をより効果的に得ることが可能となる。

[0057] 第２の周波数帯域に配置されたＭＴＣ端末用の拡張ＰＤＣＣＨ用の周波数リソースに、ＬＴＥ端末用の拡張ＰＤＣＣＨの全部、又は一部を割当ててもよい。

[0058] なお、第１の周波数帯域に割当てる拡張ＰＤＣＣＨが配置される位置（共通サーチスペース、ＵＥ固有サーチスペース）は、上記第２の周波数帯域に割当てる拡張ＰＤＣＣＨと同様に制御することができる。

[0059] また、基地局装置は、ＭＴＣ端末に対して下り制御情報の送信を行わない場合（第２の周波数領域に拡張ＰＤＣＣＨを配置しない場合）に、第２の周波数帯域にＬＴＥ端末用の下り共有データチャネル（ＰＤＳＣＨ）を配置し、ＬＴＥ端末用のデータを割当てることができる。これにより、ＭＴＣ端末が通信を行わない場合であっても、第２の周波数帯域の無線リソースを有効

に活用することが可能となる。

[0060] （無線通信システム）

ここで、本実施の形態に係る無線通信システムについて詳細に説明する。図７は、本実施の形態に係る基地局装置の全体構成を示すブロック図である。基地局装置２０は、送受信アンテナ２０１と、アンプ部２０２と、送受信部２０３と、ベースバンド信号処理部２０４と、呼処理部２０５と、伝送路インターフェース２０６とを備えている。下りリンクにより基地局装置２０からＭＴＣ端末（図１における無線通信端末１０Ｂ、１０Ｃ）に送信される送信データは、上位局装置３０から伝送路インターフェース２０６を介してベースバンド信号処理部２０４に入力される。

[0061] ベースバンド信号処理部２０４において、下りデータチャネルの信号は、ＰＤＣＰレイヤの処理、送信データの分割・結合、ＲＬＣ（Radio Link Control）再送制御の送信処理などのＲＬＣレイヤの送信処理、ＭＡＣ（Medium Access Control）再送制御、例えば、ＨＡＲＱの送信処理、スケジューリング、伝送フォーマット選択、チャネル符号化、逆高速フーリエ変換（ＩＦＦＴ）処理、プリコーディング処理が行われる。また、下りリンク制御チャネルである物理下りリンク制御チャネルの信号に関しても、チャネル符号化や逆高速フーリエ変換等の送信処理が行われる。

[0062] また、ベースバンド信号処理部２０４は、報知チャネルにより、同一セルに接続する無線通信端末１０に対して、各無線通信端末１０が基地局装置２０と無線通信するための制御情報を通知する。当該セルにおける通信のための情報には、例えば、上りリンク又は下りリンクにおけるシステム帯域幅や、ＰＲＡＣＨ（Physical Random Access Channel）におけるランダムアクセスプリアンブルの信号を生成するためのルート系列の識別情報（Root Sequence Index）などが含まれる。

[0063] 送受信部２０３は、ベースバンド信号処理部２０４から出力されたベースバンド信号を無線周波数帯に変換する。アンプ部２０２は、周波数変換された無線周波数信号を増幅して送受信アンテナ２０１へ出力する。

[0064] 一方、上りリンクにより無線通信端末１０から基地局装置２０に送信される信号については、送受信アンテナ２０１で受信された無線周波数信号がアンプ部２０２で増幅され、送受信部２０３で周波数変換されてベースバンド信号に変換され、ベースバンド信号処理部２０４に入力される。

[0065] ベースバンド信号処理部２０４は、上りリンクで受信したベースバンド信号に含まれる送信データに対して、ＦＦＴ処理、ＩＤＦＴ処理、誤り訂正復号、ＭＡＣ再送制御の受信処理、ＲＬＣレイヤ、ＰＤＣＰレイヤの受信処理を行う。復号された信号は伝送路インターフェース２０６を介して上位局装置３０に転送される。

[0066] 呼処理部２０５は、通信チャネルの設定や解放等の呼処理や、基地局装置２０の状態管理や、無線リソースの管理を行う。

[0067] 図８は、本実施の形態に係る無線通信端末の全体構成について説明するブロック図である。無線通信端末は、送受信アンテナ１０１と、アンプ部１０２と、送受信部１０３と、ベースバンド信号処理部１０４と、アプリケーション部１０５とを備えている。

[0068] 下りリンクのデータについては、送受信アンテナ１０１で受信された無線周波数信号がアンプ部１０２で増幅され、送受信部１０３で周波数変換されてベースバンド信号に変換される。このベースバンド信号は、ベースバンド信号処理部１０４でＦＦＴ処理や、誤り訂正復号、再送制御の受信処理等がなされる。この下りリンクのデータの内、下りリンクの送信データは、アプリケーション部１０５に転送される。アプリケーション部１０５は、物理レイヤやＭＡＣレイヤより上位のレイヤに関する処理等を行う。また、下りリンクのデータの内、報知情報も、アプリケーション部１０５に転送される。

[0069] 一方、上りリンクの送信データは、アプリケーション部１０５からベースバンド信号処理部１０４に入力される。ベースバンド信号処理部１０４においては、マッピング処理、再送制御（ＨＡＲＱ）の送信処理や、チャネル符号化、ＤＦＴ処理、ＩＦＦＴ処理を行う。送受信部１０３は、ベースバンド信号処理部１０４から出力されたベースバンド信号を無線周波数帯に変換す

る。その後、アンプ部１０２は、周波数変換された無線周波数信号を増幅して送受信アンテナ１０１より送信する。

[0070] 図９は、本実施の形態に係るＭＴＣ端末（無線通信端末１０Ｂ、１０Ｃ）の送受信ポートの構成例について説明する回路図である。図９に示すように、無線通信端末１０Ｂ、１０Ｃは、アンプ部１０２及び送受信部１０３に相当する送受信ポート１０６Ａと受信ポート１０６Ｂとをそれぞれ備えている。送受信ポート１０６Ａは、送受信アンテナ１０１Ａと接続されており、受信ポート１０６Ｂは受信アンテナ１０１Ｂと接続されている。これにより、１ブランチダイバーシチの送信系と、２ブランチダイバーシチの受信系とを実現している。

[0071] 送受信ポート１０６Ａは、送信系として、上りリンクの送信帯域外の信号をカットする送信フィルタ１０３Ａと、上りリンクにおいて送信する信号を増幅する高出力アンプ１０２Ａとを備えている。また、受信系として、下りリンクにおいて受信する信号を増幅するＬＮＡ１０２Ｂと、受信帯域外の信号をカットする受信フィルタ１０３Ｂとを備えている。受信ポート１０６Ｂは、下りリンクにおいて受信する信号を増幅するＬＮＡ１０２Ｃと、受信帯域外の信号をカットする受信フィルタ１０３Ｃとを備えている。

[0072] ＭＴＣ端末（無線通信端末１０Ｂ、１０Ｃ）は、上り及び下りリンクで対応可能な帯域が、ＬＴＥ端末（無線通信端末１０Ａ）の上りリンクで通信可能な最大帯域（２０ＭＨｚ）に比べて狭い帯域に制限されている。このため、ＬＴＥ端末と比較して、ポートに対して要求される性能は緩和されている。例えば、ＭＴＣ端末の送信フィルタ１０３Ａ、受信フィルタ１０３Ｂ、１０３Ｃの対応帯域は、ＬＴＥ端末の送信フィルタ、受信フィルタの対応帯域より狭くて良い。また、ＭＴＣ端末の高出力アンプ１０２Ａの出力は、ＬＴＥ端末の高出力アンプの出力より小さくて良い。このように、本実施の形態に係る無線通信システム１では無線通信端末１０Ｂ、１０Ｃの送信性能を緩和することができる結果、無線通信端末１０Ｂ、１０Ｃのコスト及び消費電力を抑制できる。

[0073] 図１０は、本実施の形態に係る基地局装置２０が有するベースバンド信号処理部２０４及び一部の上位レイヤの機能ブロック図である。ベースバンド信号処理部２０４においては、主に送信処理部の機能ブロックを示している。この基地局装置２０に無線接続されるＬＴＥ端末（無線通信端末１０Ａ）及びＭＴＣ端末（無線通信端末１０Ｂ、１０Ｃ）に対する送信データが、上位局装置３０から基地局装置２０に転送される。

[0074] 制御情報生成部３００は、上位レイヤシグナリング（例えばＲＲＣシグナリング）する上位制御信号を端末毎に生成する。例えば、制御情報生成部３００は、ＭＴＣ端末及び／又はＬＴＥ端末が初期接続処理を終了した後に、これらの端末に対してデータ送信用に適用する拡張ＰＤＣＣＨの割当て位置に関する情報等を含む上位制御信号を生成する。

[0075] データ生成部３０１は、上位局装置３０から転送された送信データをユーザ別にユーザデータとして出力する。

[0076] スケジューリング部３０２は、拡張下り制御チャネル等を配置する周波数領域（例えば、ＰＲＢ）の位置、各無線通信端末に対するリソース割り当て等を制御している。スケジューリング部３０２は、上位局装置３０から送信データ及び再送指示が入力されると共に、上りリンクの受信信号を測定した受信部からチャネル推定値やリソースブロックのＣＱＩ、端末の種別（ＭＴＣ端末であるか、ＬＴＥ端末であるか）が入力される。また、スケジューリング部３０２は、上りリンクの受信信号から、ＭＴＣ端末とＬＴＥ端末（ＬＴＥ－Ａ端末を含む）とを区別してスケジューリングを行う。

[0077] また、スケジューリング部３０２は、再送指示、チャネル推定値及びＣＱＩを参照しながら、上下制御情報及び共通チャネル用制御情報（共通制御情報）等のスケジューリングを行う。移動通信における伝搬路は、周波数選択性フェージングにより周波数毎に変動が異なる。そこで、スケジューリング部３０２は、ＬＴＥ端末に対するユーザデータ送信においては適応周波数スケジューリングを適用し、サブフレーム毎に通信品質の良好なリソースブロックを割り当てる。適応周波数スケジューリングでは、各リソースブロック

に対して伝搬路品質の良好なＬＴＥ端末を選択して割り当てる。そのため、スケジューリング部３０２は、ＬＴＥ端末からフィードバックされるリソースブロック毎のＣＱＩを用いてスループットの改善が期待されるリソースブロックを割り当てる。

[0078] また、スケジューリング部３０２は、ＬＴＥ端末（又は、ＭＴＣ端末）との間の伝搬路状況に応じてＣＣＥアグリゲーション数を制御する。また、割り当てたリソースブロックで所定のブロック誤り率を満たすＭＣＳ（符号化率、変調方式）を決定する。スケジューリング部３０２が決定したＭＣＳ（符号化率、変調方式）を満足するパラメータが、チャネル符号化部３０３、３０８、変調部３０４、３０９に設定される。

[0079] ベースバンド信号処理部２０４は、最大ユーザ多重数Ｎに対応したチャネル符号化部３０３、変調部３０４、マッピング部３０５を備えている。チャネル符号化部３０３は、データ生成部３０１から出力されるユーザデータ（一部の上位制御信号を含む）で構成される共有データチャネル（ＰＤＳＣＨ）を、端末毎にチャネル符号化する。変調部３０４は、チャネル符号化されたユーザデータを端末毎に変調する。マッピング部３０５は、変調されたユーザデータを無線リソースにマッピングする。

[0080] また、ベースバンド信号処理部２０４は、端末固有の下り制御情報である下り共有データチャネル（ＰＤＳＣＨ）用制御情報を生成する下り制御情報生成部３０６と、端末間で共有する下り共通制御チャネル用制御情報（共通制御情報）を生成する下り共通チャネル用制御情報生成部３０７と、上り共有データチャネル（ＰＵＳＣＨ）を制御する上りリンク制御情報を端末毎に生成する上り制御情報生成部３１１とを備えている。また、生成された制御情報を端末毎にチャネル符号化するチャネル符号化部３０８と、チャネル符号化された制御情報を変調する変調部３０９とを備えている。

[0081] 下り制御情報生成部３０６は、下り共有データチャネル（ＰＤＳＣＨ）を制御するための下り共有データチャネル用制御情報（DL assignment等）を生成する。当該下り共有データチャネル用制御情報は、ユーザ毎に生成され

る。

[0082] 下り共通チャネル用制御情報生成部３０７は、ＬＴＥ端末及び／又はＭＴＣ端末間で共有する共通制御情報を生成する。例えば、ＬＴＥ端末及び／又はＭＴＣ端末の初期接続処理時にＰＤＳＣＨに割当てられるシステム情報（例えば、ＳＩＢ）を受信するための共通制御信号を生成する。

[0083] 上り制御情報生成部３１１は、端末毎に決定したリソースブロック数及びリソースブロック位置を示す割当て情報、変調方式、符号化率及び冗長化バージョン、新規データか再生データかを区別する識別子（New data indicator）、ＰＵＳＣＨ用の送信電力制御コマンド、復調用リファレンスシグナルのサイクリックシフト（ＣＳ for ＤＭＲＳ）、ＣＱＩリクエスト、ＰＭＩ／ＲＩ等から上りリンク制御情報（例えば、ＤＣＩフォーマット０／４）を生成する。

[0084] 参照信号生成部３１８は、チャネル推定、シンボル同期、ＣＱＩ測定、モビリティ測定等の様々な目的に使用されるセル固有参照信号（ＣＲＳ：Cell-specific Reference Signal)をリソースブロック（ＲＢ）内にＦＤＭ／ＴＤＭで多重して送信する。また、参照信号生成部３１８は、下りリンク復調用参照信号(UE specific RS)を送信する。

[0085] 上記変調部３０９で端末毎に変調された下り／上り制御情報のうち、既存のＰＤＣＣＨに割当てられる制御情報は、制御チャネル多重部３１４で多重され、さらにインタリーブ部３１５でインタリーブされる。一方で、拡張ＰＤＣＣＨに割当てられる制御情報は、マッピング部３１２で無線リソースにマッピングされる。マッピング部３１２は、拡張ＰＤＣＣＨの共通サーチスペースに、ＬＴＥ端末及び／又はＭＴＣ端末間で共有する共通制御信号をマッピングする。また、拡張下り制御チャネルのＵＥ固有サーチスペースに、端末固有の制御信号をマッピングする。なお、マッピング部３０５とマッピング３１２は共通して設けてもよい。

[0086] インタリーブ部３１５、マッピング部３１２から出力される制御信号及びマッピング部３０５から出力されるユーザデータは下りチャネル信号として

ＩＦＦＴ部３１６へ入力される。また、参照信号生成部３１８で生成された下りリンク復調用参照信号がＩＦＦＴ部３１６へ入力される。

[0087] ＩＦＦＴ部３１６は、下りチャネル信号及び下りリンク復調用参照信号を逆高速フーリエ変換して周波数領域の信号から時間領域の信号に変換する。本実施の形態では、ＭＴＣ端末の送信帯域は、ＬＴＥ端末のシステム帯域より狭い帯域に制限されている。このため、ＬＴＥ端末と比較して逆高速フーリエ変換に係るサンプリングレートを大きくできるため、ＩＦＦＴ部３１６への負荷を軽減できる。その結果、ＩＦＦＴ部３１６を低コスト化できる。

[0088] サイクリックプレフィックス（ＣＰ）挿入部３１７は、下りチャネル信号の時系列信号に、マルチパス伝搬遅延の差を吸収するためのガードインターバルとして機能するサイクリックプレフィックスを挿入する。サイクリックプレフィックスが付加された送信データは、送受信部２０３に送出される。

[0089] 図１１は、ＭＴＣ端末及び／又はＬＴＥ端末が有するベースバンド信号処理部１０４の機能ブロック図である。まず、下りリンク構成について説明する。

[0090] 基地局装置２０から受信データとして受信された下りリンク信号は、ＣＰ除去部４０１でＣＰが除去される。ＣＰが除去された下りリンク信号は、ＦＦＴ部４０２へ入力される。ＦＦＴ部４０２は、下りリンク信号を高速フーリエ変換（ＦＦＴ：Fast Fourier Transform）して時間領域の信号から周波数領域の信号に変換し、デマッピング部４０３へ入力する。デマッピング部４０３は、下りリンク信号をデマッピングし、下りリンク信号から複数の制御情報が多重された多重制御情報、ユーザデータ、上位制御信号を取り出す。なお、デマッピング部４０３によるデマッピング処理は、アプリケーション部１０５から入力される上位制御信号に基づいて行われる。デマッピング部４０３から出力された多重制御情報は、デインタリーブ部４０４でデインタリーブされる。

[0091] また、ベースバンド信号処理部１０４は、制御情報を復調する制御情報復調部４０５、下り共有データを復調する下り共有データ復調部４０６及びチ

ャネル推定部４０７を備えている。制御情報復調部４０５は、下り共通制御チャネル用制御情報を復調する下り共通チャネル用制御情報復調部４０５ａと、上りリンク制御情報を復調する上り制御情報復調部４０５ｂと、下りリンク制御情報を復調する下り制御情報復調部４０５ｃとを備えている。

[0092] 下り共通チャネル用制御情報復調部４０５ａは、拡張ＰＤＣＣＨの共通サーチスペースのブラインドデコーディング処理、復調処理、チャネル復号処理などによりユーザ共通の下り制御情報である下り共通制御チャネル用制御情報を取り出す。例えば、ＭＴＣ端末の初期接続処理時には、第２の周波数帯域の所定の周波数領域に配置された拡張ＰＤＣＣＨの共通サーチスペースに対してブラインドデコーディング処理を行い、共通制御情報を復号する。下り共有データ復調部４０６は、得られた共通制御情報に基づいて、ＰＤＳＣＨに割当てられたシステム情報（例えば、ＳＩＢ）等を受信することができる。

[0093] 上り制御情報復調部４０５ｂは、下り制御チャネル（拡張ＰＤＣＣＨ）のユーザ個別サーチスペースのブラインドデコーディング処理、復調処理、チャネル復号処理などによりユーザ固有の上りリンク制御情報を取り出す。取り出された上りリンク制御情報は、後述するチャネル符号化部４１２やマッピング部４１５などに送られる。

[0094] 下り制御情報復調部４０５ｃは、下り制御チャネル（拡張ＰＤＣＣＨ）のユーザ個別サーチスペースのブラインドデコーディング処理、復調処理、チャネル復号処理などによりユーザ固有の下り制御信号である下りリンク制御情報を取り出す。復調された下りリンク制御情報は、下り共有データ復調部４０６へ入力されて、下り共有データチャネル（ＰＤＳＣＨ）の復調などに使用される。

[0095] 下り共有データ復調部４０６は、下り制御情報復調部４０５ｃから入力された下りリンク制御情報に基づいて、ユーザデータ、上位制御情報、システム情報等を復調する。上位制御情報は、チャネル推定部４０７に出力される。

[0096] チャネル推定部４０７は、ユーザ端末固有の参照信号、または共通参照信号を用いてチャネル推定する。推定されたチャネル変動を、下り共通チャネル用制御情報復調部４０５ａ、上り制御情報復調部４０５ｂ、下り制御情報復調部４０５ｃ及び下り共有データ復調部４０６に出力する。これらの復調部においては、推定されたチャネル変動及び復調用参照信号を用いて下りリンク割当て情報を復調する。

[0097] 続いて、上りリンク構成について説明する。ベースバンド信号処理部１０４は、データ生成部４１１、チャネル符号化部４１２、変調部４１３、ＤＦＴ部４１４、マッピング部４１５、ＩＦＦＴ部４１６、ＣＰ挿入部４１７を備えている。

[0098] データ生成部４１１は、アプリケーション部１０５から入力されるビットデータから送信データを生成する。チャネル符号化部４１２は、上りリンク制御情報に含まれるＭＣＳにより通知された符号化率などに基づいて、送信データに対して誤り訂正等のチャネル符号化処理を施す。変調部４１３は、上りリンク制御情報に含まれるＭＣＳにより通知され、又は予め固定した変調方式に基づいて、チャネル符号化された送信データをＱＰＳＫなどで変調する。

[0099] ＤＦＴ部４１４は、変調された送信データを離散フーリエ変換する。本実施の形態では、ＭＴＣ端末の上りリンクの送信帯域は、ＬＴＥ端末の上りリンクのシステム帯域より狭い帯域に制限されている。このため、ＬＴＥ端末と比較して離散フーリエ変換に係る帯域幅が小さくなり、ＤＦＴ部４１４への負荷を軽減できる。その結果、ＤＦＴ部４１４を低コスト化できる。

[0100] マッピング部４１５は、ＤＦＴ後の送信データを指示された無線リソースへマッピングする。ＩＦＦＴ部４１６は、システム帯域に相当する入力データを逆高速フーリエ変換して時間領域のデータに変換する。ＣＰ挿入部４１７は逆高速フーリエ変換後のデータに対してデータ区切りでサイクリックプレフィックスを挿入する。

[0101] 本実施の形態では、ＭＴＣ端末の送信帯域は、ＬＴＥ端末のシステム帯域

より狭い帯域に制限されている。このため、ＬＴＥ端末と比較して逆高速フーリエ変換に係るサンプリングレートを大きくできるため、ＩＦＦＴ部４１６への負荷を軽減できる。その結果、ＩＦＦＴ部４１６を低コスト化できる。

[0102] 以上、上述の実施形態を用いて本発明について詳細に説明したが、当業者にとっては、本発明が本明細書中に説明した実施形態に限定されるものではないということは明らかである。本発明は、特許請求の範囲の記載により定まる本発明の趣旨及び範囲を逸脱することなく修正及び変更態様として実施することができる。従って、本明細書の記載は、例示説明を目的とするものであり、本発明に対して何ら制限的な意味を有するものではない。

[0103] 本出願は、２０１２年５月１１日出願の特願２０１２－１０９７６４に基づく。この内容は、全てここに含めておく。

請求の範囲

[請求項1] 第１の周波数帯域で第１の通信端末と通信を行うと共に、前記第１の周波数帯域より帯域幅が狭い第２の周波数帯域で第２の通信端末と通信を行う基地局装置であって、

前記第２の周波数帯域の所定の周波数領域に、下り共有データチャネルと周波数分割多重する拡張下り制御チャネルを配置する割当て制御部と、

前記拡張下り制御チャネルの共通サーチスペースに、少なくとも前記第２の通信端末間で共有する共通制御信号をマッピングするマッピング部と、を有することを特徴とする基地局装置。

[請求項2] 前記マッピング部は、前記第２の周波数帯域に配置される下り共有データチャネルに前記共通制御信号を用いて復調されるシステム情報に関する信号をマッピングすることを特徴とする請求項１に記載の基地局装置。

[請求項3] 前記割当て制御部は、周波数軸方向において、前記第２の周波数帯域の両端に前記拡張下り制御チャネルを配置することを特徴とする請求項１又は請求項２に記載の基地局装置。

[請求項4] 前記割当て制御部は、周波数軸方向において、前記第２の周波数帯域の複数の周波数領域に前記拡張下り制御チャネルを分散して配置し、前記マッピング部は、前記共通制御信号を複数の拡張下り制御チャネルに分散してマッピングすることを特徴とする請求項１又は請求項２に記載の基地局装置。

[請求項5] 前記第２の通信端末対して、前記拡張下り制御チャネルが配置される位置を報知情報で通知する送信部をさらに有することを特徴とする請求項１に記載の基地局装置。

[請求項6] 前記割当て制御部は、前記第１の周波数帯域において、サブフレームの先頭から所定シンボル目までに、前記第１の通信端末用の下り制御チャネルを配置することを特徴とする請求項１に記載の基地局装置

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[請求項7] 前記割当て制御部は、前記拡張下り制御チャネルをサブフレームの先頭から最終シンボル目までに配置し、前記マッピング部は、前記拡張下り制御チャネルの共通サーチスペースに、前記第１の通信端末及び前記第２の通信端末間で共有する共通制御信号をマッピングすることを特徴とする請求項１に記載の基地局装置。

[請求項8] 前記割当て制御部は、前記第１の周波数帯域及び前記第２の周波数帯域において、拡張下り制御チャネルをサブフレームの先頭から最終シンボル目までに配置し、

前記マッピング部は、前記第１の周波数帯域に配置される拡張下り制御チャネルの共通サーチスペースに前記第１の通信端末間で共有する共通制御信号を送信し、前記第２の周波数帯域に配置される拡張下り制御チャネルの共通サーチスペースに前記第２の通信端末間で共有する共通制御信号をマッピングすることを特徴とする請求項１に記載の基地局装置。

[請求項9] 前記割当て制御部は、周波数軸方向において、前記第１の周波数帯域の両端に拡張下り制御チャネルを配置することを特徴とする請求項８に記載の基地局装置。

[請求項10] 前記割当て制御部は、周波数軸方向において、前記第１の周波数帯域の複数の周波数領域に前記拡張下り制御チャネルを分散して配置し、前記マッピング部は、前記第１の通信端末間で共有する共通制御信号を複数の拡張下り制御チャネルに分散してマッピングすることを特徴とする請求項８に記載の基地局装置。

[請求項11] 前記割当て制御部は、前記第２の通信端末に下り制御情報を送信しない場合に、前記第２の周波数帯域に前記第１の通信端末用の下り共有データチャネルを割当てることを特徴とする請求項１に記載の基地局装置。

[請求項12] 基地局装置がサポートする第１の周波数帯域より帯域幅が狭い第２

の周波数帯域で前記基地局装置と通信を行う無線通信端末であって、

前記第２の周波数帯域の所定の周波数領域において、下り共有データチャネルと周波数分割多重して配置される拡張下り制御チャネルの位置を決定する決定部と、

前記拡張下り制御チャネルの共通サーチスペースに割当てられた共通制御情報を受信する受信部と、

前記共通制御情報に基づいて下り共有データチャネルに割当てられたシステム情報を復調する復調部と、を有することを特徴とする無線通信端末。

[請求項13] 第１の周波数帯域で第１の通信端末と通信を行うと共に、前記第１の周波数帯域より帯域幅が狭い第２の周波数帯域で第２の通信端末と通信を行う基地局装置を具備する無線通信システムであって、

前記基地局装置は、前記第２の周波数帯域の所定の周波数領域に、下り共有データチャネルと周波数分割多重する拡張下り制御チャネルを配置する割当て制御部と、前記拡張下り制御チャネルの共通サーチスペースに、少なくとも前記第２の通信端末間で共有する共通制御信号をマッピングするマッピング部と、を有し、

前記第２の通信端末は、前記拡張下り制御チャネルの位置を決定する決定部と、前記共通サーチスペースに割当てられた共通制御情報を受信する受信部と、前記共通制御情報に基づいて下り共有データチャネルに割当てられたシステム情報を復調する復調部と、を有することを特徴とする無線通信システム。

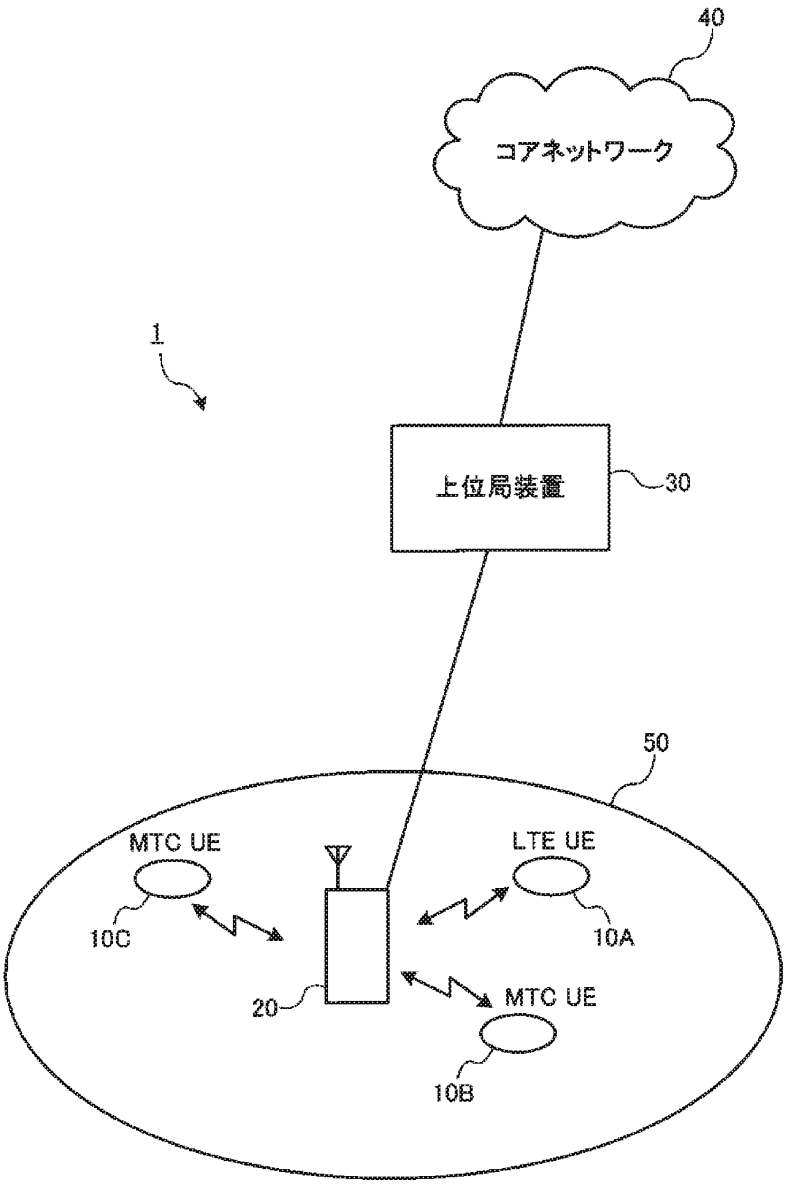
[請求項14] 第１の周波数帯域をサポートする第１の通信端末及び前記第１の周波数帯域より帯域幅が狭い第２の周波数帯域をサポートする第２の通信端末と、基地局装置との無線通信方法であって、

前記基地局装置は、前記第２の周波数帯域の所定の周波数領域に、下り共有データチャネルと周波数分割多重する拡張下り制御チャネルを配置する割当てる工程と、前記拡張下り制御チャネルの共通サーチ

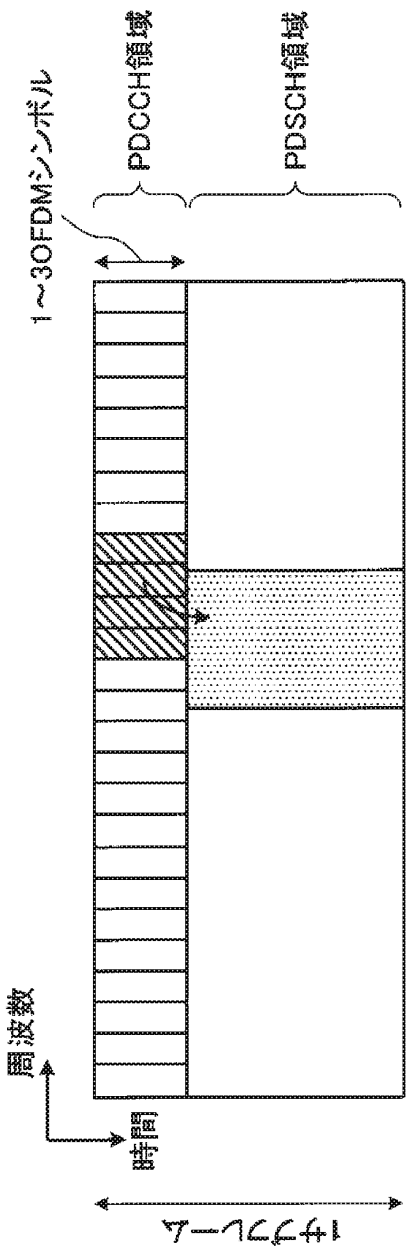
スペースに、少なくとも前記第２の通信端末間で共有する共通制御信号をマッピングする工程と、を有し、

前記第２の通信端末は、前記拡張下り制御チャネルの位置を決定する工程と、前記共通サーチスペースに割当てられた共通制御情報を受信する工程と、前記共通制御情報に基づいて下り共有データチャネルに割当てられたシステム情報を復調する工程と、を有することを特徴とする無線通信方法。

[図1]



[図2]



[図3]

図 3A

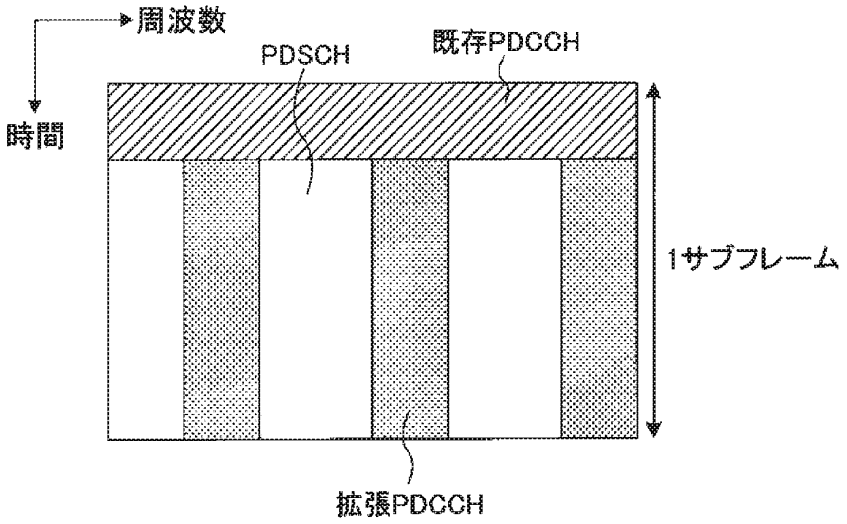


図 3B

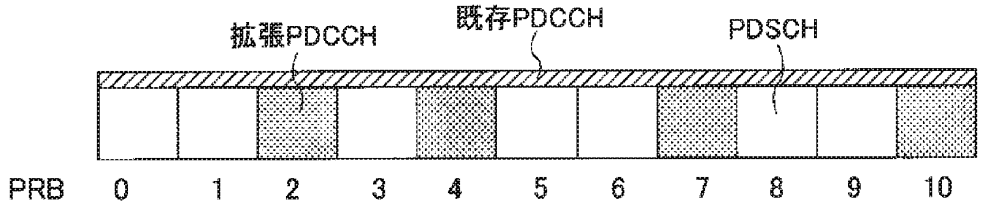
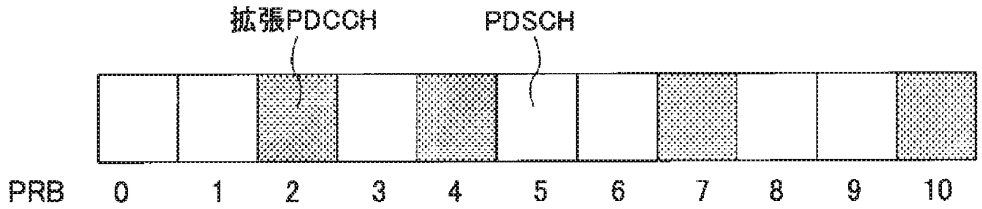
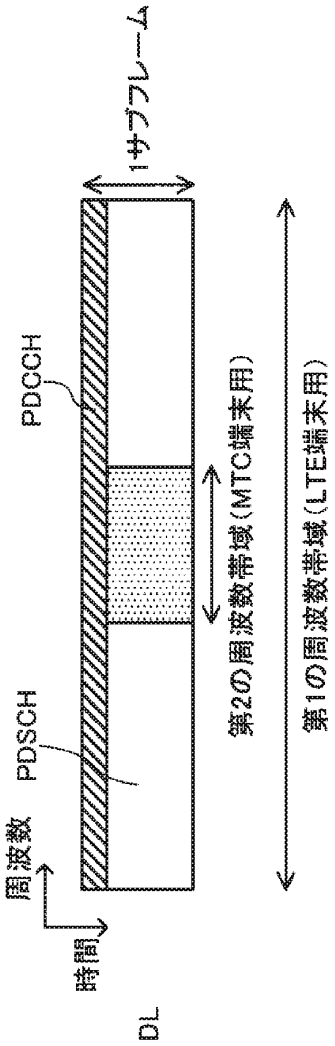


図 3C



[図4]


1サブフレーム
PDCCH
PDSCH
第2の周波数帯域（MTC端末用）
第1の周波数帯域（LTE端末用）
周波数
時間
DL

[図5]

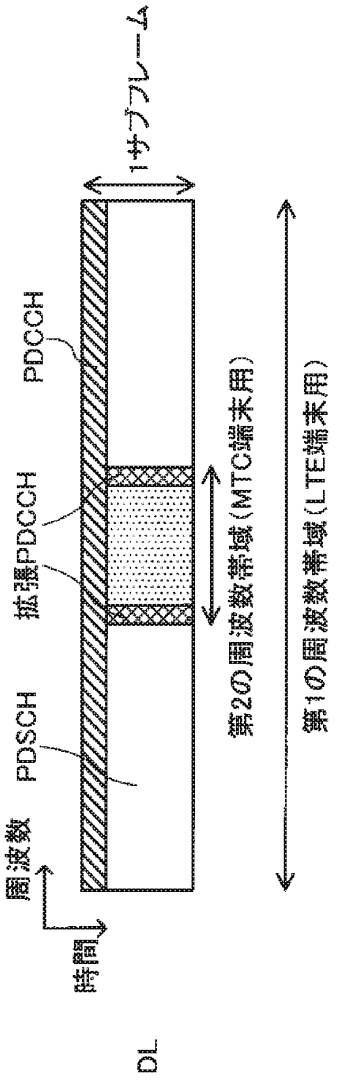

1サブフレーム
PDCCH
拡張PDCCH
PDSCH
周波数
時間
第2の周波数帯域(MTC端末用)
第1の周波数帯域(LTE端末用)
DL

図5A

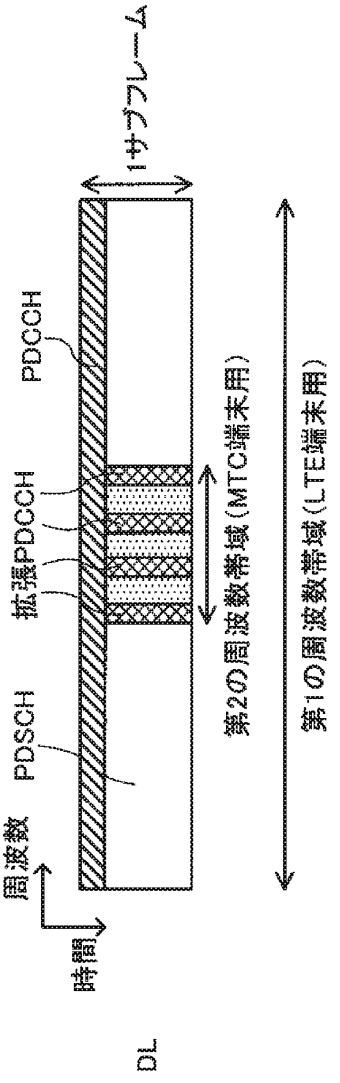

1サブフレーム
PDCCH
拡張PDCCH
PDSCH
周波数
時間
第2の周波数帯域(MTC端末用)
第1の周波数帯域(LTE端末用)
DL

図5B

[図6]

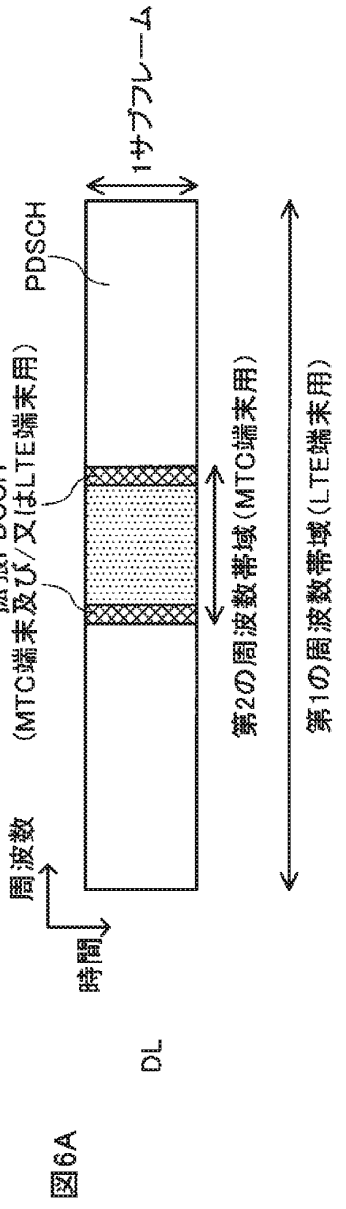

1サブフレーム
PDSCH
拡張PDCCH
(MTC端末及び/又はLTE端末用)
第2の周波数帯域(MTC端末用)
第1の周波数帯域(LTE端末用)
周波数
時間
DL

図6A

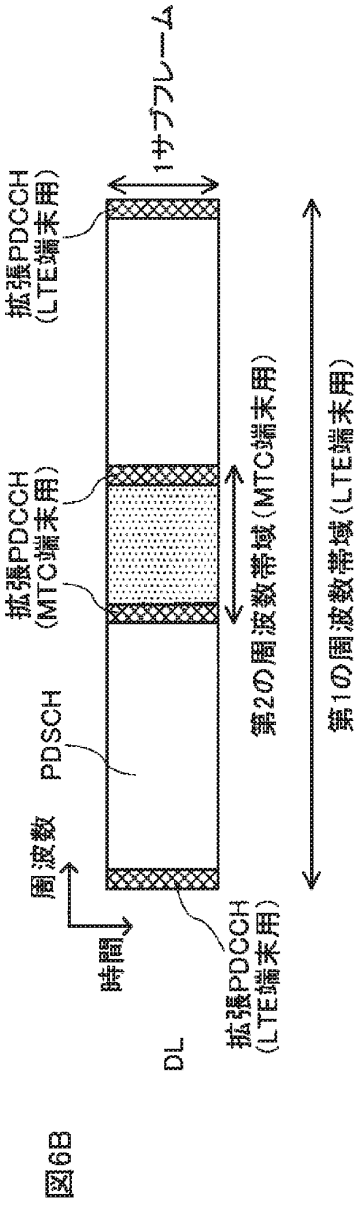
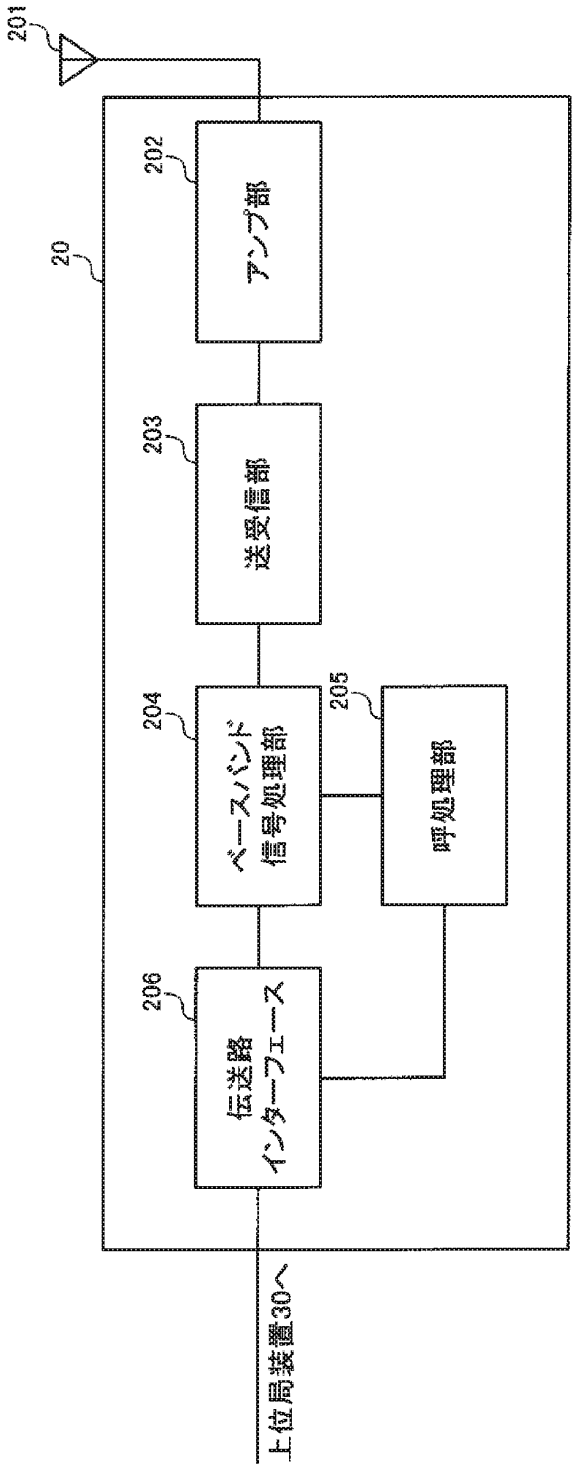
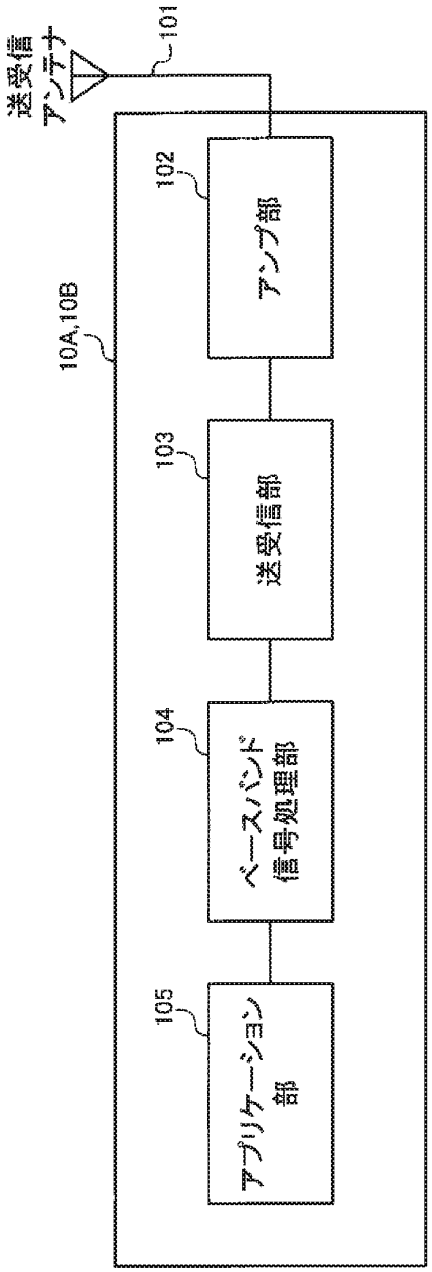

1サブフレーム
拡張PDCCH
(LTE端末用)
拡張PDCCH
(MTC端末用)
PDSCH
第2の周波数帯域(MTC端末用)
第1の周波数帯域(LTE端末用)
周波数
時間
拡張PDCCH
(LTE端末用)
DL

図6B

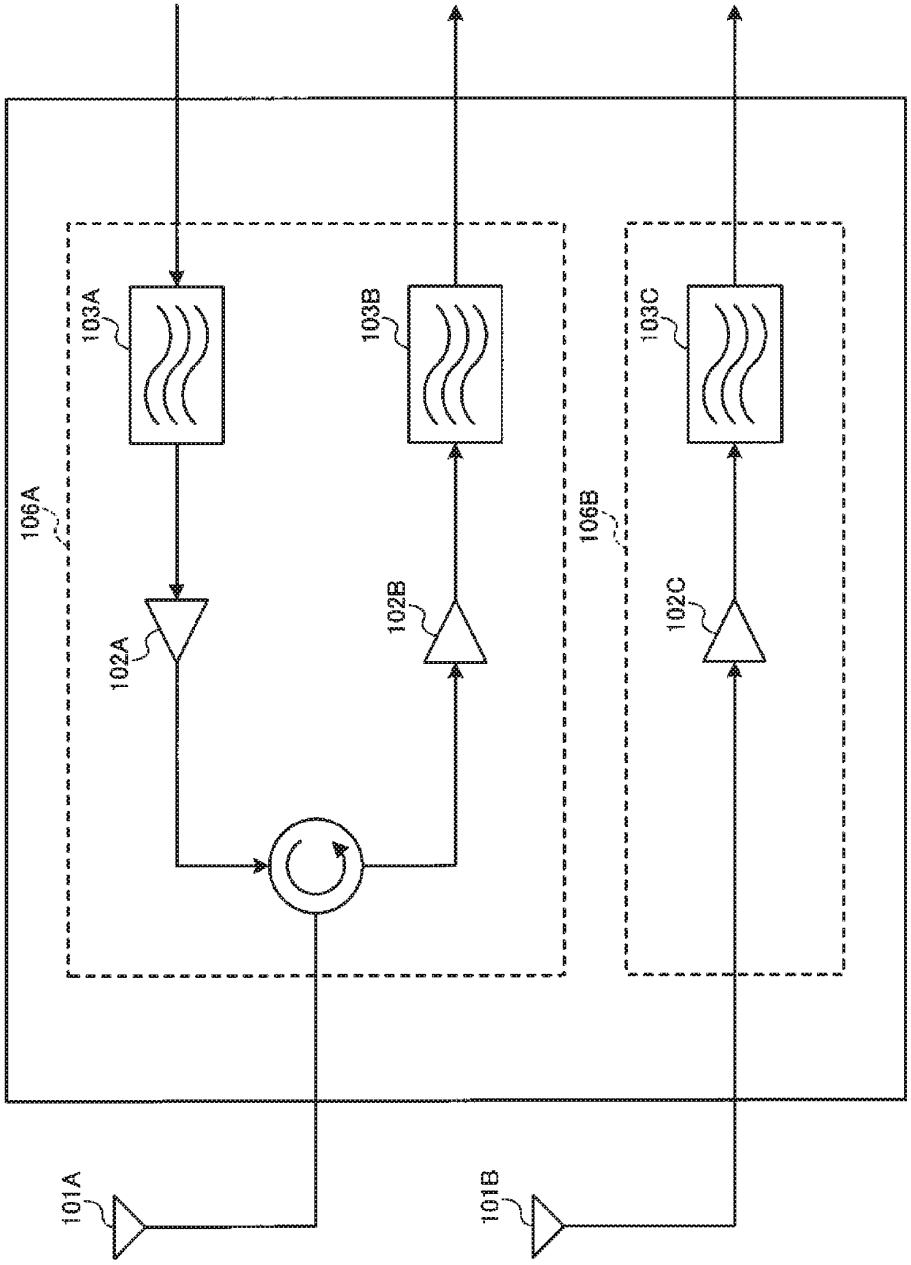
[図7]


201
20
202
アンプ部
203
送受信部
204
ベースバンド信号処理部
205
呼処理部
206
伝送路インターフェース
上位局装置30へ

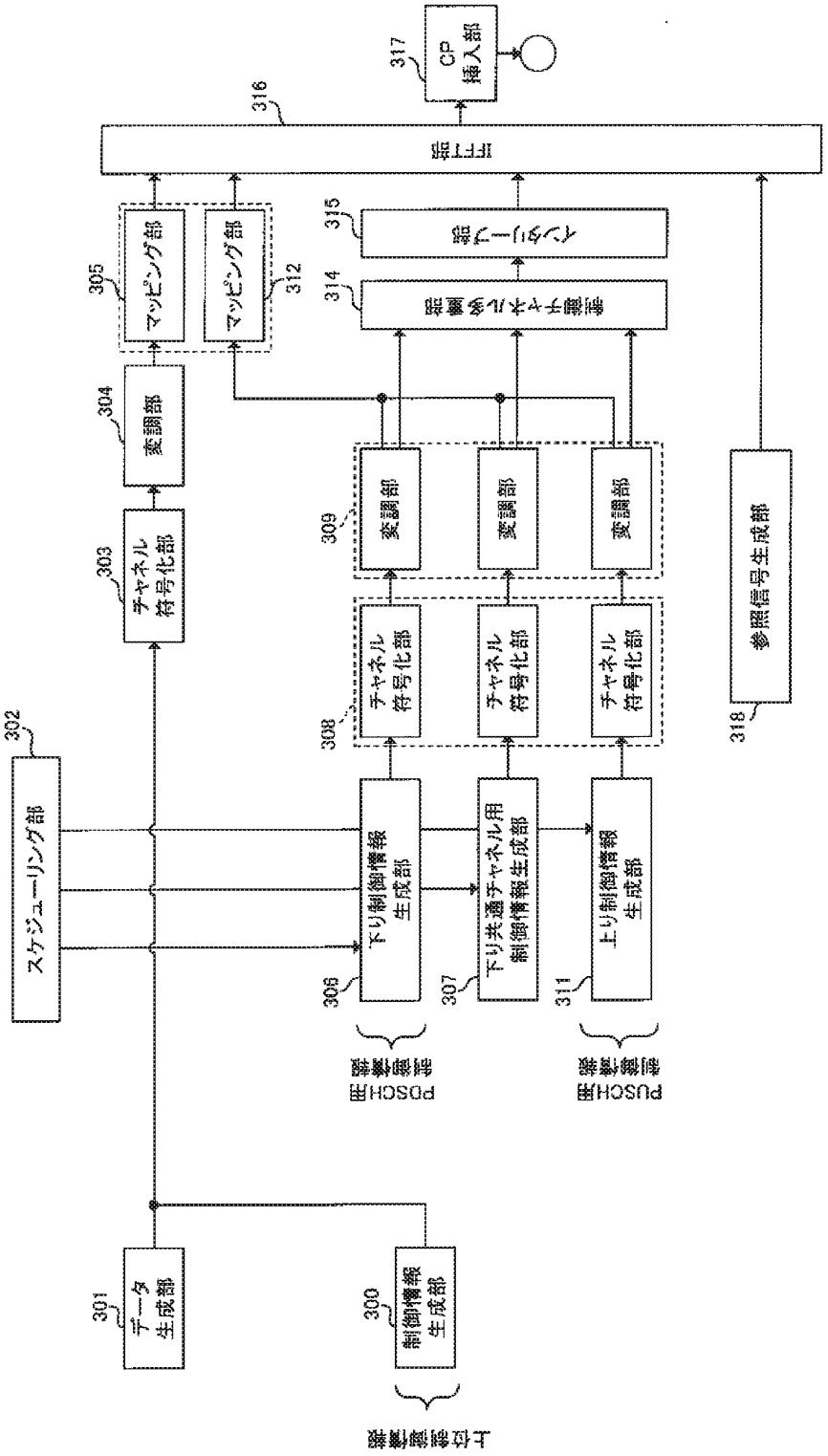
[図8]


送受信アンテナ
101
10A,10B
102
アンプ部
103
送受信部
104
ベースバンド信号処理部
105
アプリケーション部

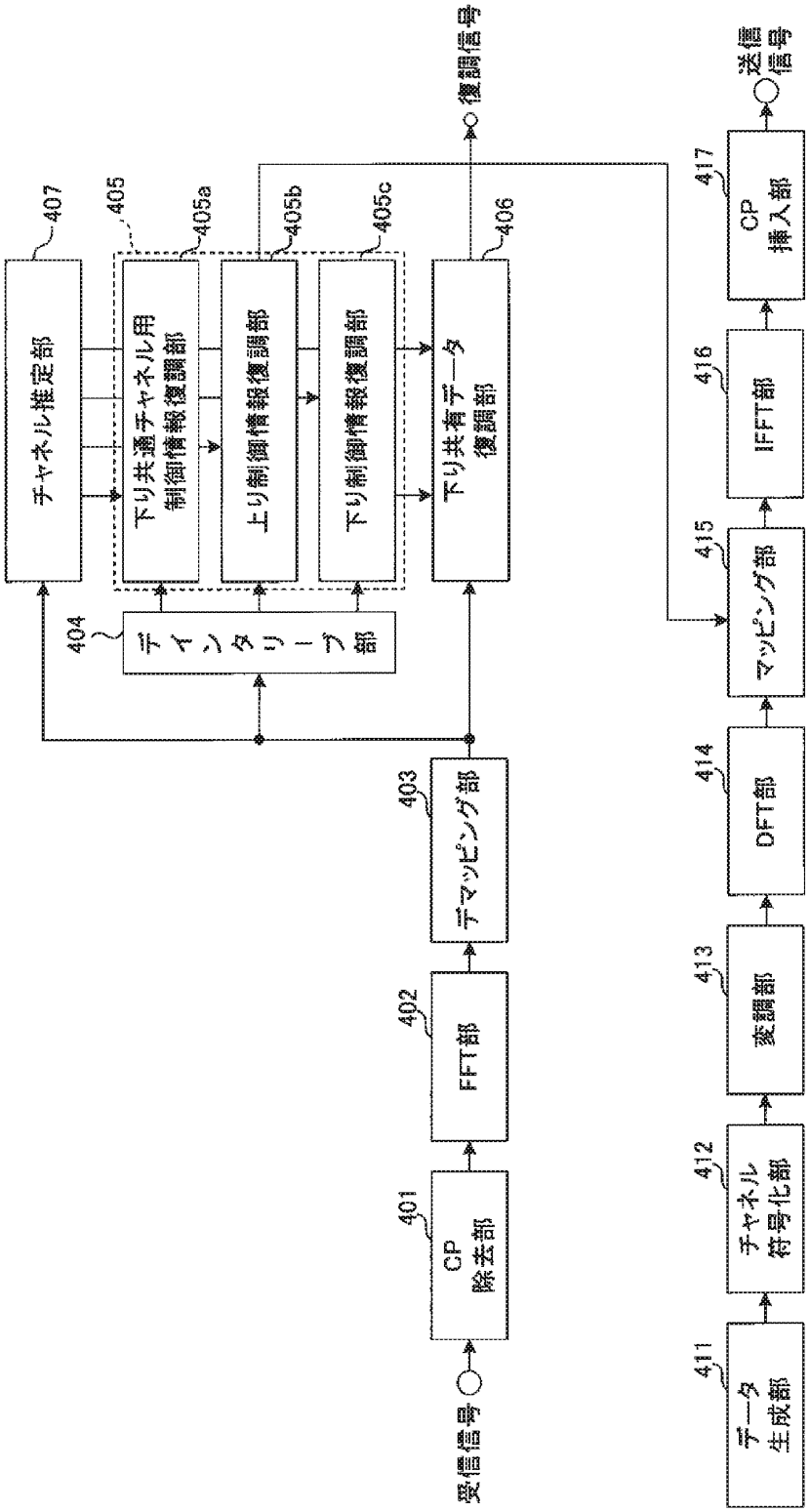
[図9]



[図10]


上位制御情報
データ生成部
制御情報生成部
スケジューリング部
チャネル符号化部
変調部
マッピング部
IFFT部
CP挿入部
参照信号生成部
下り制御情報生成部
下り共通チャネル用制御情報生成部
上り制御情報生成部
PDSCH用
PUSCH用

[図11]


受信信号
CP 除去部
401
FFT部
402
デマッピング部
403
デインタリーブ部
404
405
下り共通チャネル用 制御情報復調部
405a
上り制御情報復調部
405b
下り制御情報復調部
405c
下り共有データ 復調部
406
チャネル推定部
407
復調信号
データ 生成部
411
チャネル 符号化部
412
変調部
413
DFT部
414
マッピング部
415
IFFT部
416
CP 挿入部
417
送信信号

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/061983

A. CLASSIFICATION OF SUBJECT MATTER
H04W72/04(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W72/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	NTT DOCOMO, Issues Regarding LTE Network for Low Cost MTC, 3GPP TSG RAN WG1 Meeting #67 R1-114082, 3GPP, 2011.11.18	1-6,8-14 7
Y	Fujitsu, EPDCCH search space design to support narrow band operation, 3GPP TSG RAN WG1 #68 R1-120764, 3GPP, 2012.02.10	1-6,8-14
Y	NTT DOCOMO, On the Need of Common Search Space for E-PDCCH, 3GPP TSG RAN WG1 Meeting #68bis R1-121476, 3GPP, 2012.03.30	1-6,8-14
Y	JP 2010-518734 A (LG Electronics Inc.), 27 May 2010 (27.05.2010), paragraphs [0007] to [0008] & WO 2009/022879 A2	2-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 June, 2013 (28.06.13)	09 July, 2013 (09.07.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Research In Motion, UK Limited, Design Consideration for E-PDCCH, 3GPP TSG RAN WG1 Meeting #66 R1-112373, 3GPP, 2011.08.26	5
Y A	NTT DOCOMO, On the need for additional carrier types in Rel-11 CA, 3GPP TSG RAN WG1 Meeting #66bis R1-113289, 3GPP, 2011.10.14	8-10 7

国際調査報告

国際出願番号　ＰＣＴ／ＪＰ２０１３／０６１９８３

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Int.Cl.　H04W72/04(2009.01)i

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Int.Cl.　H04W72/04

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２０１３年
日本国実用新案登録公報	１９９６　２０１３年
日本国登録実用新案公報	１９９４－２０１３年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
Y A	NTT DOCOMO, Issues Regarding LTE Network for Low Cost MTC, 3GPP TSG RAN WG1 Meeting #67 R1-114082, 3GPP, 2011.11.18	1-6,8-14 7
Y	Fujitsu, EPDCCH search space design to support narrow band operation, 3GPP TSG RAN WG1 #68 R1-120764, 3GPP, 2012.02.10	1-6,8-14
Y	NTT DOCOMO, On the Need of Common Search Space for E-PDCCH, 3GPP TSG RAN WG1 Meeting #68bis R1-121476, 3GPP, 2012.03.30	1-6,8-14

☑　Ｃ欄の続きにも文献が列挙されている。

☐　パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー

「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの

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「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）

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「＆」同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
２８．０６．２０１３	０９．０７．２０１３

国際調査機関の名称及びあて先	特許庁審査官（権限のある職員）	５Ｊ	４２４１
日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	小林　正明 電話番号　０３－３５８１－１１０１　内線　３５３４		

Samsung Exhibit 1002, Page 298 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Ｃ（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
Y	JP 2010-518734 A (エルジー　エレクトロニクス　インコーポレイティド) 2010.05.27, 【０００７】－【０００８】 & WO 2009/022879 A2	2-4
Y	Research In Motion, UK Limited, Design Consideration for E-PDCCH, 3GPP TSG RAN WG1 Meeting #66 R1-112373, 3GPP, 2011.08.26	5
Y	NTT DOCOMO, On the need for additional carrier types in Rel-11 CA, 3GPP TSG RAN WG1 Meeting #66bis R1-113289, 3GPP, 2011.10.14	8-10
A		7

Samsung Exhibit 1002, Page 299 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

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61/303,684	12 February 2010 (12.02.2010)	US
61/307,429	23 February 2010 (23.02.2010)	US
10-2010-0022225	12 March 2010 (12.03.2010)	KR
10-2010-0040588	30 April 2010 (30.04.2010)	KR
10-2010-0040589	30 April 2010 (30.04.2010)	KR
61/349,220	28 May 2010 (28.05.2010)	US

(71) Applicant *(for all designated States except US)*: **LG ELECTRONICS INC.** [KR/KR]; 20 Yeouido-dong Yeongdeungpo-gu, Seoul 150-721 (KR).

(72) Inventors; and

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(74) Agent: **YANG, Moon Ock**; Essen Patent & Law Firm, 2F. Samheung Yeoksam Bldg., 735-10 Yeoksam-dong, Gangnam-gu, Seoul 135-080 (KR).

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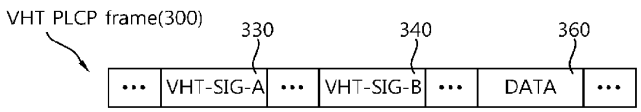
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— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: METHOD AND APPARATUS FOR TRANSMITTING CONTROL INFORMATION IN WLAN SYSTEM

[Fig. 3]



(57) Abstract: There is provided a method of transmitting control information in a Wireless Local Area Network (WLAN) system, comprising transmitting first control information by means of cyclic shift delay diversity beam-forming and transmitting second control information. The first control information comprises information necessary for each of a plurality of target stations of the second control information to receive the second control information. The second control information beamformed and transmitted to the plurality of target stations.

WO 2011/031058 A2

Description

Title of Invention: METHOD AND APPARATUS FOR TRANSMITTING CONTROL INFORMATION IN WLAN SYSTEM

Technical Field

[0001] The present invention relates to wireless communication, and more particularly, to a method and apparatus for transmitting control information in a Wireless Local Area Network (WLAN) system supporting multiple antennas.

Background Art

[0002] With the recent development of information communication technology, a variety of wireless communication techniques are being developed. From among them, a WLAN is a technique which wirelessly enables access to the Internet at home or companies or in a specific service providing area using mobile terminals, such as a Personal Digital Assistant (PDA), a laptop computer, and a Portable Multimedia Player (PMP), on the basis of radio frequency technology.

[0003] Since Institute of Electrical and Electronics Engineers (IEEE) 802 (i.e., the standard organization of WLAN technology) has been set up February, 1980, lots of standardization task are being performed.

[0004] The initial WLAN technology was able to support the rate of 1 to 2 Mbps through frequency hopping, band spreading, and infrared communication using a 2.4 GHz frequency band in accordance with IEEE 802.11, but recently can support the maximum rate of 54 Mbps using Orthogonal Frequency Division Multiplex (OFDM). In addition, in IEEE 802.11, the standardization of various techniques, such as the improvement of Quality for Service (QoS), Access Point (AP) protocol compatibility, security enhancement, radio resource measurement, wireless access vehicular environment for vehicle environments, fast roaming, a mesh network, interworking with an external network, and wireless network management, is being put to practical use being developed.

[0005] IEEE 802.11b from the IEEE 802.11 supports a maximum transmission speed of 11 Mbs while using the 2.4 GHz frequency band. IEEE 802.11a commercialized since the IEEE 802.11b has reduced the influence of interference as compared with the very complicated 2.4 GHz frequency band by using a 5 GHz frequency band not the 2.4 GHz frequency band and also improved the transmission speed up to a maximum of 54 Mbps using the OFDM technique. However, the IEEE 802.11a is disadvantageous in that the transmission distance is shorter than that of the IEEE 802.11b. Further, IEEE 802.11g implements a maximum transmission speed of 54 Mbps using the 2.4 GHz

frequency band like the IEEE 802.11b, and it is significantly being in the spotlight because it satisfies backward compatibility. The IEEE 802.11g is superior to the IEEE 802.11a even in the transmission distance.

[0006] Further, as a technique for overcoming the limit to the transmission speed pointed out as vulnerabilities in the WLAN, there is IEEE 802.11n which has recently been standardized. The IEEE 802.11n has its object to increase the speed and reliability of a network and to expand the operating distance of a wireless network. More particularly, the IEEE 802.11n is configured to support a High Throughput (HT) having a data processing speed of a maximum of 540 Mbps or more and based on a Multiple Inputs and Multiple Outputs (MIMO) technique using multiple antennas on both sides of a transmitter and a receiver in order to minimize transmission error and optimize the data rate. Further, the IEEE 802.11n may use a coding method of transmitting several redundant copies in order to increase the reliability of data and OFDM (Orthogonal Frequency Division Multiplex) in order to increase the speed.

[0007] With the wide spread of the WLAN and various applications using the WLAN, a necessity for a new WLAN system for supporting a higher throughput than the data processing speed supported by the IEEE 802.11n is recently gathering strength. A Very High Throughput (VHT) WLAN system is one of IEEE 802.11 WLAN systems which have recently been newly proposed in order to support the data processing speed of 1 Gbps or more. The name of the VHT WLAN system is arbitrary, and a feasibility test for a system using 4x4 MIMO and a channel bandwidth of 80 MHz or more in order to provide the throughput of 1 Gbps or more is being performed.

[0008] The VHT WLAN system now being discussed includes two kinds of methods using a frequency band of 6 GHz or less and a frequency band of 60 GHz. If the frequency band of 6 GHz or less is used, a possibility of coexistence with conventional WLAN systems using the frequency band of 6 GHz or less can become problematic.

[0009] Meanwhile, the physical (PHY) layer architecture of the IEEE 802.11 consists of a PHY Layer Management Entity (PLME), a Physical Layer Convergence Procedure (PLCP) sublayer, and a Physical Medium Dependent (PMD) sublayer. The PLME functions to manage the physical layer while cooperating with a MAC Layer Management Entity (MLME). The PLCP sublayer functions to transfer a MAC Protocol Data Unit (MPDU), received from the MAC layer, to the PMD sublayer or transfers frames, received from the PMD sublayer, to the MAC layer between the MAC layer and the PMD layer in accordance with an instruction of the MAC layer. The PMD sublayer is a lower layer of the PLCP and it enables the transmission and reception of a physical layer entity between two stations through a radio medium.

[0010] The PLCP sublayer attaches additional fields, including information necessary for a physical layer transceiver, to an MPDU in a process of receiving the MPDU from the

MAC layer and sending the MPDU to the PMD sublayer. The fields attached in this case can include a PLCP preamble for the MPDU, a PLCP header, tail bits over a data field, and so on. The PLCP preamble functions to have a receiver prepare for a synchronization function and antenna diversity before a PSDU (PLCP Service Data Unit = MPDU) is transmitted. The PLCP header includes information about a frame (e.g., PSDU Length Word (PLW)), information about the data rate of a PSDU portion, and information about header error check.

[0011] The PLCP sublayer generates a PLCP Protocol Data Unit (PPDU) by adding the above fields to the MPDU and sends the PPDU to a reception station via a PMD sublayer. The reception station restores data by acquiring the PLCP preamble of the received PPDU and information about data restoration from the PLCP header.

[0012] In case where a variety of legacy stations and VHT stations, such as IEEE 802.11 a/b/g/n, coexist, the legacy station cannot recognize or erroneously recognize the PLCP format and thus can malfunction. In order to prevent the above problem, in case where the PLCP format recognizable by the legacy stations and a format for the VHT stations are attached to all transmission data so that the formats can be recognized by all the stations, overhead is increased, thus hindering the efficient use of radio resources. Further, in a WLAN system supporting Multi-User (MU)-MIMO, in case where radio frames are spatially multiplexed for multiple users and transmitted, there is a problem that a station (i.e., not a target of transmission) cannot recognize the radio frames. It is also expected that the amount of control information necessary to send, receive, and decode data will be increased according to the MU-MIMO support.

[0013] Consideration is required for a new frame format for a method of transmitting control information in a WLAN system supporting MU-MIMO and for a VHT WLAN system which can accommodate increasing control information, support backward compatibility, and guarantee coexistence with a legacy station.

Summary of Invention

Technical Problem

[0014] It is an object of the present invention to provide a method of transmitting control information in a WLAN system supporting MU-MIMO.

[0015] It is another object of the present invention to provide a method of accommodating control information and transmitting frames in a WLAN system supporting MU-MIMO.

Solution to Problem

[0016] In an asepect, a method of transmitting control information in a Wireless Local Area Network (WLAN) system includes transmitting first control information by means of cyclic shift delay diversity beam-forming, and transmitting second control information,

wherein the first control information comprises information necessary for each of a plurality of target stations of the second control information to receive the second control information, and the second control information is beamformed and transmitted to the plurality of target stations.

[0017] The first control information may further include information about a transmission time taken to transmit spatially multiplexed Spatial Division Multiple Access (SDMA) data to the plurality of target stations.

[0018] The second control information may include control information about each of the plurality of target stations.

[0019] The control information about each of the plurality of target stations may include at least one of Modulation and Coding Scheme (MCS) information, channel bandwidth information, information about a number of spatial streams, and transmission power information.

[0020] The first control information and the second control information may be transmitted through a first frame, and the second control information may include information about a transmission time taken to transmit one or more second frames subsequent to the first frame.

[0021] A number of subcarriers per Orthogonal Frequency Division Multiplexing (OFDM) symbol allocated to transmit the first control information may be smaller than a number of subcarriers per OFDM symbol allocated to transmit the second control information.

[0022] A number of OFDM symbols allocated to transmit public control information may be greater than a number of OFDM symbols allocated to transmit STA-specific control information.

[0023] The first control information and the second control information are applied to different cyclic shifts.

Advantageous Effects of Invention

[0024] There are provided a control information transmission method and a PLCP frame format which can be applied to a WLAN system supporting MU-MIMO. Further, the coexistence of a VHT station and a legacy station is guaranteed because backward compatibility is supported.

Brief Description of Drawings

[0025] FIG. 1 is a diagram showing an example of a WLAN system to which an embodiment of the present invention can be applied;

[0026] FIG. 2 shows examples of the existing PLCP frame format;

[0027] FIG. 3 is a block diagram showing an example of a PLCP frame format according to an embodiment of the present invention;

[0028] FIG. 4 shows an example of a PLCP frame applied to a VHT system according to the present invention;

[0029] FIG. 5 shows the allocation of resources used to transmit VHTSIG-A and VHTSIG-B;

[0030] FIG. 6 shows an example of a BPSK constellation for VHTSIG-A;

[0031] FIG. 7 is a flowchart illustrating a method of transmitting control information according to an embodiment of the present invention;

[0032] FIGS. 8 to 37 are block diagrams showing examples of a PLCP frame structure and a transmission method according to some embodiments of the present invention; and

[0033] FIG. 38 is a block diagram showing an embodiment of a radio apparatus in which an embodiment of the present invention is implemented.

Mode for the Invention

[0034] Some embodiments of the present invention are described in detail with reference to the accompanying drawings.

[0035] FIG. 1 is a diagram showing an example of a WLAN system to which an embodiment of the present invention can be applied.

[0036] Referring to FIG. 1, the WLAN system includes one or more Basic Service Sets (BSSs). The BSS is a set of stations (STAs) which are successfully synchronized with other each and can perform transmission reciprocally. The BSS is not a concept indicative of a specific area. Further, a BSS supporting ultra-high data processing of 1 GHz or more in an MAC SAP, such as the WLAN system to which an embodiment of the present invention can be applied, is referred to as a Very High Throughput (VHT) BSS.

[0037] The VHT BSS can be classified into an infrastructure BSS and an independent BSS (IBSS). Infrastructure BSSs are shown in FIG. 1. The infrastructure BSSs BSS1 and BSS2 include one or more Non-AP STAs STA 1, STA 3, and STA 4, APs AP 1 (STA 2) and AP 2 (STA 5) (i.e., stations providing distribution service, and a Distribution System (DS) interconnecting the plurality of APs AP 1 and AP 2. In the infrastructure BSS, the AP STA manages the Non-AP STAs of the BSS.

[0038] On the other hand, the independent BSS (IBSS) is operated in the ad-hoc mode. The IBSS does not include a centralized management entity because it does not include an AP VHT STA. That is, in the IBSS, Non-AP STAs are managed in a distributed manner. In the IBSS, all STAs can be composed of mobile STAs, and the STAs form a self-contained network because they are not permitted to access a DS.

[0039] An STA is a certain function medium, including Medium Access Control (MAC) according to the IEEE 802.11 standards and a physical layer interface for a radio medium. The STA includes both an AP and a Non-AP STA in a broad sense. Further,

in a multi-channel environment to be described later, an STA supporting ultra-high data processing of 1 GHz or more is also referred to as a VHT STA. In a VHT WLAN system to which an embodiment of the present invention can be applied, all STAs included in the above BSS may be VHT STAs, or VHT STAs and legacy STAs (e.g., HT STAs according to IEEE 802.11 a/b/g/n) can coexist in the above BSS.

[0040] An STA for wireless communication includes a processor and a transceiver and can further include a user interface, display means, and so on. The processor is a function unit designed to generate frames to be transmitted over a wireless network or to process frames received over the wireless network. The processor performs several functions for controlling STAs. Further, the transceiver is functionally coupled to the processor and is a unit designed to transmit and receive frames over a wireless network for STAs.

[0041] Portable terminals manipulated by users, from among STAs, are Non-AP STAs STA1, STA3, STA4, and STA5. Assuming that the mobile terminals are simply STAs, they also refer to Non-AP STAs. The Non-AP STA may be referred to as another terminology, such as a terminal, a Wireless Transmit/Receive Unit (WTRU), a User Equipment (UE), a Mobile Station (MS), a mobile terminal, or a Mobile Subscriber Unit. Further, a Non-AP STA supporting ultra-high data processing on the basis of the MU-MIMO technique to be described later is referred to as a Non-AP VHT STA (or simply a VHT STA).

[0042] Further, the APs AP1 and AP2 are function entities which provide access to the DS via a radio medium for STAs associated therewith. It is a principle that in an infrastructure BSS including an AP, communication between Non-AP STAs is performed via the AP. However, in case where a direct link is established, such communication can be directly performed between the Non-AP STAs. The AP can be referred to as another terminology, such as a centralized controller, a Base Station (BS), a node-B, a Base Transceiver System (BTS), or a side controller, in addition to an access point. Further, an AP supporting ultra-high data processing on the basis of the MU-MIMO technique to be described later is called a VHT AP.

[0043] A plurality of infrastructure BSSs can be interconnected through a Distribution System (DS). The plurality of BSSs interconnected through the DS is called an Extended Service Set (ESS). STAs included in the ESS can communicate with each other. Non-AP STAs within the same ESS can move from one BSS to another BSS while seamlessly communicating with each other.

[0044] The DS is a mechanism for allowing one AP to communicate with another AP. In case where an AP sends frames for STAs associated with a BSS managed by the AP or any one STA moves to another BSS, the DS can transfer the frames or transfer the frames over an external network, such as a wired network. The DS needs not to be nec-

essarily a network and can include any type as long as it can provide a certain distribution service defined in the IEEE 802.11. For example, the DS may be a wireless network, such as a mesh network, or a physical structure interconnecting APs.

[0045] Meanwhile, a VHT WLAN system uses MU-MIMO so that several STAs can efficiently use wireless channels **simultaneously**. In other words, the VHT WLAN system allows several STAs to perform transmission and reception to and from an AP at the same time. The AP can send a spatially multiplexed radio frame to several STAs at the same time. To this end, the AP may perform beam-forming by measuring channel situations and may transmit and receive data using a plurality of spatial streams.

[0046] Hereinafter, to transmit the multiplexed data to a plurality of STAs is referred to as MU-MIMO transmission or SDMA transmission. In MU-MIMO transmission, at least one spatial stream is allocated to each of the STAs (i.e., targets of transmission), and data can be transmitted using the allocated spatial stream.

[0047] Hereinafter, a conventional STA (i.e., Non-VHT STA) is referred to as a legacy STA. The legacy STA includes a Non-HT STA supporting IEEE 802.11 a/b/g standards and an HT STA supporting IEEE 802.11n standards. In various PLCP frame formats proposed by the present invention and described later, fields denoted by the same name, unless specially mentioned, have the same function in the entire specification.

[0048] A PLCP frame according to the PLCP frame format proposed by the present invention is generated in the PLCP sublayer of an STA and sent to a transmission target STA using a PLCP frame transmission method, proposed by the present invention, through multiple antennas via a PMD sublayer. Hereinafter, the PLCP frame format and a method of transmitting fields constructing the same, which are described with reference to the accompanying drawings, are examples of various embodiments of the present invention, and the transmission sequence of the fields is not limited to that shown in the drawings. In the following description, the transmission sequence, unless not specially described, can be changed, and some fields can be omitted or added by necessity. The PLCP frame format and the method of transmitting the same to be described later can be adaptively selected and used according to the types and number of STAs constituting a BSS, the amount of data to be transmitted, priority, and so on.

[0049] FIG. 2 shows examples of the existing PLCP frame formats. For the PLCP frame formats, reference can be made to sub-clause 20.3 of "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications; Amendment 5: Enhancements for Higher Throughput" of IEEE 802.11n/D11.0 disclosed June, 2009.

[0050] The IEEE 802.11n standards provide three types of Physical Layer Convergence Procedure (PLCP) frames, including a Non-HT format, an HT-mixed format, and an

HT-greenfield format. The PLCP frame is used to transmit a PLCP Protocol Data Unit (PPDU).

[0051] Elements included in the PLCP frame are listed in the following table.

[0052] [Table 1]

Element	Description
L-STF (Non-HT Short Training Field)	Used for frame timing acquisition and automatic gain control (AGC) convergence
L-LTF (Non-HT Long Training Field)	Used for channel estimation
L-SIG (Non-HT SIGNAL field)	Including information for demodulating and decoding data for L-STA
HT-SIG (HT SIGNAL field)	Including information for HT-STA to demodulate and decode data
HT-STF (HT Short Training Field)	Used for frame timing acquisition and AGC convergence
HT-GF-STF (HT-Green Field Short Training Field)	Used for frame timing acquisition and AGC convergence (readable by only HT STA)
HT-LTF1 (First HT Long Training Field)	Used for channel estimation
HT-LTF (HT Long Training Field)	Including data HT-LTF used for channel estimation for data demodulation for HT-STA and extension HT-LTF used for channel sounding
Data field	Including PHY Service Data Unit (PSDU)

[0053] The Non-HT format is used for an L-STA, and it includes an L-STF, an L-LTF, and an L-SIG.

[0054] The HT-mixed format is used when an HT-STA and an L-STA coexist. In order to provide an L-STA with backward compatibility, the L-STF, the L-LTF, and the L-SIG are first sequentially. The HT-SIG is used for an HT-STA to decode data.

[0055] The HT-greenfield format is used in a system composed of only HT-STAs. That is, a L-STA cannot receive a PLCP frame that follows the HT-greenfield format.

[0056] Short Training Fields (STFs), such as the L-STF, the HT-STF, and the HT-GF-STF, are used for frame timing acquisition, AGC (automatic gain control), etc. and thus are also referred to a synchronization signal or a synchronization channel. That is, the STF is used to meet synchronization between STAs or an STA and an AP.

[0057] Long Training Fields (LTFs), such as the L-LTF and the HT-LTF, are used for

channel estimation for the demodulation of data or control information or both and thus are also referred to a reference signal, a training signal, or a preamble.

[0058] The L-SIG and the HT-SIG are referred to as control information because they provide several pieces of information necessary to decode data.

[0059] FIG. 3 is a block diagram showing an example of the PLCP frame format according to an embodiment of the present invention.

[0060] A VHT PLCP frame 300 includes a VHTSIG-A field 330, a VHTSIG-B field 340, and a DATA field 360. Each of the VHTSIG-A field 330 and the VHTSIG-B field 340 includes control information which is necessary for a reception STA to demodulate and decode the DATA field 360. The names of the VHTSIG-A field 330 and the VHTSIG-B field 340 are arbitrary and can be represented in various ways by first control information and second control information, respectively, or a first control signal and a second control signal, respectively.

[0061] The VHTSIG-A field 330 further includes common information about MU-MIMO transmission of fields to be subsequently transmitted. The VHTSIG-A field 330 can be transmitted so that all STAs within a BSS can receive the VHTSIG-A field 330. The VHTSIG-A field 330 may include information about a target STA of the VHTSIG-B field 340 to be subsequently transmitted and information necessary to receive the VHTSIG-B field 340. The VHTSIG-A field 330 can further include common information in the transmission of data to the target STA. For example, the VHTSIG-A field 330 may include information indicating an SDMA transmission time, together with information about a channel bandwidth used, modulation and coding information, and information about the number of spatial streams used. The SDMA transmission time is the time that Spatial Division Multiple Access (SDMA) data (i.e., a spatially multiplexed data frame for a plurality of STAs) is taken to be transmitted, and it can be referred to as an MU-MIMO transmission time. An STA other than a target of transmission can receive information indicating the SDMA transmission time, set a Network Allocation Vector (NAV) for the corresponding transmission time, and defer channel access.

[0062] The VHT-SIG B field 340 includes a parameter value which is used for SDMA transmission every target STA. For example, the VHT-SIG B field 340 may include information about parameter values which may be differently set according to an individual STA, such as an MCS index value indicating a Modulation and Coding Scheme (MCS) used, the bandwidth of a channel, and a value indicating the number of spatial streams.

[0063] The DATA field 360 includes SDMA-precoded data which will be transmitted to an STA (i.e., a target of transmission) and may further include tail bits or a bit padding element or both by necessity.

[0064] The VHT PLCP frame 300 may further include one or more fields, including information for performing frame timing acquisition and AGC convergence and for selecting diversity and information for channel estimation. The one or more fields may have a format recognizable by a legacy STA and an HT STA or may have the field of a format, recognizable by a legacy STA and an HT STA, added thereto.

[0065] A transmission station which transmits the VHT PLCP frame 300 transmits the VHTSIG-A field 330 omni-directionally without SDMA precoding, and applies SDMA precoding and beam-forming to the VHTSIG-B field 340 and the subsequent DATA field 360 and transmits them. In the present invention, transmission of signals omni-directionally may be transmission of signals using time domain cyclic delay diversity beam-forming, where signals transmitted in each transmit antenna are time domain cyclic shifted signals within an OFDM symbol of other transmit antennas.

[0066] The STAs of a BSS receive the VHTSIG-A field 330, transmitted omni-directionally, without SDMA precoding. An STA not belonging to targets of transmission can set an NAV during a period indicated by the SDMA transmission time information included in the VHTSIG-A field 330 and defer channel access. An STA belonging to the targets of transmission can acquire information individualized therefore from the VHTSIG-B field 340 and can receive, demodulate, and decode data transmitted thereto.

[0067] FIG. 4 shows an example of a PLCP frame applied to a VHT system according to the present invention.

[0068] The PLCP frame includes an L-STF 410, an L-STF 420, an L-SIG 420, VHTSIG-A 440, a VHT-STF 450, VHT-LTFs 460, VHTSIG-Bs 470, and data 480.

[0069] The L-STF 410 is used for frame timing acquisition, AGC (automatic gain control) control, coarse frequency acquisition, etc.

[0070] The L-LTF 420 is used for channel estimation for demodulating the L-SIG 420 and the VHTSIG-A 440.

[0071] The VHT-STF 450 is used for a VHT-STA in order to improve AGC estimation in an MIMO system.

[0072] A plurality of the VHT-LTFs 460 is included and used for channel estimation for demodulating the VHTSIG-B 470 and the data 480. The VHT-LTF 460 can also be referred to as a data VHT-LTF. In addition, an extension VHT-LTF for channel sounding can be used.

[0073] Beamforming is not applied to the L-STF 410, the L-LTF 420, the L-SIG 430, and the VHTSIG-A 440. Meanwhile, beam-forming for MU-MIMO is applied to the VHT-STF 450, the VHT-LTFs 460, the VHTSIG-Bs 470, and the data 480. In the beamforming, each field is processed through the same precoding matrix (or precoding vector). Since the data 480 and the VHT-LTFs 460 are processed through the same precoding matrix, a VHT-STA can directly demodulate or decode the data 480 through

a channel estimated using the VHT-LTF 460 although it does not know the precoding matrix.

[0074] Different cyclic shifts can be applied to a region not subjected to beam-forming and a region subjected to beam-forming, within a PLCP frame. That is, a first cyclic shift can be applied to the L-STF 410, the L-LTF 420, the L-SIG 430, and the VHTSIG-A 440, and a second cyclic shift can be applied to the VHT-STF 450, the VHT-LTFs 460, and the VHTSIG-B 470.

[0075] The cyclic shift can be applied to each OFDM symbol. Further, the cyclic shift can be given every transmission chain.

[0076] For example, assuming that a cyclic shift amount T_{cs} is applied to a signal s(t) of an interval $0 \le t \le T$, a cyclically shifted signal $s_{cs}(t)$ can be defined as follows.

[0077] [Math.1]

$$s_{cs}(t;T_{cs}) = \begin{cases} s(t-T_{cs}) & 0 \le t < T+T_{cs} \\ s(t-T_{cs}-T) & T+T_{cs} \le t \le T \end{cases}$$

[0078] Each PSDU included in the data 480 through beam-forming is transmitted to each STA.

[0079] For a VHT-STA, two kinds of control information, including the VHTSIG-A 440 and the VHTSIG-Bs 470, are included in the PLCP frame. The VHTSIG-A 440 indicates public control information (or also called first control information) for allowing the VHTSIG-B 470 to be received by each STA. The VHTSIG-B 470 indicates STA-specific control information (or called second control information) for allowing each STA to demodulate or decode or both its own data 480.

[0080] The public control information can include at least one of the following fields.

[0081]

[Table 2]

Field Name	Description
SIG-B Length	Indicate the length of VHTSIG-B
MU-MIMO Indicator	Indicate whether MU-MIMO is used or can toggle SU-MIMO/MU-MIMO
Bandwidth	Indicate the bandwidth of a channel
STA Indicator	Indicate an STA which will receive VHTSIG-B. It can indicate the address of an STA or indicate the ID of an STA or the index of VHTSIG-B
Number of multi-plexings	The number of STAs (users) multiplexed through MU-MIMO
Decoding indicator	Indicate information for decoding VHTSIG-B

[0082] The STA-specific control information (or also called user-specific control information) can include at least one of the following fields.

[0083] [Table 3]

Field Name	Description
MCS	Indicate MCS (modulation and coding scheme) information necessary to decode data
STA ID	Indicate an STA which will use MCS

[0084] In Tables 2 and 3, the field names are only illustrative and another name can be used. The fields of Tables 2 and 3 are only illustrative, some of the fields can be omitted, and other fields can be further added the fields.

[0085] FIG. 5 shows the allocation of resources used to transmit VHTSIG-A and VHTSIG-B.

[0086] Assuming that a bandwidth of 20 MHz is used, an L-STF, an L-LTF, an L-SIG, and VHTSIG-A in which beam-forming is not used uses 52 subcarriers (called narrowband (NB) subcarriers) every OFDM (Orthogonal Frequency Division Multiplexing) symbol in order to support an L-STA. The 52 NB subcarriers can be classified into 48 data NB subcarriers and 4 pilot NB subcarriers.

[0087] A VHT-LTF and VHTSIG-B in which beam-forming is used uses same subcarriers of DATA field OFDM symbols, which are 56 subcarriers (called wideband (WB) subcarriers) every OFDM symbol. The 56 WB subcarriers can be classified into 52 data WB subcarriers and 4 pilot WB subcarriers.

[0088] An L-STA uses 52 subcarriers every OFDM symbol in a 20 MHz band. In order to

provide backward compatibility, the VHTSIG-A uses the same number of subcarriers as the L-STF and the L-LTF.

[0089] The L-STF uses Quadrature Phase Shift Keying (QPSK) modulation, and it can be represented by the sequence S of the following frequency domain in one OFDM symbol.

[0090] $S_{-26,26}$=K{0,0,1+j,0,0,0,-1-j,0,0,0,1+j,0,0,0,-1-j,0,0,0,-1-j,0,0,0,1+j,0,0,0,0,0,0,0,-1-j,0,0,0,0,-1-j,0,0,0,1+j,0,0,0,1+j,0,0,0,1+j,0,0,0,1+j,0,0}

[0091] where K is a QPSK normalization factor and K=

$\sqrt{1/2}$

. A DC subcarrier is not used.

[0092] The L-LTF can be represented by the sequence T of the following frequency domain in one OFDM symbol.

[0093] $T_{-26,26}$={1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,0,1,-1,-1,1,1,-1,1,-1,1,-1,-1,-1,-1,-1,1,1,-1,-1,1,-1,1,-1,1,-1,1,1,1,1}

[0094] The L-SIG uses Binary Phase Shift Keying (BPSK) modulation and can have 48 bits because 48 data NB subcarriers are allocated thereto. When the L-SIG has a 1/2 code rate, the number of information bits of the L-SIG is 24.

[0095] The VHTSIG-A also uses BPSK modulation and can have 48 bits every OFDM symbol because 48 data NB subcarriers are allocated thereto. When the VHTSIG-A has a 1/2 code rate and 2 OFDM symbols allocated thereto, the number of information bits of the VHTSIG-A is 48.

[0096] In order to facilitate the detection of the VHTSIG-A, a BPSK constellation for the VHTSIG-A can be rotated around a BPSK constellation for the L-SIG.

[0097] FIG. 6 shows an example of BPSK constellation for VHTSIG-A.

[0098] In FIG. 6, the BPSK constellation for VHTSIG-A has been rotated by 90 degrees around a BPSK constellation for an L-SIG. This is called a rotated constellation. However, this is only illustrative, and the rotation angle can be 45 degrees, 180 degrees, and the like. Further, such rotation can be applied to not only BPSK, but also QPSK, 8-PSK, and 16-QAM.

[0099] Referring back to FIG. 4, the VHT-STF, the VHT-LTF, and the VHTSIG-B in which beam-forming is used do not need to maintain compatibility with an L-STA, and use 56 subcarriers every OFDM symbol in order to increase frequency efficiency.

[0100] The VHT-STF uses QPSK (Quadrature Phase Shift Keying) modulation and can be defined as the following sequence VHTS in one OFDM symbol.

[0101] $VHTS_{-28,28}$=K{0,0,0,0,1+j,0,0,0,-1-j,0,0,0,1+j,0,0,0,-1-j,0,0,0,-1-j,0,0,0,1+j,0,0,0,0,0,0,0,-1-j,0,0,0,-1-j,0,0,0,1+j,0,0,0,1+j,0,0,0,1+j,0,0,0,1+j,0,0,0}

[0102] where K is a QPSK normalization factor and K=

$\sqrt{1/2}$

.

[0103] The VHT-LTF can be represented by the sequence VHTT of the following frequency domain in one OFDM symbol.

[0104] $VHTT_{-28,28}$={1,1,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,0,1,-1,-1,1,1, -1,1,-1,1,-1,-1,-1,-1,-1,1,1,-1,-1,1,-1,1,-1,1,1,1,1,1,-1,-1}

[0105] The VHTSIG-B is mapped using the same modulation as the VHTSIG-A (i.e., a rotated BPSK constellation), and it uses one OFDM symbol. The VHTSIG-B uses 52 data subcarriers every OFDM symbol. Accordingly, when the VHTSIG-B has a 1/2 code rate, the number of information bits of the VHTSIG-B is 26.

[0106] In order to support MU-MIMO, control information necessary to decode data is divided into VHTSIG-A and VHTSIG-B. The VHTSIG-A is transmitted in omni-directionally and the VHTSIG-B is transmitted directionally. In other words, for transmission of the VHTSIG-A, channel specific beam-forming is not used(but cyclic delay shifted beam-forming may be used) and for transmission of the VHTSIG-B, beam-forming is used.

[0107] The number of subcarriers (e.g., 52) allocated to the VHTSIG-A is smaller than the number of subcarriers (e.g., 56) allocated to the VHTSIG-B. This means that frequency domain resources allocated to the VHTSIG-A are smaller than frequency domain resources allocated to the VHTSIG-B. This is because the VHTSIG-A is decoded using the channel estimation of an L-LTF in order to maintain backward compatibility.

[0108] The number of OFDM symbols (e.g., 2) allocated to the VHTSIG-A is greater than the number of OFDM symbols (e.g., 1) allocated to the VHTSIG-B. This means that time domain resources allocated to the VHTSIG-A is greater than time domain resources allocated to the VHTSIG-B. This is because if more STAs are multiplexed using MU-MIMO, only one OFDM symbol can be insufficient to transmit the VHTSIG-A.

[0109] When an L-STA and a VHT-STA coexist in a 20 MHz bandwidth, different time resources or different frequency resources or both can be allocated to a region providing backward compatibility and a region not providing backward compatibility. The time and frequency domains supported by all Non-AP STAs and APs within a BSS are allocated to an STF, an LTF, and public control information which are transmitted in the region providing backward compatibility. The time and frequency domains supported by only a VHT-STA or a VHT-AP are allocated to an STF, an LTF, and STA-specific control information in the region not providing backward compatibility. Accordingly, backward compatibility can be guaranteed, and higher frequency efficiency can be provided to a VHT-STA supporting MU-MIMO.

[0110] In the above structure, a time domain waveform for 20MHz VHTSIG-A can be represented by the following equation.

[0111] [Math.2]

$$r_{VHTSIG-A}^{i_{TX}}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{VHTSIG-A}^{Tone}}} \sum_{n=0}^{1} w_{T_{SYM}}(t - nT_{SYM}) \cdot \sum_{k=-26}^{26} [(\beta_n \cdot D_{k,n} + p_{n+1} P_k) \cdot \exp(j2\pi k \Delta_F (t - nT_{SYM} - T_{GI} - N_{CS}^{i_{TX}}))]$$

[0112] The β_n is phase rotation value such as +1 or +j, where VHTSIG-A modulated symbols are phase rotated to ensure VHT preamble detection. For Wider bandwidths such as 40, 80, or 160 MHz, the time domain waveform of 20MHz is duplicated in each 20MHz band frequency of the transmitted signal.

[0113] Further, a time domain waveform for the VHTSIG-B can be represented by the following equation.

[0114] [Math.3]

$$r_{VHTSIG-B}^{i_{TX}}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{VHTSIG-B}^{Tone}}} \sum_{n=0}^{1} w_{T_{SYM}}(t - nT_{SYM}) \cdot \sum_{k=-N_{SR}}^{N_{SR}} \sum_{i_{STS}=1}^{N_{STS}} [Q_k]_{i_{TX}, i_{STS}} [P_{VHTLTF}]_{i_{STS},1} (D_{k,n} + p_{n+1} P_k) \exp(j2\pi k \Delta_F (t - nT_{SYM} - T_{GI} - N_{CS}^{i_{TX}}))$$

[0115] N_{TX} : the number of transmission chains

[0116] N_{STS} : the number of space time streams

[0117] $N^{iTx}{}_{CS}$: the cyclic shift of an iTX transmission chain

[0118] $N^{iSTS}{}_{CS}$: the cyclic shift of an iSTS space time stream

[0119] $N^{tone}{}_{VHTSIG-A}$ the number of subcarriers used in VHTSIG-A

[0120] $N^{tone}{}_{VHTSIG-A}$: the number of subcarriers used in VHTSIG-B

[0121] N_{SR} : the number of subcarriers in half of the transmitted signal bandwidth used for VHTSIG-B

[0122] β_n : phase rotation value

[0123] T_{SYM} : symbol duration

[0124] T_{GI} : guard interval duration

[0125] P_{VHTLTF} : VHT-LTF mapping matrix

[0126] $D_{k,n}$, p_n, P_k, Q_k: parameters given in Paragraph 20.3 of EEE 802.11n/D11.0

[0127] Although not shown in FIG. 4, an HT-SIG can be further included in the PLCP frame. The HT-SIG can be disposed after the L-SIG or the VHTSIG-A. If the HT-SIG is further included, an HT-STF and an HT-LTF can be further included. If a PLCP frame does not provide backward compatibility to an L-STA, the L-STF, the L-LTF, and the L-SIG may not be included. Various PLCP frame formats relating to the above according to embodiments of the present invention are described in detail with

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reference to block diagrams.

[0128] In the above embodiment, although the 20 MHz bandwidth has been described, this is only illustrative. The technical spirit of the present invention can be applied to a bandwidth of 40 MHz or more. Further, the technical spirit of the present invention can be applied to a structure in which a plurality of the 20 MHz bandwidths or the 40 MHz bandwidths is combined together.

[0129] In the 40 MHz bandwidth, an L-STF, an L-LTF, an L-SIG, and VHTSIG-A in which beam-forming is not used uses 104 subcarriers every OFDM symbol in order to support an L-STA. VHT-LTF and VHTSIG-B in which beam-forming is used uses 112 subcarriers every OFDM symbol.

[0130] In the 40 MHz bandwidth, the L-LTF can be represented by the sequence T of the following frequency domain in one OFDM symbol.

[0131] $T_{-58,58}$={1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,0,1,-1,-1,1,1,-1,1,-1,1,
-1,-1,-1,-1,-1,1,1,-1,-1,1,-1,1,-1,1,-1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1
,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,0,1,-1,-1,1,1,-1,1,-1,1,-1,-1,-1,-1,1,1,-1,-1,1,-1,1,-1,1,1,
1,1}

[0132] In the 40 MHz bandwidth, the VHT-LTF can be represented by the sequence VHTT of the following frequency domain in one OFDM symbol.

[0133] $VHTT_{-58,58}$={1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,1,-1,-1,1,1,-1,1
,-1,1,-1,-1,-1,-1,-1,1,1,1,-1,-1,1,-1,1,-1,1,1,1,1,1,-1,-1,-1,1,0,0,0,-1,1,1,-1,1,1,-1,-1,1,1,1,-1,
1,-1,1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,1,1,1,1,1,1,-1,-1,1,1,-1,1,-1,1,-1,1,-1,-1,-1,-1,-1,1,1,-1,-1,1,-
1, 1,-1,1,1,1,1,1}

[0134] FIG. 7 is a flowchart illustrating a method of transmitting control information according to an embodiment of the present invention.

[0135] An STA or an AP transmits public control information at step S710. The public control information is transmitted omni-directionally without using beam-forming. The public control information is decoded using a channel which is estimated through an L-LTF transmitted in a previous OFDM symbol.

[0136] After transmitting the public control information, the STA or the AP transmits STA-specific control information at step S720. The STA-specific control information is transmitted to a specific STA (or a specific user) using beam-forming. A specific STA first receives the public control information, acquires information for receiving STA-specific control information, and then receives the STA-specific control information which has been beam-formed and transmitted. The STA-specific control information is decoded using a channel which is estimated through VHT-LTFs transmitted in an OFDM symbol between the public control information and the STA-specific control information.

[0137] Since all Non-AP STAs and APs within a BSS must be able to receive the public

control information, the time and frequency domains supported by all the Non-AP STAs and APs within the BSS are allocated to the public control information. Meanwhile, since the STA-specific control information is received by only a specific STA or a specific AP, the time/frequency domains supported by the specific STA or the specific AP are allocated to the STA-specific control information. Accordingly, backward compatibility can be guaranteed, and higher frequency efficiency can also be provided to a VHT-STA supporting MU-MIMO.

[0138] In the frequency domain, the magnitude of frequency resources of the public control information can be smaller than the magnitude of frequency resources of the STA-specific control information. For example, the number of subcarriers allocated to the public control information may be smaller than the number of subcarriers allocated to the STA-specific control information.

[0139] In the time domain, the magnitude of time resources of the public control information may be greater than the magnitude of time resources of the STA-specific control information. For example, the number of OFDM symbols allocated to the public control information may be greater than the number of OFDM symbols allocated to the STA-specific control information.

[0140] Different amounts of cyclic shifts may be applied to the public control information and the STA-specific control information.

[0141] The method of allocating frequency resources, the modulation method, the transmission method, and the method of applying a cyclic shift in relation to the control information can be applied to various PLCP frame formats likewise, proposed by the present invention.

[0142] FIG. 8 shows an example of a PLCP frame structure. FIG. 8 shows a method of adding a middle VTF-LTF to an intermediate part in which data are transmitted in the PLCP frame of FIG. 4.

[0143] Although a common WLAN system assumes an indoor environment, a possibility that the common WLAN system will be used in an outdoor environment cannot be excluded. For example, the WLAN can be used in campuses, outdoor parking places, etc. The outdoor environment has a greater change in the channel than the indoor environment.

[0144] If the amount of data is much and so the transmission interval of the data is long even though only the Doppler effects are taken into consideration, performance is expected to be deteriorated because there is a possibility that the channel can be changed during the long transmission interval.

[0145] Although the data can be divided and transmitted, there may be overhead for STFs and LTFs according to the format of a PCLP frame. Accordingly, the performance of channel estimation can be prevented from being deteriorated even in a change of a

channel environment by adding middle VHT-LTFs for the channel estimation in the middle portion of data.

[0146] Whether the middle VHT-LTFs will be transmitted can be informed through VHTSIG-A or VHTSIG-B.

[0147] FIG. 9 shows another example of the PLCP frame structure. FIG. 9 proposes a method of adding the last VTF-LTFs to the last of the PLCP frame of FIG. 4.

[0148] FIG. 10 is a block diagram showing an example of a VHT-GF PLCP frame format proposed by the present invention.

[0149] The VHT-GF PLCP frame proposed by the present invention is transmitted in order of a VHT-GF-STF (VHT Green Field Short Training Field), a VHT-LTF1 (VHT Long Training Field 1), and VHTSIG-A 1050. The VHT-GF-STF and the VHT-LTF1 include a control signal for frame timing acquisition, AGC (automatic gain control) convergence, and channel estimation. The VHT-GF-STF, the VHT-LTF1, and the VHTSIG-A 1050 are transmitted omni-directionally. It can be recognized that a channel is being used by receiving the VHT-GF-STF, the VHT-LTF1, and the VHTSIG-A 1050 in which the VHT STAs of a BSS (Basic Service Set) are transmitted omni-directionally.

[0150] VHTSIG-B 1060, VHT-LTFs, and a data field which are transmitted after the VHTSIG-A 1050 are subjected to SDMA precoding and beam-forming and then transmitted. The VHTSIG-B 1060, the VHT-LTFs, and the data field can be used to transmit information, individualized every target STA, because they are transmitted to a plurality of the target STAs through MU-MIMO.

[0151] FIG. 10 illustrates that a different cyclic shift can be used as cyclic shift CSD1 up to the VHTSIG-A 1050 and as cyclic shift CSD2 after the VHTSIG-A 1050.

[0152] FIG. 11 is a block diagram showing another example of the VHT-GF-PLCP frame format proposed by the present invention.

[0153] The VHT-GF-PLCP frame format of FIG. 11 shows an example in which a VHT-LTF2 1154 is further transmitted between the VHTSIG-A and the VHTSIG-B in the VHT-GF-PLCP frame of FIG. 10. The VHT-LTF2 1154 is transmitted anterior to the VHTSIG-B and it thus provides control information to be used for channel estimation which enables a reception STA to receive the VHTSIG-B to be subsequently transmitted.

[0154] FIG. 12 is a block diagram showing yet another example of the VHT-GF-PLCP frame format proposed by the present invention.

[0155] The VHT-GF-PLCP frame format of FIG. 12 shows an example in which a VHT-STF 1252 is further transmitted between the VHTSIG-A and the VHT-LTF2 in the VHT-GF-PLCP frame of FIG. 11. The reason why the VHT-STF 1252 is further transmitted is to transmit a control signal so that a reception STA can properly

compensate for transmission power in AGC which can vary according to a change of a transmission method because of omni-directional beam-forming transmission.

[0156] FIG. 13 is a block diagram showing still yet another example of the VHT-GF-PLCP frame format proposed by the present invention.

[0157] A VHT-GF-STF, a VHT-LTF1, and one VHTSIG 1350 are transmitted omni-directionally so that they can be received by all the STAs of a BSS. Next, precoding is performed, and a VHT-STF, VHT-LTFs, and a data field are then subjected to beam-forming and transmitted.

[0158] FIG. 14 is a block diagram showing still yet another example of the VHT-GF-PLCP frame format proposed by the present invention.

[0159] The VHT-GF-PLCP frame of FIG. 14, like the VHT-GF-PLCP frame of FIG. 13, is used to transmit a VHT-GF-STF, a VHT-LTF1, VHTSIG-A 1450, and VHTSIG-B 1460 omni-directionally so that the VHT-GF-STF, the VHT-LTF1, the VHTSIG-A 1450, and the VHTSIG-B 1460 can be received by all the STAs of a BSS. Next, precoding is performed, and a VHT-STF, VHT-LTFs, and a data field are then subjected to beam-forming and transmitted. In this case, when spatially multiplexed data are transmitted to a plurality of target STAs, the number of streams through MU-MIMO may be variable. Accordingly, control information may also be variable. In the VHT-GF-PLCP frame format of FIG. 14, the VHT-SIG 1350 of FIG. 13 is divided into the VHTSIG-A 1450 and the VHTSIG-B 1460, and the VHTSIG-A 1450 can indicate information about the magnitude of the VHTSIG-B 1460 including control information about each variable target STA.

[0160] FIG. 15 is a block diagram showing still yet another example of the VHT-GF-PLCP frame format proposed by the present invention.

[0161] The VHT-GF-PLCP frame format of FIG. 15 shows an example in which a VHT-GF-STF, a VHT-LTF1, VHTSIG-A, and VHTSIG-B are transmitted omni-directionally, and then a VHT-STF, VHT-LTFs, and a data field are then subjected to precoded, beam-forming, and then transmitted. Unlike the VHT-GF-PLCP frames of FIGS. 10 to 14 in which MU-MIMO transmission is performed, the VHT-GF-PLCP frame of FIG. 15 shows an example of a PLCP frame in which SU-MIMO transmission is performed. The reason why both VHT-SIGs (i.e., the VHTSIG-A and the VHTSIG-B) are transmitted omni-directionally is that there is no problem of collision and interference between PLCP frames toward different STAs because SDMA transmission is not performed unlike MU-MIMO transmission.

[0162] The VHTSIG-A 1550 and the VHTSIG-B 1560 can include an indicator, indicating whether the VHT-GF-PLCP frame is the VHT-GF-PLCP frame of MU-MIMO or the VHT-GF-PLCP frame of SU-MIMO, in the form of a subfield. For example, in case where a type subfield, including information indicative of the type of a VHT-GF-PLCP

frame, is set to 0 and transmitted, a reception STA can recognize the indicator as a SU-MIMO VHT-GF-PLCP frame. Further, in case where the type subfield is set to 1 and transmitted, the reception STA can recognize the indicator as an MU-MIMO VHT-GF-PLCP frame.

[0163] A VHT-STF including a control signal for compensation in AGC according to a change of a transmission method is transmitted after the VHTSIG-B 1560. Fields posterior to the VHT-STF are subjected to precoding and beam-forming and then transmitted.

[0164] FIG. 16 is a block diagram showing still yet another example of the VHT-GF-PLCP frame format proposed by the present invention.

[0165] The VHT-GF-PLCP frame format of FIG. 16 may be used in case where even VHTSIG-A needs not to be transmitted to other STAs of a BSS using a VHT-GF-PLCP frame format which can be used in SU-MIMO. Unlike in the example of FIG. 15, in the VHT-GF-PLCP frame of FIG. 16, all the fields are subjected to SDMA precoding and transmitted. Since there is no change of a transmission method in the transmission of the frame, the VHT-STF may be omitted unlike the PLCP frame format of FIG. 15.

[0166] FIG. 17 is a block diagram showing an example of a VHT-mixed PLCP frame format proposed by the present invention.

[0167] The VHT-mixed PLCP frame proposed by the present invention includes a training field and a signal (SIG) field for legacy STAs. The training field and the signal field for legacy STAs are transmitted anterior to a training field and a signal field for VHT STAs so that the legacy STAs can know that a channel is being used by receiving the training field and the signal field for legacy STAs.

[0168] Referring to FIG. 17, an L-STF (legacy short training field) ad an L-LTF (legacy long training field) (i.e., training fields for legacy STAs) are first transmitted. The L-STF is used for frame timing acquisition and AGC (automatic gain control) convergence, and the L-LTF is used for a signal field (SIG field) and channel estimation for data demodulation.

[0169] The signal field is transmitted posterior to the training fields. Here, an L-SIG for a Non-HT STA and an HT-SIG for an HT STA may be transmitted. The HT-SIG, as in the example of FIG. 10, may be transmitted in the form of one field posterior to the L-SIG or may be included in the L-SIG and then transmitted as needed. The L-SIG and the HT-SIG includes Modulation and Coding Scheme (MCS) information necessary to demodulate and decode the data field subsequently transmitted.

[0170] The training fields and the signal field for legacy STAs are first transmitted and the fields for VHT STAs are then transmitted. The fields for VHT STAs may include a VHT-STF, a VHT-LTF1, VHT-SIG, VHT-LTFs for channel estimation with in-

dividual STAs, and extension VHT-LTFs. After the training fields and the signal field for VHT STAs are transmitted, a data field is transmitted.

[0171] In the example of FIG. 17, the training fields and the signal field for legacy STAs are subjected to only CSD (cyclic shift delay) without precoding so that they can be recognized by the legacy STAs and then transmitted omni-directionally. The CSD may be performed before or after Inverse Discrete Fourier Transform (IDFT) in a signal transmission process in order to prevent unwanted beam-forming from being generated. The CSD may be performed every transmitter chain or every spatial stream and may be applied as part of a spatial mapper. Next, the training fields, the signal field, and the data field for VHT STAs may be subjected to CSD, precoding, and beam-forming and then transmitted.

[0172] FIGS. 18 and 19 are block diagrams showing another example of the VHT-mixed PLCP frame format proposed by the present invention.

[0173] The VHT-mixed PLCP frame of FIGS. 18 and 19 have the same field and transmission sequence as the PLCP frame of FIG. 8. However, the VHT-mixed PLCP frame of FIG. 18 differs from the VHT-mixed PLCP frame of FIG. 8 in that fields up to VHTSIG-A are omni-directionally and fields starting from VHTSIG-B are subjected to SDMA precoding and transmitted. The VHT-mixed PLCP frame of FIG. 19 differs from the VHT-mixed PLCP frame of FIG. 18 in that fields from a VHT-STF to VHTSIG-A are precoded and transmitted.

[0174] FIG. 20 is a block diagram showing yet another example of the VHT-mixed PLCP frame format proposed by the present invention.

[0175] Referring to FIG. 20, training fields and a signal field for legacy STAs and a signal field VHT-SIG for VHT STAs are transmitted omni-directionally. Next, a field VHT-STF to a data field are subjected to SDMA precoding and transmitted. Here, the VHT-SIG field includes control information for demodulating and decoding data received by reception STAs.

[0176] FIG. 21 is a block diagram showing an example of a VHT-mixed-GF PLCP frame format proposed by the present invention.

[0177] The VHT-mixed-GF PLCP format of FIG. 21 is effective in the case of a WLAN system composed of only IEEE 802.11n HT STAs and VHT STAs or in case where Non-HT STAs need not to be taken into consideration. In the VHT-mixed-GF PLCP frame, an L-STF, an L-LTF, and an L-SIG are not transmitted because Non-HT STAs need not to be taken into consideration. However, an HT-GF-STF, an HT-LTF1, and an HT-SIG are first transmitted so that HT STAs can recognize the PLCP frame. Next, a VHTSIG and VHT-LTFs for VHT STAs and a data field are transmitted.

[0178] In the VHT-mixed-GF PLCP frame of FIG. 21, the VHT-LTFs and the data field are transmitted immediately after the HT-SIG and the VHT-SIG without a VHT-STF

because all fields are precoded and a precoded value is applied to all the fields.

[0179] FIG. 22 is a block diagram showing another example of a VHT-mixed-GF PLCP frame format proposed by the present invention.

[0180] Unlike in the example of FIG. 21, fields up to a VHT-SIG are transmitted omni-directionally so that all HT STAs and VHT STAs within a BSS can receive an HT-SIG and the VHT-SIG. Fields subsequent to the VHT-SIG are precoded and transmitted. That is, a VHT-STF is first transmitted, and VHT-LTFs and a data frame are then transmitted.

[0181] FIG. 23 is a block diagram showing yet another example of a VHT-mixed-GF PLCP frame format proposed by the present invention.

[0182] In the VHT-mixed-GF PLCP frame of FIG. 23, an HT-GF-STF, an HT-LTF1, an HT-SIG, and VHTSIG-A are transmitted omni-directionally, and all subsequent fields are precoded and sequentially transmitted in order of a VHT-STF, a VHT-LTF1, VHTSIG-B, VHT-LTFs, and a data field. Here, the VHTSIG-A may not be additionally transmitted, and parameters for data demodulation and decoding may be transmitted in the VHTSIG-B. In this case, information of a subfield transmitted in the HT-SIG may be reused. A reception STA can demodulate and decode the data field on the basis of the information of the VHTSIG-B. Further, some of the fields of the PLCP frame format of FIG. 23 may be omitted as needed, and FIGS. 24 and 25 show an example thereof.

[0183] FIGS. 24 and 25 show formats in each of which the VHT-STF or the VHT-LTF1 is omitted in the example of FIG. 23 and show examples of the VHT-mixed-GF PLCP frame format which may be modified according to the implementation of an STA.

[0184] FIG. 26 shows an example of a VHT-Mixed-PLCP frame format and the transmission of the VHT-Mixed-PLCP frame according to an embodiment of the present invention.

[0185] The VHT-Mixed-PLCP frame 2610 includes TFs (training fields) and SIGs (recognizable by legacy STAs) for the legacy STAs, TFs and SIGs for VHT STAs, and a data field. As an example of the TFs and the SIGs for legacy STAs, the VHT-Mixed-PLCP frame 2610 of FIG. 26 includes an L-STF (Non-HT short Training Field) 2612, an L-LTF (Non-HT Long Training Field) 2614, an L-SIG (Non-HT SIGNAL Field) 2616, and an HT-SIG (HT SIGNAL field) 2618.

[0186] The L-STF 2612 is used for frame timing acquisition and AGC (automatic gain control) convergence. The L-LTF 2614 is used for channel estimation for demodulating the L-SIG 2616 and data. The L-SIG 2616 includes information for demodulating and decoding subsequent data. The HT-SIG 2618 is a SIG field for an HT STA and may be included in the L-SIG 2616 and transmitted. The L-STF 2612, the L-LTF 2614, and the L-SIG 2616 are transmitted anterior to other fields so that legacy

STAs can recognize them and can know that a channel is being used.

[0187] The VHT-Mixed-PLCP frame 2610 according to the embodiment of the present invention includes a VHT-STF 2622 for VHT STAs, a VHT-LTF1 2624, two VHT-SIGs (i.e., VHTSIG-A 2630 and VHTSIG-B 2640), and VHT-LTFs 2650-1, ..., 2650-L. The VHTSIG-A 2630 includes common information about fields subsequently transmitted and the PLCP frame. The VHTSIG-B 2640 may include information individualized every target STA to which data will be transmitted.

[0188] In a method of transmitting frames according to an embodiment of the present invention, the VHT-Mixed-PLCP frame 2610 is first transmitted, and N number of GF-PLCP frames 2690-1 to 2690-N are then transmitted. The VHT-Mixed-PLCP frame 2610 includes transmission time information about the VHT-Mixed-PLCP frame 2610 and N number of the VHT GF-PLCP frames 2690-1 to 2690-N. Legacy STAs and VHT STAs which are not transmission target STAs can know that a channel is being used through the VHT-Mixed-PLCP frame 2610 and sets an NAV and defers channel access during the time for which the channel is used on the basis of the transmission time information included in the VHT-Mixed-PLCP frame 2610. To this end, fields before the VHTSIG-A 2630 in the VHT-Mixed-PLCP frame 2610 are transmitted without SDMA precoding so that they can be recognized by all STAs including legacy STAs, and only fields subsequent to the VHTSIG-A 2630 are subjected to SDMA precoding and transmitted.

[0189] Legacy STAs and VHT STAs which are not transmission target STAs may not recognize N number of the GF-PLCP frames 2690-1 to 2690-N transmitted after the VHT-Mixed-PLCP frame 2610, but may set an NAV and defer channel access during the time for which all the VHT-Mixed-PLCP frame 2610 and N number of the GF-PLCP frames 2690-1 to 2690-N are transmitted on the basis of the transmission duration information included in the VHT-Mixed-PLCP frame 2610. Accordingly, malfunction can be prevented.

[0190] FIG. 27 is a block diagram showing a VHT-GF-PLCP frame format according to an embodiment of the present invention.

[0191] The VHT-GF-PLCP frame 2700 includes a VHT-GF-STF 2710, a VHT-LTF1 2720, two VHT-SIG fields (i.e., VHTSIG-A 2730 and VHTSIG-B 2740), N number of VHT-LTFs 2750-1, ..., 2750-N, and a data field DATA. In the example of FIG. 27, the VHTSIG-A 2730 and the VHTSIG-B 2740 are consecutively transmitted, but only illustrative. The VHTSIG-B 2740 may be transmitted immediately after the VHTSIG-A 2730 or may be transmitted after the VHTSIG-A 2730. In the VHT-GF-PLCP frame 2700 according to the present invention, the VHT-GF-STF 2710, the VHT-LTF1 2720, and the VHTSIG-A 2730 are transmitted omni-directionally so that all VHT STAs can listen to them. The VHTSIG-B 2740 and data subsequently transmitted can be

subjected to SDMA precoding and beam-forming and then transmitted. The VHTSIG-A 2730 includes common information about subsequent SDMA transmission. For example, the VHTSIG-A 2730 may include common information about SDMA transmission duration so that third STAs (i.e., not transmission target STAs) may set an NAV during the SDMA transmission duration. The VHTSIG-B 2740 has a parameter value set therein or includes the parameter value which is used for SDMA transmission to each transmission target STA. For example, an MCS index, a channel bandwidth, the number of spatial streams, and so on may be set and included in the VHTSIG-B 2740 on an STA basis and then transmitted.

[0192] The VHTSIG-B 2740 and the data subsequently transmitted are subjected to SDMA precoding and beam-forming and then transmitted. Accordingly, a third STA (i.e., not a transmission target STA) does not receive the VHTSIG-B 2740 field and the data subsequently transmitted, but can recognize a corresponding preamble by receiving the fields up to the VHTSIG1 2730.

[0193] In Single User (SU)-MIMO, a GF-PLCP frame may use one VHTSIG. This is because since SDMA transmission is not performed in the SU-MIMO, problems, such as collision and interference between PLCP frames heading for different STAs, are not generated. In order to identify GF-PLCP frames in the SU-MIMO and the MU-MIMO, a type subfield indicative of a transmission type may be included in the VHTSIG-A 2730 and the VHTSIG-B 2740. In case where a configuration value of the type subfield indicates transmission using the SU-MIMO method, only one VHTSIG field is used. In case where a configuration value of the type subfield indicates transmission using the MU-MIMO method, two VHTSIGs (i.e., VHTSIG1 and VHTSIG2) are used. As described above, the VHTSIG1 of the two VHTSIGs is used to detect and recognize the preamble of a PLCP frame which is omni-directionally transmitted and being transmitted by STAs within a BSS. Further, the VHTSIG2 of the two VHTSIGs has information about MCS index values for spatial streams heading for respective transmission target STAs, a channel bandwidth, the number of spatial streams, etc.

[0194] FIG. 28 shows an example of a PLCP frame format according to an embodiment of the present invention.

[0195] The PLCP frame of FIG. 28 has a VHT-mixed frame format and includes fields L-STF, L-LTF, L-SIG, and HT-SIG for legacy STAs. The fields L-STF, L-LTF, L-SIG, and HT-SIG have the same function as described above.

[0196] FIG. 28 shows the example in which an AP transmits 5 spatial streams to two STAs STA1 and STA2 using the MU-MIMO method, the first STA STA1 receives 3 spatial streams, and the second STA STA2 receives 2 spatial streams. Here, the number of STAs (i.e., targets of MU-MIMO transmission) and the number of spatial streams transmitted to the STAs are only illustrative, and the present invention is not limited

thereto.

[0197] The PLCP frame of FIG. 28 includes a plurality of VHTSIG fields (e.g., VHTSIG1 and VHTSIG2), each including control information about an STA (i.e., a target of MU-MIMO transmission). That is, the number of VHTSIG fields can be equal to or greater than the number of STAs (i.e., targets of MU-MIMO transmission).

[0198] In the example of FIG. 28, the field VHTSIG1 includes control information about the STA1 (i.e., a target of MU-MIMO transmission), and the field VHTSIG2 includes control information about the STA2 (i.e., a target of MU-MIMO transmission).

[0199] The VHTSIG field allocated to each STA may consist of several VHTSIG fields, such as VHTSIG1 to the VHTSIGN. For example, the HT-SIG field of the IEEE802.11n standards may include two HT-SIGs, which are transmitted in two OFDM symbols. The number of OFDM symbols of the VHTSIG field to be transmitted can be represented by the number of STAs spatially multiplexed using MU-MIMO and a function of the number of spatially multiplexed streams.

[0200] In the example of FIG. 28, the two VHTSIG fields are illustrated, but duration in which the VHTSIG fields are transmitted is increased with an increase in the number of STAs (i.e., targets of MU-MIMO transmission). If an AP transmitting eight streams is operated together with eight 1 Rx-STAs through MU-MIMO, eight VHTSIG fields (i.e., VHTSIG1 to VHTSIG8) have to consecutively transmitted.

[0201] In this case, layer index indication, informing which stream will be received by an STA (i.e., a target of MU-MIMO transmission), is required. To this end, the VHTSIG field may include an indication bit, indicating control information for a specific one of STAs (i.e., a plurality of targets of MU-MIMO transmission).

[0202] An LTF is subjected to code multiplexing and transmitted through a plurality of spatial streams at the same time. The number of LTFs transmitted may be changed in order to provide LTF orthogonality and thus represented by LTFx in the example of FIG. 28.

[0203] A method of adding a unique identification signal for control information about each of the STAs to the VHTSIG field or a method of performing bit pattern masking (i.e., exclusive OR to parity bits) on an identification value, identifying an STA, for the CRC parity bit of the VHTSIG field may be used as a method of indicating where control information for each of STAs (i.e., a plurality of targets of MU-MIMO transmission) is contained in which VHTSIG field may include. In this case, the identification value or signal may be an MAC address or an association ID of a target STA.

[0204] A cyclic shift used up to the VHTSIG field can differ from cyclic shifts subsequently used. Fields transmitted after the VHTSIG field can be subjected to precoding and beam-forming and then transmitted.

[0205] FIG. 29 shows another example of the PLCP frame format according to an em-

bodiment of the present invention. The PLCP frame format of FIG. 29 has a VHT GF PLCP format and it is basically the same as that of FIG. 28. However, since legacy STAs need not to be taken into consideration, fields (e.g., L-STF, L-LTF, L-SIG, and HT-SIG) for the legacy STAs may be omitted, and all fields may be subjected to beam-forming and transmitted.

[0206] FIGS. 30 and 31 show yet another example of the PLCP frame format according to an embodiment of the present invention.

[0207] FIG. 30 shows a VHT-mixed PLCP frame format, and FIG. 31 shows a VHT GF PLCP frame format.

[0208] In the PLCP frame of FIG. 30, fields (i.e., L-STF, L-LTF, L-SIG, and HT-SIG) for legacy STAs are transmitted omni-directionally. Next, subsequent fields starting from VHTSIG fields, each including control information about the STA, can be subjected to beam-forming every STA and then transmitted. Accordingly, in the VHT-mixed PLCP frame format of FIG. 30, the VHTSIG fields are transmitted after fields VHT-STF in each of which an AGC gain has been taken into consideration are transmitted. That is, the field HT-SIG and the fields VHTSIG are not consecutively transmitted.

[0209] In case where the VHTSIG fields of FIGS. 28 and 29 support MU-MIMO unlike an overlapped format, the transmission duration of the VHTSIG field is not changed according to the number of STAs. Further, if an AP properly performs beam-forming (e.g., using a block diagonalization scheme) for each STA (i.e., a target of MU-MIMO transmission), the corresponding STA does not interfere with other STAs because it can recognize only its own stream irrespective of a total number of streams. Accordingly, each STA does not know that it is operated according to the MU-MIMO method and considers that it is operated according to the SU-MIMO method using a small number of spatial streams.

[0210] FIGS. 30 and 31 show the examples in which an AP pairs two STAs (i.e., STA1 and STA2) for MU-MIMO. The STA1 receives 3 streams and receives 4 VHT-LTFs for channel measurement. The STA2 receives 2 streams and receives 2 VHT-LTFs for channel measurement.

[0211] In this case, an LTF mapping matrix P can be represented by Equations 4 to 6.

[0212] Equation 4 shows an example of the LTF mapping matrix which may be used when 2 LTFs are measured, Equation 5 shows an example of the LTF mapping matrix which may be used when 3 LTFs are measured, and Equation 6 shows an example of the LTF mapping matrix which may be used when 4 LTFs are measured.

[0213] [Math.4]

$$P = \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$$

[0214] [Math.5]

$$P = \begin{bmatrix} 1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & -1 \end{bmatrix}$$

[0215] [Math.6]

$$P = \begin{bmatrix} 1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 \\ 1 & 1 & 1 & -1 \\ -1 & 1 & 1 & 1 \end{bmatrix}$$

[0216] FIG. 31 shows an example of a VHT GF PLCP frame format. In this frame format, fields for legacy STAs which are non-overlapped parts are omitted in the example of FIG. 30. Further, since all fields are subjected to precoding and beam-forming and then transmitted, the transmission of VHT STF fields for controlling an ACG gain may be omitted.

[0217] In the examples of FIGS. 30 and 31, if an AP can transmit 5 or more streams, beams for STAs can be transmitted without interference with each other. However, if a total number of RXs of STAs (i.e., targets of MU-MIMO transmission) is greater than the number of streams that can be received, performance loss can be generated because the beams are not properly formed. For example, it is assumed that when an AP transmits 4 streams, an STA1 has 3 Rx antennas and an STA2 has 2 Rx antennas. Assuming that the AP forms a beam in order to transmit 2 streams to each STA, the STA1 experiences such performance loss.

[0218] Here, the performance loss can be caused by various factors. When interference zero forcing beam-forming used by the AP is performed, a transmission signal will not be transmitted to each STA without interference because of the limit of finite word length precision and channel coefficient estimation error. Here, the finite word length precision problem refers to a problem occurring because of information lost when signal information is quantized into digital data in a current wireless modem. Further, in a state in which spatial interference leakage exists, channel estimation can be erroneously performed by LTFs for different STAs composed of the same sequence. Accordingly, performance loss can be generated because data demodulation is not normally performed.

[0219] Meanwhile, if LTF indications for the streams of different STAs are included in its own VHTSIG field although interference is introduced from the different STAs (or if indication for its own LTF is included in the VHTSIG field), interference can be cancelled using a proper receiver (e.g., an MMSE receiver). As described above, there

is proposed a method of including LTF indications for different STAs except its own STA in the VHTSIG field.

[0220] Further, in order to improve the performance of channel estimation in a state in which interference occurs between different STAs because of signals for the different STAs, there is proposed a method of transmitting different sequences to an LTF and other signals (e.g., STF and VHTSIG) through STA-specific scrambling.

[0221] As a detailed embodiment, a scrambling code can be generated using the association ID of an STA. In this case, STA-specific scrambling needs not to be necessarily different every STA, and the STAs have only to have different identification classifications for scrambling signals which have been paired through the MU-MIMO method and spatially multiplexed at the same time.

[0222] This method can be applied to all schemes constructed by overlapping. Accordingly, if the overlapping scheme is included in all PLCP frame formats subsequently proposed, a pertinent indication can be included in a VHTSIG field, as needed, without special mention, and a combination of fields LTF, STF, and SIG may be scrambled.

[0223] The overlapping scheme is advantageous in that it can maintain proper overhead because the symbol duration of the field VHTSIG does not vary according to the number of STAs. A non-overlapping scheme is advantageous in that it can detect necessary spatial streams using all VHT-LTFs which are transmitted on the assumption that STAs paired for MU-MIMO can know their streams allocated thereto. Accordingly, there is proposed a PLCP frame format in which VHTSIGs are transmitted using the overlapping scheme and VHT-LTFs are transmitted using the non-overlapping scheme by making the best use of the advantages.

[0224] FIGS. 32 to 35 show examples of a PLCP frame format in which VHTSIGs are transmitted using the overlapping scheme and VHT-LTFs are transmitted using the non-overlapping scheme. FIGS. 32 and 33 illustrate cases in which when a beam-forming matrix multiplied to the VHTSIG differs from a beamformaing matrix multiplied to the VHT-LFT, a VHT-STF for controlling an AGC gain is required before the VHT-LTFs. FIGS. 34 and 35 show cases in which the VHTSIGs and the VHT-LTFs are subjected to beam-forming using the same beam-forming matrix and transmitted and in which VHT-STFs are not required before the VHT-LTFs are transmitted. FIGS. 32 and 34 show examples of a VHT-mixed PLCP frame format, and FIGS. 33 and 35 show examples of a VHT GF PLCP frame format.

[0225] In the examples of FIGS. 32 to 35, it is assumed that one RX antenna is turned on before a reception STA detects the VHTSIG field. The reception STA can know information about its own stream and about a total number of streams by measuring the VHTSIG field using the VHT-LTF and reading the VHTSIG field. Meanwhile, since one antenna is assumed before the VHTSIG field is read, a diversity gain which can be

obtained with an increase of the number of RXs may not be used.

[0226] FIGS. 36 and 37 show PLCP frame formats into which a common VHTSIG field has been introduced.

[0227] FIG. 36 shows an example of a VHT-mixed PLCP frame format, and FIG. 37 shows an example of a VHT GF PLCP frame format.

[0228] The PCLP frame of FIGS. 36 and 37 includes a VHTSIGc field including common control information. The VHTSIGc field is a common VHTSIG field, and it includes common control information about STA1 and STA2. The VHTSIGc field is transmitted onmi-direationally so that all STAs can acquire information about the VHTSIGc field. The VHTSIGc field includes information that all STAs is in common informed, such as information about streams allocated to each STA and a total number of streams, and the information is transmitted to each STA through the VHTSIGc. The fields VHTSIGc and VHT-LTFs are transmitted using the non-overlapping scheme. Next, fields VHTSIG1 and VHTSIG2, each including individualized control information about each STA, are transmitted using the overlapping scheme.

[0229] In the above several embodiments, when fields are configured using the overlapping scheme and transmitted to STAs at the same time, a beam must be well formed in the direction of each STA for the purpose of a normal operation and recognized as SU-MIMO from a viewpoint of the STA. In other words, since LTFs in other STAs do not function as interference, the corresponding STA does not need to take whether other STAs exist into consideration.

[0230] However, if interference with other STAs is generated for some reasons, it may not be easy to distinguish its own field allocated thereto from fields allocated to other STAs. For example, in the case of the PLCP frame formats of FIGS. 32 to 35, three VHT-LTFs are overlapped with the VHT-LTFs by a P matrix and transmitted to the STA1, and two VHT-LTFs are overlapped with the VHT-LTFs by a p matrix and transmitted to the STA2. In this case, in an 802.11n system supporting only SU-MIMO, an LTF OFDM symbol is given a fixed pattern consisting of {-1, 1}. Accordingly, the VHT-LTF of the STA1 and the VHT-LTF of the STA2 have OFDM symbols of the same pattern. If an ideal beam is formed, three VHT-LTFs have to be recognized in the STA1 and two VHT-LTFs have to be recognized in the STA2. However, the VHT-LTFs of the STA2 can be detected in the STA1, for some reasons. For example, all the five VHT-LTFs can be recognized in the STA1. In such a case, from a viewpoint of the STA1, there is no method of sorting out VHT-LTFs received through interference if a special indication method is not supported. In order to solve the problem, there is proposed a method of an STA to distinguish its own VHT-LTFs from other VHT-LTFs.

[0231] In accordance with an embodiment of the present invention, a scrambling code can

be applied to fields, such as LTFs and VHTSIG transmitted to STAs in order to support MU-MIMO. In this case, sequences used in the STAs can be orthogonal to each other, or they should have at least good correlation characteristic. Further, an STA can distinguish its own LTFs or VHTSIG from LTFs or VHTSIGs for other STAs although it receives the LTFs or VHTSIGs for other STAs serving as interference. Accordingly, there is an interference suppression effect. When the scrambling sequence is initialized, an ID (e.g. an Association ID (AID)) which can be replaced with an STA ID or an STA ID, STA temporary numbering or the like can be used. In case where a method using the STA temporary numbering is used, STAs can be numbered, and scrambling sequences can be initialized using the numbered values and then applied to overlapping fields.

[0232] FIG. 38 is a block diagram showing another example of a radio apparatus in which an embodiment of the present invention is implemented. The radio apparatus 3800 can be an AP or a non-AP station.

[0233] The radio apparatus 3800 includes a processor 3810, memory 3820, and a transceiver 3830. The transceiver 3830 transmits and receives a radio signal and has the physical layer of IEEE 802.11 implemented therein. The transceiver 3830 supports MIMO transmission through multiple antennas. The processor 3810 is coupled to the transceiver 3830 and configured to implement the MAC layer and the physical layer of IEEE 802.11. When the processor 3810 processes the operation of a transmission station from among the above methods, the radio apparatus 3800 becomes the transmission station. When the processor 3810 processes the operation of a reception station from among the above methods, the radio apparatus 3800 becomes the reception station.

[0234] In the PLCP sublayer of a transmission station implemented in the processor 3810, a PLCP preamble is added to a PSDU, transmitted by the MAC layer, on the basis of the above-described PLCP frame format and then transmitted to the processor 3810 or a PMD sublayer implemented in the transceiver 3830. In the PMD sublayer, the PLCP frame is transmitted through the transceiver 3830 on the basis of a transmission method for each field of the above-described PLCP frame format using a multi-antenna system. In the PLCP sublayer of a reception station implemented in the processor 3810 of the reception station, the PLCP preamble is removed on the basis of the above-described PLCP frame format, and the PSDU is transmitted to the MAC layer implemented in the processor 3810 of the reception station.

[0235] The processor 3810 or the transceiver 3830 or both can include an Application-Specific Integrated Circuit (ASIC), other chipset, a logic circuit, and/or a data processor. The memory 3820 can include Read-Only Memory (ROM), Random Access Memory (RAM), flash memory, a memory card, a storage medium and/or other

storage device. When the above embodiments are implemented in software, the above schemes can be implemented using a module (or process or function) for performing the above functions. The module can be stored in the memory 3820 and executed by the processor 3810. The memory 3820 can be placed inside or outside the processor 3810 and coupled to the processor 3810 using a variety of well-known means.

[0236] While the invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

[Claim 1] A method of transmitting control information in a Wireless Local Area Network (WLAN) system, the method comprising:transmitting first control information by means of cyclic shift delay diversity beam-forming , andtransmitting second control information,wherein the first control information comprises information necessary for each of a plurality of target stations of the second control information to receive the second control information, andthe second control information is beamformed and transmitted to the plurality of target stations.

[Claim 2] The method of claim 1, wherein the first control information further comprises information about a transmission time taken to transmit spatially multiplexed Spatial Division Multiple Access (SDMA) data to the plurality of target stations.

[Claim 3] The method of claim 1, wherein the second control information comprises control information about each of the plurality of target stations.

[Claim 4] The method of claim 3, wherein the control information about each of the plurality of target stations includes at least one of Modulation and Coding Scheme (MCS) information, channel bandwidth information, information about a number of spatial streams, and transmission power information.

[Claim 5] The method of claim 1, wherein:the first control information and the second control information are transmitted through a first frame, andthe second control information comprises information about a transmission time taken to transmit one or more second frames subsequent to the first frame.

[Claim 6] The method of claim 1, wherein a number of subcarriers per Orthogonal Frequency Division Multiplexing (OFDM) symbol allocated to transmit the first control information is smaller than a number of subcarriers per OFDM symbol allocated to transmit the second control information.

[Claim 7] The method of claim 6, wherein a number of OFDM symbols allocated to transmit public control information is greater than a number of OFDM symbols allocated to transmit STA-specific control information.

[Claim 8] The method of claim 7, further comprising transmitting a first Long Training Field (LTF) for channel estimation which is used to receive the public control information through a previous OFDM symbol of the

public control information.

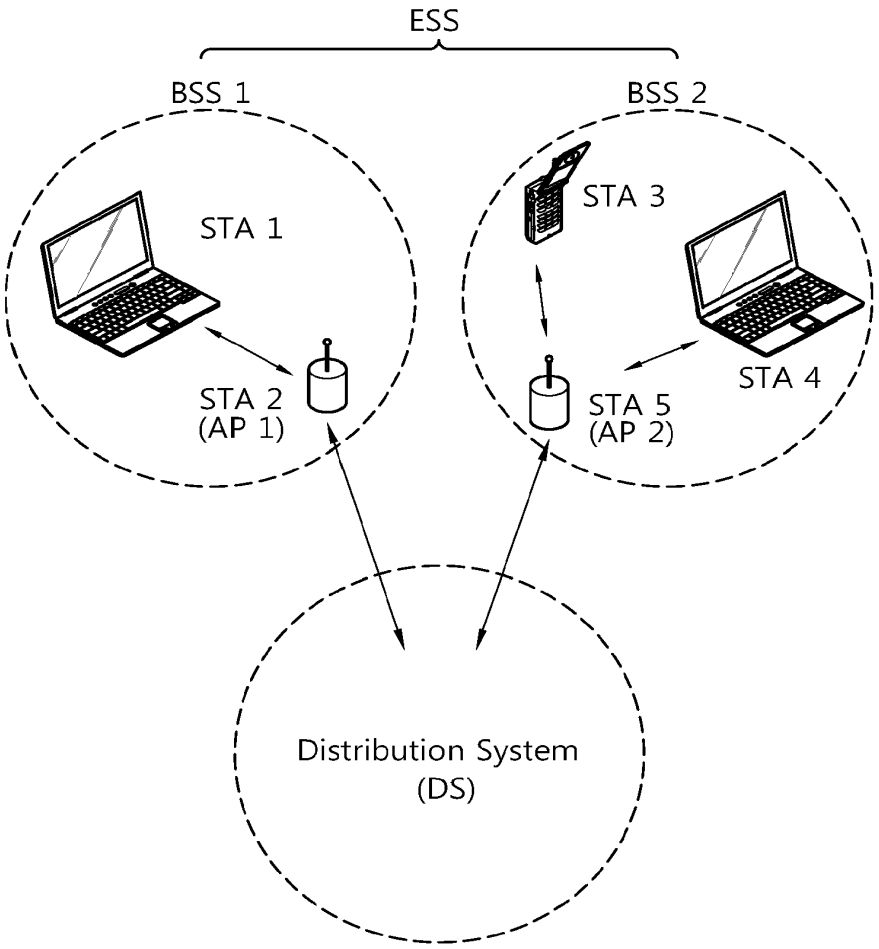
[Claim 9] The method of claim 7, further comprising transmitting a second LTF for channel estimation which is used to receive the STA-specific control information through an OFDM symbol between the public control information and the STA-specific control information.

[Claim 10] The method of claim 9, wherein the second LTF and the STA-specific control information are subjected to beam-forming using an identical precoding matrix.

[Claim 11] The method of claim 1, wherein the first control information and the second control information are applied to different cyclic shifts.

[Claim 12] A radio apparatus comprising:a processor; anda transceiver functionally coupled to the processor and configured to transmit and receive a frame,wherein the processor transmits first control information by means of cyclic shift delay diversity beam-forming and configured to transmit second control information,the first control information comprises information necessary for each of a plurality of target stations of the second control information to receive the second control information, andthe second control information is beamformed and transmitted to the plurality of target stations.

[Fig. 1]


ESS
BSS 1
BSS 2
STA 1
STA 3
STA 4
STA 2
(AP 1)
STA 5
(AP 2)
Distribution System
(DS)

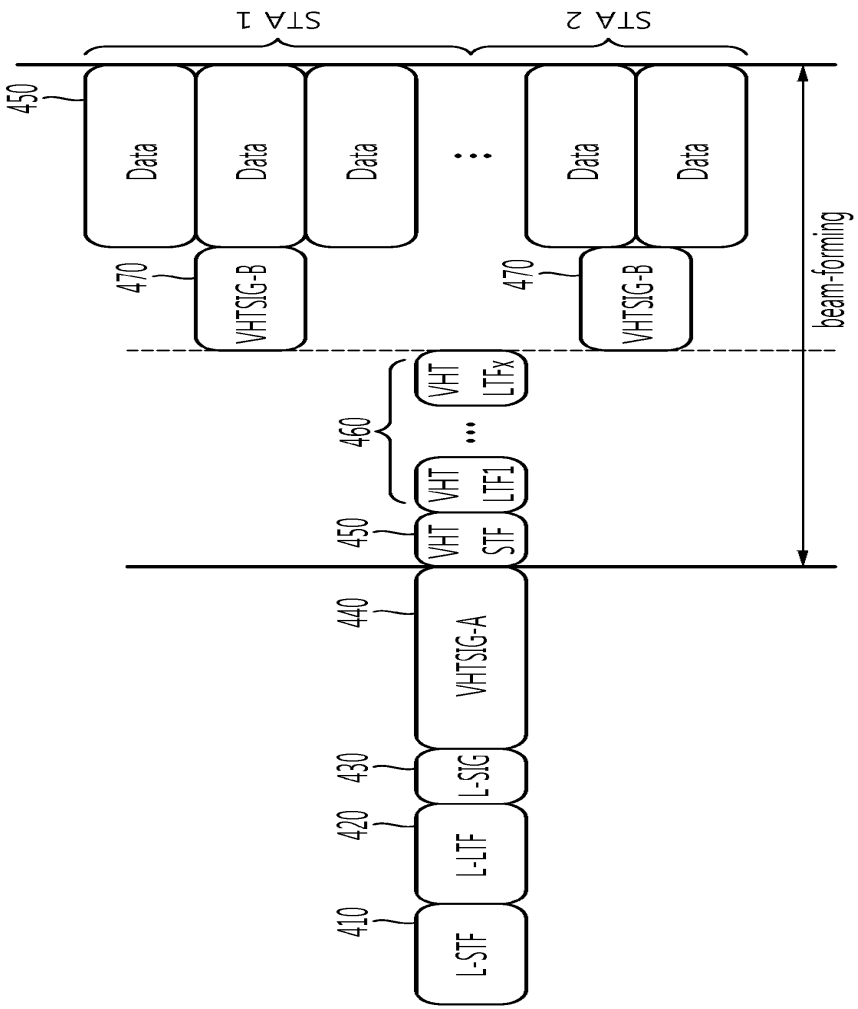
[Fig. 2]

Non-HT format
L-STF
L-LTF
L-SIG
Data
HT-mixed format
Data HT-LTFs
Extension HT-LTFs
L-STF
L-LTF
L-SIG
HT-SIG
HT-STF
HT-LTF
HT-LTF
HT-LTF
HT-LTF
HT-LTF
Data
HT-greenfield format
Data HT-LTFs
Extension HT-LTFs
HT-GF-STF
HT-LTF1
HT-SIG
HT-LTF
HT-LTF
HT-LTF
HT-LTF
Data

[Fig. 3]

VHT PLCP frame(300)
VHT-SIG-A
330
VHT-SIG-B
340
DATA
360

[Fig. 4]

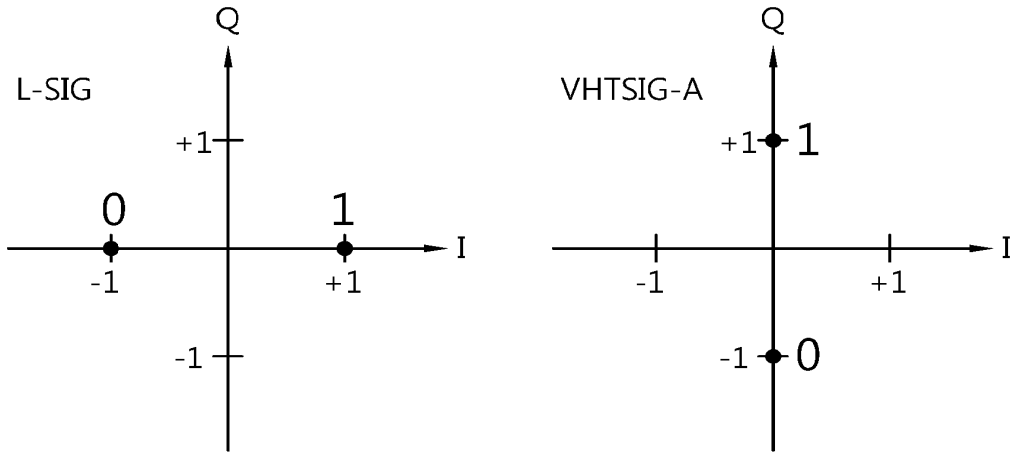


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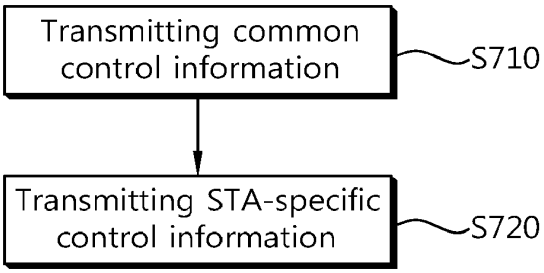
[Fig. 5]

2 symbols
1 symbol
28
26
-1 0 1
L-STF
L-LTF
L-SIG
VHTSIG-A
VHT STF
VHT LTF1
VHT LTFx
VHTSIG-B
Data
-26
-28
beam-forming
Freq.
Time

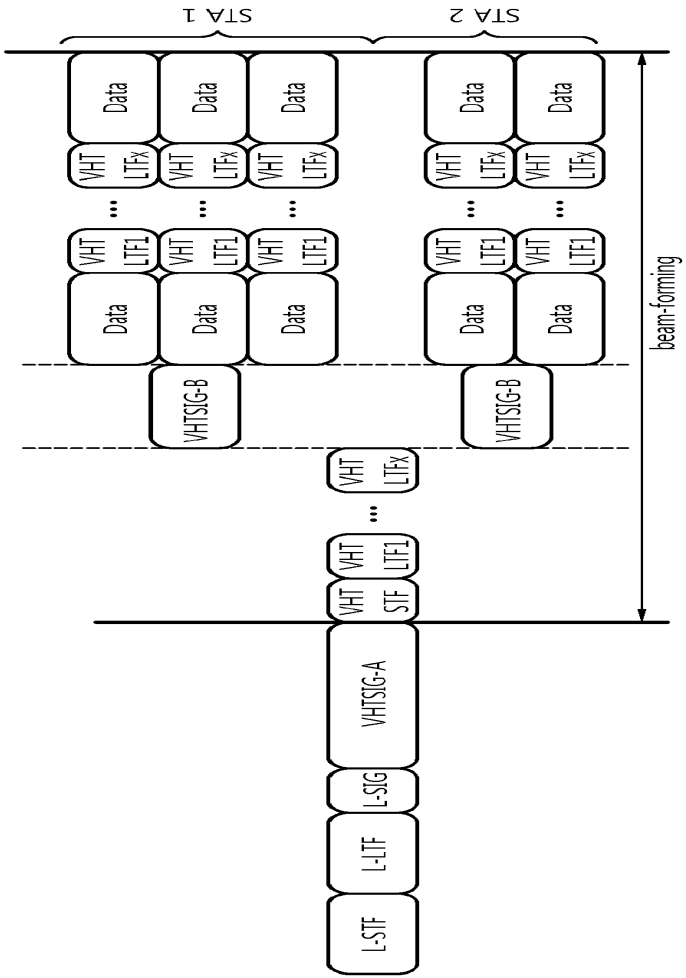
[Fig. 6]


L-SIG
Q
I
+1
-1
0
1
-1
+1
VHTSIG-A
Q
I
+1
-1
1
0
-1
+1

[Fig. 7]

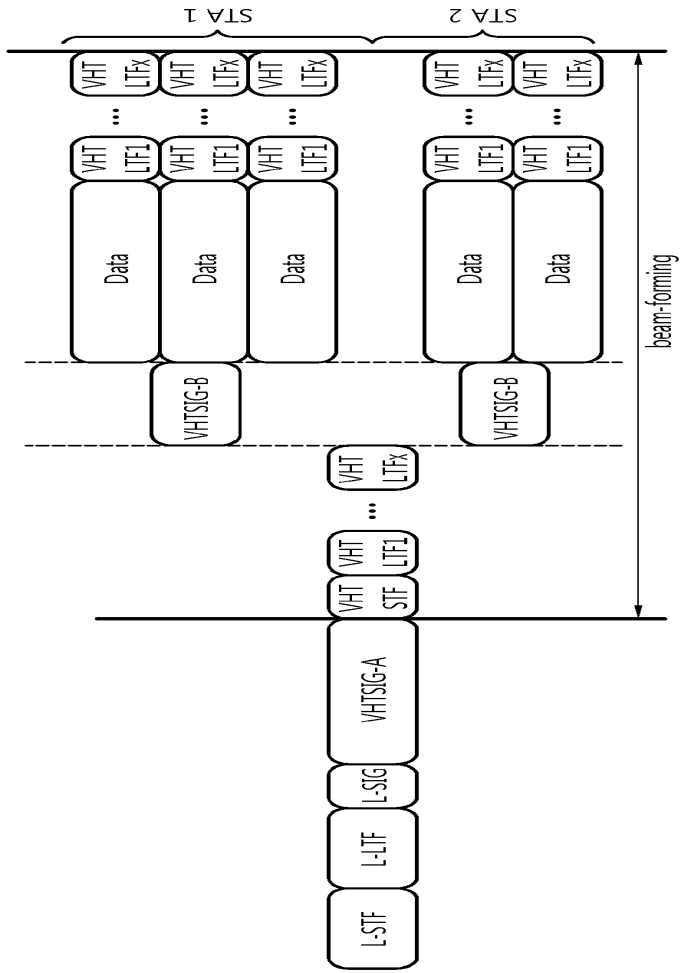

Transmitting common control information
S710
Transmitting STA-specific control information
S720

[Fig. 8]



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[Fig. 9]



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[Fig. 10]

VHT-GF PLCP
1050
1060
Data VHT-LTF
Extension VHT-LTF
VHT-GF-STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
VHT -LTF
VHT -LTF
VHT -LTF
VHT -LTF
Data
CSD1
CSD2 +SDMA Precoding Q'k

[Fig. 11]

VHT-GF PLCP
1154
Data VHT-LTF
Extension VHT-LTF
VHT-GF-STF
VHT-LTF1
VHT SIG-A
VHT-LTF2
VHT SIG-B
VHT -LTF
VHT -LTF
VHT -LTF
VHT -LTF
Data
CSD1
CSD2 +SDMA Precoding Q'k

[Fig. 12]

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[Fig. 13]

VHT-GF PLCP
1350
Data VHT-LTF
Extension VHT-LTF
VHT-GF-STF
VHT-LTF1
VHT-SIG
VHT-STF
VHT-LTF
VHT-LTF
VHT-LTF
VHT-LTF
Data
CSD1
CSD2 +SDMA Precoding Q'k

[Fig. 14]

VHT-GF PLCP
1450
1460
Data VHT-LTF
Extension VHT-LTF
VHT-GF-STF
VHT-LTF1
VHT SIG-A
VHTSIG-B
VHT-STF
VHT -LTF
VHT -LTF
VHT -LTF
VHT -LTF
Data
CSD1
CSD2 +SDMA Precoding Q'k

[Fig. 15]

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[Fig. 16]

VHT-GF PLCP
Data VHT-LTF
Extension VHT-LTF
VHT-GF-STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
VHT -LTF
VHT -LTF
VHT -LTF
VHT -LTF
Data
CSD2 +SDMA Precoding Q'k

[Fig. 17]

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[Fig. 18]

VHT-mixed PLCP
Data VHT-LTF
Extension VHT-LTF
L-STF
L-LTF
L-SIG
HT-SIG
VHT-STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
VHT -LTF
VHT -LTF
VHT -LTF
VHT -LTF
Data
CSD1
CSD3 +SDMA Precoding Q'k

[Fig. 19]

VHT-mixed PLCP
Data VHT-LTF
Extension VHT-LTF
L-STF
L-LTF
L-SIG
HT-SIG
VHT-STF
VHT-LTF1
VHT SIG-A
VHT SIG-B
VHT -LTF
VHT -LTF
VHT -LTF
VHT -LTF
Data
CSD1
CSD2 +Precoding Qk
CSD3 +SDMA Precoding Q'k

[Fig. 20]

VHT-mixed PLCP
Data VHT-LTF
Extension VHT-LTF
L-STF
L-LTF
L-SIG
HT-SIG
VHT-SIG
VHT-STF
VHT-LTF
VHT-LTF
VHT-LTF
VHT-LTF
Data
CSD1
CSD3 +SDMA Precoding Q'k

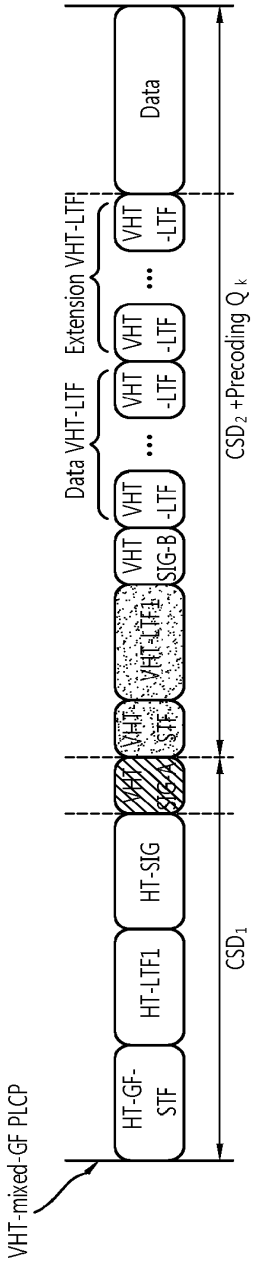
[Fig. 21]

VHT-mixed-GF PLCP
Data VHT-LTF
Extension VHT-LTF
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG
VHT-LTF
VHT-LTF
VHT-LTF
VHT-LTF
Data
CSD2 + Precoding Qk

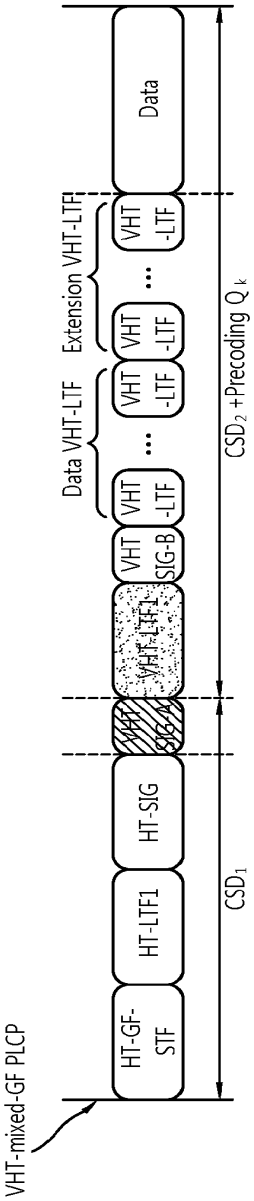
[Fig. 22]

VHT-mixed-GF PLCP
Data VHT-LTF
Extension VHT-LTF
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG
VHT-STF
VHT-LTF
VHT-LTF
VHT-LTF
VHT-LTF
Data
CSD1
CSD2 +Precoding Q k

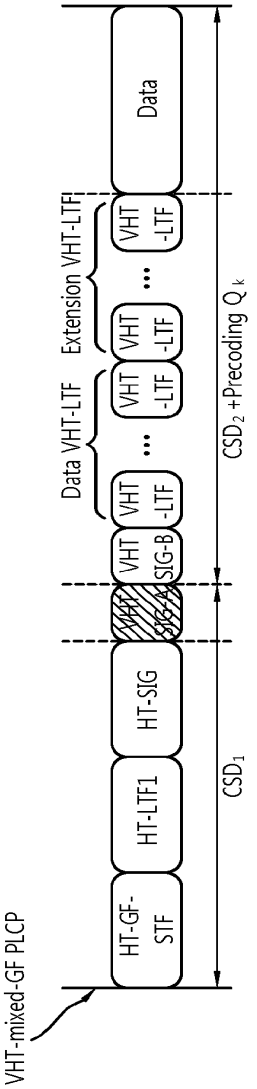
[Fig. 23]


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG-A
VHT-STF
VHT-LTF1
VHT-SIG-B
VHT-LTF
VHT-LTF
VHT-LTF
VHT-LTF
Data
Data VHT-LTF
Extension VHT-LTF
CSD1
CSD2 +Precoding Qk

[Fig. 24]


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG-A
VHT-LTF1
VHT-SIG-B
VHT-LTF
VHT-LTF
VHT-LTF
VHT-LTF
Data VHT-LTF
Extension VHT-LTF
Data
CSD1
CSD2 +Precoding Qk

[Fig. 25]


VHT-mixed-GF PLCP
HT-GF-STF
HT-LTF1
HT-SIG
VHT-SIG-A
VHT-SIG-B
VHT-LTF
VHT-LTF
VHT-LTF
Data VHT-LTF
Extension VHT-LTF
Data
CSD1
CSD2 +Precoding Qk

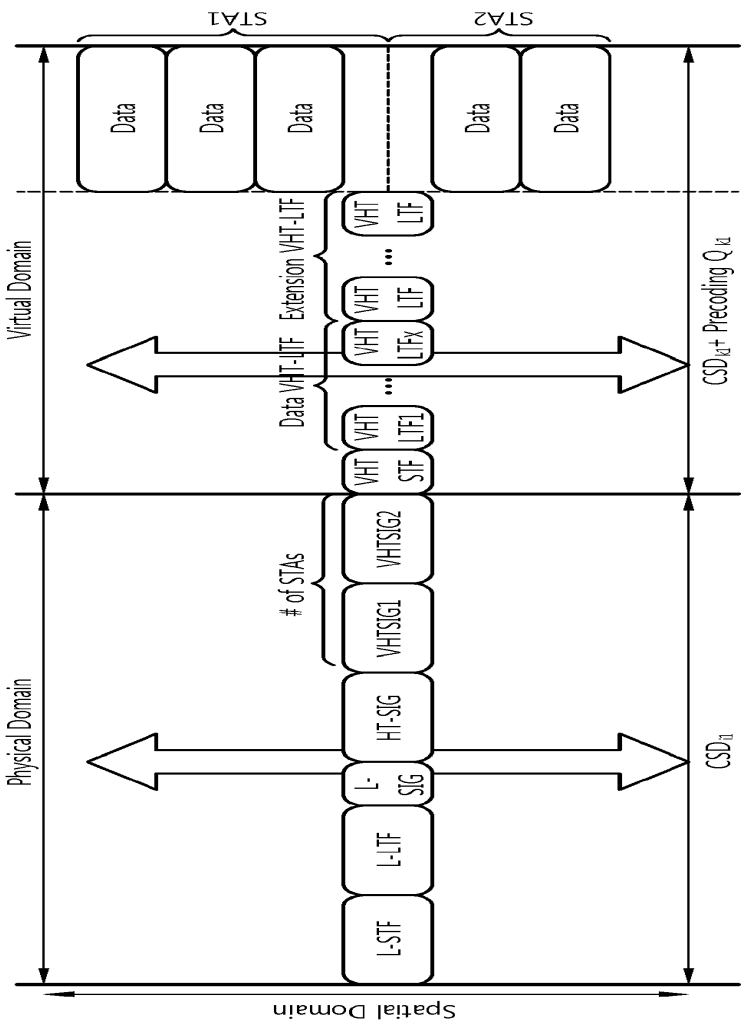
[Fig. 26]

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[Fig. 27]

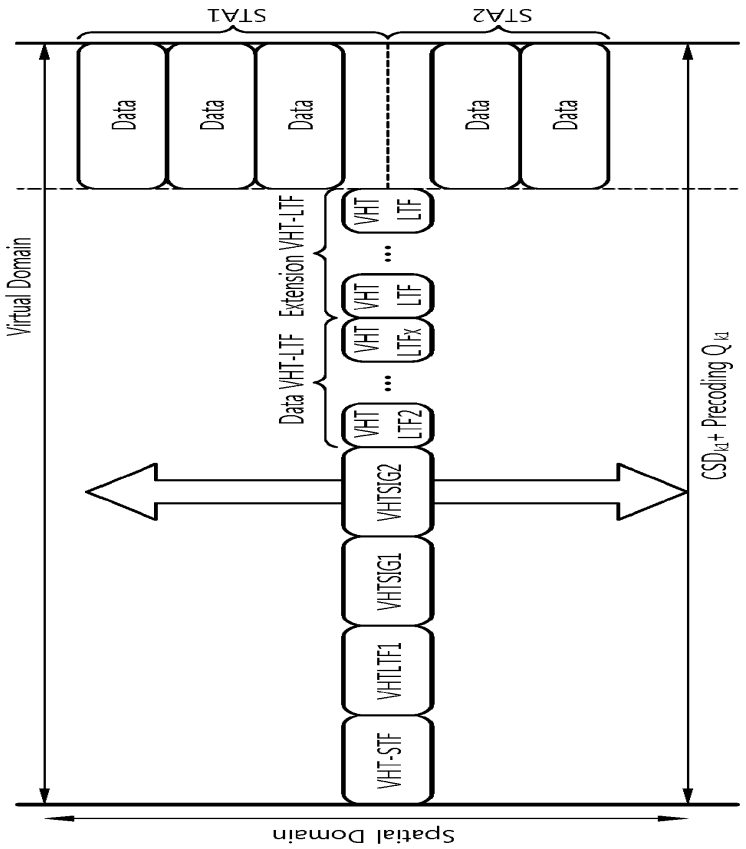
VHT-GF
-PLCP frame
(2700)
2710
2720
2730
2740
2750-1
2750-N
2760-1
2760-M
VHT-GF-STF
VHT-LTF1
VHTSIG-A
VHTSIG-B
VHT-LTF
VHT-LTF
Data
Data

[Fig. 28]



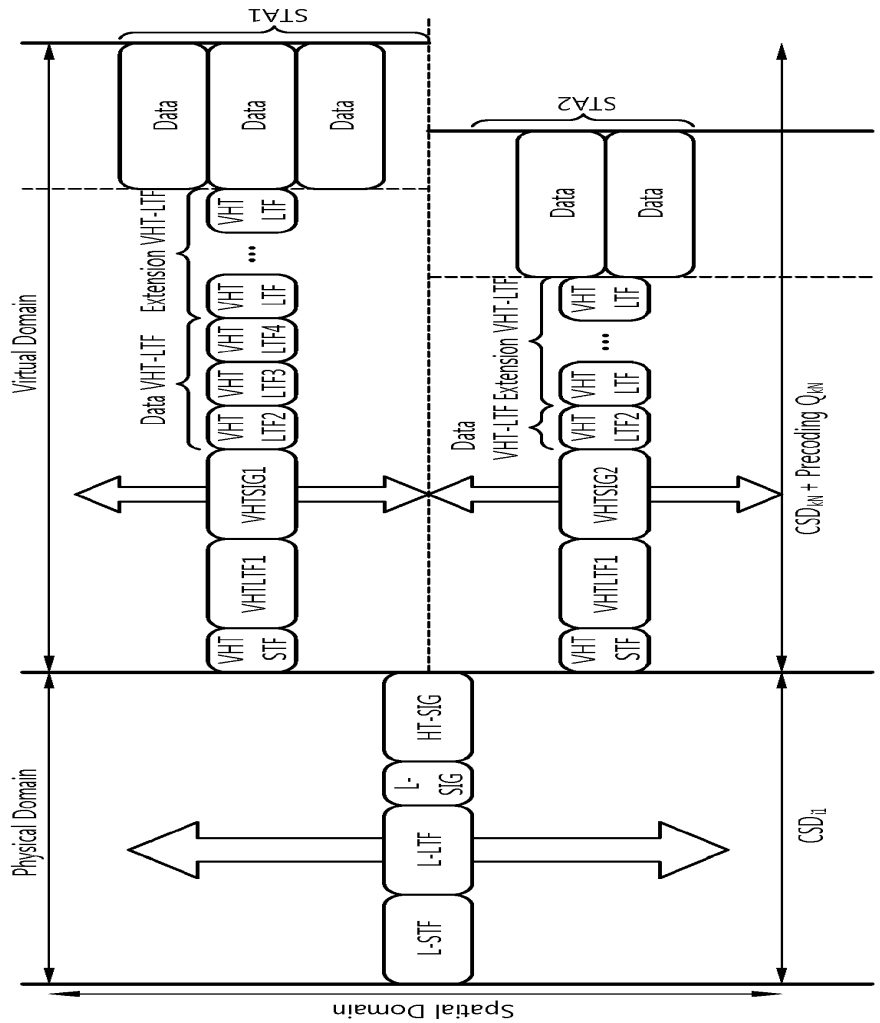
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[Fig. 29]



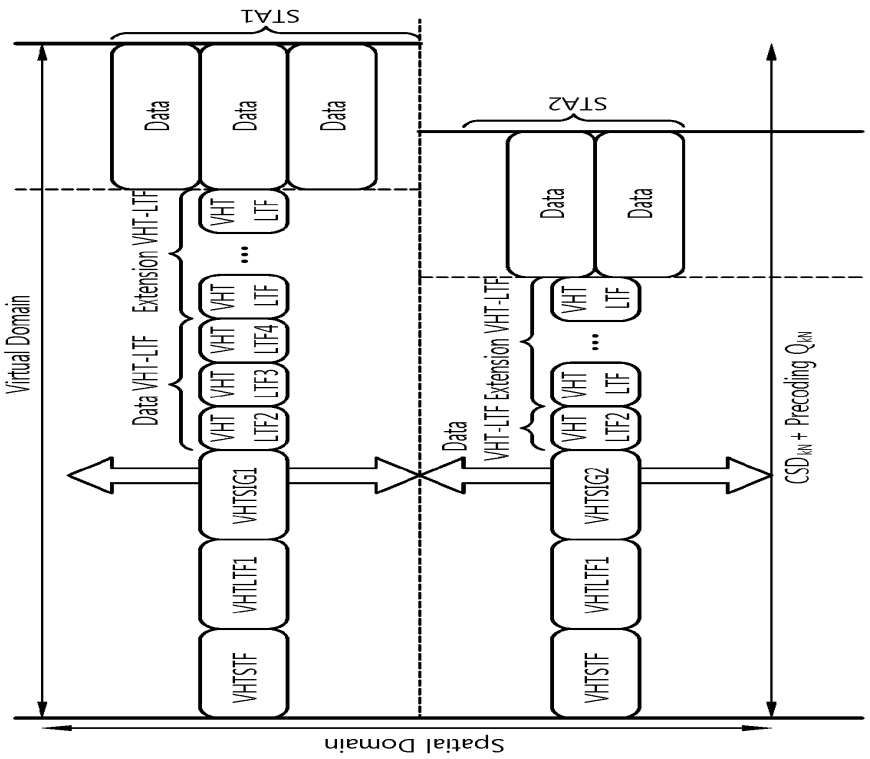
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[Fig. 30]



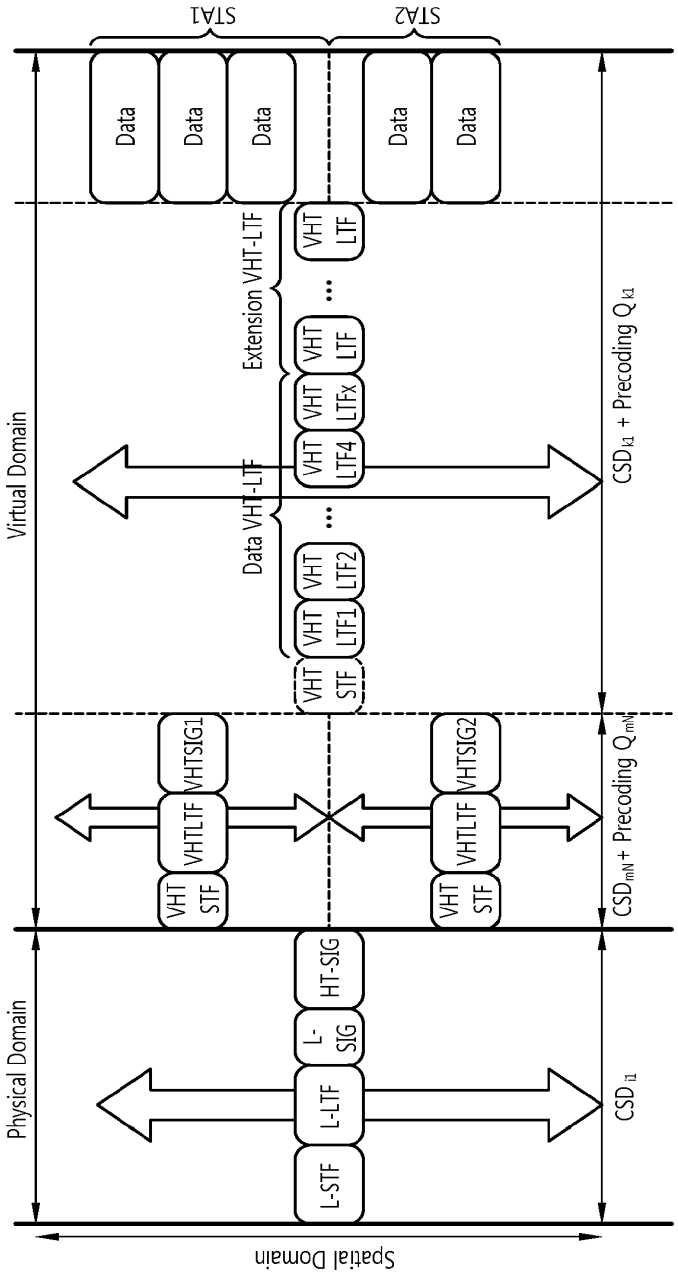
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[Fig. 31]

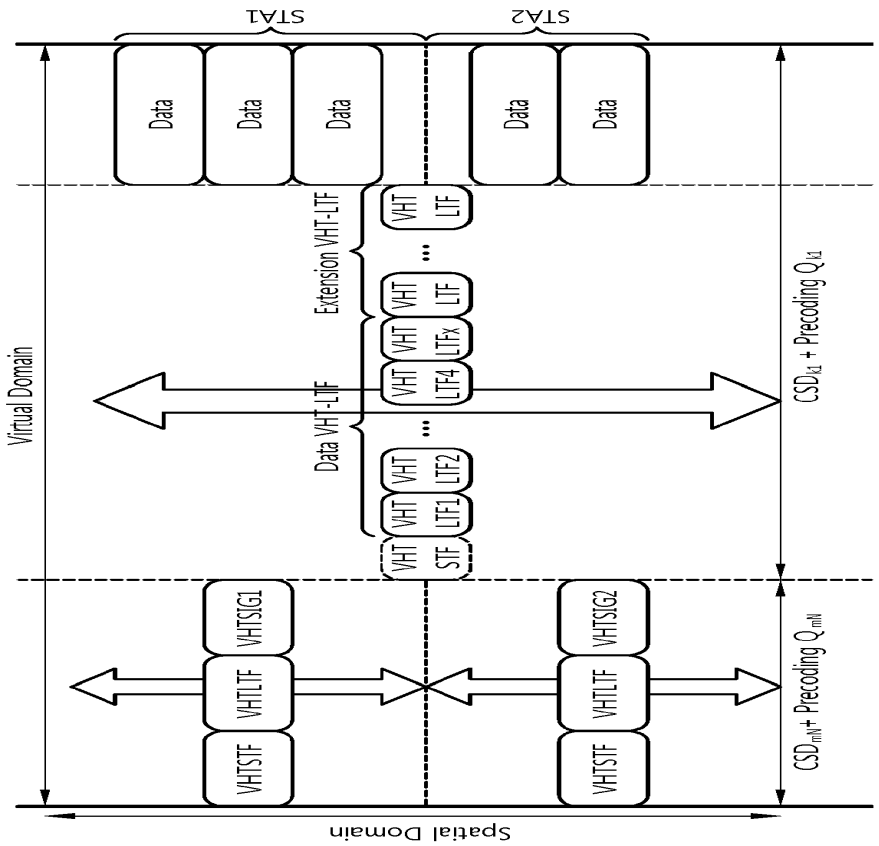


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[Fig. 32]

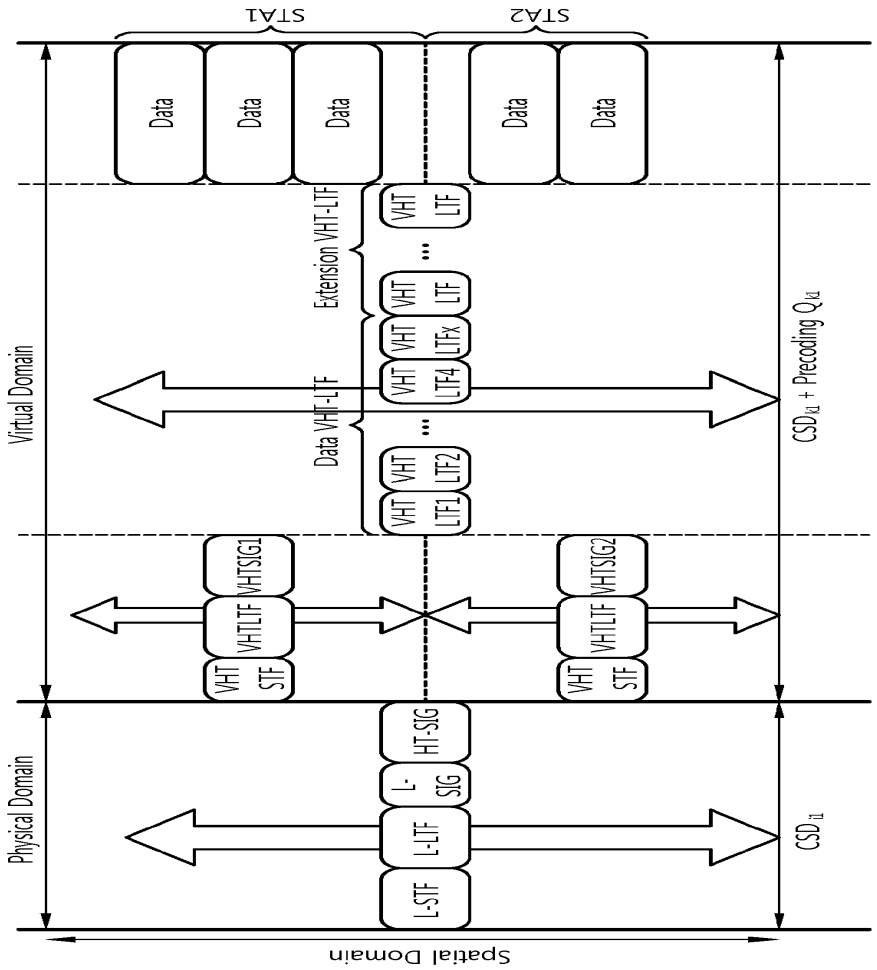

STA1
STA2
Data
Data
Data
Data
Data
Extension VHT-LTF
VHT LTF
VHT LTF
VHT LTFx
VHT LTF4
Data VHT-LTF
VHT LTF2
VHT LTF1
VHT STF
Virtual Domain
CSD k1 + Precoding Q k1
VHTSIG1
VHTLTF
VHT STF
VHTSIG2
VHTLTF
VHT STF
CSD mN + Precoding Q mN
HT-SIG
L-SIG
L-LTF
L-STF
Physical Domain
CSD 1
Spatial Domain

[Fig. 33]



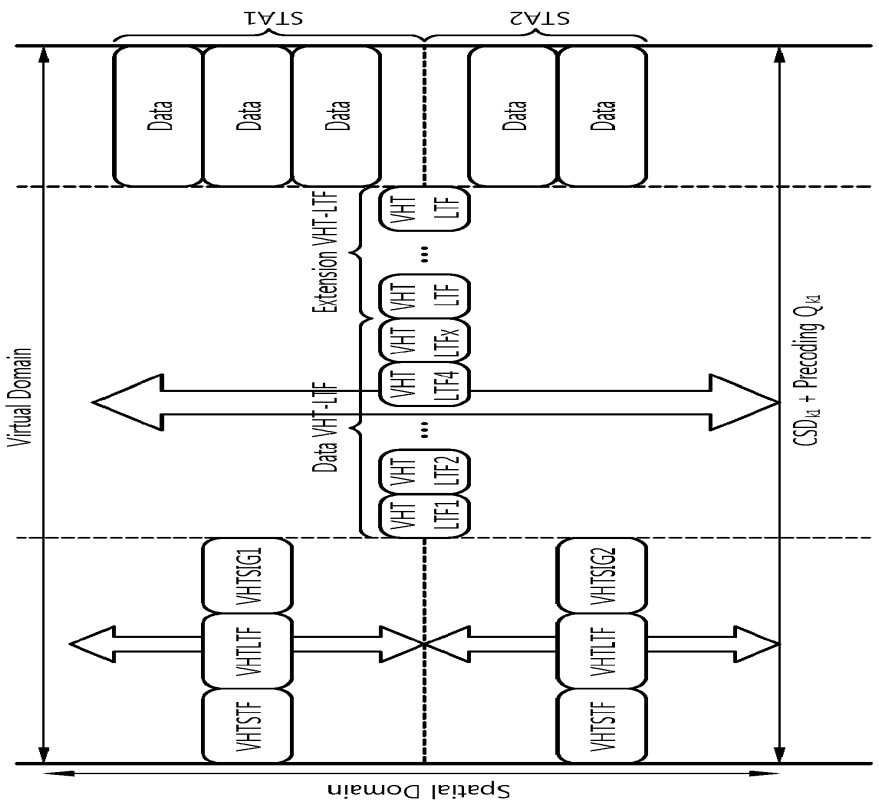
Samsung Exhibit 1002, Page 364 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

[Fig. 34]



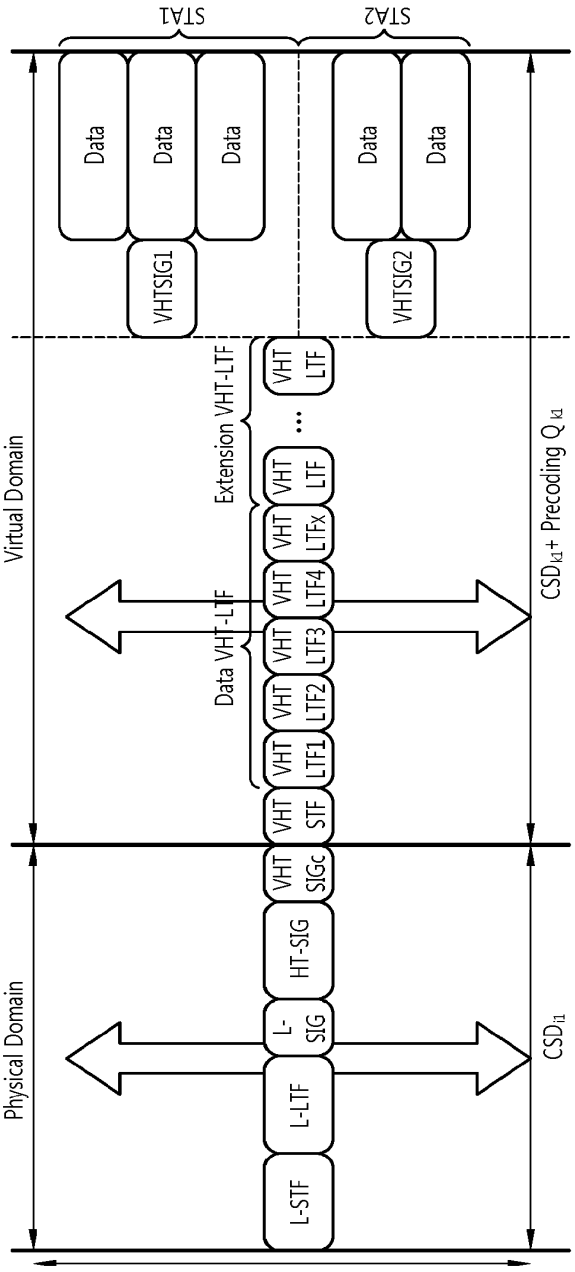
Samsung Exhibit 1002, Page 365 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

[Fig. 35]

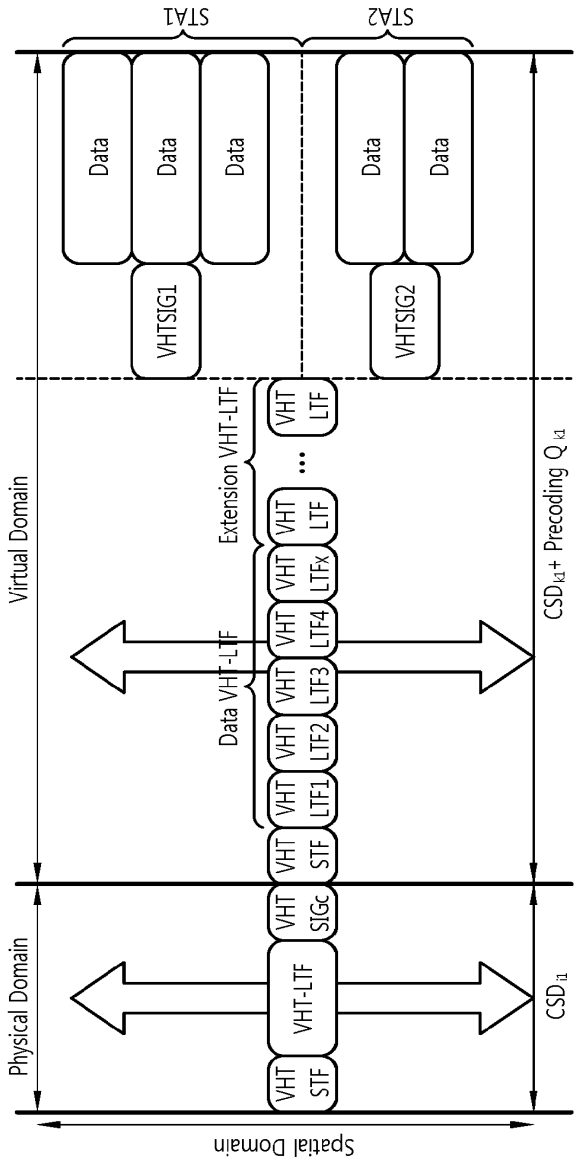


Samsung Exhibit 1002, Page 366 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

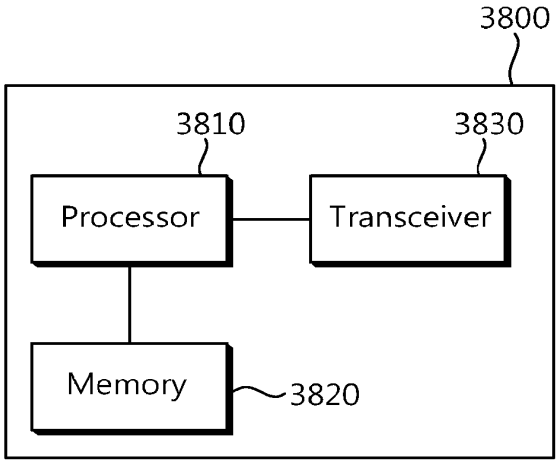
[Fig. 36]


STA1
STA2
Data
Data
Data
Data
Data
VHTSIG1
VHTSIG2
Virtual Domain
Physical Domain
Extension VHT-LTF
Data VHT-LTF
VHT LTF
VHT LTFx
VHT LTF4
VHT LTF3
VHT LTF2
VHT LTF1
VHT STF
VHT SIGc
HT-SIG
L-SIG
L-LTF
L-STF
CSD k1 + Precoding Q k1
CSD i1

[Fig. 37]


STA1
STA2
Data
Data
Data
Data
Data
VHTSIG1
VHTSIG2
Virtual Domain
Extension VHT-LTF
Data VHT-LTF
VHT LTF
VHT LTF
VHT LTFx
VHT LTF4
VHT LTF3
VHT LTF2
VHT LTF1
VHT STF
CSD i1+ Precoding Q i1
Physical Domain
VHT SIGc
VHT-LTF
VHT STF
CSD i1
Spatial Domain

[Fig. 38]



Electronic Acknowledgement Receipt

EFS ID:	30593874
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	06-OCT-2017
Filing Date:	07-JUN-2016
Time Stamp:	19:10:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	1426-077-101--IDSasFiled10062017.pdf	55476 07fdb93d030d5ce16fa7d5f618d2716b16f2e66c	no	2
Warnings:					

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	FOR-JP2013157822.pdf	2950344 20b120ebcbc33945b8e0e3c58b9f40e9f045dfd2	no	29
Warnings:					
Information:					
3	Foreign Reference	FOR-WO2013119659.pdf	5153304 502faa0e91d734e3cebe769555443c5b11e5ad9b	no	51
Warnings:					
Information:					
4	Foreign Reference	FOR-JP2013504248.pdf	4434085 07484b828181ee46134c555895bc266978e712b4	no	73
Warnings:					
Information:					
5	Foreign Reference	FOR-WO2013168562.pdf	4824874 1c12178359039234e2f47a0a5172b6fa3948d6fb	no	45
Warnings:					
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6	Foreign Reference	FOR-WO2011031058A2.pdf	2251556 168d1a6796e8d91e8e0791d243dd763583678345	no	70
Warnings:					
Information:					
7	Non Patent Literature	NPL--JPOfficeAction.pdf	130552 838d96ca16e6c45b00c81a752c2ba948dc1d12a5	no	7
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		Total Files Size (in bytes):	19800191		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

106622 7590 11/06/2017

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
NGUYEN, BRIAN D	

ART UNIT	PAPER NUMBER
2472	

NOTIFICATION DATE	DELIVERY MODE
11/06/2017	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@bluecapitallaw.com

Office Action Summary	Application No. 15/175,673	Applicant(s) GUO ET AL.	
	Examiner BRIAN D. NGUYEN	Art Unit 2472	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *6/7/16*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-20* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-20* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *6/7/16* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *10/6/17, 8/29/17, 1/10/17*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

3. Claims 1-6, 8-13 and 15-19 are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Takano (2014/0119349).

Regarding claim 1, Takano discloses a method for a network node (see Macro/Pico eNodeB in figure 1) controlling a cell, comprising: communicating with a UE (User Equipment) in the cell via downlink and uplink transmissions (see figure 25), wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols (see figure 26); and transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes, wherein the network node is not allowed to transmit a common signal in the first symbol (see figures 1, 2, 5, etc. where a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes for Macro eNodeB and/or eNodeB).

Regarding claim 2, Takano discloses wherein the network node transmits, in the cell, the common signal in a second symbol of the downlink control region (see figures 3, 6, 7, 13, etc.

where the common signal in a second symbol of the downlink control region for Macro eNodeB. Note that in some figures, the common signal is also included in the first symbol; however, to include or not to include the common signal in the first symbol is a matter of design choice).

Regarding claim 3, Takano discloses wherein the network node transmits the UE specific signal in the second symbol (see, for example, figures 1, 2, 5, 6, 8-12, etc.)

Regarding claim 4, Takano discloses wherein the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region (see PDSCH region in figure 1).

Regarding claim 5, Takano discloses wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation (the UE specific signal can be at least one of these signals).

Regarding claim 6, Takano discloses wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement (the common signal can be at least one of these signals).

Regarding claims 8-13 and 15-19, claims 8-13 and 15-19 claim a user equipment and a method performed by the user equipment which is a reverse process of the method described in claims 1-6. Therefore, they are subject to the same rejection.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 7, 14, and 20 are rejected under 35 U.S.C. 103 as being unpatentable over Takano in view of Guey et al (2016/0087707).

Regarding claims 7, 14, and 20, Takano discloses information in the first symbol is different from information in the second symbol but does not specifically disclose the use of beams for transmitting information. However, this feature is well known in the art. Guey discloses the use of different beams for different information (see figure 1). The claim would have been obvious because a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRIAN D. NGUYEN whose telephone number is (571)272-3084. The examiner can normally be reached on 8-4:30 Monday-Friday.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hassan Kizou can be reached on (571) 272-3088. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRIAN D NGUYEN/
Primary Examiner, Art Unit 2472

Notice of References Cited	Application/Control No. 15/175,673	Applicant(s)/Patent Under Reexamination GUO ET AL.	
	Examiner BRIAN D. NGUYEN	Art Unit 2472	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2014/0119349 A1	05-2014	Takano; Hiroaki	H04W16/32	370/336
*	B	US-2016/0087707 A1	03-2016	Guey; Jiann-Ching	H04L27/2613	375/267
*	C	US-9,432,985 B2	08-2016	Lee; Seungmin	H04L5/0037	1/1
*	D	US-2016/0345306 A1	11-2016	LEE; Seungmin	H04L5/0037	1/1
*	E	US-2015/0289235 A1	10-2015	Park; Jonghyun	H04L5/001	370/329
*	F	US-2016/0094374 A1	03-2016	Koorapaty; Havish	H04L27/262	370/329
*	G	US-2016/0294527 A1	10-2016	YOON; Sungjun	H04W72/0446	1/1
*	H	US-2015/0098421 A1	04-2015	BARBIERI; Alan	H04W72/042	370/329
*	I	US-2014/0362758 A1	12-2014	Lee; Seungmin	H04L5/0037	370/312
*	J	US-2014/0241276 A1	08-2014	Berberana; Ignacio	H04L5/0073	370/329
*	K	US-2014/0119349 A1	05-2014	Takano; Hiroaki	H04W16/32	370/336
*	L	US-2012/0040691 A1	02-2012	Han; Seung Hee	G01S1/042	455/456.1
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
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*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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BIB DATA SHEET

CONFIRMATION NO. 7587

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
15/175,673	06/07/2016	370	2472	1426-077.101

APPLICANTS

ASUSTeK Computer Inc., Taipei City, TAIWAN;

INVENTORS

Yu-Hsuan Guo, Taipei City, TAIWAN;
Ko-Chiang Lin, Taipei City, TAIWAN;
Richard Lee-Chee Kuo, Taipei City, TAIWAN;
Chung-Ming Sun, Taipei City, TAIWAN;

**** CONTINUING DATA ***************************

This appln claims benefit of 62/174,716 06/12/2015
and claims benefit of 62/183,460 06/23/2015

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

06/27/2016

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /BRIAN D NGUYEN/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		TAIWAN	19	20	3

ADDRESS

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626
UNITED STATES

TITLE

METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

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1600	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
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	Application Number	15175673
	Filing Date	2016-06-07
	First Named Inventor	Yu-Hsuan Guo
	Art Unit	2472
	Examiner Name	Brian D. Nguyen
	Attorney Docket Number	1426-077-101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20150016370		2015-01-15	Kazuaki Takeda	
	2	20150188684		2015-07-02	Kazuaki Takeda	

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	1	2013-157822	JP		2013-08-15	NTT DOCOMO Inc.		☒
	2	2013119659	WO		2013-08-15	Neocific, Inc.		☐

EFS Web 2.1.17

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.D.N/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15175673
Filing Date	2016-06-07
First Named Inventor	Yu-Hsuan Guo
Art Unit	2472
Examiner Name	Brian D. Nguyen
Attorney Docket Number	1426-077-101

	3	2013-504248	JP		2013-02-04	LG Electronics Inc.		☒
	4	2013168562	WO		2013-11-14	NTT DOCOMO, Inc.		☐
	5	2011031058	WO		2011-03-17	LG Electronics Inc.		☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Office Action from Japanese Patent Office from corresponding JP Patent Application No. 2016-114736, dated September 21, 2017.	☒

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Examiner Signature	/BRIAN D NGUYEN/	Date Considered	10/26/2017

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15175673
Filing Date	2016-06-07
First Named Inventor	Yu-Hsuan Guo
Art Unit	2464
Examiner Name	Ricky Quoc Ngo
Attorney Docket Number	1426-077.101

U.S.PATENTS

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20130183987		2013-07-18	Sophie Vrzic et al.	
	2	20130201925		2016-08-08	Xiaodong Li et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.D.N/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15175673
	Filing Date	2016-06-07
	First Named Inventor	Yu-Hsuan Guo
	Art Unit	2464
	Examiner Name	Ricky Quoc Ngo
	Attorney Docket Number	1426-077.101

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Erik Dahlman et al., "Downlink Physical-Layer Processing - Chapter 10" In:"4G LTE/LTE-Advanced for Mobile Broadband", 7 October 2013 (2013-10-07), Elsevier, XP055249210, pages 161-240,	☐
	2	European Search Report from corresponding EP Application No. 16173601.2, dated August 31, 2016	☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/BRIAN D NGUYEN/	Date Considered	10/26/2017

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.D.N/

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

CPC- SEARCHED		
Symbol	Date	Examiner
H04L1/1812	10/27/17	bn
H04W24/08	10/27/17	bn
H04W72/042	10/27/17	bn
H04W72/0446	10/27/17	bn
H04W72/046	10/27/17	bn
H04L5/005	10/27/17	bn
H04L5/0051	10/27/17	bn
H04L5/0053	10/27/17	bn
H04L5/0055	10/27/17	bn
H04L25/0224	10/27/17	bn
H04L25/0204	10/27/17	bn
H04B7/0617	10/27/17	bn

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
text search and symbols limited by date search	10/27/17	bn

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/27/2017								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
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	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	11181072	@ad<="20150612"	US-PGPUB; USPAT	OR	ON	2017/10/27 06:02
S2	0	(down adj2 link dl) adj2 control adj2 region same (user ue) adj2 specific with symbol	US-PGPUB; USPAT	OR	ON	2017/10/27 06:26
S3	36	(down adj2 link dl) adj2 control adj2 region and (user ue) adj2 specific with symbol	US-PGPUB; USPAT	OR	ON	2017/10/27 06:26
S4	20	S3 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 06:26
S5	2	(("20130201925") or ("20130183987")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/10/27 07:00
S6	2228	(user ue) adj2 specific with symbol	US-PGPUB; USPAT	OR	ON	2017/10/27 07:16
S7	564	(user ue) adj2 specific with symbol same subframe	US-PGPUB; USPAT	OR	ON	2017/10/27 07:17
S8	444	S7 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 07:17
S9	35	(user ue) adj2 specific with symbol same subframe with location	US-PGPUB; USPAT	OR	ON	2017/10/27 08:12
S10	2	"15175673"	US-PGPUB; USPAT	OR	ON	2017/10/27 08:17
S11	1	("9432985").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/10/27 08:31
S12	2	"15175673"	US-PGPUB; USPAT	OR	ON	2017/10/27 09:19
S13	1	("20140119349").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/10/27 09:50
S14	1	S13 and (resource allocation feedback harq reference)	US-PGPUB; USPAT	OR	ON	2017/10/27 09:51
S15	54	beam with (user ue) adj2 specific with cell adj2 specific	US-PGPUB; USPAT	OR	ON	2017/10/27 10:44
S16	42	S15 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 10:44
S17	2	"15175673"	US-PGPUB; USPAT	OR	ON	2017/10/27 11:20
S18	5252	H04L1/1812.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:21
S19	8573	H04W24/08.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:21
S20	12462	H04W72/042.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:22

S21	8144	H04W72/0446.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:22
S22	1336	H04W72/046.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:23
S23	2251	H04L5/005.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:23
S24	2519	H04L5/0051.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:23
S25	10675	H04L5/0053.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:24
S26	5246	H04L5/0055.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:24
S27	2224	H04L25/0224.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:25
S28	3723	H04L25/0204.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:25
S29	5228	H04B7/0617.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:25
S30	49783	S18 S19 S20 S21 S22 S23 S24 S25 S26 S27 S28 S29	US-PGPUB; USPAT	OR	ON	2017/10/27 11:27
S31	41638	S30 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 11:27
S32	9438	S31 and (user ue) adj2 specific	US-PGPUB; USPAT	OR	ON	2017/10/27 11:27
S33	106	(("GUO") near3 ("Yu-Hsuan")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:21
S34	39	(("LIN") near3 ("Ko-Chiang")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:21
S35	279	(("KUO") near3 ("Richard")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:21
S36	24	(("SUN") near3 ("Chung-Ming")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:22
S37	418	S33 S34 S35 S36	US-PGPUB; USPAT	OR	ON	2017/10/27 12:23
S38	33	S37 and subframe.clm.	US-PGPUB; USPAT	OR	ON	2017/10/27 12:23

EAST Search History (Interference)

< This search history is empty>

10/27/2017 12:30:08 PM
C:\ Users\ bnguyen2\ Documents\ EAST\ Workspaces\ 15175673.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15175673
Filing Date	2016-06-07
First Named Inventor	Yu-Hsuan Guo
Art Unit	2464
Examiner Name	Ricky Quoc Ngo
Attorney Docket Number	1426-077.101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20130201925		2013-08-08	Li et al.	
	2	20130183987		2013-07-18	Vrzic et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.D.N/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15175673
Filing Date	2016-06-07
First Named Inventor	Yu-Hsuan Guo
Art Unit	2464
Examiner Name	Ricky Quoc Ngo
Attorney Docket Number	1426-077.101

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	3GPP TS 36.211 V12.5.0 (2015-03-26).	☐
	2	Project Name:Mobile and wireless communications Enablers for the Twenty-twenty Information Society (METIS) Deliverable D2.4 ,Document Number: ICT-317669-METIS/D2.4 (2015-02-28).	☐
	3	3GPP TS 36.331 V12.5.0 (2015-03-27).	☐
	4	Notice of Non-Final Rejection from corresponding Korean Application No. 10-2016-0071321, dated August 21, 2017.	☒

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/BRIAN D NGUYEN/	Date Considered	10/26/2017

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.D.N/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	15/175,673
Confirmation No.	:	7587
Applicant	:	Yu-Hsuan Guo, Ko-Chiang Lin, Richard Lee-Chee Kuo, and Chung-Ming Sun
Filed	:	June 7, 2016
Title	:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	:	2472
Examiner	:	Brian D. Nguyen
Docket No.	:	1426-077.101 (1040143-US)
Customer No.	:	106622

AMENDMENT TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the non-final Office Action mailed on November 6, 2017, having a three-month period for filing a response to **February 6, 2018**, please amend the above-identified application as follows:

Amendments to Claims begin on page 2.
Remarks begin on page 7.

Samsung Exhibit 1002, Page 392 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

IN THE CLAIMS:

1. (Currently Amended) A method for a network node controlling a cell, comprising:

communicating with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols; and

transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes and a common signal in a second symbol of the downlink control region of the subframe of the multiple subframes, wherein the network node is not allowed to transmit [[a]] the common signal in the first symbol.

2. (Currently Amended) The method of claim 1, wherein the network node transmits~~, in the cell,~~ the common signal at multiple timings to cover all beams of the cell. ~~in a second symbol of the downlink control region.~~

3. (Currently Amended) The method of claim [[2]]1, wherein the network node transmits the UE specific signal in the second symbol.

4. (Original) The method of claim 1, wherein the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region.

5. (Original) The method of claim 1, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

6. (Original) The method of claim 1, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

7. (Original) The method of claim 1, wherein beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol.

8. (Currently Amended) A method for a User Equipment (UE), comprising:

communicating with a network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols; [[and]]

monitoring, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol[[,]]; and

monitoring, in the cell, the common signal in a second symbol of the downlink control region, wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe.

9. (Currently Amended) The method of claim 8, wherein the common signal and the UE specific signal indicate resources in completely different or partially different symbols of the data region of the subframe ~~the UE monitors, in the cell, the common signal in a second symbol of the downlink control region~~.

10. (Currently Amended) The method of claim [[9]]8, wherein the UE monitors the UE specific signal in the second symbol.

11. (Original) The method of claim 8, wherein the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region.

12. (Original) The method of claim 8, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

13. (Original) The method of claim 8, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a

broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

14. (Currently Amended) The method of claim 8, wherein a length of the downlink control region is two symbols and the UE does not monitor the UE specific signal in the second symbol ~~beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol~~.

15. (Currently Amended) A User Equipment (UE) for communication with a network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

communicate with the network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols; [[and]]

monitor, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe, and not monitoring a common signal in the first symbol; and

monitor, in the cell, the common signal in a second symbol of the downlink control region, wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe.

16. (Currently Amended) The UE of claim 15, wherein the common signal and the UE specific signal indicate resources in completely different or partially different symbols of the data region of the subframe. ~~the UE monitors, in the cell, the common signal in a second symbol of the downlink control region.~~

17. (Currently Amended) The UE of claim [[16]]15, wherein the UE monitors the UE specific signal in the second symbol.

18. (Original) The UE of claim 15, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

19. (Original) The UE of claim 15, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

20. (Currently Amended) The UE of claim 15, wherein a length of the downlink control region is two symbols and the UE does not monitor the UE specific signal in the second symbol ~~beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol~~.

21. (New) The method of claim 1, wherein the network node transmits, in the cell, the UE specific signal on beam(s) of the cell corresponding to the UE.

22. (New) The method of claim 1, wherein the network node transmits the common signal on predefined beams in a specific timing.

23. (New) A network node for controlling a cell, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

communicate with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols; and

transmit, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes and a common signal in a second symbol of the downlink control region of the subframe of the multiple subframes, wherein the network node is not allowed to transmit the common signal in the first symbol.

24. (New) The network node of claim 23, wherein the network node transmits the common signal at multiple timings to cover all beams of the cell.

25. (New) The network node of claim 23, wherein the network node transmits the UE specific signal in the second symbol.

26. (New) The network node of claim 23, wherein the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region.

27. (New) The network node of claim 23, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

28. (New) The network node of claim 23, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

29. (New) The network node of claim 23, wherein beam(s) of the cell generated in the first symbol is different from beam(s) generated in the second symbol.

30. (New) The network node of claim 23, wherein the network node transmits, in the cell, the UE specific signal on beam(s) of the cell corresponding to the UE.

31. (New) The network node of claim 23, wherein the network node transmits the common signal on predefined beams in a specific timing.

REMARKS

Claims 1-20 are pending in the application. In the Office Action, claims 1-6, 8-13, and 15-19 stand rejected under 35 U.S.C. § 102 as being anticipated by Takano (U.S. Patent Publication No. 2014/0119349). *See* Office Action, ¶ 3. Furthermore, claims 7, 14, and 20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Takano, in view of Guey (U.S. Patent Publication No. 2016/0087707). *See* Office Action, ¶ 5.

Claims 1, 2, 3, 8, 9, 10, 14, 15, 16, 17, and 20 have been amended. The claim amendments are supported by at least FIG. 15 and Paragraphs [0069]-[0074] of the present application. Claim 21-31 are newly added. Applicants respectfully request reconsideration of the claims as amended and as added.

Claims 1 and 23 recite "transmitting, in the cell, a UE specific signal in a first symbol of a downlink control region of a subframe of the multiple subframes and a common signal in a second symbol of the downlink control region of the subframe of the multiple subframes, wherein the network node is not allowed to transmit the common signal in the first symbol." Applicants respectfully submit that the cited prior art references fail to disclose the note limitations.

In rejecting the claims, the Office Action cites to Takano. *See* Office Action, Page 2. According to FIG. 2 and FIG. 3 of Takano and the text in Takano describing the figures, subcarriers used to carry common signal are placed from the first symbol and from lower frequency to higher frequency. Therefore, depending on the number of subcarriers in the frequency domain or the number of subcarriers used to carry common signal, the common signal can be carried on any symbol in the control region. However, Takano fails to disclose a downlink control region with a first symbol and a second symbol, wherein the network is allowed to use the first symbol for transmission of the UE specific signal that is intended for a specific UE in the cell, and the network node is not allowed to use the first symbol for transmission of the common signal that is intended for multiple UEs in the cell, as recited in the claims.

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Claims 8 and 15 recite "wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe." Applicants respectfully submit that the cited prior art references fail to disclose the note limitations.

According to Paragraphs [0003], [0007], [0008], and [0118] of Takano, the method used to avoid interference of Het-net is only applied to PDCCH (control channel) instead of PDSCH (data channel), since the mentioned Rel-8 ICIC, which schedules distinct frequency resources for different type of cells, is applied to PDSCH. However, Takano fails to disclose control signals on different symbols would indicate data resources on different symbols, as recited in the claims.

Furthermore, even if there is a motivation to introduce new interference avoidance technics for data channel in a same way as control channel, the data resources on different symbols should be used for different types of eNB, e.g., Macro eNB and Pico eNB. However, the resources in different symbols for data in Claims 8 and 15 are used in the same cell, i.e., by a single network node, which cannot be derived from the solution disclosed in Takano.

For the reasons stated the above, Applicants respectfully submit that claims 1-31 are patentable over any combination of Takano and/or Guey.

In view of the foregoing it is respectfully submitted that the pending claims are in condition for allowance. Reconsideration of the rejections is requested. Allowance of the claims at an early date is solicited.

The Examiner is invited to contact Applicant's undersigned counsel by telephone at (714) 839-3800 to expedite the prosecution of this case should there be any unresolved matters remaining.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made.

Respectfully submitted,
Sang N. Dang
BLUE CAPITAL LAW FIRM, P.C.

Dated: January 30, 2018

/Sang N. Dang/
Reg. No. 51,186
Tel.: (714) 839-3800

Samsung Exhibit 1002, Page 400 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Yu-Hsuan Guo; Ko-Chiang Lin; Richard Lee-Chee Kuo; and Chung-Ming Sun	
Title:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	15/175,673	Filed: June 7, 2016
Examiner:	Brian D. Nguyen	Group Art Unit: 2472
Attorney Docket No.:	1426-077.101 (1040143-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION UNDER 37 CFR § 1.8

I hereby certify that the enclosed 2 Page Amendment Transmittal; and 9 Page Amendment are being transmitted to the United States Patent and Trademark Office via EFS-Web on January 30, 2018.

Date: January 30, 2018 /Sandy Kim/

Sandy Kim

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Fax: 714-795-2995

Electronic Patent Application Fee Transmittal

Application Number:	15175673
Filing Date:	07-Jun-2016
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-077.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	11	100	1100
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	460	460
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1560**

Electronic Acknowledgement Receipt	
EFS ID:	31647696
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	30-JAN-2018
Filing Date:	07-JUN-2016
Time Stamp:	15:23:51
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1560
RAM confirmation Number	013118INTEFSW15243700
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		v3-1426-077-101--ROAof11062017asFiled01302018.pdf	148512 640f02eb27f524492093b0f7a5abe017d0893d9b	yes	12

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal Letter	1	2
Amendment/Req. Reconsideration-After Non-Final Reject	3	3
Claims	4	8
Applicant Arguments/Remarks Made in an Amendment	9	11
Miscellaneous Incoming Letter	12	12

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	31860 d452bd1b233cd3f08181e86c4a47e3988ddd688f	no	2

Warnings:

Information:

Total Files Size (in bytes):	180372

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Amendment Transmittal Letter

Docket Number
1426-077.101

Address To
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Title of Invention

METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

First Named Inventor	Yu-Hsuan Guo
Application No.	15/175,673
Filing Date	June 7, 2016
Examiner	Brian D. Nguyen
Art Unit	2472

Transmitted herewith is an amendment in the above-identified application.

The fee has been calculated and is transmitted as shown below.

☐ **Applicant claims Small Entity Status.** See 37 CFR 1.27.

Fee Calculation

Claims as Amended

For	#Filed	#Previously Paid For	#Extra	Rate	Fee
Total Claims	31	- 20 =	11	x 100 =	1100.00
Total Indep. Claims	4	- 3 =	1	x 460 =	460
Multiple Dependent Claims (check if applicable) ☐					
				TOTAL	1,560

Method of Payment

☐ Deposit Account ☒ Credit Card ☐ Check ☐ Money Order ☐ Other: _____

Deposit Account Number

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge the fee(s) set forth above
☐ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
☐ Charge fee(s) indicated above, **except for the filing fee**
☐ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on form PTO-2038.

Amount Grand Total 1,560

Samsung Exhibit 1002, Page 407 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Amendment Transmittal Letter

Docket Number
1426-077.101

Correspondence Address

Customer Number	106622		
-OR-			
Name			
Address			
City		State	
Country		Postal Code	
Phone Number			
E-mail Address			

Certificate of Mailing by Express Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing)

(Typed or Printed Name of Person Mailing Correspondence)

(Signature of Person Mailing Correspondence)

("Express Mail" Mailing Label Number)

Certificate of Mailing by First Class Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing) *(Name of Person Mailing Correspondence)*

(Signature of Person Mailing Correspondence)

Certificate of Transmission

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) authorization are being facsimile transmitted to the United States Patent and Trademark Office on the date indicated below:

(Date of Transmission) *(Name of Person Transmitting Correspondence)*

(Signature of Person Transmitting Correspondence)

Signature Instructions

Select the name of the person who will electronically sign the Amendment from the drop-down box below.

If a practitioner is not present in the drop-down list, you must close this form and select 'Add Practitioner...' in the Form Manager's Utility menu.

Verify that the signatory information is correct and press the 'eSign' button to electronically sign the submission. If you prefer to sign the form manually, simply do not click the 'eSign' button; just print and manually sign.

Signatory Drop-Down Box Sang N. Dang

Name	Sang N. Dang	Registration Number	51,186
Signatory Capacity	Attorney for Applicant(s)	E-mail Address	sdang@bluecapitallaw.com
eSign	/Sang N. Dang/	Date Signed	01/30/2018

Samsung Exhibit 1002, Page 408 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/175,673	Filing Date 06/07/2016	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $80 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $420 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	01/30/2018	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 31	Minus	** 20	= 11		x $100 =	1100
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1		x $460 =	460
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	1560

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	Moliki I May
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

106622 7590 04/20/2018

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER
NGUYEN, BRIAN D

ART UNIT	PAPER NUMBER
2472	

DATE MAILED: 04/20/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

TITLE OF INVENTION: METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0	$0	$1000	07/20/2018

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

106622 7590 04/20/2018
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

TITLE OF INVENTION: METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0	$0	$1000	07/20/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, BRIAN D	2472	370-252000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Samsung Exhibit 1002, Page 411 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

106622 7590 04/20/2018

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
NGUYEN, BRIAN D	
ART UNIT	PAPER NUMBER
2472	

DATE MAILED: 04/20/2018

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Samsung Exhibit 1002, Page 412 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/175,673	Applicant(s) GUO ET AL.	
	Examiner BRIAN D. NGUYEN	Art Unit 2472	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the amendment filed 1/30/18*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-31*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/BRIAN D NGUYEN/
Primary Examiner, Art Unit 2472

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

CPC- SEARCHED		
Symbol	Date	Examiner
H04L1/1812	10/27/17	bn
H04W24/08	10/27/17	bn
H04W72/042	10/27/17	bn
H04W72/0446	10/27/17	bn
H04W72/046	10/27/17	bn
H04L5/005	10/27/17	bn
H04L5/0051	10/27/17	bn
H04L5/0053	10/27/17	bn
H04L5/0055	10/27/17	bn
H04L25/0224	10/27/17	bn
H04L25/0204	10/27/17	bn
H04B7/0617	10/27/17	bn

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
text search and symbols limited by date search	10/27/17	bn
updated	4/15/18	bn

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**
see the attached printout		4/15/18	bn

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	**Art Unit**
	BRIAN D NGUYEN	2472

CPC							
Symbol						**Type**	**Version**
H04W		72	/	0446		F	2013-01-01
H04L		1	/	1812		I	2013-01-01
H04W		24	/	08		I	2013-01-01
H04W		72	/	042		I	2013-01-01
H04W		72	/	046		I	2013-01-01
H04B		7	/	0617		A	2013-01-01
H04L		5	/	005		I	2013-01-01
H04L		5	/	0051		I	2013-01-01
H04L		5	/	0053		I	2013-01-01
H04L		5	/	0055		I	2013-01-01
H04L		25	/	0204		A	2013-01-01
H04L		25	/	0224		A	2013-01-01
			/				
			/				
			/				

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	31	
/BRIAN D NGUYEN/ Primary Examiner.Art Unit 2472	04/15/2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	17

U.S. Patent and Trademark Office — Part of Paper No. 20180415

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	**Art Unit**
	BRIAN D NGUYEN	2472

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
		H	0	4	W	72 / 04 (2009.01.01)						
CROSS REFERENCE(S)		H	0	4	W	24 / 08 (2009.01.01)						
		H	0	4	L	1 / 18 (2006.01.01)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)											

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	31	
/BRIAN D NGUYEN/ Primary Examiner.Art Unit 2472	04/15/2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	17

Samsung Exhibit 1002, Page 418 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	**Art Unit**
	BRIAN D NGUYEN	2472

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	19	17												
2	2	20	18												
3	3	21	19												
4	4	22	20												
5	5	8	21												
6	6	9	22												
7	7	23	23												
10	8	24	24												
11	9	25	25												
12	10	26	26												
13	11	27	27												
14	12	28	28												
15	13	29	29												
16	14	30	30												
17	15	31	31												
18	16														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	31	
/BRIAN D NGUYEN/ Primary Examiner.Art Unit 2472	04/15/2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	17

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	11181072	@ad<="20150612"	US-PGPUB; USPAT	OR	ON	2017/10/27 06:02
S2	0	(down adj2 link dl) adj2 control adj2 region same (user ue) adj2 specific with symbol	US-PGPUB; USPAT	OR	ON	2017/10/27 06:26
S3	36	(down adj2 link dl) adj2 control adj2 region and (user ue) adj2 specific with symbol	US-PGPUB; USPAT	OR	ON	2017/10/27 06:26
S4	20	S3 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 06:26
S5	2	(("20130201925") or ("20130183987")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/10/27 07:00
S6	2228	(user ue) adj2 specific with symbol	US-PGPUB; USPAT	OR	ON	2017/10/27 07:16
S7	564	(user ue) adj2 specific with symbol same subframe	US-PGPUB; USPAT	OR	ON	2017/10/27 07:17
S8	444	S7 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 07:17
S9	35	(user ue) adj2 specific with symbol same subframe with location	US-PGPUB; USPAT	OR	ON	2017/10/27 08:12
S10	2	"15175673"	US-PGPUB; USPAT	OR	ON	2017/10/27 08:17
S11	1	("9432985").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/10/27 08:31
S12	2	"15175673"	US-PGPUB; USPAT	OR	ON	2017/10/27 09:19
S13	1	("20140119349").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/10/27 09:50
S14	1	S13 and (resource allocation feedback harq reference)	US-PGPUB; USPAT	OR	ON	2017/10/27 09:51
S15	54	beam with (user ue) adj2 specific with cell adj2 specific	US-PGPUB; USPAT	OR	ON	2017/10/27 10:44
S16	42	S15 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 10:44
S17	2	"15175673"	US-PGPUB; USPAT	OR	ON	2017/10/27 11:20
S18	5252	H04L1/1812.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:21
S19	8573	H04W24/08.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:21
S20	12462	H04W72/042.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:22

S21	8144	H04W72/0446.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:22
S22	1336	H04W72/046.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:23
S23	2251	H04L5/005.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:23
S24	2519	H04L5/0051.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:23
S25	10675	H04L5/0053.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:24
S26	5246	H04L5/0055.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:24
S27	2224	H04L25/0224.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:25
S28	3723	H04L25/0204.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:25
S29	5228	H04B7/0617.cpc.	US-PGPUB; USPAT	OR	ON	2017/10/27 11:25
S30	49783	S18 S19 S20 S21 S22 S23 S24 S25 S26 S27 S28 S29	US-PGPUB; USPAT	OR	ON	2017/10/27 11:27
S31	41638	S30 and S1	US-PGPUB; USPAT	OR	ON	2017/10/27 11:27
S32	9438	S31 and (user ue) adj2 specific	US-PGPUB; USPAT	OR	ON	2017/10/27 11:27
S33	106	(("GUO") near3 ("Yu-Hsuan")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:21
S34	39	(("LIN") near3 ("Ko-Chiang")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:21
S35	279	(("KUO") near3 ("Richard")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:21
S36	24	(("SUN") near3 ("Chung-Ming")).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2017/10/27 12:22
S37	418	S33 S34 S35 S36	US-PGPUB; USPAT	OR	ON	2017/10/27 12:23
S38	33	S37 and subframe.clm.	US-PGPUB; USPAT	OR	ON	2017/10/27 12:23
S39	2	"15175673"	US-PGPUB; USPAT	OR	ON	2018/04/15 16:55

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S40	9166	H04W72/0446.cpc.	US-PGPUB; USPAT	OR	ON	2018/04/15 17:04
S41	5568	H04L1/1812.cpc.	US-PGPUB; USPAT	OR	ON	2018/04/15 17:04
S42	13727	H04W72/042.cpc.	US-PGPUB; USPAT	OR	ON	2018/04/15 17:04
S43	9330	H04W24/08.cpc.	US-PGPUB; USPAT	OR	ON	2018/04/15 17:04

S44	1461	H04W72/046.cpc.	US-PGPUB; USPAT	OR	ON	2018/04/15 17:04

4/15/2018 5:05:36 PM
C:\Users\bnguyen2\Documents\EAST\Workspaces\15175673.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15175673	GUO ET AL.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/27/2017	04/15/2018							
1	1	✓	=							
2	2	✓	=							
3	3	✓	=							
4	4	✓	=							
5	5	✓	=							
6	6	✓	=							
7	7	✓	=							
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27	27		=							
28	28		=							
29	29		=							
30	30		=							
31	31		=							

Samsung Exhibit 1002, Page 423 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Doc Code: R48.REQ
Document Description: Request under Rule 48 correcting inventorship

PTO/AIA/40 (04-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST FOR CORRECTION IN A PATENT APPLICATION RELATING TO INVENTORSHIP OR AN INVENTOR NAME, OR ORDER OF NAMES, OTHER THAN IN A REISSUE APPLICATION (37 CFR 1.48)

Application Number	15/175,673
Filing Date	June 7, 2016
First Named Inventor	Yu-Hsuan Guo
Art Unit	2472
Examiner Name	Brian D. Nguyen
Practitioner Docket Number	1426-077.101

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby **requests that the inventorship be corrected or changed, or that the name of the inventor or a joint inventor, or the order of the names of joint inventors, be changed,** in the above-identified application. **Note:** 37 CFR 1.48 applies to any request to correct inventorship filed on or after September 16, 2012, regardless of the application filing date. **Do not submit this form after payment of the issue fee or if the application has been patented.** See 37 CFR 1.324 for correction of inventorship in a patent.

Please check the applicable box(es) below.

For a nonprovisional application:

☒ 1. This request is to correct or change the inventorship in a **nonprovisional** application **(under 37 CFR 1.48(a))** and includes:

☒ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). See the Manual of Patent Examining Procedure (MPEP) section 601.05(a) for information about filing an ADS in an application filed on/after September 16, 2012. For information about filing a Supplemental ADS in an application filed before September 16, 2012, see MPEP 601.05(b).

☒ The processing fee set forth in 37 CFR 1.17(i). $ 150.00

☐ An inventor is being added. An inventor's oath or declaration by any actual inventor who has not yet executed an oath or declaration is required (see 37 CFR 1.48(b)). See MPEP 602.01(a) for information about an inventor's oath or declaration for an application filed on/after September 16, 2012 (*e.g.*, form **PTO/AIA/01**). For information about an inventor's oath or declaration for an application filed before September 16, 2012 (*e.g.*, form **PTO/SB/01**), see MPEP 602.01(b).

☒ This request is being filed after the first Office action on the merits has been given or mailed (see 37 CFR 1.48(c) and 1.17(d)). Check one of the following:

☐ This request to correct or change the inventorship is due solely to the cancellation of claims in the application.

OR

☒ The fee set forth in 37 CFR 1.17(d) is due (in addition to the fee set forth in 37 CFR 1.17(i)). $ 600.00

[Page 1 of 2]

This collection of information is required by 37 CFR 1.48. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/40 (04-18)
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U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CORRECTION IN A PATENT APPLICATION RELATING TO INVENTORSHIP OR AN INVENTOR NAME, OR ORDER OF NAMES, OTHER THAN IN A REISSUE APPLICATION (37 CFR 1.48)

☐ 2. This request is to correct or update the name of the inventor or a joint inventor, or the order of names of joint inventors, in a **nonprovisional** application (**under 37 CFR 1.48(f)**) and includes:

☐ An application data sheet in accordance with 37 CFR 1.76(c) identifying the complete inventive entity, including the corrected or updated name of the inventor, or the new order of names shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). See the MPEP 601.05(a) for information about filing an ADS in an application filed on/after September 16, 2012. For information about filing a Supplemental ADS in an application filed before September 16, 2012, see MPEP 601.05(b).

☐ The processing fee set forth in 37 CFR 1.17(i). $ _____

For a provisional application:

☐ This request is to change or correct the inventorship, or correct or update the name of the inventor or a joint inventor, in a **provisional** application (**under 37 CFR 1.48(d)**) and includes:

☐ **Attached hereto** is a document that is signed by a party set forth in 37 CFR 1.33(b) and identifies each inventor by his or her legal name, in the preferred order. Note: the document may be an application data sheet in accordance with 37 CFR 1.76(c) that identifies the changes with markings (underlining for insertions, strikethrough for deletions).

☐ The processing fee set forth in 37 CFR 1.17(q). $ _____

Fee Payment Information:

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. _____.

☒ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ Applicant*

☒ attorney or agent of record
Registration number 51,186

☐ attorney or agent acting under 37 CFR 1.34
Registration number _____

Signature /Sang N. Dang/

Typed or printed name Sang N. Dang

Date May 11, 2018

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

☐ ** Total of _____ forms are submitted.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	15/175,673
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yu-Hsuan		Guo	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country [i]	TW

Inventor 2

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Ko-Chiang		Lin	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country [i]	TW

Inventor 3

Legal Name

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Richard	Lee-Chee	Kuo	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence [i]	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country [i]	TW

Inventor 4

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	~~Chung-Ming~~		~~Sun~~	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	~~Taipei City~~	Country of Residence [i]	~~TW~~

Mailing Address of Inventor:

Address 1	~~No. 15, Lite Rd., Peitou District~~		
Address 2			
City	~~Taipei City 112~~	State/Province	OT
Postal Code		Country [i]	~~TW~~

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	106622		
Email Address		Add Email	Remove Email

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM		
Attorney Docket Number	1426-077.001	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	19	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	106622		

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	
					Remove
Registration Number					

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove

Registration Number	

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
15/175,673	Claims benefit of provisional	62174716	2015-06-12

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
15/175,673	Claims benefit of provisional	62183460	2015-06-23

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

WEB ADS 1.0

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:	

If the Applicant is an Organization check here. ☒

Organization Name	ASUSTeK Computer Inc.		
Mailing Address Information For Applicant:			
Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	**State/Province**	OT
Country[i]	TW	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country [i]		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-077.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Sang N. Dang/			Date (YYYY-MM-DD)	2018-05-11
First Name	Sang N.	Last Name	Dang	Registration Number	51186

Additional Signature may be generated within this form by selecting the Add button.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Yu-Hsuan Guo; Ko-Chiang Lin; and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	15/175,673	Filed: June 7, 2016
Examiner:	Brian D. Nguyen	Group Art Unit: 2472
Attorney Docket No.:	1426-077.101 (1040143-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 2 Page Request for Correction in a Patent Application Relating to Inventorship; and 9 Page Application Data Sheet with Correction marked thereon are being transmitted to the United States Patent and Trademark Office via EFS-Web on May 11, 2018.

Date: May 11, 2018 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

Electronic Patent Application Fee Transmittal

Application Number:	15175673
Filing Date:	07-Jun-2016
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-077.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
PROCESSING FEE CORRECTING INVENTORSHIP	1816	1	150	150

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
CORRECTION OF INVENTORSHIP ON MERITS	1819	1	600	600
		Total in USD ($)		**750**

Electronic Acknowledgement Receipt	
EFS ID:	32603819
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	11-MAY-2018
Filing Date:	07-JUN-2016
Time Stamp:	16:18:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$750
RAM confirmation Number	051418INTEFSW16190900
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		1426-077-101--RequestforCorrectionInventorshipv2.pdf	201434 ffe24ba5eb46f64849ea5d5b118a7490b21adc5c	yes	12

Multipart Description/PDF files in .zip description

Document Description	Start	End
Request under Rule 48 correcting inventorship	1	2
Application Data Sheet	3	11
Miscellaneous Incoming Letter	12	12

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	32105 51f26eab9a810d2f57e1865d3d710f42cade0ce1	no	2

Warnings:

Information:

Total Files Size (in bytes):	233539

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 05/15/2018

MTEKLEMI SALE #00000043 Mailroom Dt: 05/11/2018 15175673
01 FC : 1830 140.00 OP

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 05/15/2018

MTEKLEMI ADJ #00000021 Mailroom Dt: 05/11/2018
Seq No: 3073 Sales Acctg Dt: 05/14/2018 15175673
01 FC : 1816 -150.00 OP

Document code: WFEE

United States Patent and Trademark Office
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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/175,673	06/07/2016	2472	3160	1426-077.101	20	3

CONFIRMATION NO. 7587

UPDATED FILING RECEIPT

106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

OC000000099545991

Date Mailed: 05/16/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Yu-Hsuan Guo, Taipei City, TAIWAN;
Ko-Chiang Lin, Taipei City, TAIWAN;
Richard Lee-Chee Kuo, Taipei City, TAIWAN;

Applicant(s)

ASUSTeK Computer Inc., Taipei City, TAIWAN;

Power of Attorney: The patent practitioners associated with Customer Number 106622

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/174,716 06/12/2015
and claims benefit of 62/183,460 06/23/2015

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: No

Title

METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101

CONFIRMATION NO. 7587

106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

37 CFR 1.48 ACKNOWLEDGEMENT LETTER

OC000000099545992

Date Mailed: 05/16/2018

NOTICE OF ACCEPTANCE OF REQUEST UNDER 37 CFR 1.48(a)

This is in response to the applicant's request under 37 CFR 1.48(a) submitted on 05/11/2018.

The request under 37 CFR 1.48(a) to correct the inventorship, to correct or update the name of an inventor, or to correct the order of names of joint inventors is accepted.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/hteffera/

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	15/175,673	Filing Date	2016-06-07	Docket Number (if applicable)	1426-077.101	Art Unit	2472
First Named Inventor	Yu-Hsuan Guo			Examiner Name	Brian D. Nguyen		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Sang N. Dang/	Date (YYYY-MM-DD)	2018-07-16
Name	Sang N. Dang	Registration Number	51186

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Amendment Transmittal Letter

Docket Number
1426-077.101

Address To
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Title of Invention

METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

First Named Inventor	Yu-Hsuan Guo
Application No.	15/175,673
Filing Date	June 7, 2016
Examiner	Brian D. Nguyen
Art Unit	2472

Transmitted herewith is an amendment in the above-identified application.

The fee has been calculated and is transmitted as shown below.

☐ **Applicant claims Small Entity Status.** See 37 CFR 1.27.

Fee Calculation

Claims as Amended

For	#Filed	#Previously Paid For	#Extra	Rate	Fee
Total Claims	34	- 31 =	3	x =	300.00
Total Indep. Claims	4	- 4 =	0	x =	
Multiple Dependent Claims (check if applicable) ☐					
				TOTAL	

Method of Payment

☐ Deposit Account ☒ Credit Card ☐ Check ☐ Money Order ☐ Other: _____

Deposit Account Number

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge the fee(s) set forth above
☐ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
☐ Charge fee(s) indicated above, **except for the filing fee**
☐ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on form PTO-2038.

Amount Grand Total 300

Samsung Exhibit 1002, Page 450 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Amendment Transmittal Letter

Docket Number
1426-077.101

Correspondence Address

Customer Number	106622		
-OR-			
Name			
Address			
City		State	
Country		Postal Code	
Phone Number			
E-mail Address			

Certificate of Mailing by Express Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing)

(Typed or Printed Name of Person Mailing Correspondence)

(Signature of Person Mailing Correspondence)

("Express Mail" Mailing Label Number)

Certificate of Mailing by First Class Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing) *(Name of Person Mailing Correspondence)*

(Signature of Person Mailing Correspondence)

Certificate of Transmission

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) authorization are being facsimile transmitted to the United States Patent and Trademark Office on the date indicated below:

(Date of Transmission) *(Name of Person Transmitting Correspondence)*

(Signature of Person Transmitting Correspondence)

Signature Instructions

Select the name of the person who will electronically sign the Amendment from the drop-down box below.

If a practitioner is not present in the drop-down list, you must close this form and select 'Add Practitioner...' in the Form Manager's Utility menu.

Verify that the signatory information is correct and press the 'eSign' button to electronically sign the submission. If you prefer to sign the form manually, simply do not click the 'eSign' button; just print and manually sign.

Signatory Drop-Down Box Sang N. Dang

Name	Sang N. Dang	Registration Number	51,186
Signatory Capacity	Attorney for Applicant(s)	E-mail Address	sdang@bluecapitallaw.com
eSign	/Sang N. Dang/	Date Signed	07/16/2018

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	15/175,673
Confirmation No.	:	7587
Applicant	:	Yu-Hsuan Guo, Ko-Chiang Lin, Richard Lee-Chee Kuo, and Chung-Ming Sun
Filed	:	June 7, 2016
Title	:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	:	2472
Examiner	:	Brian D. Nguyen
Docket No.	:	1426-077.101 (1040143-US)
Customer No.	:	106622

RESPONSE TO NOTICE OF ALLOWANCE

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice of Allowance mailed on April 20, 2018, having a three-month period for filing a response to **July 20, 2018**, Applicants respectfully submit the following amendments and remarks along with a RCE:

Amendments to Claims begin on page 2.
Remarks begin on page 8.

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

IN THE CLAIMS:

1. (Currently Amended) A method for a network node controlling a cell, comprising:

communicating with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols; and

transmitting, in the cell, a UE specific signal to the UE in [[a]] at least one first symbol of a downlink control region of a subframe of the multiple subframes and a common signal to the UE in [[a]] at least one second symbol of the downlink control region of the subframe of the multiple subframes, wherein the network node ~~is not allowed to~~ does not transmit the common signal to the UE in the at least one first symbol and wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe.

2. (Previously Presented) The method of claim 1, wherein the network node transmits the common signal at multiple timings to cover all beams of the cell.

3. (Currently Amended) The method of claim 1, wherein the network node transmits the UE specific signal in the at least second symbol.

4. (Currently Amended) The method of claim 1, wherein ~~the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region~~ the network node does not transmit the UE specific signal in the at least one second symbol.

5. (Original) The method of claim 1, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

6. (Original) The method of claim 1, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a

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broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

7. (Currently Amended) The method of claim 1, wherein beam(s) of the cell generated in the first symbol is different from beam(s) generated in the at least one second symbol.

8. (Currently Amended) A method for a User Equipment (UE), comprising:

communicating with a network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols;

monitoring, in the cell, a UE specific signal in [[a]] at least one first symbol of a downlink control region of a subframe, and not monitoring a common signal in the at least one first symbol; and

monitoring, in the cell, the common signal in [[a]] at least one second symbol of the downlink control region, wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe.

9. (Previously Presented) The method of claim 8, wherein the common signal and the UE specific signal indicate resources in completely different or partially different symbols of the data region of the subframe.

10. (Previously Presented) The method of claim 8, wherein the UE monitors the UE specific signal in the second symbol.

11. (Currently Amended) The method of claim 8, wherein ~~the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region~~ the UE does not monitor the UE specific signal in the at least one second symbol.

12. (Original) The method of claim 8, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

13. (Original) The method of claim 8, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

14. (Currently Amended) The method of claim 8, wherein a length of the downlink control region is two symbols and the UE does not monitor the UE specific signal in the at least one second symbol.

15. (Currently Amended) A User Equipment (UE) for communication with a network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

communicate with the network node in a cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames, each radio frame includes multiple subframes, and each subframe includes multiple symbols;

monitor, in the cell, a UE specific signal in [[a]] at least one first symbol of a downlink control region of a subframe, and not monitoring a common signal in the at least one first symbol; and

monitor, in the cell, the common signal in [[a]] at least one second symbol of the downlink control region, wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe.

16. (Previously Presented) The UE of claim 15, wherein the common signal and the UE specific signal indicate resources in completely different or partially different symbols of the data region of the subframe.

17. (Currently Amended) The UE of claim 15, wherein the UE monitors the UE specific signal in the at least one second symbol.

18. (Original) The UE of claim 15, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

19. (Original) The UE of claim 15, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

20. (Currently Amended) The UE of claim 15, wherein a length of the downlink control region is two symbols and the UE does not monitor the UE specific signal in the at least one second symbol.

21. (Previously Presented) The method of claim 1, wherein the network node transmits, in the cell, the UE specific signal on beam(s) of the cell corresponding to the UE.

22. (Currently Amended) The method of claim 1, wherein the network node transmits the common signal on predefined beams [[in]] at a specific timing.

23. (Currently Amended) A network node for controlling a cell, comprising:
a control circuit;
a processor installed in the control circuit; and
a memory installed in the control circuit and operatively coupled to the processor;
wherein the processor is configured to execute a program code stored in the memory to:

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

communicate with a UE (User Equipment) in the cell via downlink and uplink transmissions, wherein the downlink and uplink transmissions are organized into radio frames and each radio frame contains multiple subframes and each subframe contains multiple symbols; and

transmit, in the cell, a UE specific signal to the UE in [[a]] at least one first symbol of a downlink control region of a subframe of the multiple subframes and a common signal to the UE in [[a]] at least one second symbol of the downlink control region of the subframe of the multiple subframes, wherein the network node ~~is not allowed to~~ does not transmit the common signal to the UE in the at least one first symbol and wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe.

24. (Previously Presented) The network node of claim 23, wherein the network node transmits the common signal at multiple timings to cover all beams of the cell.

25. (Currently Amended) The network node of claim 23, wherein the network node transmits the UE specific signal in the at least one second symbol.

26. (Currently Amended) The network node of claim 23, wherein ~~the subframe includes a data region for uplink (UL), a data region for downlink (DL), and/or an UL control region~~ the network node does not transmit the UE specific signal in the at least one second symbol.

27. (Previously Presented) The network node of claim 23, wherein the UE specific signal is a signaling indicating resource allocation, a signaling indicating HARQ (Hybrid Automatic Repeat reQuest) feedback, and/or a reference signal for demodulation.

28. (Previously Presented) The network node of claim 23, wherein the common signal is a signaling indicating a system frame number (SFN), a signaling indicating resource allocation for a broadcast message, a synchronization signal, or a reference signal for DL radio condition measurement.

29. (Currently Amended) The network node of claim 23, wherein beam(s) of the cell generated in the at least one first symbol is different from beam(s) generated in the at least one second symbol.

30. (Previously Presented) The network node of claim 23, wherein the network node transmits, in the cell, the UE specific signal on beam(s) of the cell corresponding to the UE.

31. (Previously Presented) The network node of claim 23, wherein the network node transmits the common signal on predefined beams in a specific timing.

32. (New) The network node of claim 25, wherein the common signal and the UE specific signal indicate resources in completely different or partially different symbols of the data region of the subframe.

33. (New) The method of claim 1, wherein the common signal and the UE specific signal indicate resources in completely different or partially different symbols of the data region of the subframe.

34. (New) The UE of claim 15, wherein the UE does not monitor the UE specific signal in the at least one second symbol.

REMARKS

Claims 1-31 have been allowed. *See* Notice of Allowance dated April 20, 2018. Applicants respectfully submit this Response along with a RCE to further amend the claims.

In the Office Action dated February 6, 2018, claims 1-6, 8-13, and 15-19 stand rejected under 35 U.S.C. § 102 as being anticipated by Takano (U.S. Patent Publication No. 2014/0119349). *See* Office Action, ¶ 3. Furthermore, claims 7, 14, and 20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Takano, in view of Guey (U.S. Patent Publication No. 2016/0087707). *See* Office Action, ¶ 5.

Claims 1, 3, 4, 7, 8, 11, 14, 15, 17, 20, 22-26, and 29 have been amended. Claims 32-34 have been added. The amendments of claims 1 and 23 are supported by at least Paragraphs [0069], [0078], [0082], and [0083] of the present application. The amendments of claims 4 and 26 and new claim 34 are supported by at least Paragraph [0070] of the present application. New claims 32 and 33 are supported by at least Paragraph [0078] of the present application . No new matter has been added. Applicants respectfully request reconsideration of the claims as amended and as added.

Claims 1 and 23 recite "transmitting [or transmit], in the cell, a UE specific signal to the UE in at least one first symbol of a downlink control region of a subframe of the multiple subframes and a common signal to the UE in at least one second symbol of the downlink control region of the subframe of the multiple subframes, wherein the network node does not transmit the common signal to the UE in the at least one first symbol and wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe." Applicants respectfully submit that the cited prior art references fail to disclose the note limitations.

In rejecting the claims, the Office Action cites to Takano. *See* Office Action dated February 6, 2018, Page 2. According to FIG. 2 and FIG. 3 of Takano and the text in Takano describing the figures, subcarriers used to carry common signal are placed from the first symbol and from lower frequency to higher frequency. Therefore, depending on the number of subcarriers in the frequency domain or the number of subcarriers used to carry common signal, the common signal can be carried on any symbol in the control region. However, Takano fails to

disclose a downlink control region with a first symbol and a second symbol, wherein the network is allowed to use the first symbol for transmission of the UE specific signal that is intended for a specific UE in the cell, and the network node is not allowed to use the first symbol for transmission of the common signal that is intended for multiple UEs in the cell does not transmit the common signal to the UE in the first symbol and wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe, as recited in the claims.

Claims 8 and 15 recite "wherein the common signal and the UE specific signal indicate resources in different symbols of a data region of the subframe." Applicants respectfully submit that the cited prior art references fail to disclose the note limitations.

According to Paragraphs [0003], [0007], [0008], and [0118] of Takano, the method used to avoid interference of Het-net is only applied to PDCCH (control channel) instead of PDSCH (data channel), since the mentioned Rel-8 ICIC, which schedules distinct frequency resources for different type of cells, is applied to PDSCH. However, Takano fails to disclose control signals on different symbols would indicate data resources on different symbols, as recited in the claims.

Furthermore, even if there is a motivation to introduce new interference avoidance technics for data channel in a same way as control channel, the data resources on different symbols should be used for different types of eNB, e.g., Macro eNB and Pico eNB. However, the resources in different symbols for data in Claims 8 and 15 are used in the same cell, i.e., by a single network node, which cannot be derived from the solution disclosed in Takano.

For the reasons stated the above, Applicants respectfully submit that claims 1-34 are patentable over any combination of Takano and/or Guey.

In view of the foregoing it is respectfully submitted that the pending claims are in condition for allowance. Reconsideration of the rejections is requested. Allowance of the claims at an early date is solicited.

The Examiner is invited to contact Applicant's undersigned counsel by telephone at (714) 839-3800 to expedite the prosecution of this case should there be any unresolved matters remaining.

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made.

Respectfully submitted,
Sang N. Dang
BLUE CAPITAL LAW FIRM, P.C.

Dated: July 16, 2018

/Sang N. Dang/
Reg. No. 51,186
Tel.: (714) 839-3800

Samsung Exhibit 1002, Page 461 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Yu-Hsuan Guo; Ko-Chiang Lin; and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	15/175,673	Filed: June 7, 2016
Examiner:	Brian D. Nguyen	Group Art Unit: 2472
Attorney Docket No.:	1426-077.101 (1040143-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 2 Page Request for Continued Examination; 2 Page Amendment Transmittal Sheet; and 10 Page Amendment are being transmitted to the United States Patent and Trademark Office via EFS-Web on July 16, 2018.

Date: July 16, 2018 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
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Electronic Patent Application Fee Transmittal

Application Number:	15175673
Filing Date:	07-Jun-2016
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-077.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	3	100	300
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**1600**

Electronic Acknowledgement Receipt	
EFS ID:	33188928
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	16-JUL-2018
Filing Date:	07-JUN-2016
Time Stamp:	16:05:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1600
RAM confirmation Number	071718INTEFSW16065100
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		1426-077-101--ResponseafterNOARCE07162018.pdf	225918 6835548937b4a5918d65a2828982b9e3504ac6c7	yes	15

Multipart Description/PDF files in .zip description

Document Description	Start	End
Request for Continued Examination (RCE)	1	2
Transmittal Letter	3	4
Amendment Submitted/Entered with Filing of CPA/RCE	5	5
Claims	6	11
Applicant Arguments/Remarks Made in an Amendment	12	14
Miscellaneous Incoming Letter	15	15

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	32208 986bbb62bda8677ff204d286383485b1c30c27c6	no	2

Warnings:

Information:

Total Files Size (in bytes):	258126

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/175,673	Filing Date 06/07/2016	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 07/16/2018	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 34	Minus	** 31	= 3	X $100 =	300
Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $460 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	**300**

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
SHERRY DAVIS

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

106622 7590 08/15/2018

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CALIFORNIA 92626
UNITED STATES OF AMERICA

EXAMINER	
NGUYEN, BRIAN D	
ART UNIT	PAPER NUMBER
2472	

DATE MAILED: 08/15/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

TITLE OF INVENTION: METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	11/15/2018

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

106622 7590 08/15/2018
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CALIFORNIA 92626
UNITED STATES OF AMERICA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

TITLE OF INVENTION: METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	11/15/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, BRIAN D	2472	370-252000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

106622 7590 08/15/2018

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CALIFORNIA 92626
UNITED STATES OF AMERICA

EXAMINER	
NGUYEN, BRIAN D	
ART UNIT	PAPER NUMBER
2472	

DATE MAILED: 08/15/2018

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/175,673	Applicant(s) Guo et al.	
	Examiner BRIAN D NGUYEN	Art Unit 2472	AIA Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the amendment filed 7/16/18.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-34 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file areply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/BRIAN D NGUYEN/
Primary Examiner, Art Unit 2472

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/175,673	Guo et al.
	Examiner	**Art Unit**
	BRIAN D NGUYEN	2472

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/27/2017	04/15/2018	08/02/2018						
1	1	✓	=	=						
2	2	✓	=	=						
3	3	✓	=	=						
4	4	✓	=	=						
5	5	✓	=	=						
6	6	✓	=	=						
7	7	✓	=	=						
11	8	✓	=	=						
12	9	✓	=	=						
13	10	✓	=	=						
14	11	✓	=	=						
15	12	✓	=	=						
16	13	✓	=	=						
17	14	✓	=	=						
18	15	✓	=	=						
19	16	✓	=	=						
20	17	✓	=	=						
21	18	✓	=	=						
22	19	✓	=	=						
23	20	✓	=	=						
8	21		=	=						
9	22		=	=						
25	23		=	=						
26	24		=	=						
27	25		=	=						
29	26		=	=						
30	27		=	=						
31	28		=	=						
32	29		=	=						
33	30		=	=						
34	31		=	=						
28	32			=						
10	33			=						
24	34			=						

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/175,673	Guo et al.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

CPC - Searched*		
Symbol	Date	Examiner
H04L1/1812	10/27/17	bn
H04W24/08	10/27/17	bn
H04W72/042	10/27/17	bn
H04W72/0446	10/27/17	bn
H04W72/046	10/27/17	bn
H04L5/005	10/27/17	bn
H04L5/0051	10/27/17	bn
H04L5/0053	10/27/17	bn
H04L5/0055	10/27/17	bn
H04L25/0224	10/27/17	bn
H04L25/0204	10/27/17	bn
H04B7/0617	10/27/17	bn

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/175,673	Guo et al.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

Search Notes		
Search Notes	**Date**	**Examiner**
text search and symbols limited by date search	10/27/17	bn
updated	4/15/18	bn
updated	08/02/2018	bn

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
see the attached printout		4/15/18	bn

Samsung Exhibit 1002, Page 476 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/175,673	Guo et al.
	Examiner	**Art Unit**
	BRIAN D NGUYEN	2472

CPC						
Symbol					**Type**	**Version**
H04W	/	72	/	0446	F	2013-01-01
H04L	/	1	/	1812	I	2013-01-01
H04W	/	24	/	08	I	2013-01-01
H04W	/	72	/	042	I	2013-01-01
H04W	/	72	/	046	I	2013-01-01
H04L	/	5	/	005	I	2013-01-01
H04L	/	5	/	0051	I	2013-01-01
H04L	/	5	/	0053	I	2013-01-01
H04L	/	5	/	0055	I	2013-01-01
H04B	/	7	/	0617	A	2013-01-01
H04L	/	25	/	0204	A	2013-01-01
H04L	/	25	/	0224	A	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	34	
/BRIAN D NGUYEN/ Primary Examiner, Art Unit 2472	02 August 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	17

U.S. Patent and Trademark Office — Part of Paper No.: 20180802

Samsung Exhibit 1002, Page 477 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/175,673	Guo et al.
	Examiner	**Art Unit**
	BRIAN D NGUYEN	2472

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04W	/	72	/	04
H04W	/	24	/	08
H04L	/	1	/	18

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	34	
/BRIAN D NGUYEN/ Primary Examiner, Art Unit 2472	02 August 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	17

U.S. Patent and Trademark Office — Part of Paper No.: 20180802

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/175,673	Guo et al.
	Examiner	Art Unit
	BRIAN D NGUYEN	2472

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	13	10	22	19	31	28								
2	2	14	11	23	20	32	29								
3	3	15	12	8	21	33	30								
4	4	16	13	9	22	34	31								
5	5	17	14	25	23	28	32								
6	6	18	15	26	24	10	33								
7	7	19	16	27	25	24	34								
11	8	20	17	29	26										
12	9	21	18	30	27										

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	34	
/BRIAN D NGUYEN/ Primary Examiner, Art Unit 2472	02 August 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	17

U.S. Patent and Trademark Office — Part of Paper No.: 20180802

Samsung Exhibit 1002, Page 479 of 487
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01217

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Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

Courtesy Reminder for
Application Serial No: 15/175,673

Attorney Docket No: 1426-077.101
Customer Number: 106622
Date of Electronic Notification: 08/21/2018

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
docketing@bluecapitallaw.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://sportal.uspto.gov/secure/myportal/privatepair.** If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Yu-Hsuan Guo; Ko-Chiang Lin; and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	15/175,673	Filed: June 7, 2016
Examiner:	Brian D. Nguyen	Group Art Unit: 2472
Attorney Docket No.:	1426-077.101 (1040143-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 1 Page Issue Fee Transmittal; and Payment by EFS-WEb are being transmitted to the United States Patent and Trademark Office via EFS-Web on September 4, 2018.

Date: September 4, 2018 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

Electronic Patent Application Fee Transmittal

Application Number:	15175673
Filing Date:	07-Jun-2016
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-077.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1000**

Electronic Acknowledgement Receipt	
EFS ID:	33617195
Application Number:	15175673
International Application Number:	
Confirmation Number:	7587
Title of Invention:	METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yu-Hsuan Guo
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-077.101
Receipt Date:	04-SEP-2018
Filing Date:	07-JUN-2016
Time Stamp:	14:35:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	090518INTEFSW14361000
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		1426-077-101--IssueFeeAsFiled09042018.pdf	160199 e1f3f362ae401357f1546cdfa60b8dbb8f3fe8a1	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Issue Fee Payment (PTO-85B)	1	1
	Miscellaneous Incoming Letter	2	2

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30184 e6e0190928e3312003a3ea7d01c335586b74d125	no	2

Warnings:

Information:

Total Files Size (in bytes):	190383

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
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PART B – FEE(S) TRANSMITTAL

Complete and send this form, together with the applicable fee(s), by mail or fax, or via EFS-Web.

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Alexandria, VA 22313-1450

By fax, send to: (571) 273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
15/175,673	06/07/2016	Yu-Hsuan Guo	1426-077.101	7587

TITLE OF INVENTION: METHOD AND APPARATUS FOR DELIVERY OF CONTROL SIGNALING IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0	$0	$1000	11/15/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, BRIAN D	2472	370-252000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363)

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1. Blue Capital Law Firm, P.C.
2.
3.

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: ASUSTeK Computer Inc.

(B) RESIDENCE: (CITY and STATE or COUNTRY): Taipei City, Taiwan

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☑ Corporation or other private group entity ☐ Government

4a. Fees Submitted: ☑ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

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☐ Applicant asserting small entity status. See 37 CFR 1.27. NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status. NOTE: Checking this box will be taken as a notification of loss of entitlement to small or micro entity status, as applicable.

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Authorized Signature /Sang N. Dang/ Date September 4, 2018

Typed or printed name Sang N. Dang Registration No. 51,186

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/175,673	10/16/2018	10104658	1426-077.101	7587

106622 7590 09/26/2018

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Costa Mesa, CA 92626

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 4 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Yu-Hsuan Guo, Taipei City, TAIWAN;
ASUSTeK Computer Inc., Taipei City, TAIWAN;
Ko-Chiang Lin, Taipei City, TAIWAN;
Richard Lee-Chee Kuo, Taipei City, TAIWAN;

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