AO 120 (Rev. 08/10)

TO: **Mail Stop 8** **Director of the U.S. Patent and Trademark Office** **P.O. Box 1450** **Alexandria, VA 22313-1450**	**REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK**

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Northern District of Illinois on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. 1:22-cv-02176	DATE FILED 4/26/2022	U.S. DISTRICT COURT Northern District of Illinois
PLAINTIFF Togail Technologies Ltd.		DEFENDANT Motorola Mobility LLC

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		See attached
2		
3		
4		
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
Thomas G. Bruton	Jennifer Kuldanek	4/27/2022

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

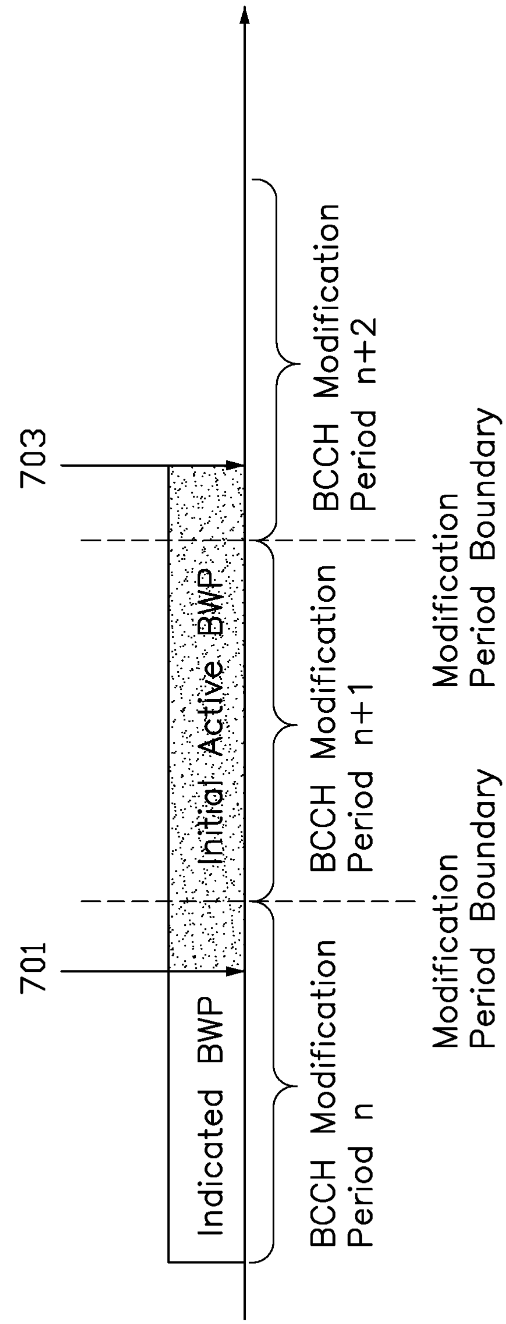
703
701
Initial Active BWP
Indicated BWP
BCCH Modification Period n+2
BCCH Modification Period n+1
BCCH Modification Period n
Modification Period Boundary
Modification Period Boundary

FIG. 7

In some of the present implementations, the BS may indicate at least one sTRP resource set to the UE through at least one of the configuration of the sTRP, the predetermined resource(s) associated with the sTRP ID, and the best compatible channel quality in terms of the pTRP determined by the BS or UE.

In some of the present implementations, the UE may identify different resource(s)/resource set(s) from different TRPs via at least one of the information of QCL assumption(s), the target RS port group(s), and reference RS correlation indication.

For example, the network/BS may indicate target RSs to the UE in terms of two reference RS resource sets. According to the TCI state configuration, the target DMRS may be spatially quasi co-located with the reference RS from a TRP. The DMRS ports may be in different target DMRS port groups. In some other implementations, the UE may be configured with an information element of correlation information, and the UE may use it to determine whether two or more resources are from the same TRP. In this case, a low correlation means that the reference RS resources may have a rich spatial multiplexing/diversity and come from different TRPs, and a high correlation may mean that the reference RS resources may come from the same TRP.

FIG. **6** is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure. As shown in FIG. **6**, a node **600** may include a transceiver **620**, a processor **628**, a memory **634**, one or more presentation components **638**, and at least one antenna **636**. The node **600** may also include an RF spectrum band module, a BS communications module, a network communications module, and a system communications management module, Input/Output (I/O) ports, I/O components, and power supply (not explicitly shown in FIG. **6**). Each of these components may be in communication with each other, directly or indirectly, over one or more buses **640**. In one implementation, the node **600** may be a UE or a BS that performs various functions described herein, for example, with reference to FIGS. **1** through **5**.

The transceiver **620** having a transmitter **622** (e.g., transmitting/transmission circuitry) and a receiver **624** (e.g., receiving/reception circuitry) may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, the transceiver **620** may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. The transceiver **620** may be configured to receive data and control channels.

The node **600** may include a variety of computer-readable media. Computer-readable media may be any available media that may be accessed by the node **600** and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or data.

Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, Digital Versatile Disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

The memory **634** may include computer-storage media in the form of volatile and/or non-volatile memory. The memory **634** may be removable, non-removable, or a combination thereof. Example memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in FIG. **6**, The memory **634** may store computer-readable, computer-executable instructions **632** (e.g., software codes) that are configured to, when executed, cause the processor **628** to perform various functions described herein, for example, with reference to FIGS. **1** through **5**. Alternatively, the instructions **632** may not be directly executable by the processor **628** but be configured to cause the node **600** (e.g., when compiled and executed) to perform various functions described herein.

The processor **628** (e.g., having processing circuitry) may include an intelligent hardware device, e.g., a Central Processing Unit (CPU), a microcontroller, an ASIC, and etc. The processor **628** may include memory. The processor **628** may process the data **630** and the instructions **632** received from the memory **634**, and information through the transceiver **620**, the base band communications module, and/or the network communications module. The processor **628** may also process information to be sent to the transceiver **620** for transmission through the antenna **636**, to the network communications module for transmission to a core network.

One or more presentation components **638** presents data indications to a person or other device. Examples of presentation components **638** may include a display device, speaker, printing component, vibrating component, etc.

From the above description, it is manifested that various techniques may be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes may be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

What is claimed is:

1. A user equipment (UE) comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

receive, in a Physical Download Control Channel (PDCCH), Transmission Configuration Indicator (TCI) state data for determining a plurality of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups; and

obtain a plurality of Quasi Co-Location (QCL) assumptions for receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data, wherein:

each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups,

the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets, and

each of the plurality of QCL RS sets corresponds to one of the plurality of DMRS port groups.

2. The UE of claim **1**, wherein the at least one processor is further configured to execute the computer-executable instructions to:

identify a plurality of Transmit/Receive Points (TRPs) based on the plurality of QCL assumptions.

3. The UE of claim **1**, wherein the at least one processor is further configured to execute the computer-executable instructions to:

receive an instruction for indicating a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups via Medium Access Control (MAC) Control Element (CE) signaling.

4. The UE of claim **1**, wherein the at least one processor is further configured to execute the computer-executable instructions to:

indicate a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups when a timer configured for the UE expires.

5. The UE of claim **1**, wherein the at least one processor is further configured to execute the computer-executable instructions to:

receive the plurality of DMRS port groups via Radio Resource Control (RRC) signaling, wherein the plurality of DMRS port groups is associated with the plurality of PDSCHs.

6. The UE of claim **1**, wherein each of the plurality of QCL assumptions includes at least one of a time-domain QCL parameter, a frequency-domain QCL parameter, and a spatial-domain QCL parameter.

7. A method of wireless communications by a user equipment (UE), the method comprising:

receiving, in a Physical Download Control Channel (PDCCH) Transmission Configuration Indicator (TCI) state data for determining a plurality of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups; and

obtaining a plurality of Quasi Co-Location (QCL) assumptions for receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data, wherein:

each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups,

the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets, and

each of the plurality of QCL RS sets corresponds to one of the plurality of DMRS port groups.

8. The method of claim **7**, further comprising:

identifying a plurality of Transmit/Receive Points (TRPs) based on the plurality of QCL assumptions.

9. The method of claim **7**, further comprising:

receiving an instruction for indicating a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups via Medium Access Control (MAC) Control Element (CE) signaling.

10. The method of claim **7**, further comprising:

indicating a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups when a timer configured for the UE expires.

11. The method of claim **7**, further comprising:

receiving the plurality of DMRS port groups via Radio Resource Control (RRC) signaling, wherein the plurality of DMRS port groups is associated with the plurality of PDSCHs.

12. The method of claim **7**, wherein each of the plurality of QCL assumptions includes at least one of a time-domain QCL parameter, a frequency-domain QCL parameter, and a spatial-domain QCL parameter.

* * * * *

EXHIBIT 5

U.S. Patent No. 10,743,238 ("'238 Patent")

Defendant's Accused Products, including those which comply with 3GPP Standard TS 38.311 V15.15.0, 3GPP Standard TS 38.331 V16.6.0, 3GPP Standard TS 38.212 V.16.7, 3GPP Standard TS 38.213 V.16.7, and 3GPP Standard TS 38.214 V.16.7, infringe at least claim of the '238 patent as set forth below, which Plaintiff provides without the benefit of information about the Accused Products obtained through discovery.

Claim 1

Claim 1	Accused Products
Element a A method for a user equipment (UE) of a connected state, the method comprising:	
Element b receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period;	**TS 38.331 V15.15.0 (2021-09)** **Section 5.2.2.2.2 SI change indication and PWS notification** A modification period is used, i.e. updated SI (other than for ETWS and CMAS) is broadcasted in the modification period following the one where SI change indication is transmitted. The modification period boundaries are defined by SFN values for which SFN mod m = 0, where m is th number of radio frames comprising the modification period. The modification period is configured by system information. The UE receives indications about SI modifications and/or PWS notifications using Short Message transmitted with P-RNTI over DCI (see clause 6.5). Repetitions of SI change indication may occur within preceding modification period. For Short Message reception in a paging occasion, the UE monitors the PDCCH monitoring occasion(s) for paging as specified in TS 38.304 [20] and TS 38.213 [13]. If the UE receives a Short Message, the UE shall: 1> if the UE is ETWS capable or CMAS capable, the *etwsAndCmasIndication* bit of Short Message is set, and the UE is provided with *searchSpaceOtherSystemInformation* on the active BWP or the initial BWP: 2> immediately re-acquire the *SIB1*; 2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB6*: 3> acquire *SIB6*, as specified in sub-clause 5.2.2.3.2,

Claim 1	Accused Products
	immediately; 2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB7*: 3> acquire *SIB7*, as specified in sub-clause 5.2.2.3.2, immediately; 2> if the UE is CMAS capable and *si-SchedulingInfo* includes scheduling information for *SIB8*: 3> acquire *SIB8*, as specified in sub-clause 5.2.2.3.2, immediately; NOTE: In case *SIB6*, *SIB7*, or *SIB8* overlap with a measurement gap it is left to UE implementation how to immediately acquire *SIB6*, *SIB7*, or *SIB8*. 1> if the *systemInfoModification* bit of Short Message is set: 2> apply the SI acquisition procedure as defined in sub-clause 5.2.2.3 from the start of the next modification period.
Element c in response to receiving the SI change indication, switching from the currently active BWP to an initial active BWP for an SI update;	**TS 38.331 (V15.15.0)** **Section 5.2.2.3 Acquisition of System Information** 5.2.2.3.1 Acquisition of *MIB* and *SIB1* The UE shall: 1> apply the specified BCCH configuration defined in 9.1.1.1; 1> if the UE is in RRC_IDLE or in RRC_INACTIVE; or 1> if the UE is in RRC_CONNECTED while T311 is running: 2> acquire the *MIB*, which is scheduled as specified in TS 38.213 [13]; 2> if the UE is unable to acquire the *MIB*; 3> perform the actions as specified in clause 5.2.2.5; 2> else: 3> perform the actions specified in clause 5.2.2.4.1. 1> if the UE is in RRC_CONNECTED with an active BWP with common search space configured by *searchSpaceSIB1* and *pagingSearchSpace* and has received an indication about change of system information; or 1> if the UE is in RRC_IDLE or in RRC_INACTIVE; or 1> if the UE is in RRC_CONNECTED while T311 is running: 2> if *ssb-SubcarrierOffset* indicates *SIB1* is transmitted in the cell (TS 38.213

Claim 1	Accused Products
	[13]) and if *SIB1* acquisition is required for the UE: 3> acquire the *SIB1*, which is scheduled as specified in TS 38.213 [13]; 3> if the UE is unable to acquire the *SIB1*: 4> perform the actions as specified in clause 5.2.2.5; 3> else: 4> upon acquiring *SIB1*, perform the actions specified in clause 5.2.2.4.2. 2> else if *SIB1* acquisition is required for the UE and *ssb-SubcarrierOffset* indicates that *SIB1* is not scheduled in the cell: 3> perform the actions as specified in clause 5.2.2.5. NOTE: The UE in RRC_CONNECTED is only required to acquire broadcasted *SIB1* if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located. **Section 5.2.2.4.2 Actions upon reception of the *SIB1*** Upon receiving the *SIB1* the UE shall: ……. 4> if the UE has not stored a valid version of a SIB, in accordance with sub- clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub- clause 5.2.2.1: 5> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to broadcasting: 6> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2; – ***PDCCH-ConfigCommon*** The IE *PDCCH-ConfigCommon* is used to configure cell specific PDCCH parameters provided in SIB as well as in dedicated signalling. ***PDCCH-ConfigCommon* information element** -- ASN1START -- TAG-PDCCH-CONFIGCOMMON-START PDCCH-ConfigCommon ::= SEQUENCE { controlResourceSetZero ControlResourceSetZero

Claim 1	Accused Products
	OPTIONAL, -- Cond InitialBWP-Only commonControlResourceSet ControlResourceSet OPTIONAL, -- Need R searchSpaceZero SearchSpaceZero OPTIONAL, -- Cond InitialBWP-Only commonSearchSpaceList SEQUENCE (SIZE(1..4)) OF SearchSpace OPTIONAL, -- Need R searchSpaceSIB1 SearchSpaceId OPTIONAL, -- Need S searchSpaceOtherSystemInformation SearchSpaceId OPTIONAL, -- Need S pagingSearchSpace SearchSpaceId OPTIONAL, -- Need S ra-SearchSpace SearchSpaceId OPTIONAL, -- Need S ..., [[firstPDCCH-MonitoringOccasionOfPO CHOICE { sCS15KHZoneT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139), sCS30KHZoneT-SCS15KHZhalfT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279), sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559), sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119), sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239), sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),

Claim 1	Accused Products
	sCS120KHZoneEighthT-SCS60KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959), sCS120KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919) } OPTIONAL -- Cond OtherBWP]] } -- TAG-PDCCH-CONFIGCOMMON-STOP -- ASN1STOP ***searchSpaceSIB1*** ID of the search space for *SIB1* message. In the initial DL BWP of the UE's PCell, the network sets this field to 0. If the field is absent, the UE does not receive *SIB1* in this BWP. (see TS 38.213 [13], clause 10)
Element d receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period wherein the RMSI includes information associated with changed system information blocks (SIBs);	**TS 38.331 (V15.15.0)** **Section 5.2.2.2.2 SI change indication and PWS notification** A modification period is used, i.e. updated SI (other than for ETWS and CMAS) is broadcasted in the modification period following the one where SI change indication is transmitted. The modification period boundaries are defined by SFN values for which SFN mod m = 0, where m is th number of radio frames comprising the modification period. The modification period is configured by system information. The UE receives indications about SI modifications and/or PWS notifications using Short Message transmitted with P-RNTI over DCI (see clause 6.5). Repetitions of SI change indication may occur within preceding modification period. **Section 5.2.2.3.1 Acquisition of *MIB* and *SIB1*** The UE shall: 1> apply the specified BCCH configuration defined in 9.1.1.1; 1> if the UE is in RRC_IDLE or in RRC_INACTIVE; or 1> if the UE is in RRC_CONNECTED while T311 is running:

Claim 1	Accused Products
	2> acquire the *MIB*, which is scheduled as specified in TS 38.213 [13]; 2> if the UE is unable to acquire the *MIB*; 3> perform the actions as specified in clause 5.2.2.5; 2> else: 3> perform the actions specified in clause 5.2.2.4.1. 1> if the UE is in RRC_CONNECTED with an active BWP with common search space configured by *searchSpaceSIB1* and *pagingSearchSpace* and has received an indication about change of system information; or 1> if the UE is in RRC_IDLE or in RRC_INACTIVE; or 1> if the UE is in RRC_CONNECTED while T311 is running: 2> if *ssb-SubcarrierOffset* indicates *SIB1* is transmitted in the cell (TS 38.213 [13]) and if *SIB1* acquisition is required for the UE: 3> acquire the *SIB1*, which is scheduled as specified in TS 38.213 [13]; 3> if the UE is unable to acquire the *SIB1*: 4> perform the actions as specified in clause 5.2.2.5; 3> else: 4> upon acquiring *SIB1*, perform the actions specified in clause 5.2.2.4.2. 2> else if *SIB1* acquisition is required for the UE and *ssb-SubcarrierOffset* indicates that *SIB1* is not scheduled in the cell: 3> perform the actions as specified in clause 5.2.2.5. NOTE: The UE in RRC_CONNECTED is only required to acquire broadcasted *SIB1* if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located. **Section 5.2.2.4.2 Actions upon reception of the *SIB1*** Upon receiving the *SIB1* the UE shall: ……. 4> if the UE has not stored a valid version of a SIB, in accordance with sub- clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub- clause 5.2.2.1: 5> for the SI message(s) that, according to the *si-SchedulingInfo* contain at least one required SIB and for which *si-BroadcastStatus*

Claim 1	Accused Products

	is set to broadcasting:
	6> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2;
	
	SIB1
	SIB1 contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information. It also contains radio resource configuration information that is common for all UEs and barring information applied to the unified access control.
	Signalling radio bearer: N/A
	RLC-SAP: TM
	Logical channels: BCCH
	Direction: Network to UE
	SIB1 message
	-- ASN1START
	-- TAG-SIB1-START
	
	SIB1 ::= SEQUENCE {
	cellSelectionInfo SEQUENCE {
	q-RxLevMin Q-RxLevMin,
	q-RxLevMinOffset INTEGER (1..8)
	OPTIONAL, -- Need S
	q-RxLevMinSUL Q-RxLevMin
	OPTIONAL, -- Need R
	q-QualMin Q-QualMin
	OPTIONAL, -- Need S
	q-QualMinOffset INTEGER (1..8)
	OPTIONAL -- Need S
	}
	OPTIONAL, -- Cond Standalone
	cellAccessRelatedInfo CellAccessRelatedInfo,
	connEstFailureControl ConnEstFailureControl

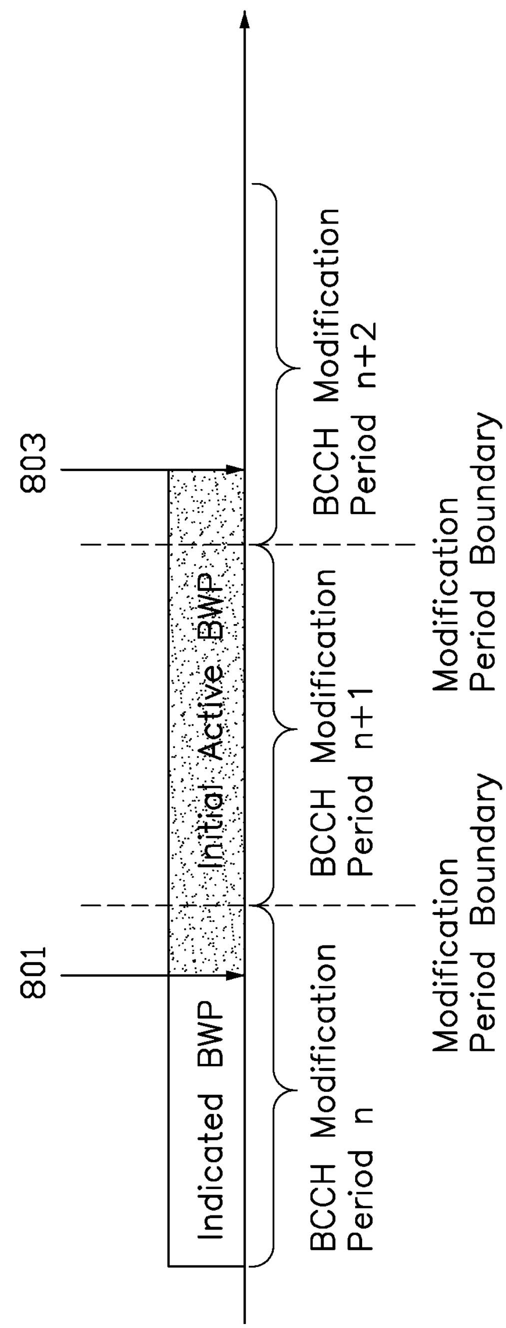
803
801
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 8

Claim 1	Accused Products

	OPTIONAL, -- Need R
	
	OPTIONAL, -- Need R
	servingCellConfigCommon ServingCellConfigCommonSIB
	OPTIONAL, -- Need R
	ims-EmergencySupport ENUMERATED {true}
	OPTIONAL, -- Need R
	eCallOverIMS-Support ENUMERATED {true}
	OPTIONAL, -- Cond Absent
	ue-TimersAndConstants UE-TimersAndConstants
	OPTIONAL, -- Need R
	
	uac-BarringInfo SEQUENCE {
	uac-BarringForCommon UAC-BarringPerCatList
	OPTIONAL, -- Need S
	uac-BarringPerPLMN-List UAC-BarringPerPLMN-List
	OPTIONAL, -- Need S
	uac-BarringInfoSetList UAC-BarringInfoSetList, uac-AccessCategory1-SelectionAssistanceInfo CHOICE {
	plmnCommon UAC-AccessCategory1-SelectionAssistanceInfo,
	individualPLMNList SEQUENCE (SIZE (2..maxPLMN)) OF UAC-AccessCategory1-SelectionAssistanceInfo
	}
	OPTIONAL -- Need S
	}
	OPTIONAL, -- Need R
	
	useFullResumeID ENUMERATED {true}
	OPTIONAL, -- Need R
	
	lateNonCriticalExtension OCTET STRING

Claim 1	Accused Products

	OPTIONAL,
	    nonCriticalExtension SEQUENCE{}
	OPTIONAL
	}
	
	SI-SchedulingInfo
	The IE *SI-SchedulingInfo* contains information needed for acquisition of SI messages.
	***SI-SchedulingInfo* information element**
	-- ASN1START
	-- TAG-SI-SCHEDULINGINFO-START
	
	SI-SchedulingInfo ::= SEQUENCE {
	    schedulingInfoList SEQUENCE (SIZE (1..maxSI-Message)) OF
	SchedulingInfo,
	    si-WindowLength ENUMERATED {s5, s10, s20, s40, s80, s160,
	s320, s640, s1280},
	    si-RequestConfig SI-RequestConfig
	OPTIONAL, -- Cond MSG-1
	    si-RequestConfigSUL SI-RequestConfig
	OPTIONAL, -- Cond SUL-MSG-1
	    systemInformationAreaID BIT STRING (SIZE (24))
	OPTIONAL, -- Need R
	    ...
	}
	SchedulingInfo ::= SEQUENCE {
	    si-BroadcastStatus ENUMERATED {broadcasting,
	notBroadcasting},
	    si-Periodicity ENUMERATED {rf8, rf16, rf32, rf64, rf128,
	rf256, rf512},
	    sib-MappingInfo SIB-Mapping
	}

Claim 1	Accused Products

	SIB-Mapping ::= SEQUENCE (SIZE (1..maxSIB)) OF SIB-TypeInfo
	SIB-TypeInfo ::= SEQUENCE {
	type ENUMERATED {sibType2, sibType3, sibType4, sibType5, sibType6, sibType7, sibType8, sibType9,
	spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1,... },
	valueTag INTEGER (0..31) OPTIONAL, -- Cond SIB-TYPE
	areaScope ENUMERATED {true} OPTIONAL -- Need S
	}
	-- Configuration for Msg1 based SI Request
	SI-RequestConfig ::= SEQUENCE {
	rach-OccasionsSI SEQUENCE {
	rach-ConfigSI RACH-ConfigGeneric,
	ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}
	} OPTIONAL, -- Need R
	si-RequestPeriod ENUMERATED {one, two, four, six, eight, ten, twelve, sixteen} OPTIONAL, -- Need R
	si-RequestResources SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources
	}
	SI-RequestResources ::= SEQUENCE {
	ra-PreambleStartIndex INTEGER (0..63),
	ra-AssociationPeriodIndex INTEGER (0..15) OPTIONAL, -- Need R
	ra-ssb-OccasionMaskIndex INTEGER (0..15) OPTIONAL -- Need R
	}
	-- TAG-SI-SCHEDULINGINFO-STOP

Claim 1	Accused Products
	-- ASN1STOP
Element e determining which of the changed SIBs is required to be updated for the UE according to the received RMSI;	**TS 38.331 (V15.15.0)** **Section 5.2.2.4.2 Actions upon reception of the *SIB1*** Upon receiving the *SIB1* the UE shall: ……. 4> if the UE has not stored a valid version of a SIB, in accordance with sub- clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub- clause 5.2.2.1: 5> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to broadcasting: 6> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2; 5.2.2.2.1 SIB validity The UE shall apply the SI acquisition procedure as defined in clause 5.2.2.3 upon cell selection (e.g. upon power on), cell-reselection, return from out of coverage, after reconfiguration with sync completion, after entering the network from another RAT, upon receiving an indication that the system information has changed, upon receiving a PWS notification; and whenever the UE does not have a valid version of a stored SIB. The UE shall: 1> delete any stored version of a SIB after 3 hours from the moment it was successfully confirmed as valid; 1> for each stored version of a SIB: 2> if the *areaScope* is associated and its value for the stored version of the SIB is the same as the value received in the *si-SchedulingInfo* for that SIB from the serving cell: 3> if the first *PLMN-Identity* included in the *PLMN-IdentityInfoList*, the *systemInformationAreaID* and the *valueTag* that are included in the *si-SchedulingInfo* for the SIB received from the serving cell are identical to

Claim 1	Accused Products

	the *PLMN-Identity*, the *systemInformationAreaID* and the *valueTag* associated
	with the stored version of that SIB:
	4> consider the stored SIB as valid for the cell;
	2> if the *areaScope* is not present for the stored version of the SIB and the *areaScope* value is not included in the *si-SchedulingInfo* for that SIB from the serving cell:
	3> if the first *PLMN-Identity* in the *PLMN-IdentityInfoList,* the *cellIdentity* and
	valueTag that are included in the *si-SchedulingInfo* for the SIB received from the serving cell are identical to the *PLMN-Identity,* the *cellIdentity* and the *valueTag* associated with the stored version of that SIB:
	4> consider the stored SIB as valid for the cell;
	
	SI-SchedulingInfo
	The IE *SI-SchedulingInfo* contains information needed for acquisition of SI messages.
	***SI-SchedulingInfo* information element**
	-- ASN1START
	-- TAG-SI-SCHEDULINGINFO-START
	SI-SchedulingInfo ::= SEQUENCE {
	schedulingInfoList SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo,
	si-WindowLength ENUMERATED {s5, s10, s20, s40, s80, s160, s320, s640, s1280},
	si-RequestConfig SI-RequestConfig OPTIONAL, -- Cond MSG-1
	si-RequestConfigSUL SI-RequestConfig OPTIONAL, -- Cond SUL-MSG-1
	systemInformationAreaID BIT STRING (SIZE (24)) OPTIONAL, -- Need R
	...
	}

Claim 1	Accused Products

	SchedulingInfo ::= SEQUENCE {
	si-BroadcastStatus ENUMERATED {broadcasting, notBroadcasting},
	si-Periodicity ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},
	sib-MappingInfo SIB-Mapping
	}
	SIB-Mapping ::= SEQUENCE (SIZE (1..maxSIB)) OF SIB-TypeInfo
	SIB-TypeInfo ::= SEQUENCE {
	type ENUMERATED {sibType2, sibType3, sibType4, sibType5, sibType6, sibType7, sibType8, sibType9,
	spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1,... },
	valueTag INTEGER (0..31) OPTIONAL, -- Cond SIB-TYPE
	areaScope ENUMERATED {true} OPTIONAL -- Need S
	}
	-- Configuration for Msg1 based SI Request
	SI-RequestConfig ::= SEQUENCE {
	rach-OccasionsSI SEQUENCE {
	rach-ConfigSI RACH-ConfigGeneric,
	ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}
	}
	OPTIONAL, -- Need R
	si-RequestPeriod ENUMERATED {one, two, four, six, eight, ten, twelve, sixteen} OPTIONAL, -- Need R
	si-RequestResources SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources
	}
	SI-RequestResources ::= SEQUENCE {

Claim 1	Accused Products
	ra-PreambleStartIndex INTEGER (0..63), ra-AssociationPeriodIndex INTEGER (0..15) OPTIONAL, -- Need R ra-ssb-OccasionMaskIndex INTEGER (0..15) OPTIONAL -- Need R } -- TAG-SI-SCHEDULINGINFO-STOP -- ASN1STOP
Element f and receiving content of the required changed SIBs based on the determination.	**TS 38.331 (V15.15.0)** **Section 5.2.2.4.2 Actions upon reception of the *SIB1*** Upon receiving the *SIB1* the UE shall: .... 4> if the UE has not stored a valid version of a SIB, in accordance with sub- clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub- clause 5.2.2.1: 5> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to broadcasting: 6> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2;

EXHIBIT 6

U.S. Patent No. 10,791,502 ("'502 Patent")

Defendant's Accused Products, including those which comply with 3GPP Standard TS 38.311 V15.15.0, 3GPP Standard TS 38.331 V16.6.0, 3GPP Standard TS 38.212 V.16.7, 3GPP Standard TS 38.213 V.16.7, and 3GPP Standard TS 38.214 V.16.7, infringe at least claim of the '502 patent as set forth below, which Plaintiff provides without the benefit of information about the Accused Products obtained through discovery.

Claim 1

Claim 1	Accused Products
Element a A method of an on-demand system information (SI) request procedure performed by a user equipment (UE), the method comprising:	**TS 38.331 (v16.6.0)** **Section 5.2.2.3.5** Request for on demand system information **in RRC_CONNECTED** The UE shall: 1> if the UE is in RRC_CONNECTED with an active BWP not configured with common search space with the field *searchSpaceOtherSystemInformation* and the UE has not stored a valid version of a SIB, in accordance with sub-clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub-clause 5.2.2.1 or if requested by upper layers: 2> for the SI message(s) that, according to the *si-SchedulingInfo* or *posSI-SchedulingInfo* in the stored SIB1, contain at least one required SIB or requested posSIB: 3> if *onDemandSIB-Request* is configured and timer T350 is not running: 4> initiate transmission of the DedicatedSIBRequest message in accordance with 5.2.2.3.6; 4> start timer T350 with the timer value set to the *onDemandSIB-RequestProhibitTimer*; 1> else if the UE is in RRC_CONNECTED with an active BWP configured with common search space with the field *searchSpaceOtherSystemInformation* and the UE has not stored a valid version of a SIB, in accordance with sub-clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub-clause
Element b transmitting a first SI request message to a base station (BS) after determining that the UE is in a connected state, the first SI request message including at least one requested system information block (SIB);	

Claim 1	Accused Products
	5.2.2.1 or if requested by upper layers: 2> for the SI message(s) that, according to the *si-SchedulingInfo* in the stored SIB1, contain at least one required SIB and for which *si-BroadcastStatus* is set to *broadcasting*: 3> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2; > for the SI message(s) that, according to the *si-SchedulingInfo* in the stored SIB1, contain at least one required SIB and for which *si-BroadcastStatus* is set to *notBroadcasting*: 3> if *onDemandSIB-Request* is configured and timer T350 is not running: 4> initiate transmission of the *DedicatedSIBRequest* message in accordance with 5.2.2.3.6; 4> start timer T350 with the timer value set to the *onDemandSIB-RequestProhibitTimer*; 3> acquire the requested SI message(s) corresponding to the requested SIB(s) as defined in sub-clause 5.2.2.3.2. **Section 5.2.2.3.6 Actions related to transmission of DedicatedSIBRequest message** The UE shall set the contents of *DedicatedSIBRequest* message as follows: 1> if the procedure is triggered to request the required SIB(s): 2> include *requestedSIB-List* in the *onDemandSIB-RequestList* to indicate the requested SIB(s);

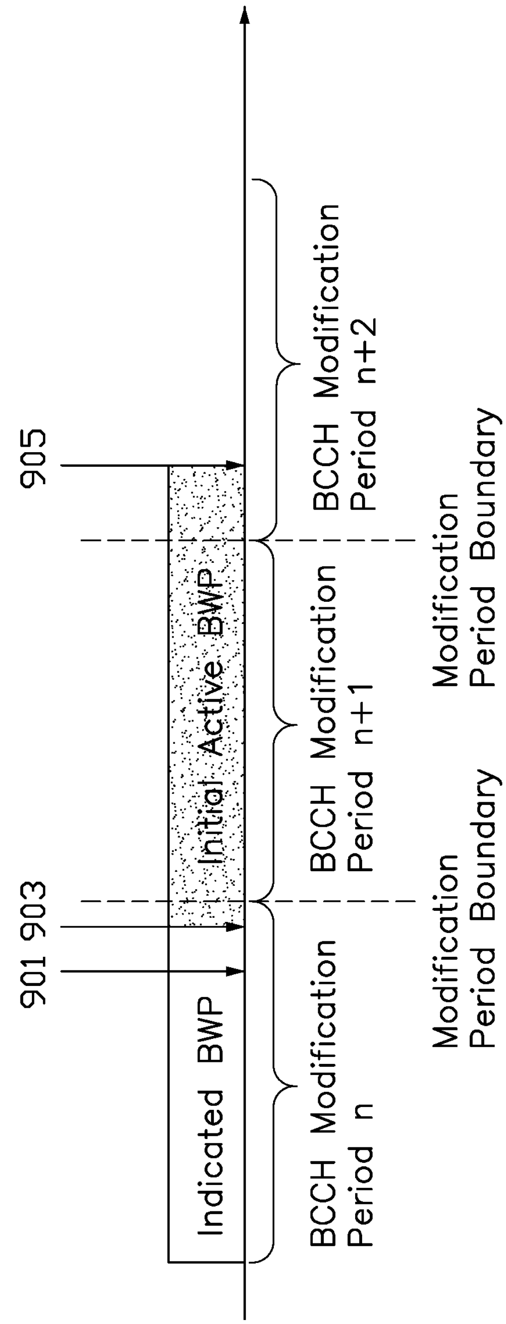
905
901
903
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 9

Claim 1	Accused Products

	1> if the procedure is triggered to request the required posSIB(s):
	
	2> include *requestedPosSIB-List* in the *onDemandSIB-RequestList* to indicate the requested posSIB(s).
	
	Section 6.2.2 Message definitions
	– *DedicatedSIBRequest*
	
	The *DedicatedSIBRequest* message is used to request SIB(s) required by the UE in RRC_CONNECTED as specified in clause 5.2.2.3.5.
	Signalling radio bearer: SRB1 RLC-SAP: AM
	
	Logical channel: DCCH
	
	Direction: UE to Network
	
	DedicatedSIBRequest message
	
	`-- ASN1START`
	`-- TAG-DEDICATEDSIBREQUEST-START`
	
	`DedicatedSIBRequest-r16 ::= SEQUENCE { criticalExtensions CHOICE { dedicatedSIBRequest-r16 DedicatedSIBRequest-r16-IEs, criticalExtensionsFuture SEQUENCE {} } }`
	
	`DedicatedSIBRequest-r16-IEs ::= SEQUENCE { onDemandSIB-`

Claim 1	Accused Products

	RequestList-r16 SEQUENCE {
	
	requestedSIB-List-r16 SEQUENCE (SIZE (1..maxOnDemandSIB-r16)) OF SIB-ReqInfo-r16 OPTIONAL,
	requestedPosSIB-List-r16 SEQUENCE (SIZE (1..maxOnDemandPosSIB- r16)) OF PosSIB-ReqInfo-r16
	OPTIONAL
	} OPTIONAL,
	lateNonCriticalExtension OCTET
	STRING OPTIONAL,
	nonCriticalExtension SEQUENCE {} OPTIONAL
	}
	
	SIB-ReqInfo-r16 ::= ENUMERATED { sib12, sib13, sib14, spare6, spare5, spare4, spare3, spare2, spare1 }
	
	PosSIB-ReqInfo-r16 ::= SEQUENCE {
	gnss-id-r16 GNSS-ID-r16 OPTIONAL,
	sbas-id-r16 SBAS-ID-r16 OPTIONAL,
	posSibType-r16 ENUMERATED { posSibType1-1, posSibType1-2, posSibType1-3, posSibType1-4, posSibType1-5, posSibType1-6,
	posSibType1-7, posSibType1-8, posSibType2-1, posSibType2-2, posSibType2-3, posSibType2-4,
	posSibType2-5, posSibType2-6, posSibType2-7, posSibType2-8, posSibType2-9, posSibType2-10,
	posSibType2-11, posSibType2-12, posSibType2-13, posSibType2-14, posSibType2-15,
	posSibType2-16, posSibType2-17, posSibType2-18, posSibType2-19,

Claim 1	Accused Products
	posSibType2-20, posSibType2-21, posSibType2-22, posSibType2-23, posSibType3-1, posSibType6-1, posSibType6-2, posSibType6-3,... } -- TAG-DEDICATEDSIBREQUEST-STOP -- ASN1STOP ***DedicatedSIBRequest* field descriptions** *requestedSIB-List* Contains a list of SIB(s) the UE requests while in RRC_CONNECTED. ***requestedPosSIB-List*** Contains a list of posSIB(s) the UE requests while in RRC_CONNECTED.
Element c activating a prohibit timer; and transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires.	**TS 38.331 (v16.6.0)** **Section 5.2.2.3.5 Request for on demand system information in RRC_CONNECTED** The UE shall: 1> if the UE is in RRC_CONNECTED with an active BWP not configured with common search space with the field *searchSpaceOtherSystemInformation* and the UE has not stored a valid version of a SIB, in accordance with sub-clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub-clause 5.2.2.1 or if requested by upper layers: 2> for the SI message(s) that, according to the *si-SchedulingInfo* or *posSI-SchedulingInfo* in the stored SIB1, contain at least one required SIB or requested posSIB: 3> if *onDemandSIB-Request* is configured and timer T350 is not running:

Claim 1	Accused Products
	4> initiate transmission of the DedicatedSIBRequest message in accordance with 5.2.2.3.6; 4> start timer T350 with the timer value set to the *onDemandSIB-RequestProhibitTimer*; 1> else if the UE is in RRC_CONNECTED with an active BWP configured with common search space with the field *searchSpaceOtherSystemInformation* and the UE has not stored a valid version of a SIB, in accordance with sub-clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub-clause 5.2.2.1 or if requested by upper layers: 2> for the SI message(s) that, according to the *si-SchedulingInfo* in the stored SIB1, contain at least one required SIB and for which *si-BroadcastStatus* is set to *broadcasting*: 3> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2; 2> for the SI message(s) that, according to the *si-SchedulingInfo* in the stored SIB1, contain at least one required SIB and for which *si-BroadcastStatus* is set to *notBroadcasting*: 3> if *onDemandSIB-Request* is configured and timer T350 is not running: 4> initiate transmission of the *DedicatedSIBRequest* message in accordance with 5.2.2.3.6; 4> start timer T350 with the timer value set to the *onDemandSIB-RequestProhibitTimer*; 3> acquire the requested SI message(s) corresponding to the requested SIB(s) as defined in sub-clause 5.2.2.3.2.

Exhibit 7

U.S. Patent No. 10,972,972 ("'972 Patent")

Defendant's Accused Products, including those which comply with 3GPP Standard TS 38.311 V15.15.0, 3GPP Standard TS 38.331 V16.6.0, 3GPP Standard TS 38.212 V.16.7, 3GPP Standard TS 38.213 V.16.7, and 3GPP Standard TS 38.214 V.16.7, infringe at least claim of the '972 patent as set forth below, which Plaintiff provides without the benefit of information about the Accused Products obtained through discovery.

Claim 1

Claim 1	Accused Products
Element a A wireless communication device comprising: a plurality of antenna panels; a processor coupled to the plurality of antenna panels and configured to:	Each of the Accused Products are wireless communication devices comprising a plurality of antenna panels and a processor coupled to the plurality of antenna panels.
Element b maintain a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations; receive an indicator for antenna panel status information from a base station (BS);	**TS 38.214 (v16.7)** **Section 5.3.1 Application delay of the minimum scheduling offset restriction** When the UE is scheduled with DCI format 0_1 or 1_1 with a '*Minimum applicable scheduling offset indicator*' field in slot *n*, it shall determine the $K0_{min}$ and $K2_{min}$ values, if configured respectively, to be applied, while the previously applied $K0_{min}$ and/or $K2_{min}$ values are applied until the new values take effect. If the DCI in slot *n* also indicates an active DL (UL) BWP change for a serving cell, the indicated $K0_{min}$ ($K2_{min}$) value in the new active DL (UL) BWP, if configured, is applied from the slot indicated by the slot offset value of the time domain resource assignment field in the DCI. Otherwise, change of applied minimum scheduling offset restriction indication carried by DCI in slot *n*, shall be applied in slot $n+X$ of the scheduling cell. The UE does not expect to be scheduled with DCI format 0_1 or 1_1 with '*Minimum applicable scheduling offset indicator*' field indicating another change to $K0_{min}$ or $K2_{min}$ for the same active BWP of the scheduled cell before slot $n+X$ of the scheduling cell. When the DCI format 0_1 or 1_1 with '*Minimum applicable scheduling offset indicator*'

Claim 1	Accused Products
	field indicating a change to the applied $K0$min or $K2$min is contained within the first three symbols of slot n, the value of application delay X is determined by, X = max ($\lceil K0$minOld · $2^{\mu PDCCH}$ / $2^{\mu PDSCH}$ $\rceil$, Z_{μ}) where K0minOld is the currently applied K0min value of the active DL BWP in the scheduled cell and is zero, if *minimumSchedulingOffsetK0* is not configured for the active DL BWP in the scheduled cell, Z_{μ} is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot n, and given in Table 5.3.1-1, and μPDCCH and μPDSCH are the sub-carrier spacing configurations for PDCCH of the active DL BWP in the scheduling cell and PDSCH of the active DL BWP in the scheduled cell, respectively, in slot n.
Element c apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information; receive a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel;	**TS 38.312 (v16.7)** **Section 7.3.1.1.2 Format 0_1** Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs $n_{BWP,RRC}$ configured by higher layers, excluding the initial UL bandwidth part. The bitwidth for this field is determined as $\lceil \log_2(n_{BWP}) \rceil$ bits, where - $n_{BWP} = n_{BWP,RRC} + 1$ if $n_{BWP,RRC} \leq 3$, in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*; - otherwise $n_{BWP} = n_{BWP,RRC}$, in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1; Minimum applicable scheduling offset indicator – 0 or 1 bit - 0 bit if higher layer parameter *minimumSchedulingOffsetK2* is not configured;

Claim 1	Accused Products
	1 bit if higher layer parameter *minimumSchedulingOffsetK2* is configured. The 1 bit indication is used to determine the minimum applicable K2 for the active UL BWP and the minimum applicable K0 value for the active DL BWP, if configured respectively, according to Table 7.3.1.1.2-33. If the minimum applicable K0 is indicated, the minimum applicable value of the aperiodic CSI-RS triggering offset for an active DL BWP shall be the same as the minimum applicable K0 value. **TS 38.331 (v16.6)** **PDSCH-Config** The PDSCH-Config IE is used to configure the UE specific PDSCH parameters. minimumSchedulingOffsetK0-r16 SetupRelease { MinSchedulingOffsetK0-Values-r16 } OPTIONAL, --Need M minimumSchedulingOffsetK0 List of minimum K0 values.Minimum K0 parameter denotes minimum applicable value(s) for the TDRA table for PDSCH and for A-CSI RS triggering Offset(s) (see TS 38.214 [19], clause 5.3.1). **PUSCH-Config** The IE PUSCH-Config is used to configure the UE specific PUSCH parameters applicable to a particular BWP. ... minimumSchedulingOffsetK2-r16 SetupRelease { MinSchedulingOffsetK2-

Claim 1	Accused Products
	Values-r16 } OPTIONAL, --NeedM minimumSchedulingOffsetK2 List of minimum K2 values.Minimum K2 parameter denotes minimum applicable value(s) for the Time domain resource assignment table for PUSCH (see TS 38.214 [19], clause 6.1.2.1).
Element d and determine that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than a leading time duration indicated by the applied leading time value.	**TS 38.214 (v16.7)** **Section 5.1.2.1 Resource allocation in time domain** When the UE is configured with *minimumSchedulingOffsetK0* in an active DL BWP it applies a minimum scheduling offset restriction indicated by the 'Minimum applicable scheduling offset indicator' field in DCI format 1_1 or DCI format 0_1 if the same field is available. When the UE is configured with *minimumSchedulingOffsetK0* in an active DL BWP and it has not received 'Minimum applicable scheduling offset indicator' field in DCI format 0_1 or 1_1, the UE shall apply a minimum scheduling offset restriction indicated based on 'Minimum applicable scheduling offset indicator' value '0'. When the minimum scheduling offset restriction is applied the UE is not expected to be scheduled with a DCI in slot *n* to receive a PDSCH scheduled with C-RNTI, CS-RNTI or MCS-C-RNTI with K_0 smaller than $\lceil K0_{min} \cdot \frac{2^{\mu'}}{2^{\mu}} \rceil$, where $K0_{min}$ and μ are the applied minimum scheduling offset restriction and the numerology of the active DL BWP of the scheduled cell when receiving the DCI in slot *n*, respectively, and μ' is the numerology of the new active DL BWP in case of active DL BWP change in the scheduled cell and is equal to μ, otherwise.

Exhibit 8

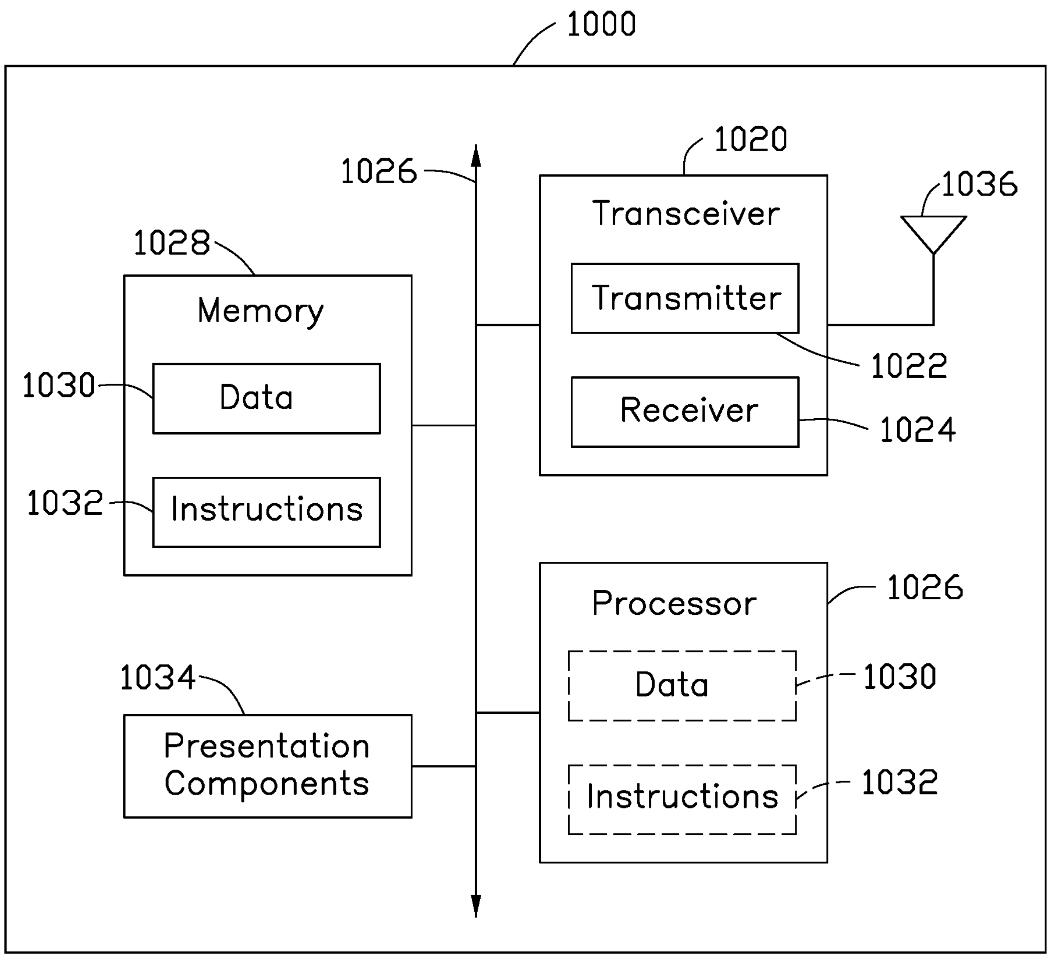
1000
1026
1020
Transceiver
1036
1028
Memory
Transmitter
1030
Data
1022
Receiver
1024
1032
Instructions
Processor
1026
1034
Data
1030
Presentation Components
Instructions
1032

FIG. 10

U.S. Patent No. 11,115,165 ("'165 Patent")

Defendant's Accused Products, including those which comply with 3GPP Standard TS 38.311 V15.15.0, 3GPP Standard TS 38.331 V16.6.0, 3GPP Standard TS 38.212 V.16.7, 3GPP Standard TS 38.213 V.16.7, and 3GPP Standard TS 38.214 V.16.7, infringe at least claim of the '165 patent as set forth below, which Plaintiff provides without the benefit of information about the Accused Products obtained through discovery.

Claim 1

Claim 1	Accused Products
Element a A user equipment (UE) comprising: one or more non- transitory computer-readable media having computer-executable instructions embodied thereon; and at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:	The Accused Products include a user equipment (UE) comprising one or more non-transitory computer-readable media having computer- executable instructions embodied thereon; and at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions.
Element b receive, in a Physical Download Control Channel (PDCCH), Transmission Configuration Indicator (TCI) state data for determining a plurality of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups;	**TS 38.212 (v16.7)** **Section 7.3.1.2.2 Format 1_1** DCI format 1_1 is used for the scheduling of PDSCH in one cell. - Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4 and Tables 7.3.1.2.2- 1A/2A/3A/4A, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports {p0,...,pv−1} shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4 or Tables 7.3.1.2.2-1A/2A/3A/4A. When a UE receives an activation command that maps at least one codepoint of DCI field 'Transmission Configuration Indication' to two TCI states, the UE shall use Table 7.3.1.2.2-1A/2A/3A/4A; otherwise, it

Claim 1	Accused Products
	shall use Tables 7.3.1.2.2-1/2/3/4. The UE can receive an entry with DMRS ports equals to 1000, 1002, 1003 when two TCI states are indicated in a codepoint of DCI field 'Transmission Configuration Indication'. **TS 38.214 (v16.7)** **Section 5.1.5 Antenna ports quasi co-location** When a UE supports two TCI states in a codepoint of the DCI field 'Transmission Configuration Indication' the UE may receive an activation command, as described in clause 6.1.3.24 of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field 'Transmission Configuration Indication'. The UE is not expected to receive more than 8 TCI states in the activation command.
Element c and obtain a plurality of Quasi Co-Location (QCL) assumptions for receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data,	**TS 38.213 (v16.7)** **Section 5 Radio link monitoring** if the active TCI state for PDCCH reception includes two RS, the UE expects that one RS is configured with qcl-Typeset to 'typeD' [6, TS 38.214] and the UE uses the RS configured with qcl-Typeset to 'typeD' for radio link monitoring; the UE does not expect both RS to be configured with qcl-Type set to 'typeD' **TS 38.214 (v16.7)** **Section 5.1.5 Antenna ports quasi co-location** The UE can be configured with a list of up to M TCI-State configurations within the higher layer parameter PDSCHConfig to decode PDSCH according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M depends on the UE capability maxNumberConfiguredTCIstates PerCC. Each TCI-State contains parameters for configuring a quasi co-location relationship

Claim 1	Accused Products
	between one or two downlink reference signals and the DM-RS ports of the PDSCH, the DM-RS port of PDCCH or the CSI-RS port(s) of a CSI-RS resource. The quasi co-location relationship is configured by the higher layer parameter qcl-Type1 for the first DL RS, and qcl-Type2 for the second DL RS (if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter qcl-Type in QCL-Info and may take one of the following values: - 'typeA': {Doppler shift, Doppler spread, average delay, delay spread} - 'typeB': {Doppler shift, Doppler spread} - 'typeC':{Doppler shift, average delay} - 'typeD': {Spatial Rx parameter}
Element d wherein: each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups, the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets, and each of the plurality of QCL RS sets corresponds to one of the plurality of DMRS port groups	**TS 38.214 (v16.7)** **Section 5.1.5 Antenna ports quasi co-location** The UE can be configured with a list of up to M TCI-State configurations within the higher layer parameter PDSCHConfig to decode PDSCH according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M depends on the UE capability maxNumberConfiguredTCIstates PerCC. Each TCI-State contains parameters for configuring a quasi co-location relationship between one or two downlink reference signals and the DM-RS ports of the PDSCH, the DM-RS port of PDCCH or the CSI-RS port(s) of a CSI-RS resource. The quasi co-location relationship is configured by the higher layer parameter qcl-Type1 for the first DL RS, and qcl-Type2 for the second DL RS (if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter qcl-Type in QCL-Info and may take one of the following values: - 'typeA': {Doppler shift, Doppler spread, average delay, delay spread} - 'typeB': {Doppler shift, Doppler spread} - 'typeC': {Doppler shift, average delay} - 'typeD': {Spatial Rx parameter}

Claim 1	Accused Products

	TS 38.331 (v16.6)
	
	TCI-State
	
	The IE TCI-State associates one or two DL reference signals with a corresponding quasi- colocation (QCL) type. TCI-State information element
	
	TCI-State ::= SEQUENCE {
	tci-StateId TCI-StateId, qcl-Type1 QCL-Info,
	qcl-Type2 QCL-Info OPTIONAL, -- Need R
	
	...
	
	}
	
	QCL-Info ::= SEQUENCE {
	
	cell ServCellIndex OPTIONAL, -- Need R
	
	bwp-Id BWP-Id OPTIONAL, -- Cond CSI-RS-
	
	Indicated referenceSignal CHOICE {
	
	csi-rs NZP-CSI-RS-ResourceId,
	
	ssb SSB-Index
	
	},
	
	qcl-Type ENUMERATED {typeA, typeB, typeC, typeD},

SYSTEM INFORMATION UPDATES IN BAND WIDTH PART (BWP) SWITCH OPERATION

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of and priority to U.S. Provisional Application No. 62/586,598 filed on Nov. 15, 2017 and entitled "SYSTEM INFORMATION UPDATE IN BWP SWITCH OPERATION," (hereinafter referred to as "US72315 application"). The disclosure of the US72315 application is hereby incorporated fully by reference into the present disclosure.

TECHNICAL FIELD

The present disclosure generally relates to a method for bandwidth part switching operations performed by a user equipment and user equipment performing the same.

BACKGROUND

In a cellular network, a UE-specific serving cell may configure one or more bandwidth parts (BWPs) in downlink and uplink respectively for a UE by dedicated RRC signaling. One the other hand, a UE may be allocated to with at most one active DL BWP and one active UL BWP at a given time by the cell. A single scheduled downlink control information (DCI) may be applied to switching from one active BWP to another for an operating UE.

For a UE, an initial active DL BWP is defined as the frequency location and bandwidth dedicated for broadcasting remaining minimum SI (RMSI). When the NW sends to a Connected_UE a system information (SI) change indication that notifies of system information change, the Connected_UE may have to switch from the currently active BWP to the initial active BWP for accessing the RMSI and updating to the changed SI if there is no SI broadcasting on the currently active BWP. Furthermore, the Connected_UE may not successfully complete SI update if there is no clear UE behavior defined for BWP switching. As a result of BWP switching inability problem, the UE may not be able to update system information.

SUMMARY

The present disclosure is directed to bandwidth part (BWP) switching operations in conjunction with system information updates for a user equipment.

In one aspect of the present disclosure, a method for bandwidth part (BWP) operations performed by a user equipment (UE) of a connected state is provided. The method comprises receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period; switching from the currently active bandwidth part (BWP) for data transmission to an initial active BWP for an SI update; receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period, the RMSI including information associated with changed system information blocks (SIBs); determining which of the changed SIBs is required to be updated for the UE; and receiving content of the required changed SIBs based on the determination.

In one aspect of the present disclosure, a user equipment (UE) of a connected state is configured to receive a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period; to switch from the currently active bandwidth part (BWP) for data transmission to an initial active BWP for an SI update; to receive remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period, the RMSI including information associated with changed system information blocks (SIBs); to determine which of the changed SIBs is required to be updated for the UE; and to receive content of the required changed SIBs based on the determination.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the exemplary disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale, dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

FIG. **1** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving an SI change indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **2** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving an SI change indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **3** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving an SI change indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **4** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving an SI change indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **5** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving an SI change indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **6** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving an SI change indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **7** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving a public warning system (PWS) notification indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **8** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving a public warning system (PWS) notification indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **9** is a schematic diagram illustrating a BWP switching operation for a Connected_UE due to receiving a public warning system (PWS) notification indication in accordance with one exemplary embodiment of the present disclosure.

FIG. **10** is a block diagram of a device for wireless communication in accordance with various embodiments of the present disclosure.

DETAILED DESCRIPTION

The following description contains specific information pertaining to exemplary implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely exemplary implementations. However, the present disclosure is not limited to merely these exemplary implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale, and are not intended to correspond to actual relative dimensions.

The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent.

It is noted that the term "and/or" includes any and all combinations of one or more of the associated listed items. It will also be understood that, although the terms first, second, third etc. may be used herein to describe various elements, components, regions, parts and/or sections, these elements, components, regions, parts and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, part or section from another element, component, region, layer or section. Thus, a first element, component, region, part or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present disclosure.

It should be noted that, in the present disclosure, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, a personal digital assistant (PDA), or a television display with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

A base station may include, but is not limited to a node B (NB) as in the UMTS, an evolved node B (eNB) as in the LTE-A, a radio network controller (RNC) as in the UMTS, a base station controller (BSC) as in the GSM/GERAN, an NG-eNB as in an E-UTRA base station in connection with the 5GC, a next generation node B (gNB) as in the 5G Access Network (5G-AN), and any other apparatus capable of controlling radio communication with cellular positioning technology and managing radio resources within a cell. The base station may connect to serve the one or more UEs through a radio interface to the network.

In one embodiment of the present disclosure, a Connected_UE may implicitly switch to an initial active BWP upon receiving a system information (SI) change indication broadcasted by paging from cellular network (NW). The SI change indication indicates a SI change/modification and notifies the UE to update to the changed SI if required by the UE. This results in reduction of redundant L1 signaling for switching from a currently active BWP to the initial active BWP for the UE. In FIG. **1**, a BWP switching operation for a Connected_UE due to receiving an SI change indication is illustrated. In DL, the UE may operate on an indicated BWP as currently active DL BWP for DL data transmission (e.g., based on RRC configuration, DCI control or the behavior for BWP inactivity timer) or operate on an initial active DL BPW able to receive the content of changed SI required for the UE SI update. The UE may also have an uplink (UL) BWP for UL data transmission and an initial active UL BWP. Within n^{th} broadcast control channel modification period (denoted as BCCH modification period n), the UE may operate on the indicated BWP as the currently active BWP for data transmission according to L1 signaling.

The SI change indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE operates on the indicated BWP. Specifically, the UE receives indications about SI modifications and/or PWS notifications using Short Message transmitted with P-RNTI over downlink control information (DCI). At **101**, upon receiving the SI change indication, UE may switch immediately to the initial active BWP from the indicated BWP during BCCH modification period n. The SI change indication is used to inform the UE that there is a system information change(s) or update(s), and may be carried as part of the Short Message. Then, RRC sublayer of the NW may inform the PHY sublayer that the paging has been sent to the UE and the switching of the UE to the initial active BWP has been performed. So, the NW may stop sending to the UE any other L1 signaling (e.g., DCI) for BWP switching operations.

After switching to the initial active BWP, the UE may continue to stay on the initial active BWP until BCCH modification period n+1 ends. The BCCH modification period n+1 immediately follows the BCCH modification period n in time sequence. Although the UE has switched to the initial active BWP at certain timing (e.g., at **101**) within BCCH modification period n, it is in the next BCCH modification period n+1 that the UE performs the system information acquisition to update to changed system information. In modification period n+1, the UE may receive broadcast remaining minimum system information (RMSI) carrying information associated with changed system information blocks (SIBs) via the initial active BWP and perform the SI update(s) according to the information. The RMSI is also known as SIB1 (system information block 1). The UE may receive the RMSI at certain time point in modification period n+1 (e.g., at the start time point of the modification period n+1). After receiving the RMSI, the UE may determine which of the changed SIB(s) is (or are) required for the SI update(s) according to the received information. For example, the UE may identify one or more of the changed SIB(s) that the UE requires for the SI update(s). Then the UE may receive the content(s) of the changed SIBs which are identified as being required for the SI update(s) based on the determination. For another example, the UE may identify none of the changed SIBs is required to update and may not perform any SI update(s). The UE may not update the changed SIB(s) based on the identification within BCCH modification period n+1.

After the UE completes the SI update(s), the NW may re-take control over the BWP switching of the UE on the end of BCCH modification period n+1.

In this case, since the NW may know the UE by default will complete the SI update within modification period n+1, the PHY sublayer may re-take control over the BWP switching after BCCH modification period n+1 ends. Therefore, at **103** on the ending boundary of modification period n+1 the NW re-takes the BWP switching operations by sending L1 signaling to switch the initial active BWP to a BWP for subsequent data transmission.

In one embodiment, the currently active BWP happens to be the initial active BWP. In this case, it is not necessary that a BWP switching operation is involved for updating the SI when receiving the SI change indication. For example, the Connected UE has already been on the initial active BWP as currently active BWP because of certain on-going services in modification period n and will stay on the initial active BWP to perform system information acquisition to conduct the SI update in BCCH modification period n+1. The PHY sublayer of the NW may consider the completeness of the SI update in the next BCCH modification period n+1. Then, the PHY sublayer of the NW may re-take control over the BWP switching operation on the end of BCCH modification period n+1.

In one embodiment, the UE may be only permitted to receive the Short Message of the paging on the initial active BWP. For example, based on the paging frame and paging occasion derived from an associated UE ID and per-configured parameters, the Short Message cannot be broadcasted on other BWPs but the initial active BWP. On occasions, the UE may switch to the initial active BWP automatically to detect whether there is a Short Message and receiving the Short Message. If receiving the SI change indication carried in the Short Message, the UE may stay on the initial active BWP for the subsequent SI update without the need for additional BWP switching. If receiving no Short Message or no SI change indication carried in the Short Message, the UE may switch back to the previous active BWP without involvement of the NW. Alternatively, the UE may not switch back but stay on the initial active BWP after modification period n+1 ends, waiting for next L1 signaling from the NW (e.g., DCI) for BWP switching.

In one embodiment of the present disclosure, the Connected UE may feedback to the NW while the SI update is completed, and the NW may re-take control over the BWP switching immediately upon receiving the feedback. In FIG. **2**, a BWP switching operation for an RRC_connected UE due to receiving an SI change indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for the UE SI update. Within modification period n, the UE may operate on the indicated BWP for data transmission according to L1 signaling.

The SI change indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE may operate on the indicated BWP. At **201**, upon receiving the SI change indication, UE may switch to the initial active BWP immediately from the indicated BWP in BCCH modification period n. The SI change indication is used to inform the UE that there is SI change(s) or update(s), and may be carried as part of Short Message in the paging. Then, RRC sublayer of the NW may inform the PHY sublayer that the paging has been sent to the UE and the switching of the UE to the initial active BWP has been performed. So, the NW may stop sending to the UE any other L1 signaling for BWP switching operations, and wait for the UE feedback indicating the completeness of the SI update.

After switching to the initial active BWP, the UE may continue to stay on the initial active BWP until the update to SI is completed. At **203**, the UE completed the SI update if required and feedback to the NW that the system information update is completed by sending an SI update complete indication. Upon receiving the SI update complete indication as the UE feedback, the PHY sublayer of the NW may re-take control over the BWP switching operation immediately. Although the UE has to operate on the initial active BWP for the SI update in DL, the NW may be still able to schedule data transmission on the initial active BWP.

The UE feedback of SI update complete may be sent by L1 signaling (via PUCCH) or by MAC-CE transmission on an uplink (UL) BWP paired with the initial active DL BWP. If using L1 signaling, the upper sublayer (e.g., RRC) of the UE may inform PHY sublayer that the SI update is completed, and the UE PHY sublayer may feedback it to the NW. The NW may re-take control over the BWP switching after receiving the feedback in NW PHY sublayer. Alternatively, if using MAC-CE transmission, the upper sublayer of the UE may inform MAC sublayer that the system information update is completed, and the UE MAC sublayer may feedback it to the NW. The NW may re-take control over the BWP switching once receiving the feedback in NW MAC sublayer.

In one embodiment of the present disclosure, upon receiving the SI change indication, the UE may not switch to the initial active BPW until the current BCCH modification period ends. In FIG. **3**, a BWP switching operation for an RRC_connected UE due to receiving an SI change indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for the UE SI update. Within BCCH modification period n, the UE may operate on the indicated BWP for data transmission according to L1 signaling.

The SI change indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE may operate on the indicated BWP. At **301**, upon receiving the SI change indication, UE may continue to stay on the indicated BWP instead of switching immediately to the initial active BWP. Then, the UE switches to the initial active BWP automatically on the ending boundary of BCCH modification period n. The BWP switching operation(s) for the UE could be still performed for certain required services before the automatic switching to the initial active BWP takes place on the end of BCCH modification period n.

In this case, PHY sublayer of the NW may know that the UE switches to the initial active BWP automatically on the end of BCCH modification period n, and may stop sending to the UE any other L1 signaling for BWP switching operations after modification period n ends. The PHY sublayer of the NW may know the UE by default will complete the SI update within the next modification period n+1, the PHY sublayer may re-take control over the BWP switching after BCCH modification period n+1 ends. Therefore, at **303** on the ending boundary of modification period n+1 the NW re-takes the BWP switching operations by sending L1 signaling to switch the initial active BWP to a BWP for data transmission.

After switching to the initial active BWP on the end of modification period n, the UE may wait to receive, via the initial active BWP, broadcast information required for updating to the changed SI in a next BCCH modification period directly following modification period n. Therefore, within BCCH modification period n+1 (the next BCCH modification period as shown in FIG. **3**), the UE performs the system information acquisition to update the changed system information if required.

In this case, since the NW may know the UE by default will complete the SI update within the next modification period n+1, the PHY sublayer may re-take control over the BWP switching after BCCH modification period n+1 ends. Therefore, at **303** on the ending boundary of modification period n+1 the NW re-takes the BWP switching operations by sending L1 signaling to switch the initial active BWP to a BWP for data transmission.

In one embodiment of the present disclosure, the Connected UE may feedback to the NW while the SI update is completed, and the NW may take control over the BWP switching immediately upon receiving the feedback. In FIG. **4**, a BWP switching operation for an RRC_connected UE due to receiving an SI change indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for the UE SI update. Within BCCH modification period n, the UE may operate on the indicated BWP for data transmission according to L1 signaling.

The SI change indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE may operate on the indicated BWP. At **401**, upon receiving the SI change indication, UE may continue to stay on the indicated BWP instead of switching immediately to the initial active BWP. Then, the UE switches to the initial active BWP automatically on the ending boundary of BCCH modification period n. The BWP switching operation(s) for the UE could be still performed for certain required services before the automatic switching to the initial active BWP takes place on the end of modification period n. In this case, PHY sublayer of the NW may know that the UE switches to the initial active BWP automatically on the end of BCCH modification period n, and may stop sending to the UE any other L1 signaling for BWP switching operations after period n ends.

After switching to the initial active BWP on the end of modification period n, the UE may continue to stay on the initial active BWP until the update of the required SI change(s) is completed. At **403**, the UE complete the SI update and feedback to the NW that the system information update is completed by sending an SI update complete indication. Upon receiving the SI update complete indication as the UE feedback, the PHY sublayer of the NW may re-take control over the BWP switching operation at **403**. Although the UE has to operate on the initial active BWP for the SI update in DL, the NW may be still able to schedule data transmission on the initial active BWP.

The UE feedback of SI update complete may be sent by L1 signaling (via PUCCH) or by MAC-CE transmission on an uplink (UL) BWP paired with the initial active DL BWP. If using L1 signaling, the upper sublayer (e.g., RRC) of the UE may inform PHY sublayer that the SI update is completed, and the UE PHY sublayer may feedback it to the NW. The NW may re-take control over the BWP switching after receiving the feedback in NW PHY sublayer. Alternatively, if using MAC-CE transmission, the upper sublayer of the UE may inform MAC sublayer that the system information update is completed, and the UE MAC sublayer may feedback it to the NW. The NW may re-take control over the BWP switching once receiving the feedback in NW MAC sublayer.

In one embodiment of the present disclosure, after receiving an SI change indication the UE may not switch to an initial active BWP until an L1 signaling is received from the NW. In FIG. **5**, a BWP switching operation for an RRC_connected UE due to receiving an SI change indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for the UE SI update. Within BCCH modification period n, the UE may operate on the indicated BWP for data transmission according to L1 signaling.

The SI change indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE may operates on the indicated BWP in BCCH modification period n. At **501**, upon receiving the SI change indication, the UE may not switch to the initial active BWP but continue to stay on the indicated BWP. On the NW side, the RRC sublayer may inform the PHY sublayer that the SI change indication is sent to the UE. The SI change indication may be carried as part of the Short Message in the paging. In response to the UE reception of the SI change indication, the PHY sublayer of the NW may schedule the L1 signaling and decide when to send the L1 signaling to switch the UE to the initial active BWP. After sending the SI change indication, the NW may perform the L1 signaling before BCCH modification period n ends.

At **503**, the UE switches to the initial active BWP in response to receiving the L1 signaling sent from the NW in BCCH modification period n, and the NW may also stop sending to the UE any other L1 signaling for BWP switching operations. In this case, the PHY sublayer of the NW may know the UE by default will complete the SI update within the next modification period (i.e., BCCH modification period n+1 as shown in FIG. **5**), and the PHY sublayer may re-take control over the BWP switching after BCCH modification period n+1 ends.

Thus, at **505** the NW re-takes control over the BWP switching operations on the ending boundary of modification period n+1 by sending L1 signaling to switch the initial active BWP to a BWP for data transmission.

Alternatively, the NW may re-take control over the BWP switching operations upon receiving a feedback from the UE indicating the SI update is complete before BCCH modification period n+1 ends. In FIG. **6**, the UE receives a L1 signaling for switching to the initial active BWP at **603** after receiving the SI change indication at **601** in modification period n, followed by the SI update operations in modification period n+1. Once the UE completes the SI update at **605**, the UE feedback of SI update complete (e.g., an SI update completeness indication) may be sent by another L1 signaling (via PUCCH) or by MAC-CE transmission on an uplink (UL) BWP paired with the initial active DL BWP. If using L1 signaling, the upper sublayer (e.g., RRC) of the UE may inform PHY sublayer that the SI update is completed, and the UE PHY sublayer may feedback it to the NW. The NW may re-take control over the BWP switching after receiving the feedback in NW PHY sublayer. If using MAC-CE transmission, the upper sublayer of the UE may inform MAC sublayer that the system information update is completed, and the UE MAC sublayer may feedback it to the NW. The NW may re-take control over the BWP switching once receiving the feedback in NW MAC sublayer.

In one embodiment of the present disclosure, the UE may receive a public warning system (PWS) notification indication for ETWS indication or CMAS indication carried in Short Message of a paging. The PWS notification indication notifies the UE of immediate reception of a PWS notification. When a Connected UE receives a PWS notification indication broadcasted by paging of the NW, the RRC sublayer of the UE may inform the PHY sublayer that a PWS notification reception is required immediately.

If the UE receives the PWS notification indication(s) of a paging from the NW, the UE has to immediately start receiving the PWS notification(s) according to the scheduling information in RMSI. The PWS notification indication may trigger the UE to perform re-acquisition of the scheduling information in RMSI for checking scheduling changes for the SIBs associated with the PWS notification(s). Once the SIB(s) associated with the corresponding PWS notification(s) is no longer scheduled, the UE could stop receives the SIB(s).

In FIG. **7**, a BWP switching operation for an RRC_connected UE due to receiving a PWS notification indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for the UE SI update. Within BCCH modification period n, the UE may operate on the indicated BWP as the current active BWP for data transmission according to L1 signaling.

The PWS notification indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE operates on the indicated BWP. At **701**, upon receiving the PWS notification indication, UE may switch automatically to the initial active BWP from the indicated BWP in BCCH modification period n. The PWS notification indication may be carried as part of Short Message in the paging. Then, RRC sublayer of the NW may inform the PHY sublayer that the paging has been sent to the UE. So, the PHY sublayer of the NW knows successful automatic switching to the initial active BWP and may stop sending to the UE any other L1 signaling for BWP switching operations. The PHY sublayer of the NW would wait for the information from upper layer(s) indicating the stop of broadcasting PWS notification(s) at a certain time point, e.g. at **703** in BBCH modification period n+2. Then, the PHY sublayer in the NW could re-start to take control over BWP switching operation(s).

In another embodiment of the present disclosure, the Connected UE may feedback to the NW while the PWS notification is no longer scheduled, and the NW may re-take control over the BWP switching immediately upon receiving the feedback. In FIG. **8**, a BWP switching operation for an RRC_connected UE due to receiving a PWS notification indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for the UE SI update. Within BCCH modification period n, the UE may operate on the indicated BWP for data transmission according to L1 signaling.

The PWS notification indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE may operates on the indicated BWP. At **801**, upon receiving the PWS notification indication, UE may switch to the initial active BWP automatically from the indicated BWP in BCCH modification period n. The PWS notification indication may be carried as part of Short Message in the paging. Then, RRC sublayer of the NW may inform the PHY sublayer that the paging has been sent to the UE and the switching of the UE to the initial active BWP has been performed. So, the NW may stop sending to the UE any other L1 signaling for BWP switching operations, and wait for the UE feedback indicating the PWS notification is no longer scheduled.

At **803**, the UE may inform the NW of the stopping broadcast of the PWS notification(s) by a feedback that indicates the PWS notification is no longer scheduled.

In one embodiment of the present disclosure, after receiving a PWS notification indication the UE may not switch to an initial active BWP until an L1 signaling is received from the NW. Since the PWS notification is for emergence, the L1 signalling for switching the UE to the initial active BWP shall be transmitted as fast as possible. In FIG. **9**, a BWP switching operation for an RRC_connected UE due to receiving a PWS notification indication is illustrated. The UE may operate on an indicated BWP as currently active BWP for data transmission or operate on an initial active BPW able to receive the content of changed SI required for

the UE SI update. Within BCCH modification period n, the UE may operate on the indicated BWP for data transmission according to L1 signaling.

The PWS notification indication is sent to the UE by paging (e.g., a Short Message) from the NW while the UE may operate on the indicated BWP in BCCH modification period n. At **901**, upon receiving the PWS notification indication, the UE may not switch to the initial active BWP but continue to stay on the indicated BWP until an L1 signaling from the NW is received. At **903**, the UE switches to the initial active BWP in response to receiving the L1 signaling sent from the NW in BCCH modification period n, and the NW may also stop sending to the UE any other L1 signaling for BWP switching operations. At **905**, the PHY sublayer of the NW would wait for the information from upper layer(s) indicating the stop of broadcasting PWS notification(s) at a certain time point, e.g. in BCCH modification period n+2. Then, the PHY sublayer in the NW could re-start to take control over BWP switching operation(s).

Alternatively, the UE may inform the NW of the stopping broadcast of the PWS notification(s) by a feedback that indicates the PWS notification is no longer scheduled in this case.

In some embodiments of the present disclosure, a BWP inactivity timer is introduced to switch an ongoing indicated BWP (or the currently active BWP) to a default BWP after a certain inactive time. The BWP inactivity timer may start to run for an inactive time period immediately after the UE switches off the default BWP. In other words, no matter what BWPs the Connected_UE currently operates on, the UE may switch back to the default BWP immediately after the BWP inactivity timer expires.

If the initial active BWP is the default BWP, the currently running BWP inactivity timer would stop after receiving Short Message on the configured active BWP. The UE may switch to another BWP after SI acquisition in response to receiving an L1 signalling, and the BWP inactivity timer would reset with the configured value and start running.

If the initial active BWP is not the default BWP, the currently running BWP inactivity timer may keep running. In some embodiments, the BWP inactivity timer would restart with the configured value and start running. It is noted that the configured value may be different from the normal one (i.e., the normal one is not used for SI acquisition upon switching to the initial active BWP). For example, gNB(s) may configure the BWP inactivity timer with two values, one is 5 ms, the other is 40 ms (e.g., equal to the duration of one BCCH modification period), and UE will automatically apply the second one when the UE needs to perform SI acquisition after receiving the SI change indication carried in the Short Message.

In one embodiment of the present application, if the BWP inactivity timer expires but the SI update is not complete, the UE may keep staying on the initial active BWP until the next L1 signalling (e.g., DCI) controls the UE to perform another BWP switching. The NW may need the timing of the SI update completeness by an NW control mechanism (e.g., waiting for the whole BCCH modification period for SI updated as introduced in the above embodiments) or an UE control mechanism (e.g., by waiting for the UE feedback as introduced in the above embodiments). The BWP inactivity timer would then reset and restart while the UE is switched to another BWP, which is not the default BWP. On the other hand, if the BWP inactivity timer is expired but the PWS notification receiving is not complete, the UE would keep staying on the initial active BWP until the next L1 signalling (e.g., DCI) controls the UE to perform another BWP switch. The NW would need the timing of the SI complete by an NW control mechanism (e.g., waiting for the whole BCCH modification period for SI updated as introduced in the embodiments) or an UE control mechanism (e.g., by waiting for the UE feedback as introduced in the embodiment). The BWP inactivity timer may then reset and restart while the UE switches to another BWP, which is not the default BWP. If there is no system information change indication or Public Warning System (PWS) notification indication indicating that the following SI update or PWS notification receiving procedure is required, once the BWP inactivity timer expires, the UE would automatically switch to the default BWP without L1 signalling.

FIG. **10** illustrates a block diagram of a device for wireless communication, according to various exemplary implementations of the present disclosure. As shown in FIG. **10**, device **1000** may include transceiver **1020**, processor **1026**, memory **1028**, one or more presentation components **1034**, and at least one antenna **1036**. Device **1000** may also include an RF spectrum band module, a base station communications module, a network communications module, and a system communications management module, input/output (I/O) ports, I/O components, and power supply (not explicitly shown in FIG. **10**). Each of these components may be in communication with each other, directly or indirectly, over one or more buses **1026**.

Transceiver **1020** having transmitter **1022** and receiver **1024** may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, transceiver **1020** may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. Transceiver **1020** may be configured to receive data and control channels.

Device **1000** may include a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by device **1000** and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data.

Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

Memory **1028** may include computer-storage media in the form of volatile and/or non-volatile memory. Memory **1028** may be removable, non-removable, or a combination thereof. Exemplary memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in FIG. **10**, memory **1028** may store computer-readable, computer-executable instructions **1032** (e.g., software codes) that are configured to, when executed, cause processor **1026** to perform various functions described herein, for example, with reference to FIGS. **1** through **9**. Alternatively, instructions **1032** may not be directly executable by processor **1026** but be configured to cause device **1000** (e.g., when compiled and executed) to perform various functions described herein.

Processor **1026** may include an intelligent hardware device, e.g., a central processing unit (CPU), a microcontroller, an ASIC, and etc. Processor **1026** may include memory. Processor **1026** may process data **1030** and instructions **1032** received from memory **1028**, and information through transceiver **1020**, the base band communications module, and/or the network communications module. Processor **1026** may also process information to be sent to transceiver **1020** for transmission through antenna **1036**, to the network communications module for transmission to a core network.

One or more presentation components **1034** presents data indications to a person or other device. Exemplary one or more presentation components **1034** include a display device, speaker, printing component, vibrating component, and etc.

From the above description it is manifest that various techniques can be used for implementing the concepts described in the present disclosure without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art would recognize that changes can be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present disclosure is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

What is claimed is:

1. A method for a user equipment (UE) of a connected state, the method comprising:

receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period;

in response to receiving the SI change indication, switching from the currently active BWP to an initial active BWP for an SI update;

receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period, wherein the RMSI includes information associated with changed system information blocks (SIBs);

determining which of the changed SIBs is required to be updated for the UE according to the received RMSI; and

receiving content of the required changed SIBs based on the determination.

2. The method of claim **1**, wherein the currently active BWP is switched to the initial active BWP automatically on the end of the modification period.

3. The method of claim **1**, wherein the currently active BWP is switched to the initial active BWP immediately upon receiving the SI change indication.

Exhibit 1

4. The method of claim 1, wherein the currently active BWP is switched to the initial active BWP in response to receiving downlink control information (DCI).

5. The method of claim 1, further comprising:

completing the SI update of the required changed SIBs within the next modification period in response to receiving the content of the required changed SIBs.

6. The method of claim 1, further comprising:

sending an SI update complete indication as a feedback indicating completeness of the SI update via an uplink BWP.

7. The method of claim 1, wherein the UE is pre-configured with a default BWP and a BWP inactivity timer for the connected state, and wherein the UE starts the BWP inactivity timer after switching off the default BWP and switches back to the default BWP after the BWP inactivity timer expires.

8. The method of claim 7, wherein the BWP inactivity timer stops after the currently active BWP for data transmission is switched to an initial active BWP in response to receiving the SI change indication.

9. The method of claim 7, wherein the BWP inactivity timer is further configured to have a short period and a long period, and wherein the UE selects the long period for the BWP inactivity timer upon receiving the SI change indication.

10. The method of claim 7, wherein the UE stays on the initial active BWP in order to complete the SI update after the BWP inactivity timer expires.

11. A user equipment (UE) for wireless communication, comprising:

a non-transitory machine-readable medium storing computer-executable instructions;

a processor coupled to the non-transitory computer-readable medium, and configured to execute the computer-executable instructions to cause the UE of a connected state to perform operations comprising:

receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period;

in response to receiving the SI change indication, switching from currently active BWP to an initial active BWP for an SI update; and

receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period, wherein the RMSI includes information associated with changed system information block (SIB);

determining which of the changed SIBs is required to be updated for the UE according to the received RMSI; and

receiving content of the required changed SIBs based on the determination.

12. The UE of claim 11, wherein the currently active BWP is switched to the initial active BWP automatically on the end of the modification period.

13. The UE of claim 11, wherein the currently active BWP is switched to the initial active BWP immediately upon receiving the SI change indication.

14. The UE of claim 11, wherein the currently active BWP is switched to the initial active BWP in response to receiving downlink control information (DCI).

15. The UE of claim 11, wherein the processor is further configured to execute the computer-executable instructions to cause the UE of a connected state to perform operations comprising:

completing the SI update of the required changed SIBs within the next modification period in response to receiving the content of the required changed SIBs.

16. The UE of claim 15, wherein the processor is further configured to execute the computer-executable instructions to cause the UE of a connected state to perform operations comprising:

sending an SI update complete indication as a feedback indicating completeness of the SI update via an uplink BWP.

17. The UE of claim 11, wherein the UE is pre-configured with a default BWP and a BWP inactivity timer for the connected state, and wherein the UE starts the BWP inactivity timer after switching off the default BWP and switches back to the default after the BWP inactivity timer expires.

18. The UE of claim 17, wherein the BWP inactivity timer stops after the currently active BWP for data transmission is switched to an initial active BWP in response to receiving the SI change indication.

19. The UE of claim 17, wherein the BWP inactivity timer is further configured to have a short period and a long period, and wherein the UE selects the long period for the BWP inactivity timer upon receiving the SI change indication.

20. The UE of claim 17, wherein the UE stays on the initial active BWP in order to complete the SI update after the BWP inactivity timer expires.

* * * * *

Exhibit 2

US010791502B2

(12) **United States Patent**
Chen et al.

(10) **Patent No.: US 10,791,502 B2**
(45) **Date of Patent: Sep. 29, 2020**

(54) **ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING**

(71) Applicant: **FG Innovation Company Limited**, Tuen Mun (HK)

(72) Inventors: **Hung-Chen Chen**, Hsinchu (TW); **Chie-Ming Chou**, Hsinchu (TW); **Yung-Lan Tseng**, Hsinchu (TW)

(73) Assignee: **FG Innovation Company Limited**, Tuen Mun (HK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/372,389**

(22) Filed: **Apr. 1, 2019**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 62/651,312, filed on Apr. 2, 2018.

(51) **Int. Cl.**

H04W 4/00	(2018.01)
H04W 48/14	(2009.01)
H04W 48/16	(2009.01)
H04W 76/18	(2018.01)
H04W 36/30	(2009.01)
H04W 76/15	(2018.01)
H04W 36/08	(2009.01)
H04W 74/08	(2009.01)
H04W 76/28	(2018.01)

(52) **U.S. Cl.**

CPC ***H04W 48/14*** (2013.01); ***H04W 36/08*** (2013.01); ***H04W 36/305*** (2018.08); ***H04W 48/16*** (2013.01); ***H04W 76/15*** (2018.02); ***H04W 76/18*** (2018.02); *H04W 74/0833* (2013.01); *H04W 76/28* (2018.02)

(58) **Field of Classification Search**

CPC H04W 48/14; H04W 48/16; H04W 76/18; H04W 36/305; H04W 76/15; H04W 36/08; H04W 74/0833; H04W 76/28

USPC 455/434; 370/338

See application file for complete search history.

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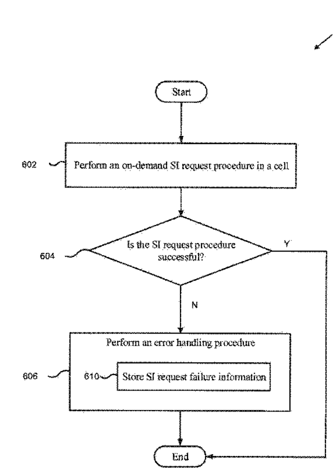
Primary Examiner — Marcos Batista
(74) *Attorney, Agent, or Firm* — ScienBiziP, P.C.

(57) **ABSTRACT**

A method of wireless communications performed by a user equipment (UE) is provided. The method includes performing an on-demand system information (SI) request procedure in a cell; and performing an error handling procedure if the on-demand SI request procedure in the cell is unsuccessful. The error handling procedure includes storing SI request failure information.

20 Claims, 7 Drawing Sheets



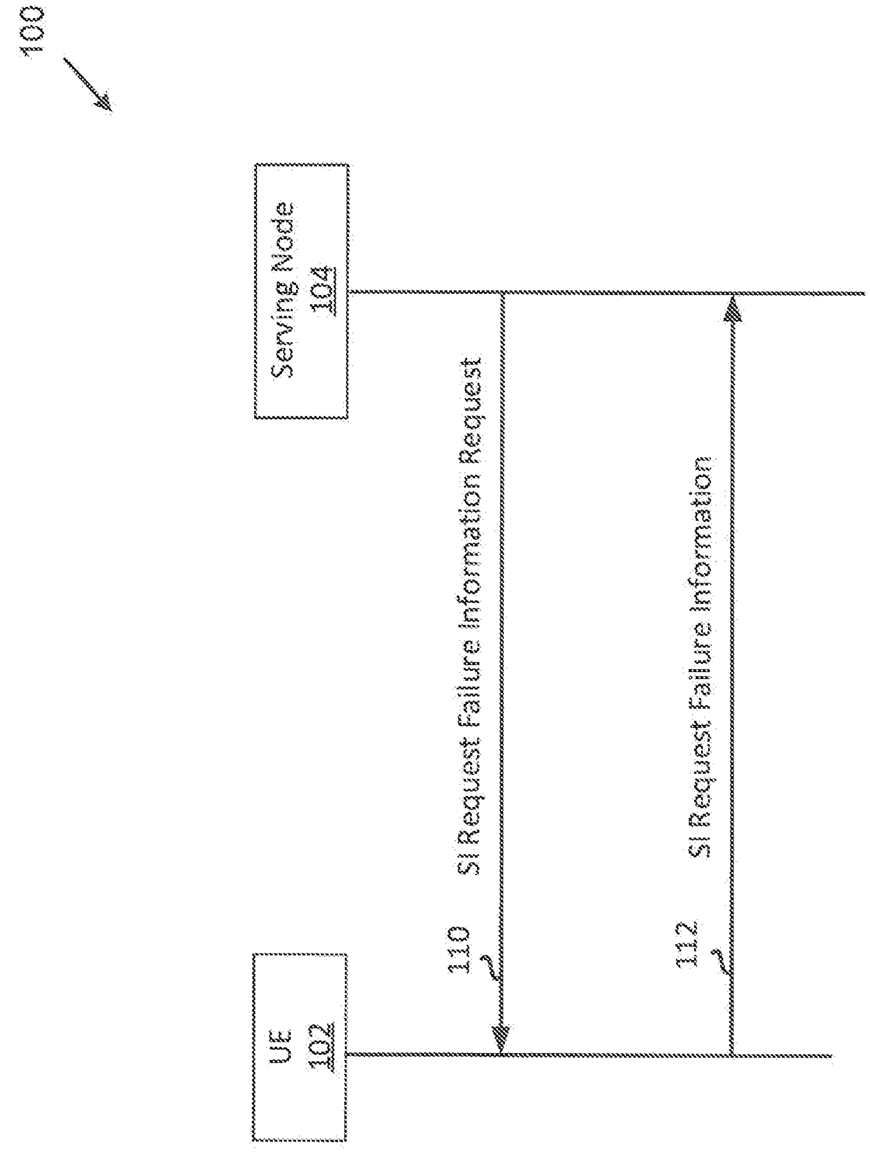

100
Serving Node
104
UE
102
SI Request Failure Information Request
110
SI Request Failure Information
112

FIG. 1

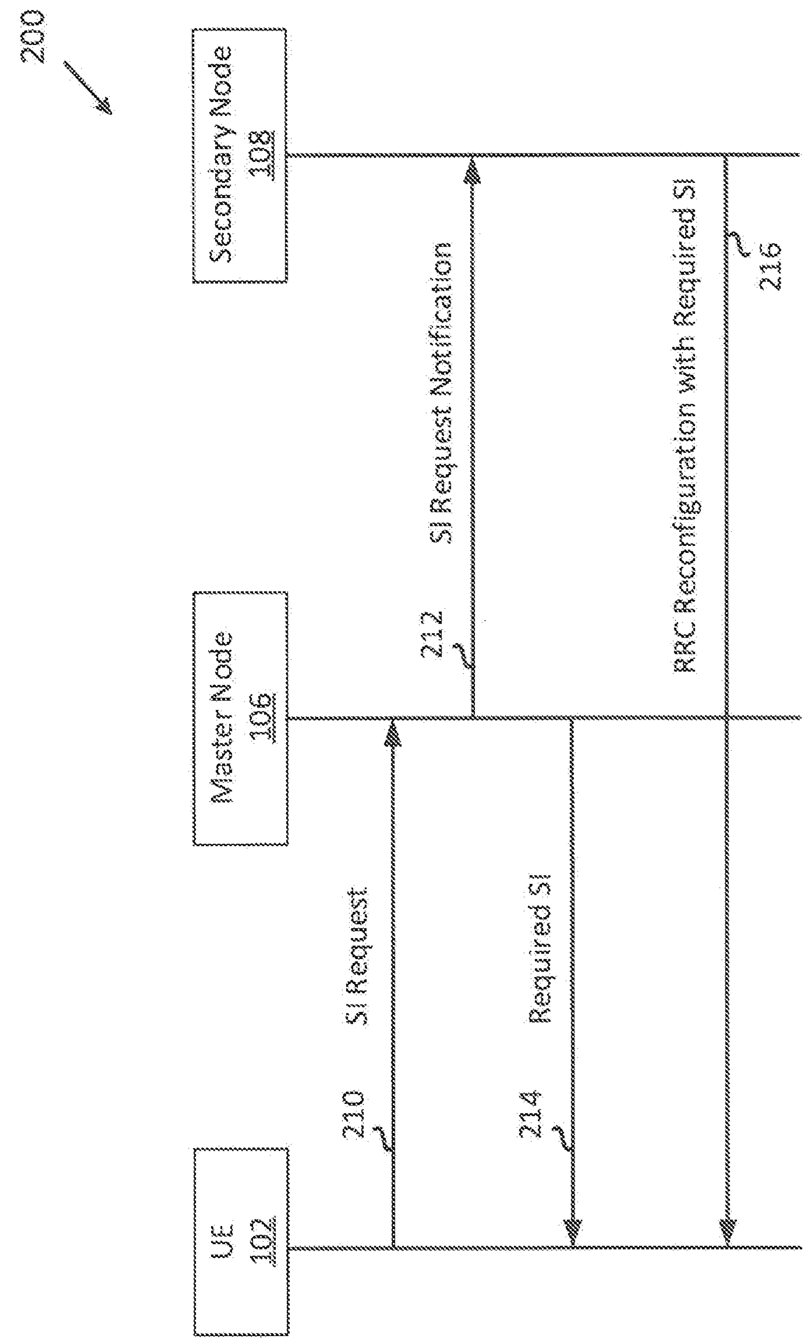

200
Secondary Node
108
Master Node
106
UE
102
SI Request
210
SI Request Notification
212
Required SI
214
RRC Reconfiguration with Required SI
216

FIG. 2

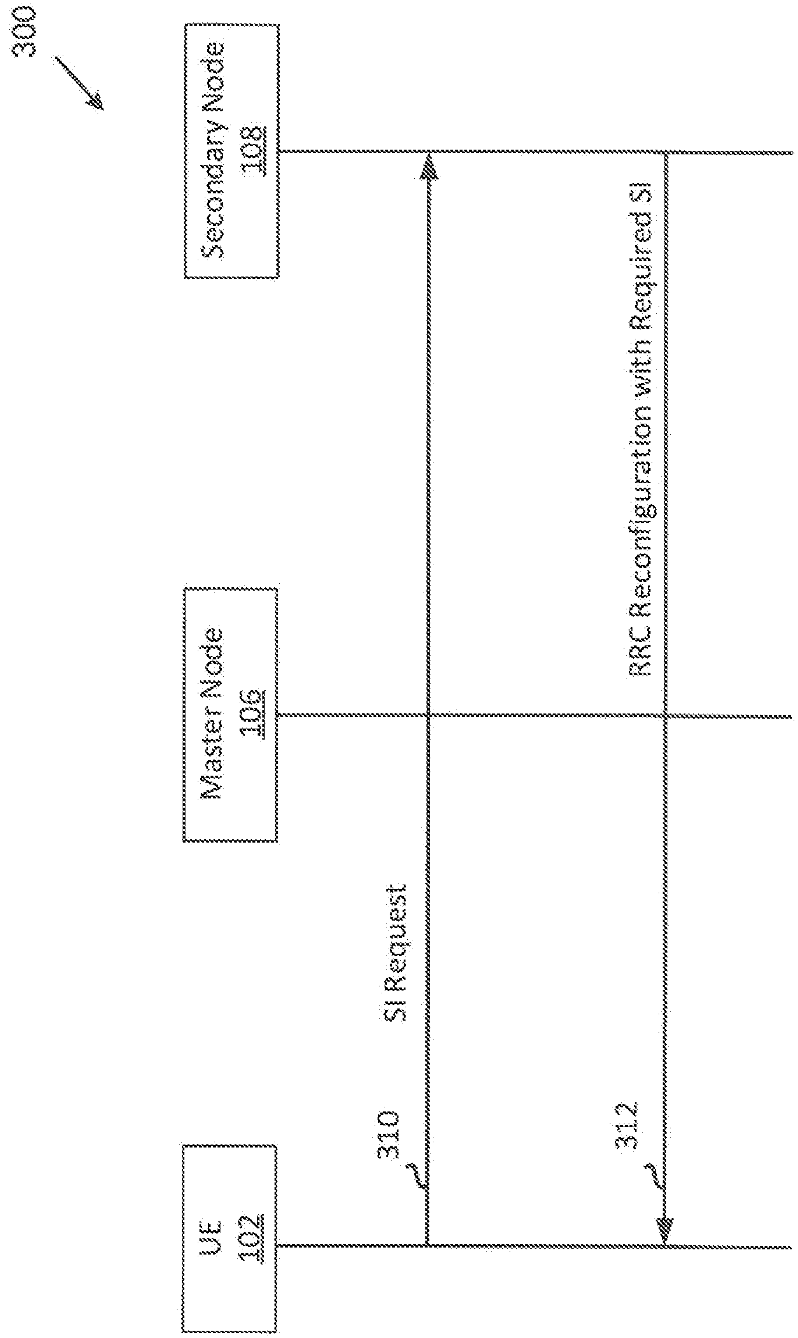

300
Secondary Node
108
Master Node
106
UE
102
310
SI Request
312
RRC Reconfiguration with Required SI

FIG. 3

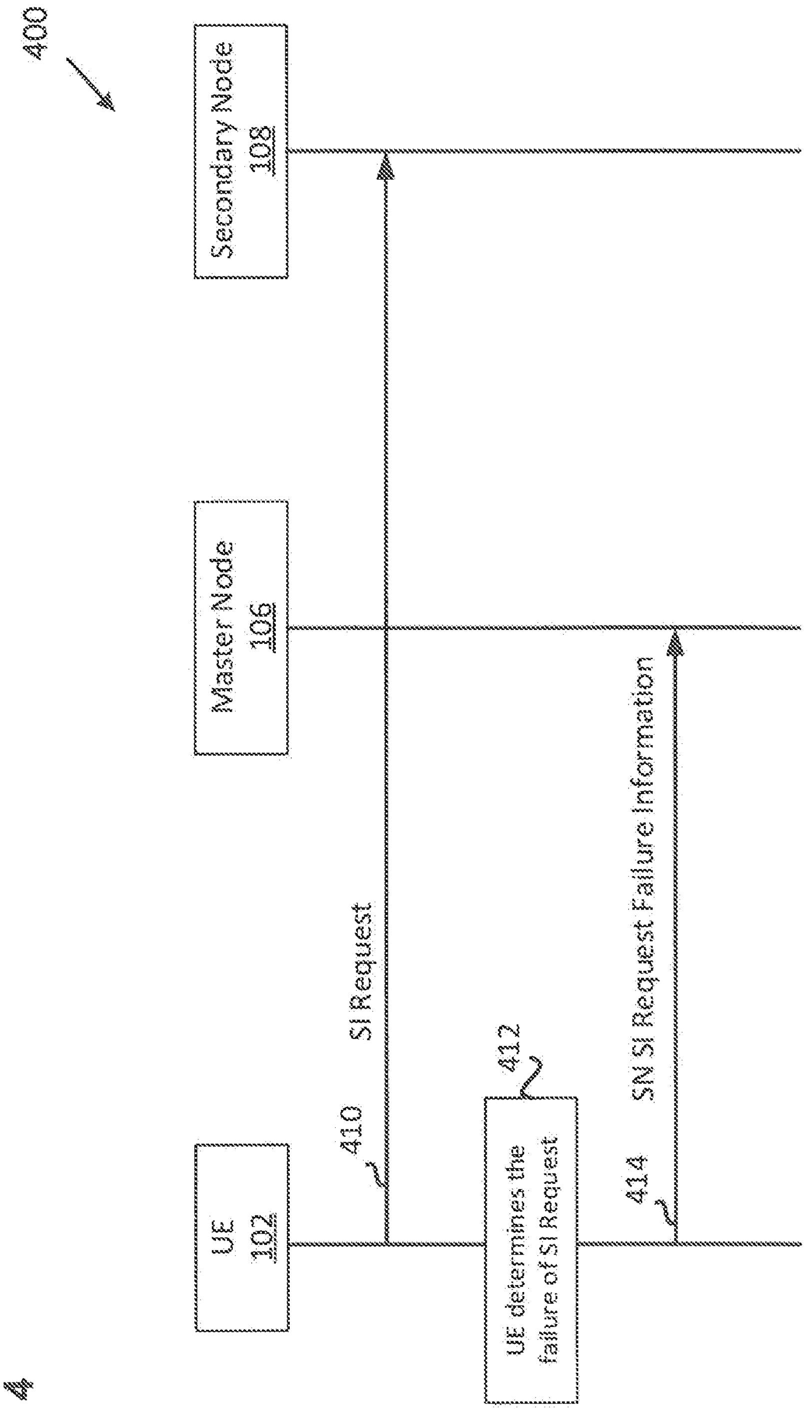

400
Secondary Node
108
Master Node
106
UE
102
410
SI Request
412
UE determines the failure of SI Request
414
SN SI Request Failure Information

FIG. 4

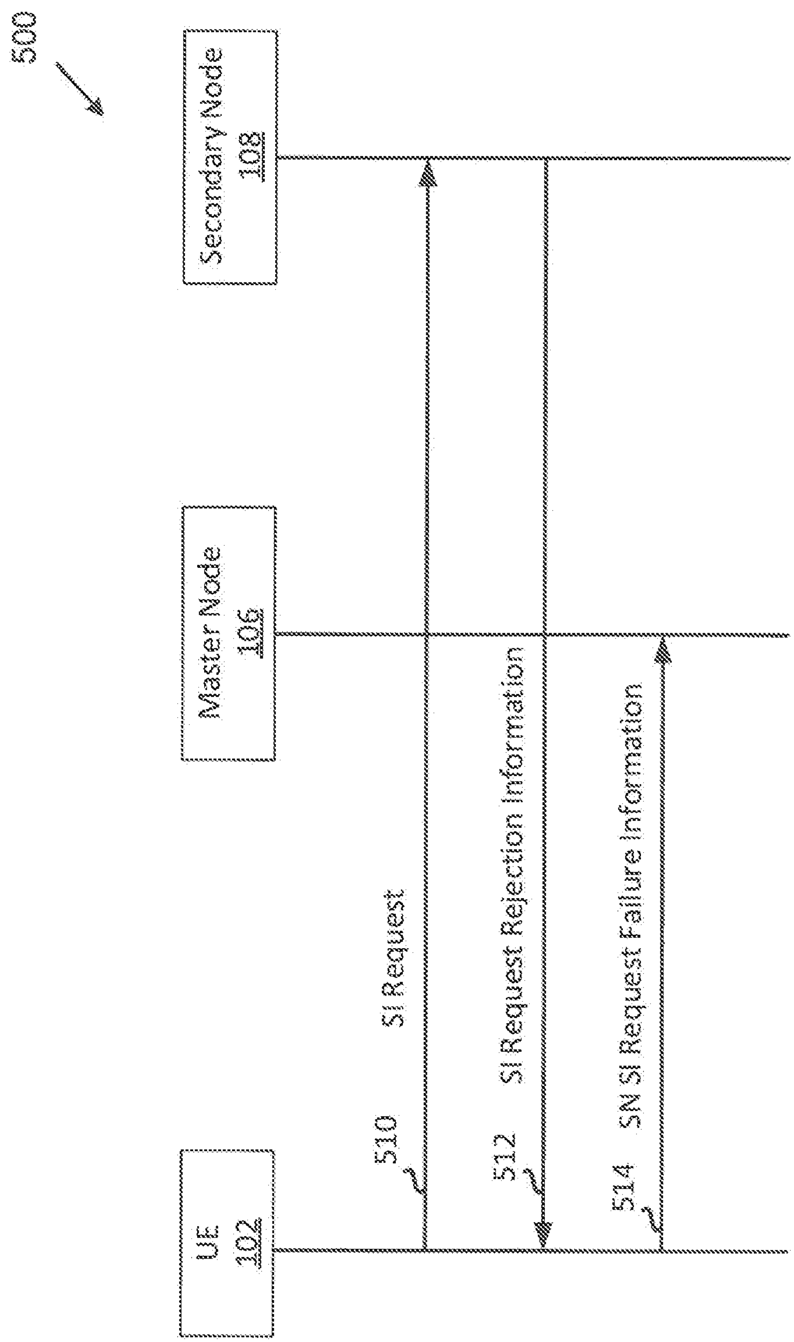
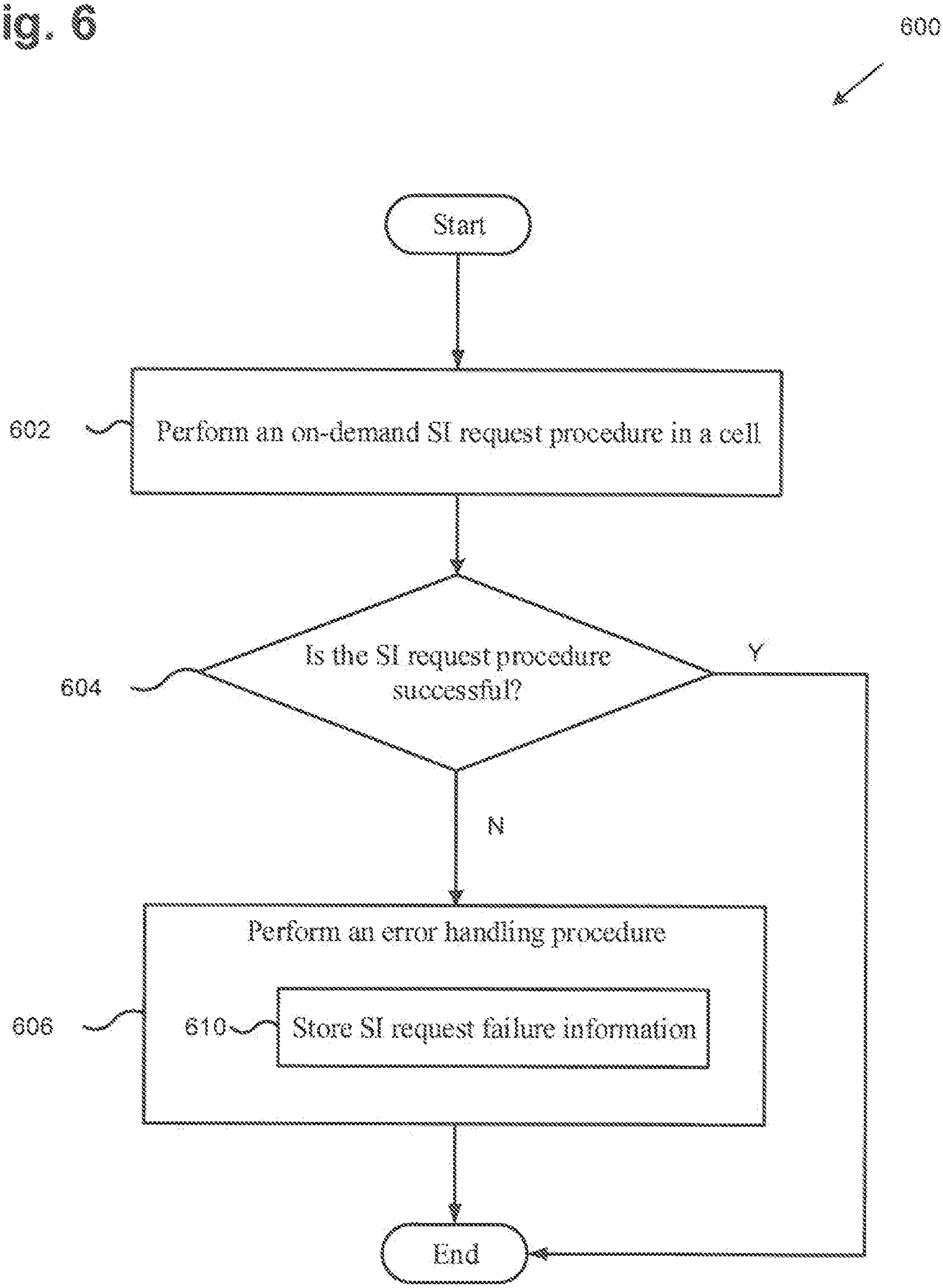

500
Secondary Node
108
Master Node
106
UE
102
510
SI Request
512
SI Request Rejection Information
514
SN SI Request Failure Information

FIG. 5

Fig. 6


600
Start
602
Perform an on-demand SI request procedure in a cell
604
Is the SI request procedure successful?
Y
N
Perform an error handling procedure
606
610
Store SI request failure information
End

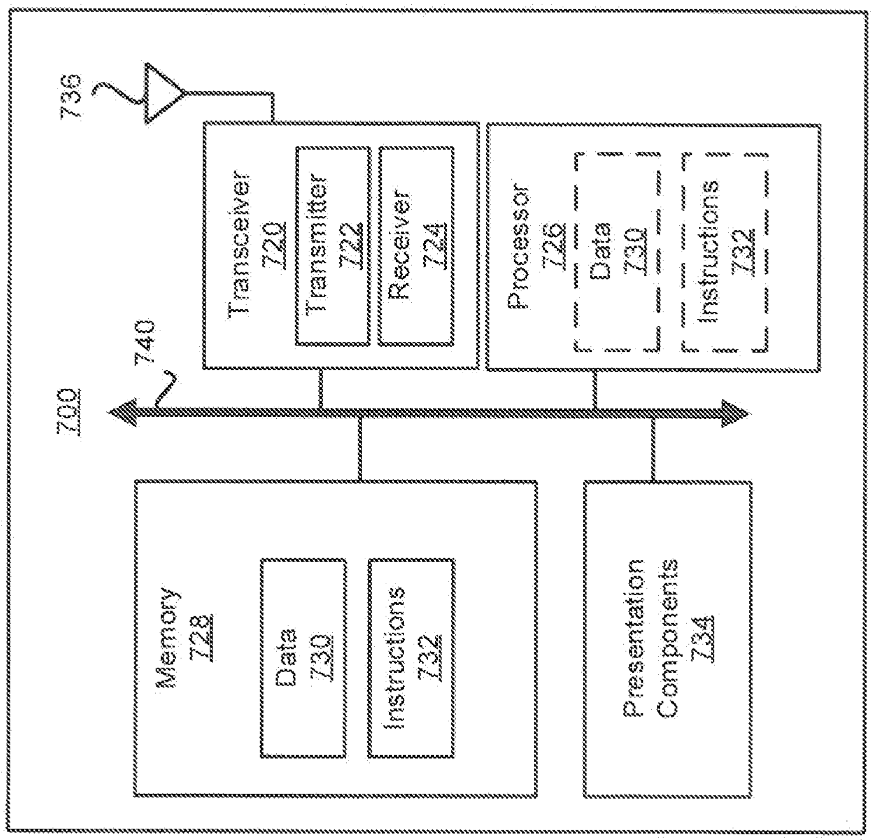

736
Transceiver 720
Transmitter 722
Receiver 724
Processor 726
Data 730
Instructions 732
740
700
Memory 728
Data 730
Instructions 732
Presentation Components 734

FIG. 7

US010743238B2

(12) **United States Patent**
Chen et al.

(10) **Patent No.: US 10,743,238 B2**
(45) **Date of Patent: Aug. 11, 2020**

(54) **SYSTEM INFORMATION UPDATES IN BAND WIDTH PART (BWP) SWITCH OPERATION**

(71) Applicant: **FG Innovation Company Limited**, Tuen Mun (HK)

(72) Inventors: **Hung-Chen Chen**, Hsinchu (TW); **Chie-Ming Chou**, Hsinchu (TW)

(73) Assignee: **FG Innovation Company Limited**, Tuen Mun (HK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/191,465**

(22) Filed: **Nov. 15, 2018**

(65) **Prior Publication Data**

US 2019/0150064 A1 May 16, 2019

Related U.S. Application Data

(60) Provisional application No. 62/586,598, filed on Nov. 15, 2017.

(51) **Int. Cl.**

H04W 4/00	(2018.01)
H04W 48/10	(2009.01)
H04W 48/12	(2009.01)

(52) **U.S. Cl.**
CPC ***H04W 48/10*** (2013.01); *H04W 48/12* (2013.01)

(58) **Field of Classification Search**
CPC H04W 48/10; H04W 48/12
USPC 370/328, 329, 330
See application file for complete search history.

(56) **References Cited**

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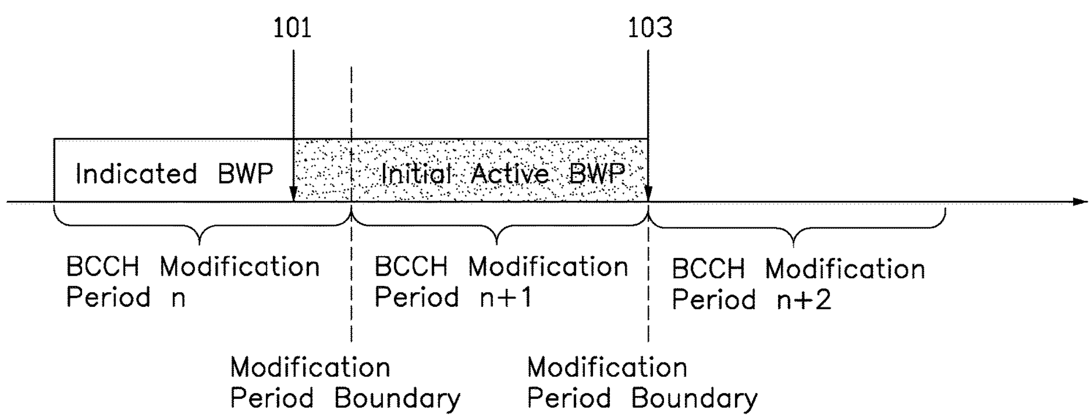
Primary Examiner — Chuong T Ho
(74) *Attorney, Agent, or Firm* — ScienBiziP, P.C.

(57) **ABSTRACT**

A user equipment (UE) for wireless communication is configured to perform bandwidth part (BWP) switching operation in response to receiving a system information change indication. The UE receives the system information change indication via a currently active BWP in a BCCH modification period. The system information change indication notifies the UE that contents of system information have been changed. The UE switches from the currently active BWP to an initial active BWP to receive the changed contents of system information which are required for the UE. The UE receives the changed contents of system information via the initial active BWP in a next BCCH modification period that immediately follows the BCCH modification period. The UE updates the system information according to the changed contents.

20 Claims, 10 Drawing Sheets



ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present application claims the benefit of and priority to a provisional U.S. Patent Application Ser. No. 62/651,312, filed on Apr. 2, 2018, entitled "On-Demand System Information Request Procedure and Error Handling," (hereinafter referred to as "US73481 application"). The disclosure of the US73481 application is hereby incorporated fully by reference into the present application.

FIELD

The present disclosure generally relates to wireless communication, and more particularly, to the on-demand system information (SI) request procedure for the next generation wireless communication networks.

BACKGROUND

The concept of on-demand System Information (SI) request has been introduced in the next generation wireless network (e.g., a 5^{th} generation (5G) new radio (NR) network). When a UE finds that a required SI message(s) is not broadcasted, based on information in the System Information Block Type 1 (SIB1) (e.g., a one-bit indicator that shows whether the corresponding SI message is currently broadcasted or not) and the mapping of the SIBs to SI messages, the UE may perform an on-demand SI request procedure to ask the network (also referred to as NW) to broadcast the required SIB(s) and/or SI message(s). However, the next generation wireless network lacks an efficient mechanism for error handling associated with the on-demand SI request procedure.

SUMMARY

The present disclosure is directed to on-demand system information request procedure and the corresponding error handling procedure for the next generation wireless communication networks.

According to an aspect of the present disclosure, a method of wireless communications performed by a user equipment (UE) is provided. The method includes performing an on-demand system information (SI) request procedure in a first cell; and performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful. The error handling procedure includes storing SI request failure information.

According to another aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to perform an on-demand system information (SI) request procedure in a first cell, and perform an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful. The error handling procedure includes storing SI request failure information.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the exemplary disclosure are best understood from the following detailed description when read with the

accompanying figures. Various features are not drawn to scale, dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

FIG. **1** is a sequence diagram illustrating the transmission of SI request failure information, according to an exemplary implementation of the present application.

FIG. **2** is a sequence diagram illustrating an example of an on-demand SI request being transmitted to an MN in the DC mode, according to an exemplary implementation of the present application.

FIG. **3** is a sequence diagram illustrating an example of an on-demand SI request being transmitted to an SN in the DC mode, according to an exemplary implementation of the present application.

FIG. **4** is a sequence diagram illustrating an example of a UE determining the failure of an SI request in the DC mode, according to an exemplary implementation of the present application.

FIG. **5** is a sequence diagram illustrating an example of a UE receiving SI request rejection information in the DC mode, according to an exemplary implementation of the present application.

FIG. **6** is a flowchart for a method of wireless communications performed by a UE, according to an example implementation of the present application.

FIG. **7** illustrates a block diagram of a node for wireless communication, in accordance with various aspects of the present application.

DETAILED DESCRIPTION

The following description contains specific information pertaining to exemplary implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely exemplary implementations. However, the present disclosure is not limited to merely these exemplary implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale, and are not intended to correspond to actual relative dimensions.

For the purpose of consistency and ease of understanding, like features are identified (although, in some examples, not shown) by numerals in the exemplary figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, system, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or algorithm(s). The microprocessors or general purpose computers may be formed of applications specific integrated circuitry (ASIC), programmable logic arrays, and/or using one or more digital signal processor (DSPs). Although some of the exemplary implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative exemplary implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

The computer readable medium includes but is not limited to random access memory (RAM), read only memory (ROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), flash memory, compact disc read-only memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

A radio communication network architecture (e.g., a long term evolution (LTE) system, a LTE-Advanced (LTE-A) system, a LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network) typically includes at least one base station, at least one user equipment (UE), and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a core network (CN), an evolved packet core (EPC) network, an Evolved Universal Terrestrial Radio Access network (E-UTRAN), a 5G Core (5GC), or an internet), through a radio access network (RAN) established by one or more base stations.

It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, or a personal digital assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

A base station may include, but is not limited to, a node B (NB) as in the UMTS, an evolved node B (eNB) as in the LTE-A, a radio network controller (RNC) as in the UMTS, a base station controller (BSC) as in the GSM/GERAN, a ng-eNB as in an E-UTRA base station in connection with the 5GC, a next generation node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The base station may connect to serve the one or more UEs through a radio interface to the network.

A base station may be configured to provide communication services according to at least one of the following radio access technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM EDGE radio access Network (GERAN), General Packet Radio Service (GRPS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic wideband-code division multiple access (W-CDMA), high-speed packet access (HSPA), LTE, LTE-A, eLTE (evolved LTE), New Radio (NR, often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above mentioned protocols.

The base station is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The base station supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage, (e.g., each cell schedules the downlink and optionally uplink resources to at least one UE within its radio coverage for downlink and optionally uplink packet transmissions). The base station can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate sidelink (SL) resources for supporting proximity service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as enhanced mobile broadband (eMBB), massive machine type communication (mMTC), ultra reliable communication and low latency communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The orthogonal frequency-division multiplexing (OFDM) technology as agreed in 3GPP may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) low-density parity-check (LDPC) code and (2) Polar Code. The coding scheme adaption may be configured based on the channel conditions and/or the service applications.

Moreover, it is also considered that in a transmission time interval TX of a single NR frame, a downlink (DL) transmission data, a guard period, and an uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, sidelink resource may also be provided in a NR frame to support ProSe services or V2X services.

The 3rd Generation Partnership Project (3GPP) has introduced a new radio resource control (RRC) state (i.e., the RRC_INACTIVE state) for the next generation (e.g., 5th generation (5G)) wireless communication networks. The RRC_INACTIVE state (also referred to as inactive state in the following description) aims to achieve power saving with acceptable access latency, and is suitable especially for small data transmission, such as in machine type communications (MTC) scenarios. When a UE is in an inactive state, the 5G radio access network (5G-RAN) (e.g., the next generation radio access network (NG-RAN), other 3GPP/non-3GPP access network connected to a 5G core network) and the UE store the "UE context" (which may include Access Stratum (AS) context and Non-Access Stratum (NAS) context of the UE) separately. In addition, when the UE is in the inactive state, the UE may not have an RRC connection with the 5G-RAN, although the 5G-RAN may keep a connection with the next generation core network (e.g., 5G Core Network (5GC)).

The on-demand SI request procedure may be implemented differently for the UEs that are in different Radio Resource Control (RRC) states. For example, in one implementation, for a UE that is in a connected state, the NW may deliver on-demand SI messages or SIB(s) via dedicated signaling to the UE after receiving an SI request from the UE. In some implementations, for a UE that is in an idle state or an inactive state, the NW may deliver on-demand SI messages or SIB(s) via broadcasting. In some implementations, the NW may control the message type for the on-demand SI request procedure. For example, the message type for the on-demand SI request procedure may include a Message 1 (MSG1) based approach and a Message 3 (MSG3) based approach.

In some of the present embodiments, if a Random Access (RA) preamble and/or a Physical Random Access Channel (PRACH) resource specific to each SIB or set of SIBs (which the UE needs to acquire) is included in the minimum SI (e.g., in the Master Information Block and the SIB1), the SI request may be indicated using an MSG 1-based approach.

In an MSG1-based SI request, in some implementations, the minimum granularity for a requested SI may be one SI message (for a set of SIBs, as in an LTE scenario). In some of such implementations, one RA preamble may be used to request for multiple SI messages. In some implementations, a Random Access Preamble Index (RAPID) may be included in a Message 2 (MSG2). Other fields, such as Timing Advance (TA), UL grant and Temporary Cell Radio Network Temporary Identifier (C-RNTI), may not be included in the MSG2 in some implementations.

In some of the present embodiments, an RA procedure for SI request may be considered successful when the UE receives an MSG2 that includes a RAPID corresponding to the transmitted preamble. The MSG2 reception may use an RA-RNTI that corresponds to the MSG1 transmitted by the UE.

In some of the present embodiments, the UE may retransmit the RA preamble according to an NR RA power ramping when the SI request is considered to be unsuccessful. The MSG1 for SI request re-transmission may be continued until reaching maximum preamble transmissions in some of the present embodiments. Thereafter, an RA problem may be indicated to the upper layer (e.g., RRC layer). In some of the present embodiments, a Back off mechanism may be applicable to the MSG1-based SI requests. In some of such embodiments, however, no special back off sub-header/procedure may be required.

In some of the present embodiments, if the RA preamble and/or the PRACH resource (or PRACH occasions) specific to each SIB or set of SIBs (which the UE needs to acquire) is not included in the minimum SI, the SI request may be included in an MSG3. The UE may determine whether the MSG3-based approach is successful or not based on a reception of the MSG4. The preamble(s) and/or the PRACH occasions for the SI request using the MSG3-based approach may not be reserved in some aspects of the present embodiments. RRC signaling may be used for the SI request in an MSG3-based approach. In some embodiments, the UE's ID may not be included in the MSG3.

In some of the present embodiments, a temporary C-RNTI received in the MSG2 may be used for an MSG4 reception. The UE may check the contention resolution Medium Access Control (MAC) Control Element (CE) against the transmitted request.

Specifically, based on the MSG1-based SI request procedure, a UE which transmits a preamble on a dedicated PRACH resource (or PRACH occasions) for the SI request may need to wait for a corresponding Random Access Response (RAR) within a configured RAR window. If no RAR that contains a RAPID corresponding to the transmitted preamble is received, the UE may retransmit the RA preamble until the corresponding RAR is received. The MSG1 for SI request re-transmission, in some of the present embodiments, may be continued until a maximum preamble transmission is reached. In some of such embodiments, an RA problem may be indicated to the upper layers. However, during the whole MSG1-based SI request procedure, the requested SIB(s) or SI message(s) may be broadcasted based on the NW decision or other UE's SI request(s). There may be a power consumption issue if the UE does not stop the ongoing MSG1-based SI request procedure when the required SIB(s) has been broadcasted.

As described above, based on the MSG1-based SI request procedure, a UE which transmits a preamble on a dedicated PRACH resource for the SI request may need to wait for the corresponding RAR within a configured RAR window. If no RAR that contains a RAPID corresponding to the transmitted preamble is received, the UE may retransmit the RA preamble until reaching a maximum preamble transmission, and then an RA problem may be indicated to upper layers. If the corresponding RAR is received, the UE may send an MSG3 to indicate the required SIB(s) and/or SI message(s). After sending the MSG3, the UE may need to wait for a period e.g., defined by a contention resolution timer) for receiving the MSG4 for contention resolution. If the contention resolution timer expires and no MSG4 is received, the UE may retransmit a preamble again. In some of the present embodiments, the MSG1 for the SI request re-transmission may be continued until a maximum preamble transmission is reached. In some aspects of the present embodiments, an RA problem may be indicated to the upper layers. Similarly, since contention resolution is also adopted for the MSG3-based SI request procedure, an RA problem may be indicated to the upper layers if the maximum preamble transmission is reached.

CASE 1: A UE's Behaviour when an On-Demand SI Request is Unsuccessful for the UE in an Idle State or an Inactive State:

When an MSG1-based SI request or an MSG3-based SI request procedure in a cell is failed, the UE may consider the cell as barred, or may consider that the required SIB(s) and/or SI message(s) are not available. In one implementation, the UE may consider the on-demand SI request procedure as unsuccessful when the number of times the UE transmits a random access preamble reaches a threshold (e.g., maximum allowable preamble transmissions), and/or the UE receives SI request rejection information (e.g., in a RAR) in some of the present embodiments.

If the UE considers that a cell is barred due to an SI request failure, the UE may consider the cell as barred for a configurable time period or a fixed time period (e.g., for 300 s). The UE may perform a cell reselection procedure to find another cell to camp on. The barring time period may be broadcasted to the UE in system information, carried in an MSG2 or MSG4, or may be predefined as a fixed value in some of the present embodiments.

If the UE considers that the required SIB(s) and/or SI message(s) are not available, the UE may not perform the SI request for the unavailable SIB(s) and/or SI message(s) again on the cell. In some of the present embodiments, when the UE considers that the required SIB(s) and/or SI message(s) are not available (e.g., when an RA procedure problem is reported, or when SI request rejection information is received), the UE may activate a prohibit timer. In some of such embodiments, the UE may avoid initiating another on-demand SI request procedure until the prohibit timer expires. In one implementation, the UE is forbidden to perform another on-demand SI request procedure until the prohibit timer expires. For example, the prohibit timer may start when an upper layer (e.g., the RRC layer) receives the SI request rejection information, or receives the RA problem due to an SI request failure from a lower layer (e.g., the MAC layer). After the prohibit timer expires, the UE may initiate another SI request procedure. The prohibit timer may be preconfigured or may be a fixed value in some of the present embodiments. The value of the prohibit timer may be broadcasted in system information, carried in an MSG2 or MSG4, or may be predefined as a fixed value in some embodiments.

In one implementation, if the prohibit timer is not present in the signaling from the NW, it is up to UE's implementation on when to start the SI request procedure again.

In one implementation, the UE may determine whether to perform a cell reselection procedure due to a failure of the MSG1-based SI request or the MSG3-bsed SI request. The UE may make such a determination based on whether the required SIB(s) and/or SI message(s) are essential for the UE (e.g. essential for the UE's targeting services) or based on some other predefined rules. For example, the UE may determine to perform a cell reselection procedure as a result of an unsuccessful SI request if the required SIB(s) and/or SI message(s) are essential.

The UE may perform a cell reselection procedure due to a failure of the MSG1-based SI request or the MSG3-based SI request. Specifically, when the UE performs a cell reselection procedure, the UE may consider the cell, for which the UE fails to request the required SIB(s) and/or SI messages(s), as barred or having a lower priority (e.g., by setting the priority of the frequency on which the barred cell is to a default value). In one implementation, the requested SIB(s) and/or SI messages(s) may be defined/considered as the essential SI for different UE categories or UE types. If the requested SIB(s) and/or SI messages(s) are not defined/considered as the essential SI for the category or type of the UE, the UE may decide whether to re-request the requested SIB(s) or SI messages(s) on the camped cell. In one implementation, if the requested SIB(s) or SI messages(s) are not defined/considered as the essential SI for the category or type of the UE, a prohibit timer may start when the upper layer (e.g., the RRC layer) receives the RA problem due to an SI request failure from the lower layer (e.g., the MAC layer). After the prohibit timer expires, the UE may perform the SI request procedure again. The prohibit timer may be preconfigured or be a fixed value. The value of the prohibit timer may be broadcasted in the system information, carried in an MSG2 or MSG4, or may be predefined as a fixed value.

CASE 2: A UE's Behaviour when the On-Demand SI Request is Unsuccessful for the UE in a Connected State:

A UE may also request the required SIB(s) or SI message(s) while the UE is in a connected state. Normally, the UE may receive the required SIB(s) or SI message(s) via dedicated signaling. If the UE does not receive the required SIB(s) or SI message(s) via dedicated signaling, (e.g., no response from the NW side to deliver the required SIB(s) or SI message(s), or receiving SI request rejection information), the UE may consider that there is an NW error and perform reestablishment to another qualified cell if there is another qualified cell with a valid UE context. If there is no such a qualified cell or if the reestablishment is rejected/failed, the UE may switch to an idle state and perform a cell reselection procedure by considering the cell as barred. In another implementation, the UE may directly switch to the idle state and then perform a cell reselection procedure by considering the cell as barred.

In one implementation, the NW may respond an SI request rejection message/information to the UE. After receiving the SI request rejection message/information, the UE may consider that the required SIB(s) or SI message(s) are not available and may not perform the SI request for those SIB(s) or SI message(s) again on the cell. In another implementation, a prohibit timer may be initiated when the UE receives the SI request rejection message/information. After the prohibit timer expires, the UE may perform an SI request procedure again. The prohibit timer may be preconfigured or may be a fixed value.

In one implementation, when the SI request procedure is unsuccessful, the UE may perform, at least, a reestablishment procedure, switch to an idle state for a cell reselection procedure, mark that the requested SIB(s) or SI message(s) are not available, etc.

In one implementation, the requested SIB(s) or SI messages(s) may be defined/considered as the essential SI for different UE categories or UE types. The UE may switch to the idle state and perform a cell reselection procedure when the SI request for essential SI is failed. The UE may consider the cell in which the SI request is failed as barred, or having a lower priority when performing a cell reselection procedure (e.g., by setting the priority of the frequency on which the barred cell is to a default value). The UE, in some of the present embodiments, may only mark that the requested SIB(s) or SI message(s) are not available when the SI request for non-essential SI is failed.

In the connected state, the NW may perform a handover (HO) procedure (e.g., from a source gNB to a target gNB) when receiving the SI request for required SIB(s) or SI message(s) that are not provided by the NW. The target gNB may provide the required SIB(s) or SI message(s) in the HO command (e.g., based on the SI request information provided in the HO Request message from the source gNB).

In the Dual Connectivity (DC) mode, the UE may inform the cause of a Secondary Node (SN) SI request failure, or the information related to the SI request failure to a Master Node (MN) when the on-demand SI request for the SIB(s) of the SN is rejected or failed. After the MN receives the cause of an SI request failure or the information related to the SI request failure, in some of the present embodiments, the MN may try to resolve the SN SI request rejection/failure problem. For example, in one aspect of the present embodiments, the MN may release the SN or change the SN to a new SN for the UE.

CASE 3: Store and Report the Information Related to the SI Request Failure:

An MSG1-based SI request or an MSG3-bsed SI request procedure may be failed when a lower layer (e.g., the MAC layer) informs an upper layer (e.g., the RRC layer) of an RA problem. Since the RRC layer knows the RA procedure is triggered for the SI request, the UE may store the SI request failure information. The SI request failure information may include one or more parameters used in the on-demand SI request procedure. The SI request failure information may include at least one of the following: the on-demand SIB(s) requested by the UE, the on-demand SI message(s) requested by the UE, the cell ID (of the cell in which the UE has performed the SI procedure but has failed), SSB Index(s) (Synchronization Signal Block Index(s)) to perform the SI request procedure, the message type of the failed SI request procedure (e.g., MSG1-based or MSG3-based), the time-stamp (e.g., when to perform the SI request procedure), etc. The SSB Index may indicate which SSB with RA resource (or RA occasions) is used for a preamble transmission. For example, for an MSG1-based approach, the dedicated RA resource (or RA occasions) for transmitting a preamble may be associated with an SSB. For an MSG3-based approach, the common RA resource (or RA occasions) for transmitting a preamble may be associated with an SSB. The UE may report such failure information to the NW when switching to a connected state later. The UE may mandatorily report the information of the SI request failure, according to the configuration, or upon an NW request. The content of the SI request failure information may be predefined, may be based on the required information indicated in the received SI request failure information message, or may be based on the configuration.

FIG. **1** is a sequence diagram illustrating the transmission of SI request failure information, according to an exemplary implementation of the present application. As shown in diagram **100**, in action **110**, serving node **104** (e.g., a gNB) may send a request to UE **102** to provide the information related to SI request failure. For example, serving node **104** may send an SI Request Failure Information Request message to UE **102** if UE **102** informs serving node **104** that such information is stored. In one implementation, UE **102** may set one bit in an RRC message (e.g., in the RRC Connection Setup Complete message or in the RRC Connection Resume message) to true (or '1') to inform serving node **104** that UE **102** supports storage of the SI request failure information and it has the SI request failure information stored. Serving node **104** may determine to request the SI request failure information after receiving such information from UE **102**. In action **112**, UE **102** may send a message including the SI request failure information to serving node **104**.

By utilizing the SI request failure information, serving node **104** may know how to adjust the SI request mechanism between the MSG1-based approach and the MSG3-based approach. For example, if UE **102** reports failure of an MSG3-based SI request procedure in a cell or a certain area, serving node **104** may consider adopting the MSG1-based SI request for the UEs in idle/inactive state to avoid an RA collision by using the dedicated RA resource(s) for SI request. Alternatively, serving node **104** may continue to adopt the MSG3-based SI request procedure when UE **102** reports the failure of the MSG3-based SI request procedure.

In one implementation, UE **102** may store the information related to the SI request failure when UE **102** considers the cell as barred and performs a cell reselection procedure. UE **102** may not store the information related to the SI request failure when UE **102** considers that the required SIB(s) or SI message(s) are not available.

When the SI request procedure for a UE that is in a connected state is failed (e.g., UE **102** does not receive the required SIB(s) or SI message(s) via dedicated signaling, or UE **102** receives the SI request rejection information), UE **102** may store the information of the SI request failure. In one implementation, when the SI request procedure is unsuccessful, UE **102** may perform re-establishment to another qualified cell, or UE **102** may switch to an idle state and then perform a cell reselection procedure by considering the cell as barred. The information of the SI request failure may include at least one of the following: the required SIB(s), the required SI message(s), the cell ID (of the cell in which the UE preforms SI procedure but failed), and the timestamp of the SI request procedure. UE **102** may report such failure information to the NW when switching to a connected state later. UE **102** may mandatorily report the information of the SI request failure, according to the configuration, or upon receiving an NW request. The content of the SI request failure information may be predefined, may be based on the required information indicated in the received SI request failure information message, or may be based on the configuration.

Similarly, UE **102** may store the SI request failure information when UE **102** is in a connected state if the SI request is unsuccessful (where SI request procedure may be an MSG1-based SI approach or an MSG3-based SI approach). The SI request failure information may include at least one of the following: the on-demand SIB(s) requested by UE **102**, the on-demand SI message(s) requested by UE **102**, the cell ID (of the cell which UE **102** preforms SI procedure but failed), SSB Index(s) (Synchronization Signal Block Index(s)) to perform the on-demand SI request procedure, the message type of the unsuccessful SI request procedure (e.g., MSG1-based or MSG3-based), and the timestamp (e.g., when to perform the SI request procedure). The UE may mandatorily report the SI request failure information, according to the configuration, or by an NW request (e.g., requested by serving node **104**). The content in the SI request failure information may be predefined, may be based on the required information indicated in the received SI Request Failure Information message, or may be based on the configuration.

It may be beneficial for the NW to know the information related to SI request failure. For example, the NW may determine which cell, SIB(s)/SI message(s), or the related dedicated preamble may have problems. As a result, the NW is likely to overcome the problem afterwards, or the NW may consider adopting another mechanism for serving the SI request.

In the DC mode, a UE may inform the cause of a Secondary Node (SN) SI request failure, or the information related to the SI request failure, to a Master Node (MN) when the on-demand SI request for the SIB(s) of the SN is rejected or failed. After MN receives the cause of the SI request failure or the information related to the SI request failure, the MN may try to resolve the SN's SI request rejection/failure problem. For example, the MN may release the SN or change the SN to a new SN for the UE.

CASE 4: Harmonization of the SI Request Messages in Idle, Inactive, and Connected States:

For an MSG3-bsed SI request procedure, the MSG3 may include an SI request message (which may be an RRC message) containing no UE ID. In an idle state, there may be no security key and/or security algorithm configured to the UE yet. Therefore, the SI request message transmitted in an idle state may be transmitted on Signaling Radio Bearer 0 (SRB0). Neither integrity protection, nor ciphering, apply to the SRB0 in some embodiments. In one implementation, the SI request message (which is an RRC message) may be the same for idle, inactive, and connected states, resulting in an RRC message harmonization. The SI request message may be transmitted on the SRB0 without integrity protection and ciphering, even if the UE is in a connected state, or in an inactive state, where integrity protection and ciphering may have been already applied.

In one implementation, the SI request message (which is an RRC message) that includes no UE ID may be the same for idle, inactive, and connected states. The UE may transmit the SI request message on the SRB0 when the UE is in an idle or an inactive state. The UE may transmit the SI request message on Signaling Radio Bearer 1 (SRB1) when the UE is in a connected state. Both integrity protection and ciphering may apply to the SRB1.

In one implementation, the SI Request message (which is an RRC message) may be the same for idle, inactive, and connected states. The UE may transmit the SI request message on the SRB0 when the UE is in an idle state. The UE may transmit the SI request message on the SRB1 when the UE is in an inactive or a connected state. Both integrity protection and ciphering may apply to the SRB1. In an inactive State, the UE may still have the UE context and the NW's configuration for integrity protection and ciphering.

In one implementation, whether the SI request message is transmitted on the SRB0 or the SRB1 for a UE in an inactive state may be determined based on the UE's implementation, the NW's preconfiguration, and/or whether the UE context for integrity protection and ciphering is stored/valid or not.

It may be beneficial to keep the commonality of the SI Request message with respect to the UEs in different states, which may lead to simplification of the overall system design in some of the present embodiments.

CASE 5: The Structure of an SI Request Message:

In one implementation, the SI request message in the MSG3 (e.g., in an MSG3-based SI request procedure) may be the same for idle, inactive, and connected states. Different minimum granularity of the requested SI (e.g., SIB-based or SI message-based) may be considered in connection with the SI request message. For example, it may be beneficial for the SI request message to use SI message-based granularity (e.g., the UE indicates which SI message(s) is requested) in the MSG3-based SI request procedure, since there is a one-bit indicator in the NR SIB1 to show whether the corresponding SI message is currently broadcasted or not, and the number of SI messages may be much less than the number of SIBs. However, the SI message-based granularity may not provide sufficient information to the NW in regards to which SIB(s) needs to be broadcasted and/or whether the mapping of the SIB(s) and the SI message(s), and the associated periodicity may need to be re-arranged based on the UE's requirements. The UE in connected state may receive the required SI via dedicated signaling. Therefore, in one implementation, the SIB-based granularity may be used, e.g., by the UE indicating which SIB(s) is requested.

Different implementations regarding the different SIB-based granularities will be discussed next:

CASE 5-1:

In the SI Request message, there may be a choice structure in which the UE may choose to use the SI message-based granularity or the SIB-based granularity. The UE may consider the signaling overhead to select which granularity to use. In one implementation, the UE may use a first bitmap to indicate which SI message(s) is requested and a second bitmap to indicate which SIB(s) is requested. In one implementation, there may be a common bitmap for the UE to indicate which SI message(s) is requested or which SIB ID(s) is requested.

CASE 5-2:

In the SI Request message, there may be a choice structure in which the UE may choose to use the SI message-based granularity or the SIB-based granularity. The UE may select one of the two types of granularity based on the NW configuration. The NW configuration may be delivered to the UE via dedicated signaling or via broadcasting. In one implementation, the UE may use a first bitmap to indicate which SI message(s) is requested and a second bitmap to indicate which SIB(s) is requested. In one implementation, there may be a common bitmap for the UE to indicate which SI message(s) is requested or which SIB ID(s) is requested.

CASE 5-3:

In the SI Request message, in some of the present embodiments, the UE may request one or more SI messages together with one or more SIBs. For example, both SI message-based granularity and SIB-based granularity may be potentially used in the SI Request message. Specifically, a UE may send an SI Request message that only uses the SI message-based granularity, only uses the SIB-based granularity, or uses both SI message-based granularity and SIB-based granularity. The UE may use a first bitmap to indicate which SI message(s) is requested and a second bitmap to indicate which SIB(s) is requested. In one implementation, there may be a common bitmap for the UE to indicate which SI message(s) is requested or which SIB ID(s) is requested.

CASE 5-4:

In some of the present embodiments, the UE may use a two-level bitmap for the SI request messages. In some of such embodiments, the first level bitmap may be used for the SI-based granularity, which may be mandatorily appended in the SI request message. The second level bitmap may be used for the SIB-based granularity, which may be optionally appended in the SI request message if the corresponding SI bit is set to "1" in the first level bitmap. As an example, in which there are 5 SI messages, and the SI message#3 includes SIB#7, SIB#8, SIB#9 and SIB#10, when the UE wants to request SIB#9, the first level bitmap of the UE's SI request message may be "0100" (which indicates SI message#3), and the UE may further optionally append the second level bitmap "0100" (which indicates the third SIB in the SI message#3). Consequently, a gNB may provide SIB#9 specifically in response to such an SI request message. In one implementation, if the second bitmap does not appear, the gNB may provide the complete SI message#3.

CASE 6: On-Demand SI Request Procedure in an NR-NR DC Scenario:

A UE in an NR-NR Dual Connectivity (DC) mode may request one or more required SIBs or one or more SI messages for certain purpose(s) or certain service(s). Several implementations are described below regarding how the UE may request and receive the required SIB(s) from a secondary node (SN) or the serving cells in a secondary cell group (SCG).

CASE 6-1:

When a UE is in an NR-NR DC mode and one or more SIBs or one or more SI messages are required, the UE may be only allowed to send the SI request message to the master node (MN) in some of the present embodiments.

FIG. **2** is a sequence diagram illustrating an example of an on-demand SI request being transmitted to an MN in the DC mode, according to an exemplary implementation of the present application. As shown in diagram **200**, in action **210**, UE **102** may transmit an SI request message to MN **106** when UE **102** requires on-demand system information of a cell belonging to MN **106** or a cell belonging to SN **108**. In action **212**, MN **106** may inform SN **108** to provide the required SIB(s) or SI message(s) to UE **102** based on the SI request message. For example, MN **106** may use a signaling message between two base stations (e.g., X2-AP message or Xn-AP message) with fields indicating the requested SIB(s) or SI message(s). When SN **108** receives the SI request from MN **106**, SN **108** may transmit the required SIB(s) or SI message(s) to UE **102** by initiating serving cell release and addition action in the same RRC reconfiguration message to update the SIB(s) or SI message(s) for certain, or all, serving cell(s). As shown in diagram **200**, this RRC reconfiguration may be transmitted via MN **106** or transmitted via Signaling Radio Bearer 3 (SRB3), if configured.

When the UE requires on-demand system information of a cell belonging to MN **106**, if the requested SI message or SIB is not broadcasted, in action **214**, MN **106** may transmit the required SI to UE **102**. When the UE requires on-demand system information of a cell belonging to SN **108**, if the requested SI message or SIB is not provided before, in action **216**, SN **108** may transmit RRC Reconfiguration with the required SI to UE **102** (e.g., via the SRB3). In one implementation, SN **108** may transmit RRC Reconfiguration with required SI (e.g., action **216**) only when SN **108** receives the SI Request Notification from MN **106** (e.g., action **212**).

In one implementation, SN **108** may directly transmit the modified SIB(s) or SI messages(s) to UE **102** without taking cell release and addition action, when MN **106** sends the SI Request Notification to SN **108**. SN **108** may transmit the modified SIB(s) or SI messages(s) directly to UE **102** only when receiving the SI Request Notification from MN **106**.

In one implementation, UE **102** is only allowed to send the SI request message to MN **106**. The UE may indicate in the SI request message that the SI Request is for the SIB(s) or the SI message(s) on MN **106** or SN **108**. If the SI Request message is marked for MN **106**, MN **106** may be responsible for this SI Request message. On the other hand, if the SI Request message is marked for SN **108**, MN **106** may forward this message to SN **108** and SN **108** may be responsible for this SI Request message. It should be noted that UE **102** may follow the minimum SI's indication (e.g., SI transmission period) of MN **106** or SN **108** to receive the SI while the SI request message is marked to MN **106** or SN **108**, respectively. In another implementation, UE **102** may not mark the SI request toward MN **106** or SN **108**, and MN **106** may provide all (MN **106** and SN **108**) relative SI to UE **102** in a unicast approach.

If some or all of the serving cells in the SCG do not provide the requested SIB(s) or SI message(s), SN **108** may inform MN **106** that the SCG, or some serving cells in the SCG, does not provide the requested SIB(s) or SI message(s). MN **106** may decide whether to perform the SCG change action or release SN **108** for UE **102**.

CASE 6-2:

When a UE in the NR-NR DC mode and one or more SIBs or SI messages are required, the UE may send the SI request message to the MN and/or the SN when required.

FIG. **3** is a sequence diagram illustrating an example of the on-demand SI request being transmitted to an SN in the DC mode, according to an exemplary implementation of the present application. As shown in diagram **300**, in action **310**, UE **102** may transmit the SI request message to SN **108** (e.g., via SRB3, if configured). In action **312**, SN **108** may transmit RRC Reconfiguration with the required SI to UE **102** via SRB3. If SRB3 is not configured, UE **102** may transmit the SI request message to MN **106** and let MN **106** forward the SI request message to SN **108**.

When some or all of the serving cells in the SCG cannot provide the required SIB(s) or SI message(s), SN **108** may inform MN **106** that the SCG, or some serving cells in the SCG, does not provide the requested SIB(s) or SI message(s). MN **106** may decide whether to perform the SCG change action or release SN **108** for UE **102**.

FIG. **4** is a sequence diagram illustrating an example of the UE determining the failure of an SI request in the DC mode, according to an exemplary implementation of the present application. As shown in diagram **400**, in action **410**, UE **102** sends an SI request message to SN **108**. In action **412**, UE **102** determines the failure of the SI request, e.g., when the number of times UE **102** transmits the random access preamble reaches a threshold. After determining the on-demand SI request procedure is unsuccessful, UE **102** may store the SI request failure information related to SN **108**. In action **414**, UE **102** may transmit the SN SI request failure information to MN **106**.

FIG. **5** is a sequence diagram illustrating an example of the UE receiving SI request rejection information in the DC mode, according to an exemplary implementation of the present application. As shown in diagram **500**, in action **510**, UE **102** sends an SI request message to SN **108**. In action **512**, UE **102** receives the SI request rejection information from SN **108**. After determining the on-demand SI request procedure is unsuccessful, UE **102** may store the SI request failure information related to SN **108**. In action **514**, UE **102** may send the SN SI request failure information to MN **106**.

If UE **102** determines that the SI request procedure on SN **108** has failed (e.g., action **412** in diagram **400** or action **512** in diagram **500**), UE **102** may inform MN **106** of the cause of SN SI request failure or the information related to SN SI request failure (e.g., by sending an SN SI Request Failure Information when the on-demand SI request for the SIB(s) of SN **108** is rejected or failed, e.g., in action **414** of diagram **400**, or action **514** of diagram **500**). The information of the SI request failure may include at least one of the following: the required SIB(s), the required SI message(s), the cell ID (of the cell which the UE preforms SI procedure but failed), SSB Index(s) (Synchronization Signal Block Index(s)) to perform SI request, the failed SI request procedure type (e.g., MSG1-based or MSG3-based), or the timestamp (e.g., when to perform the SI request procedure). After MN **106** receives the cause of the SI request failure or the information related to the SI request failure, MN **106** may resolve the SN SI request rejection/failure problem. For example, MN **106** may release SN **108** or change SN **108** to a new SN for UE **102**.

CASE 7: An RA Problem Caused by the MSG1-Based/MSG3-Based SI Request Procedure:

A UE in connected state may be allowed to apply an MSG1-based SI request procedure and/or an MSG3-based SI request procedure. In one implementation, if the RA problem is caused by the MSG1-based or the MSG3-bsed SI request procedures, the UE's operation in connected state is not affected if the requested SI message(s) or SIB(s) is not essential for the UE to perform the targeting services.

In one implementation, the UE may still be fine even if the requested SIB(s) or SI message(s) is not received from the serving node (e.g., in a single connectivity mode) or the MN (e.g., in dual connectivity mode) (e.g., the requested SIB or SI message may not be essential). In this scenario, the UE may not consider the RA problem as a normal radio link failure, and the UE may not perform a re-establishment procedure, or enter into an idle state.

In one implementation, the UE may still be fine even if the requested SIB(s) or SI message(s) is not received from the SN (e.g., in a dual connectivity mode). In this scenario, the UE may not consider the RA problem as a normal radio link failure, and the UE may report the SI failure information to the MN. For example, when the RA problem is reported and the upper layer (e.g., the RRC layer) knows that the problem is caused by an SI request, the UE may initiate a transmission of the SI failure information report to the MN. In this implementation, the UE may not suspend all of the SCG data radio bearers (DRBs) or SCG transmission for the split DRBs or the duplication DRBs. Also, the UE may not reset the MAC entity associated with the SCG (or SN).

In one implementation, the UE may still be fine even if the requested SIB(s) or SI message(s) is not received from the SN (e.g., in a dual connectivity mode). In this scenario, the UE may not consider the RA problem as a normal radio link failure, and the UE may not report the SI failure information to the MN. For example, when the RA problem is reported and the upper layer (e.g., RRC layer) knows that the problem is caused by an SI request, the UE may not initiate a transmission of the SI failure Information report to the MN. In this implementation, the UE may not suspend all of the SCG DRBs or SCG transmission for the split DRBs or the duplication DRBs. Also, the UE may not reset the MAC entity associated with the SCG (or SN). When the upper layer (e.g., the RRC layer) receives the RA problem caused by the SI request from the lower layer (e.g., the MAC layer), it may also inform the NAS layer (or the application layer) so that the NAS layer (or the application layer) does not trigger the SI request procedure for one or more required SIBS on the same cell, or not trigger the SI request procedure for a while (which may follow the NW configuration or a predefined period). How to handle the SI request failure condition may depend on the UE's implementation, if the NAS layer (or the application layer) is informed about the SI request failure.

In one implementation, whether the SN initiates the transmission of the SI failure information report to the MN may depend on the NW configuration.

FIG. **6** is a flowchart for a method of wireless communications performed by a UE, according to an example implementation of the present application. In FIG. **6**, the process/method **600** includes actions **602**, **604**, **606**, and **610**.

In action **602**, the UE may perform an on-demand system information request procedure in a cell. The UE may be in idle, inactive, or connected state. In addition, the UE may be in a single connectivity mode or a dual connectivity mode.

In action **604**, the UE may determine whether the on-demand SI request procedure is successful. In one implementation, the on-demand SI request procedure is considered unsuccessful when the number of times the UE transmits a random access preamble reaches a threshold, and/or the UE receives the SI request rejection information. If the process **600** determines, in action **604**, that the SI request procedure is unsuccessful, the UE may proceed to action **606**. On the other hand, if the request procedure is successful, the process **600** may end.

In action **606**, the UE may perform an error handling procedure corresponding to the on-demand SI request procedure. There may be several implementations regarding the error handling procedure in different implementations. In one implementation, the error handling procedure may include action **610**, in which the UE may store the SI request failure information. For example, the SI request failure information may include one or more parameters used in the on-demand SI request procedure. In one implementation, the error handling procedure may further include at least one of following: a prohibit timer activation, a cell re-selection procedure, and a re-establishment procedure.

FIG. **7** illustrates a block diagram of a node for wireless communication, in accordance with various aspects of the present application. As shown in FIG. **7**, node **700** may include transceiver **720**, processor **726**, memory **728**, one or more presentation components **734**, and at least one antenna **736**. Node **700** may also include a Radio Frequency (RF) spectrum band module, a base station communications module, a network communications module, and a system communications management module, input/output (I/O) ports, I/O components, and power supply (not explicitly shown in FIG. **7**). Each of these components may be in communication with each other, directly or indirectly, over one or more buses **740**.

Transceiver **720** having transmitter **722** and receiver **724** may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, transceiver **720** may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. Transceiver **720** may be configured to receive data and control channels.

Node **700** may include a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by node **700** and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data.

Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

Memory **728** may include computer-storage media in the form of volatile and/or non-volatile memory. Memory **728** may be removable, non-removable, or a combination thereof Exemplary memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in FIG. **7**, memory **728** may store computer-readable, computer-executable instructions **732** (e.g., software codes) that are configured to, when executed, cause processor **726** to perform various functions described herein, for example, with reference to FIGS. **1** through **6**. Alternatively, instructions **732** may not be directly executable by processor **726** but be configured to cause node **700** (e.g., when compiled and executed) to perform various functions described herein.

Processor **726** may include an intelligent hardware device, e.g., a central processing unit (CPU), a microcontroller, an ASIC, and etc. Processor **726** may include memory. Processor **726** may process data **730** and instructions **732** received from memory **728**, and information through transceiver **720**, the base band communications module, and/or the network communications module. Processor **726** may also process information to be sent to transceiver **720** for transmission through antenna **736**, to the network communications module for transmission to a core network.

One or more presentation components **734** presents data indications to a person or other device. Exemplary one or more presentation components **734** include a display device, speaker, printing component, vibrating component, and etc.

From the above description, it is manifest that various techniques can be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes can be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

What is claimed is:

1. A method of an on-demand system information (SI) request procedure performed by a user equipment (UE), the method comprising:

transmitting a first SI request message to a base station (BS) after determining that the UE is in a connected state, the first SI request message including at least one requested system information block (SIB);

activating a prohibit timer; and

transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires.

2. The method of claim **1**, wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met:

a number of times the UE transmits a random access preamble reaches a threshold; and

the UE receives SI request rejection information.

3. The method of claim **1**, wherein when the UE is in a dual connectivity mode, the method further comprises:

transmitting a third SI request message to a master node when the UE requires on-demand system information of a cell belonging to a secondary node.

4. The method of claim **1**, wherein the first SI request message is transmitted on signaling radio bearer **1** (SRB1).

5. The method of claim **1**, further comprising:

receiving, from the BS, the at least one requested SIB via dedicated signaling that is transmitted in response to the first SI request message.

6. The method of claim **1**, further comprising:

transmitting a fourth SI request message to the BS after determining that the UE is not in the connected state, the fourth SI request message including at least one requested SI message.

7. The method of claim **6**, wherein the fourth SI request message is transmitted on signaling radio bearer 0 (SRB0).

8. The method of claim **1**, further comprising:

storing SI request failure information after determining that the on-demand SI request procedure is unsuccessful.

9. The method of claim **8**, wherein the SI request failure information comprises at least one of the following:

the at least one requested SIB;

the at least one requested SI message;

a cell identifier (ID) associated with the BS;

a synchronization signal block (SSB) index for performing the on-demand SI request procedure;

a message type of the on-demand SI request procedure; and

a timestamp for performing the on-demand SI request procedure.

10. The method of claim **8**, further comprising:

transmitting the SI request failure information;

wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode.

11. A user equipment (UE), comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to perform operations for an on-demand system information (SI) request procedure, the operations comprising:

transmitting a first SI request message to a base station (BS) after determining that the UE is in a connected state, the first SI request message including at least one requested system information block (SIB);

activating a prohibit timer; and

transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires.

12. The UE of claim **11**, wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met:

a number of times the UE transmits a random access preamble reaches a threshold; and

the UE receives SI request rejection information.

13. The UE of claim **11**, wherein when the UE is in a dual connectivity mode, the operations further comprise:

transmitting a third SI request message to a master node when the UE requires on-demand system information of a cell belonging to a secondary node.

14. The UE of claim **11**, wherein the first SI request message is transmitted on signaling radio bearer 1 (SRB1).

15. The UE of claim **11**, wherein the operations further comprise:

receiving, from the BS, the at least one requested SIB via dedicated signaling that is transmitted in response to the first SI request message.

16. The UE of claim **11**, wherein the operations further comprise:

transmitting a fourth SI request message to the BS after determining that the UE is not in the connected state, the fourth SI request message including at least one requested SI message.

17. The UE of claim **16**, wherein the fourth SI request message is transmitted on signaling radio bearer **0** (SRB0).

18. The UE of claim **11**, wherein the operations further comprise:

storing SI request failure information after determining that the on-demand SI request procedure is unsuccessful.

19. The UE of claim **18**, wherein the SI request failure information comprises at least one of the following:

the at least one requested SIB;

the at least one requested SI message;

a cell identifier (ID) associated with the BS;

a synchronization signal block (SSB) index for performing the on-demand SI request procedure;

a message type of the on-demand SI request procedure; and

a timestamp for performing the on-demand SI request procedure.

20. The UE of claim **18**, wherein the operations further comprise:

transmitting the SI request failure information;

wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode.

* * * * *

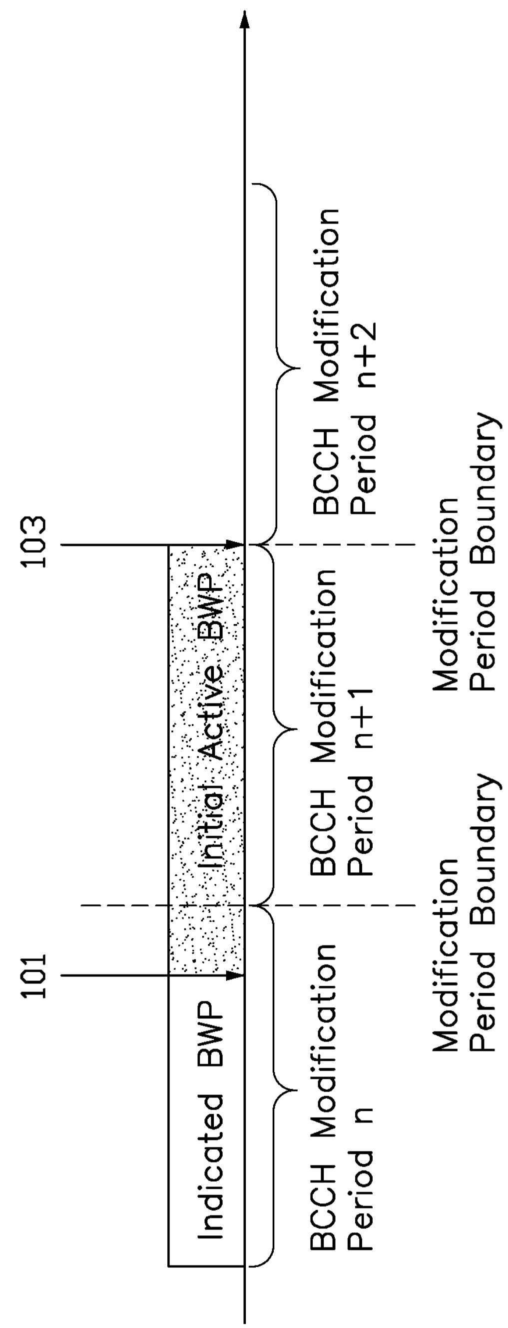

103
101
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 1

Exhibit 3

US010972972B2

(12) **United States Patent**
Cheng et al.

(10) **Patent No.: US 10,972,972 B2**
(45) **Date of Patent: Apr. 6, 2021**

(54) **METHODS AND APPARATUSES FOR OPERATING MULTIPLE ANTENNA PANELS**

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(73) Assignee: **FG Innovation Company Limited**, Tuen Mun (HK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/511,170**

(22) Filed: **Jul. 15, 2019**

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Related U.S. Application Data

(60) Provisional application No. 62/699,465, filed on Jul. 17, 2018.

(51) **Int. Cl.**

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H04W 76/28	(2018.01)
H04W 52/02	(2009.01)
H04B 17/309	(2015.01)
H04W 24/10	(2009.01)
H04W 72/04	(2009.01)

(52) **U.S. Cl.**

CPC ***H04W 48/20*** (2013.01); ***H04B 17/309*** (2015.01); ***H04W 24/10*** (2013.01); ***H04W 52/0216*** (2013.01); ***H04W 72/042*** (2013.01); ***H04W 76/28*** (2018.02)

(58) **Field of Classification Search**

CPC H04W 48/20; H04W 76/28; H04W 24/10; H04W 52/0216; H04W 72/042; H04B 17/309

See application file for complete search history.

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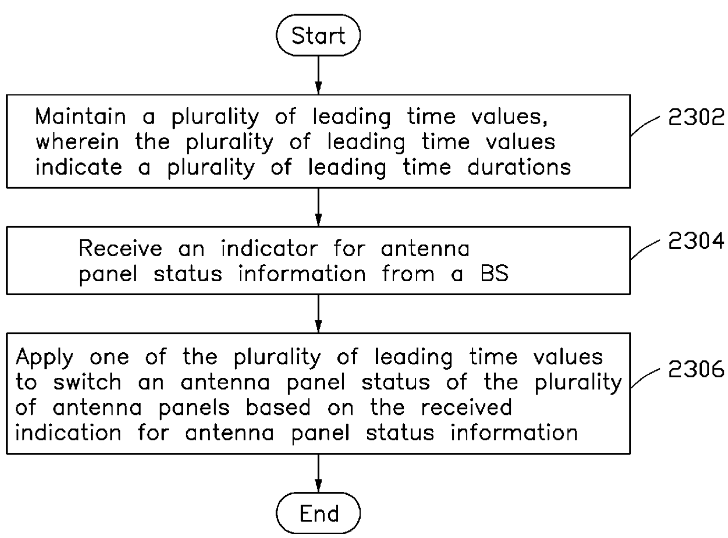
Primary Examiner — Chi H Pham
Assistant Examiner — Ji-Hae Yea
(74) *Attorney, Agent, or Firm* — ScienBiziP, P.C.

(57) **ABSTRACT**

Methods and apparatuses for operating multiple antenna panels are provided. The wireless communication device includes a plurality of antenna panels and a processor coupled to the antenna panels. The processor is configured to maintain a plurality of leading time values. The plurality of leading time values may indicate a plurality of leading time durations. The processor is further configured to receive an indicator for antenna panel status information from a base station, and apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information.

28 Claims, 27 Drawing Sheets



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* cited by examiner

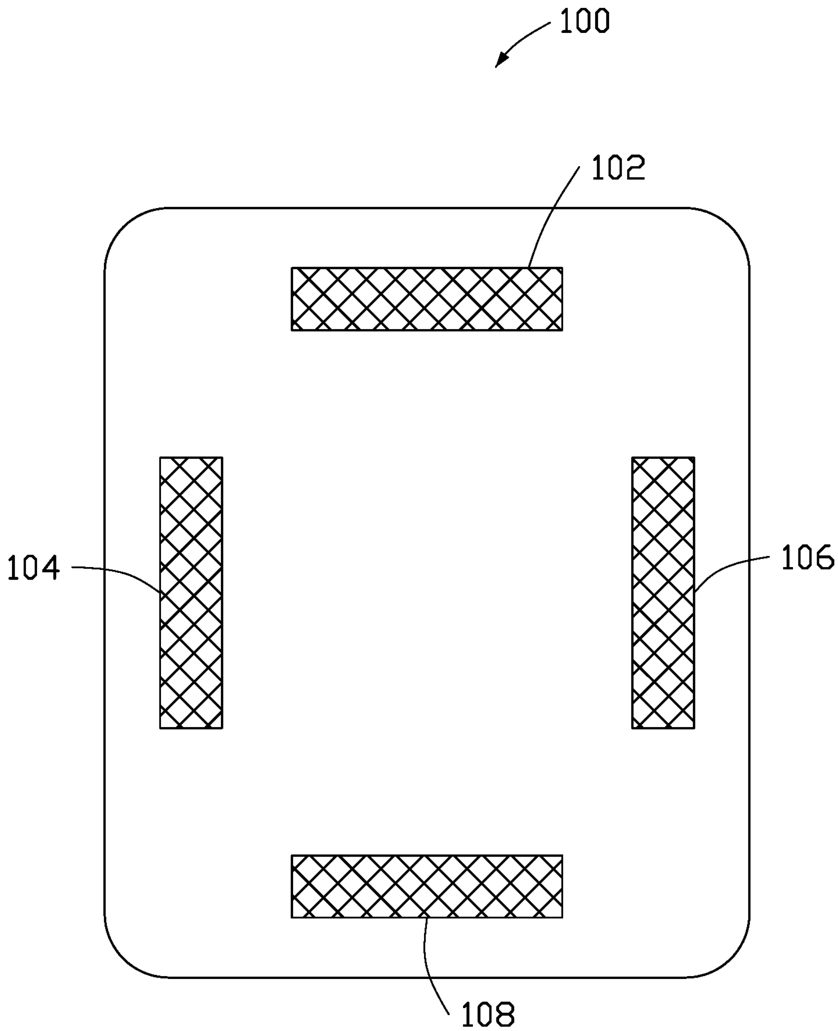
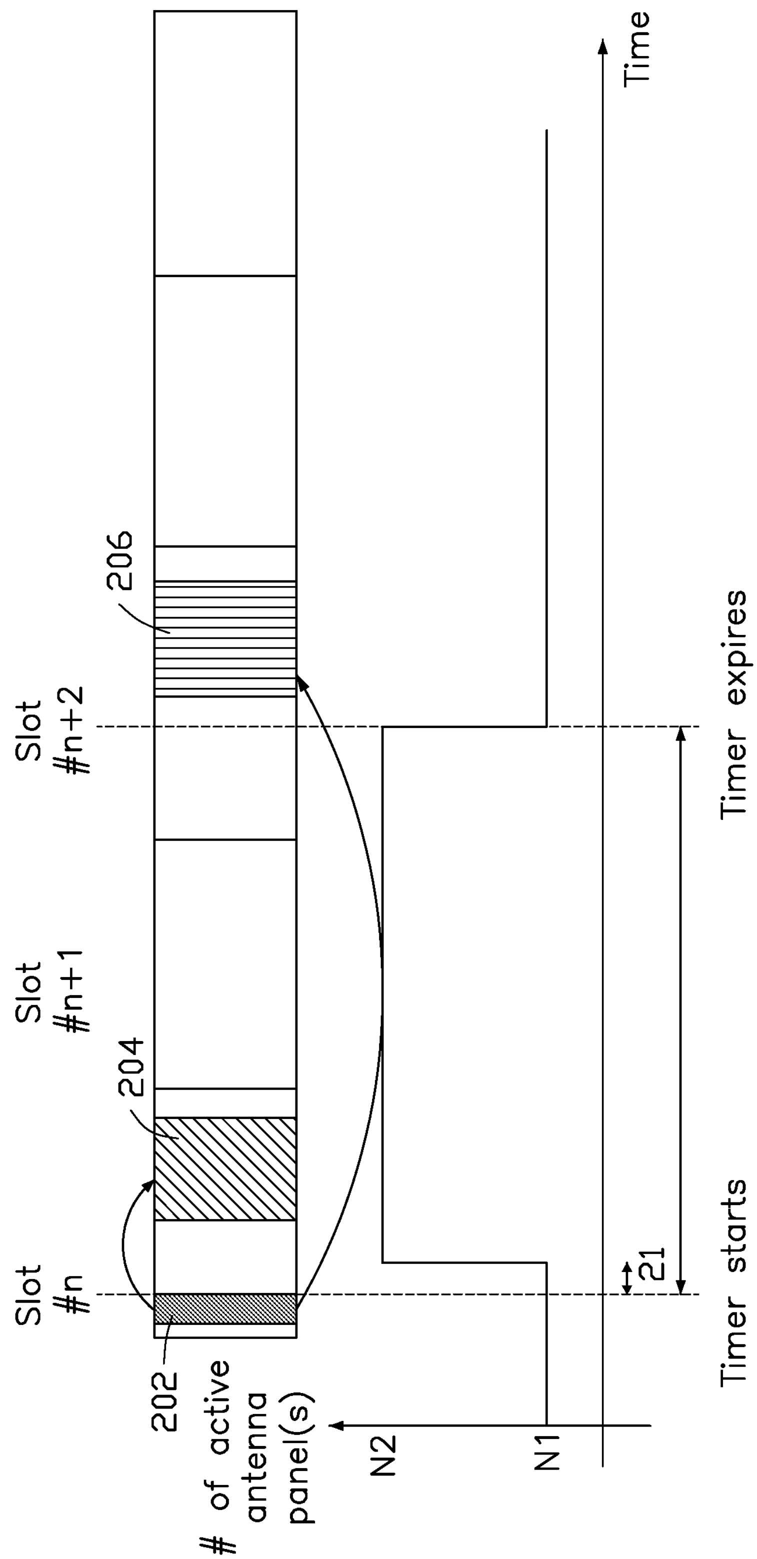


FIG. 1



Time
206
Slot #n+2
Slot #n+1
204
Slot #n
202
# of active antenna panel(s)
N2
N1
21
Timer starts
Timer expires

FIG. 2

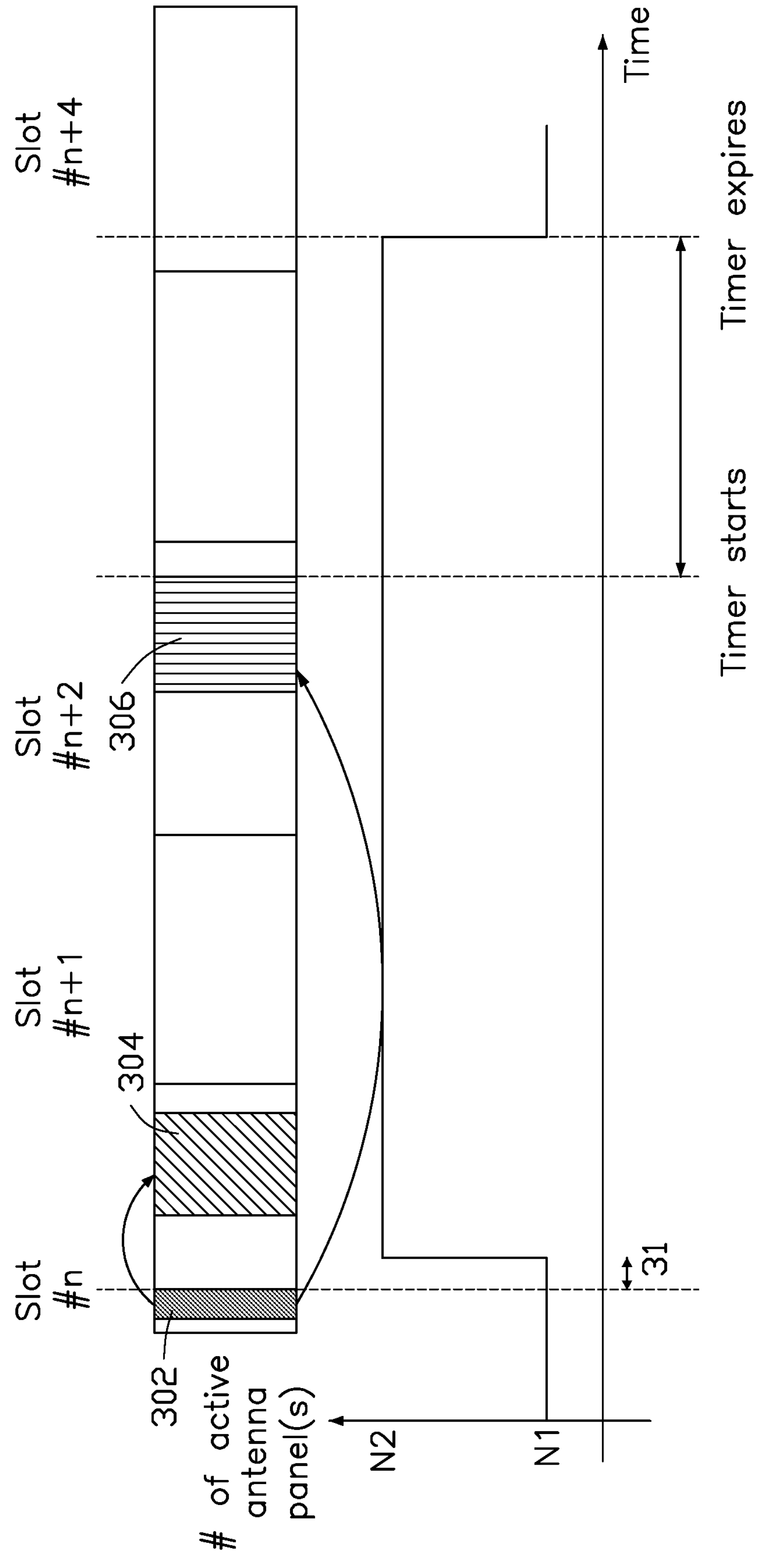

Slot #n
Slot #n+1
Slot #n+2
Slot #n+4
302
304
306
31
# of active antenna panel(s)
N2
N1
Timer starts
Timer expires
Time

FIG. 3

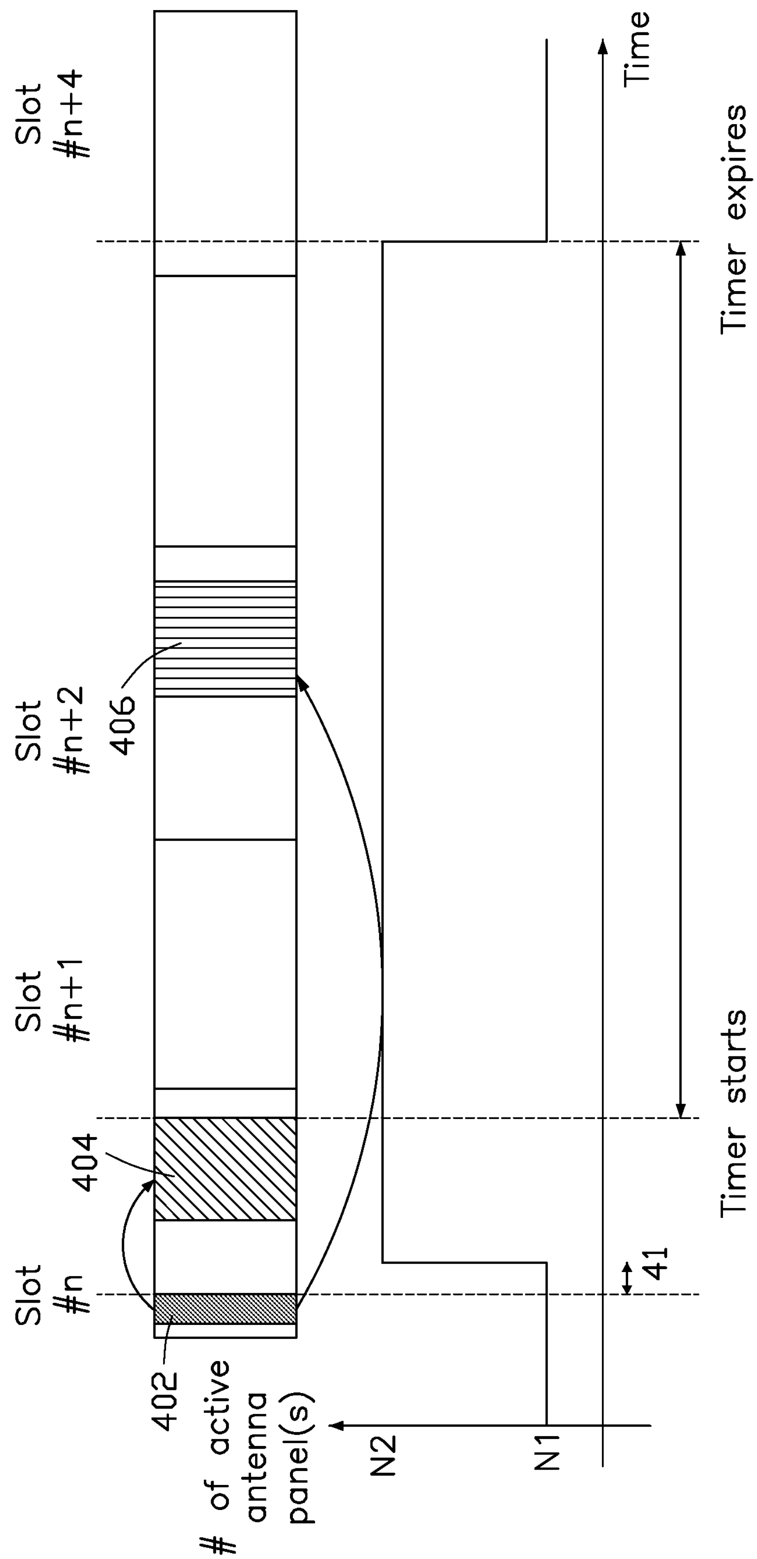

Slot #n
Slot #n+1
Slot #n+2
Slot #n+4
402
404
406
41
# of active antenna panel(s)
N2
N1
Timer starts
Timer expires
Time

FIG. 4

502

- UE capability
  - power saving indicator
    - {True/Support, False/Not support}
  - timer for antenna panel status
    - {True/Support, False/Not support}
  - maximum number of support antenna panels
    - {one, two, four or eight}
  - support indication method
    - {True/Support, False/Not support}
  - require time for antenna panel status switch
    - {1ms, 2ms, 3ms, 4ms}
  - UE assistance
    - {True/Support, False/Not support}

FIG. 5

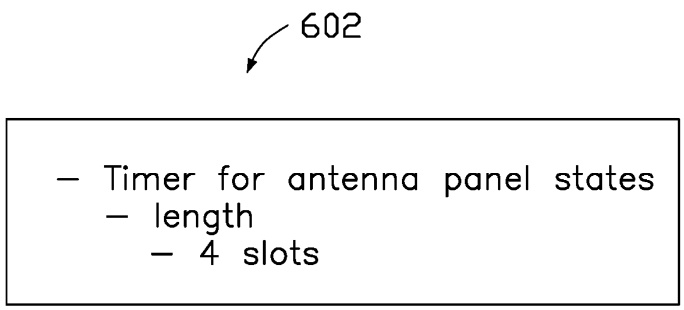


FIG. 6

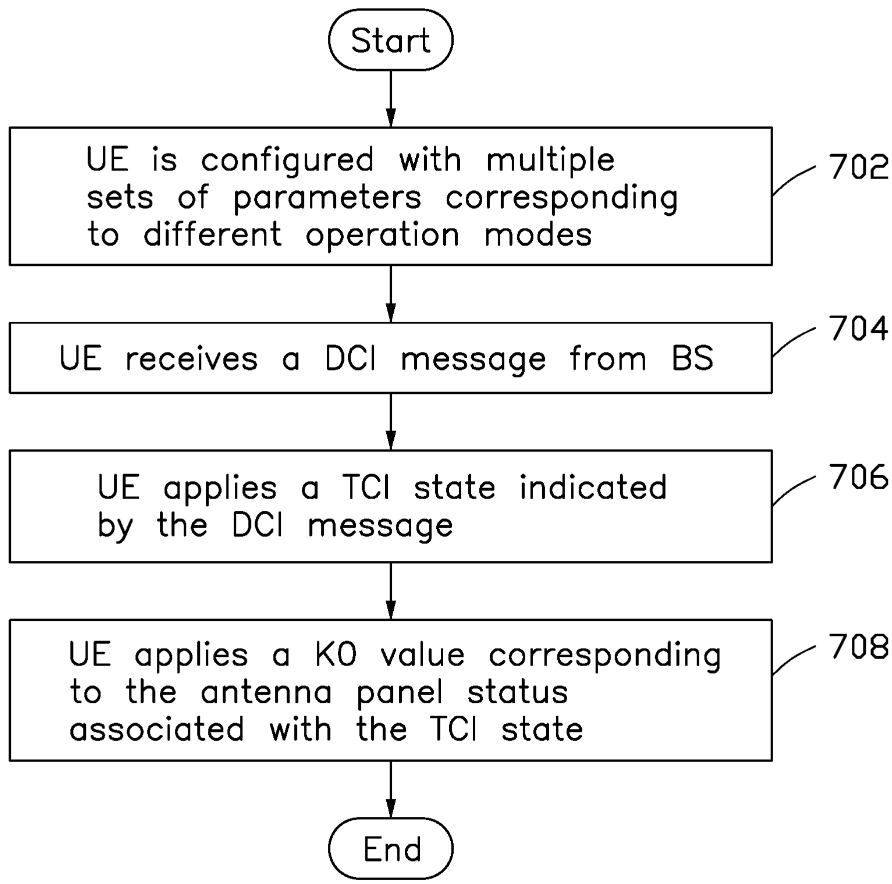

Start
UE is configured with multiple sets of parameters corresponding to different operation modes
702
UE receives a DCI message from BS
704
UE applies a TCI state indicated by the DCI message
706
UE applies a K0 value corresponding to the antenna panel status associated with the TCI state
708
End

FIG. 7

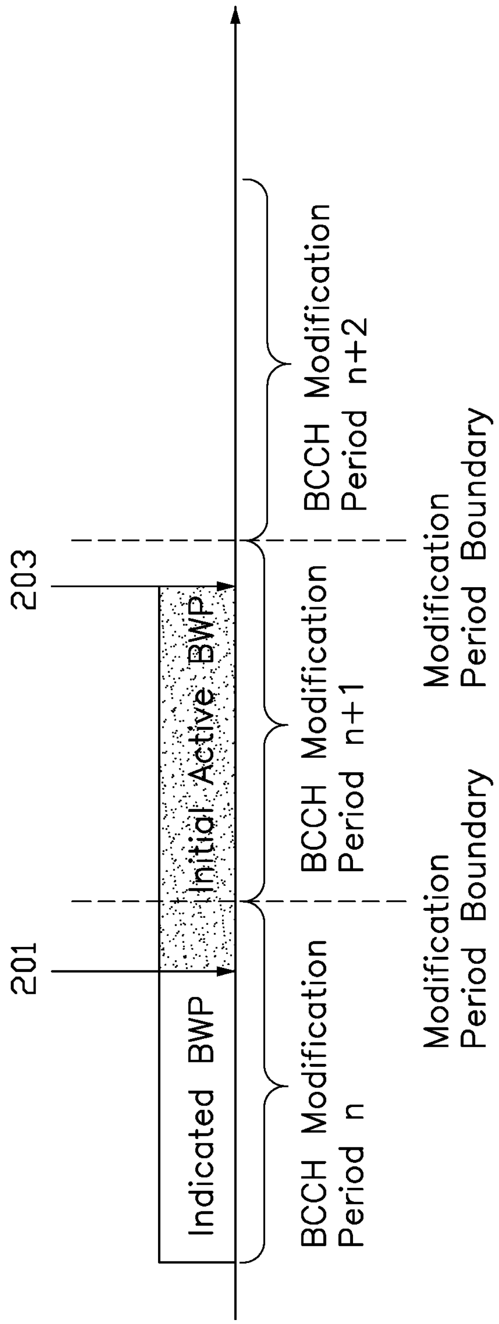

201
203
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 2

802

- tci-State #1
  - qcl-Type1
    - referenceSignal
      - CSI RS resource#4
    - qcl-TypeA
  - qcl-Type2
    - referenceSignal
      - CSI RS resource#5
    - qcl-TypeA
  - power saving mode
    - true

⋮

- tci-State #64
  - qcl-Type1
    - referenceSignal
      - CSI RS resource#4
    - qcl-TypeA
  - qcl-Type2
    - referenceSignal
      - CSI RS resource#5
    - qcl-TypeA
  - power saving mode
    - false

FIG. 8

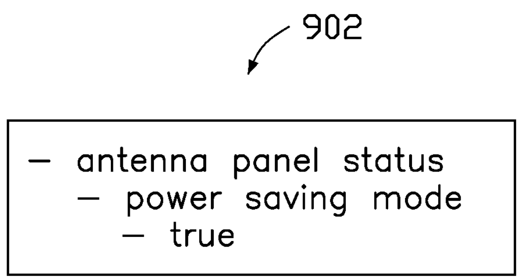


FIG. 9

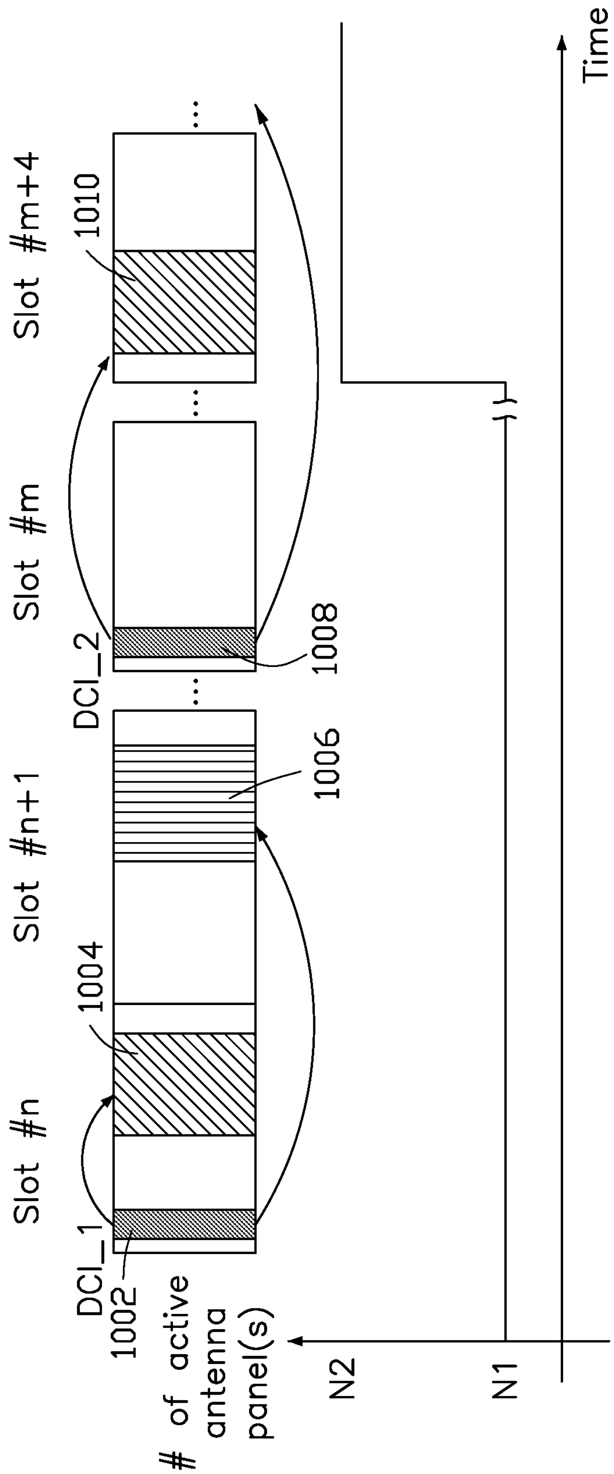

Slot #n
Slot #n+1
Slot #m
Slot #m+4
DCI_1
DCI_2
1002
1004
1006
1008
1010
# of active antenna panel(s)
N2
N1
Time

FIG. 10A

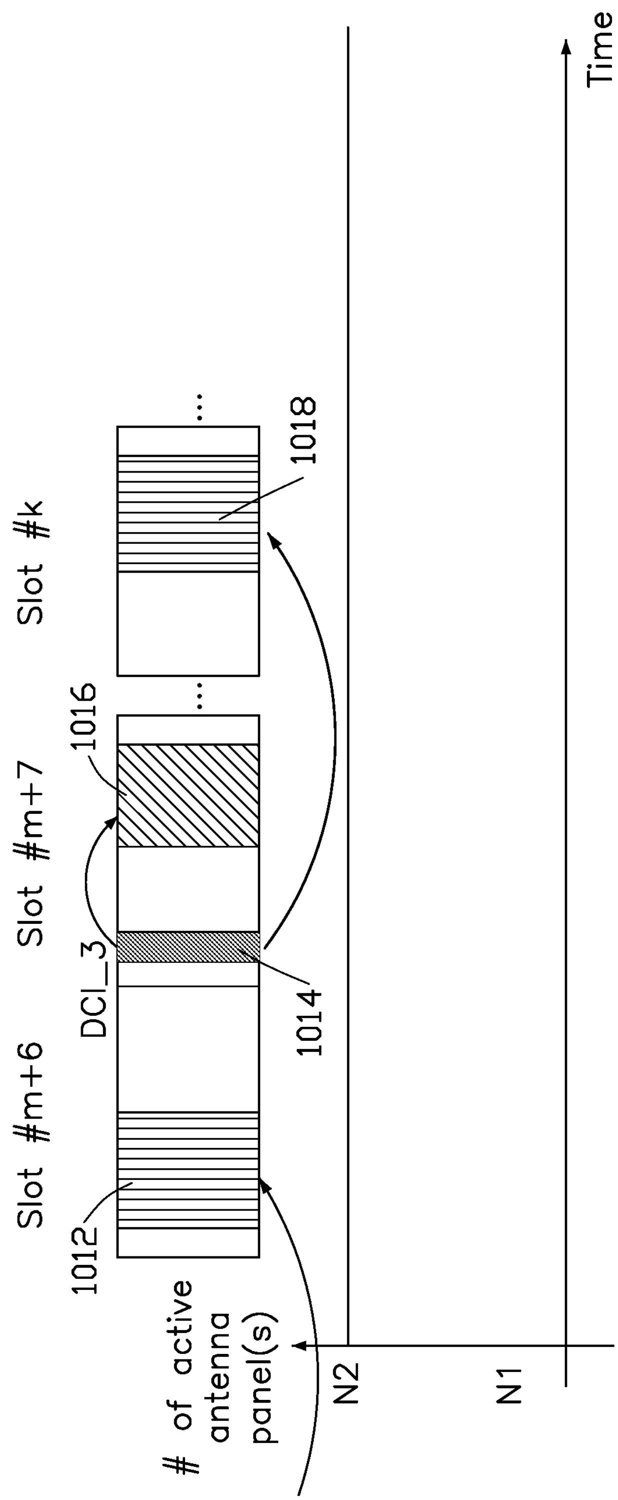
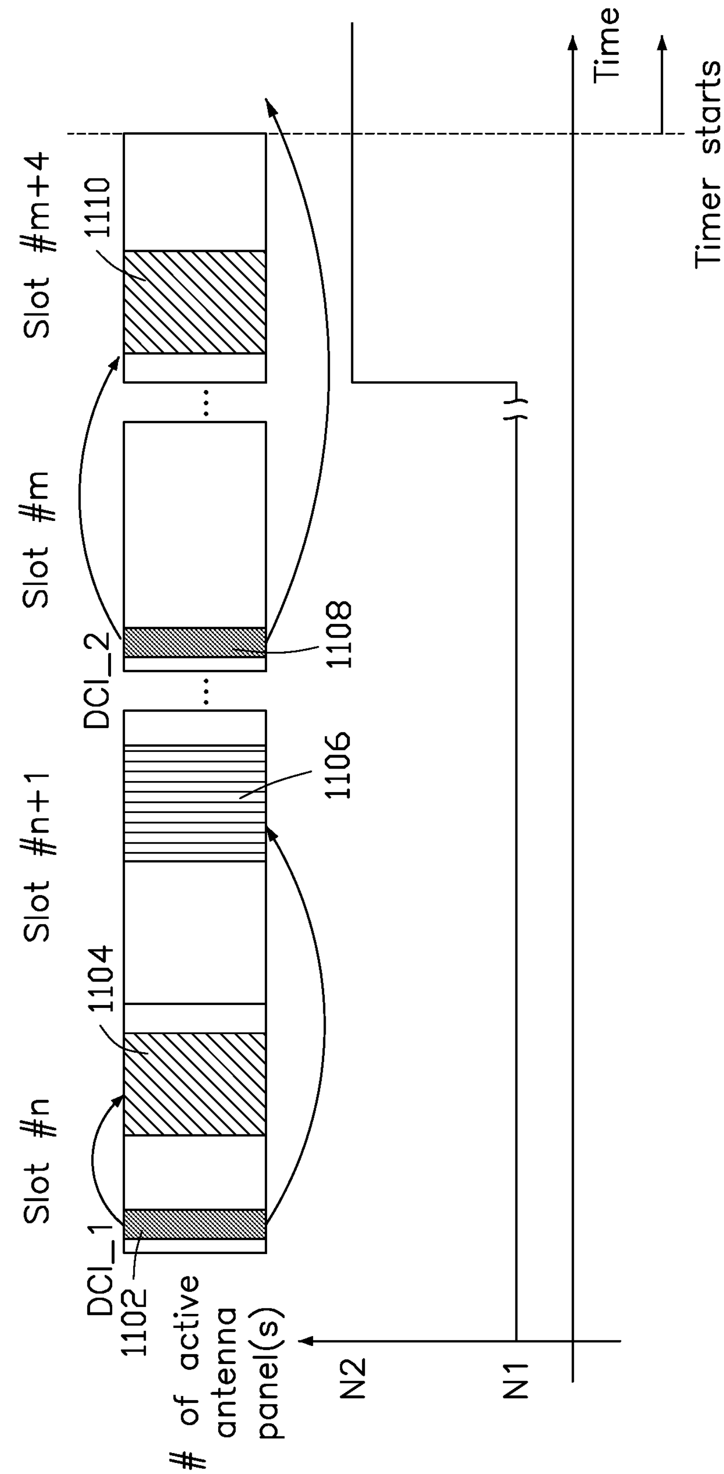

Slot #m+6
Slot #m+7
Slot #k
1012
DCI_3
1014
1016
1018
# of active antenna panel(s)
N2
N1
Time

FIG. 10B



Slot #n
Slot #n+1
Slot #m
Slot #m+4
DCI_1
DCI_2
1102
1104
1106
1108
1110
# of active antenna panel(s)
N2
N1
Time
Timer starts

FIG. 11A

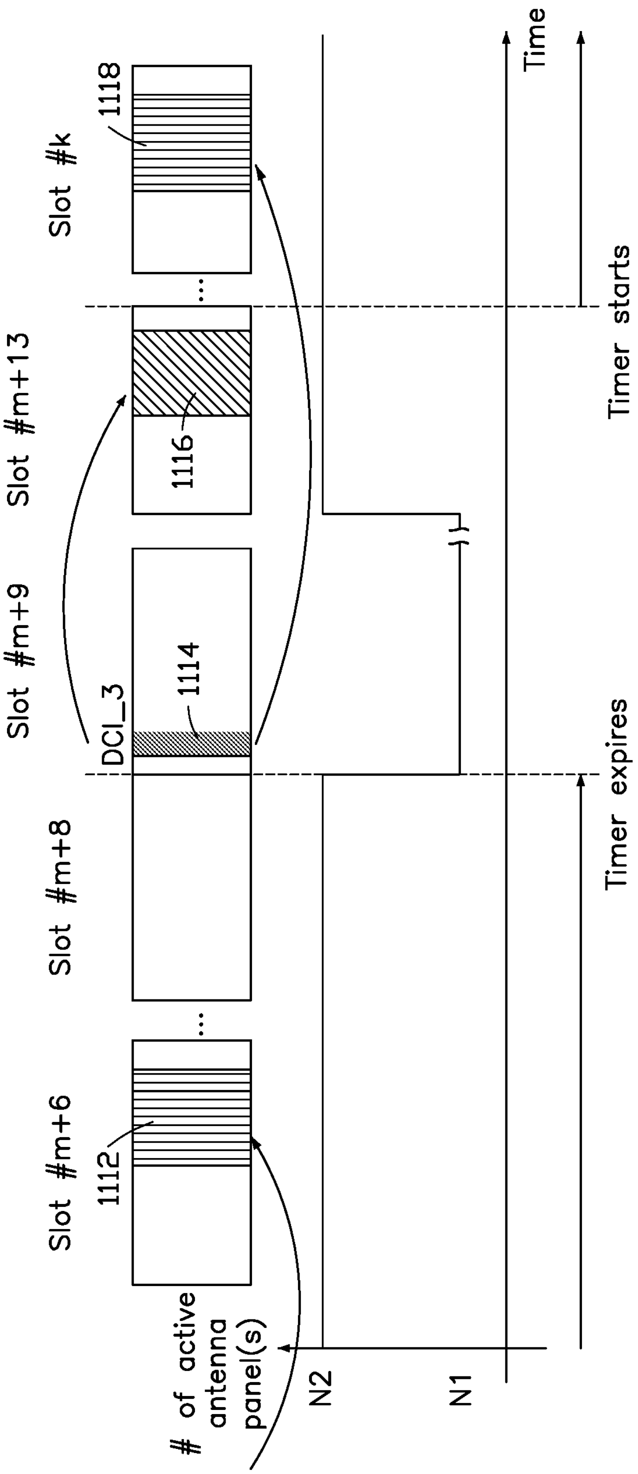

Slot #m+6
Slot #m+8
Slot #m+9
Slot #m+13
Slot #k
1112
1114
1116
1118
DCI_3
# of active antenna panel(s)
N2
N1
Time
Timer expires
Timer starts

FIG. 11B

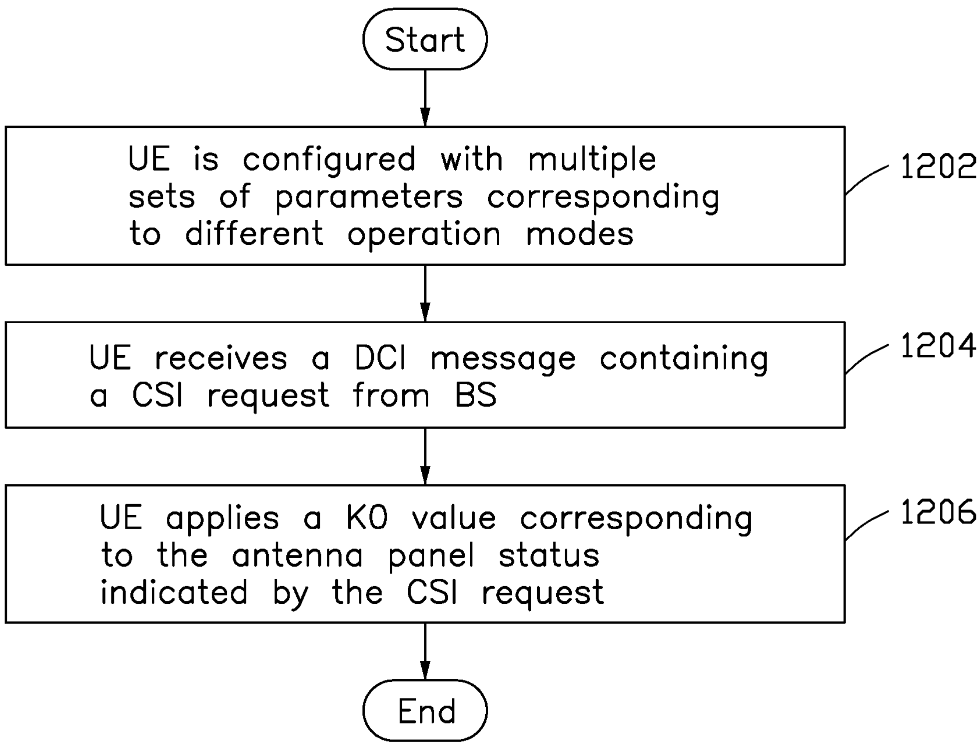

Start
UE is configured with multiple sets of parameters corresponding to different operation modes
1202
UE receives a DCI message containing a CSI request from BS
1204
UE applies a K0 value corresponding to the antenna panel status indicated by the CSI request
1206
End

FIG. 12

1302

- NZP-CSI-RS-ResourceSet
  - aperiodicTriggeringOffset
    - index:10

1304

Row index	K0(normal,long)
00	(0 slot, 4 slots)
01	(1 slot, 4 slots)
10	(2 slot, 6 slots)
11	(3 slot, 7 slots)

FIG. 13

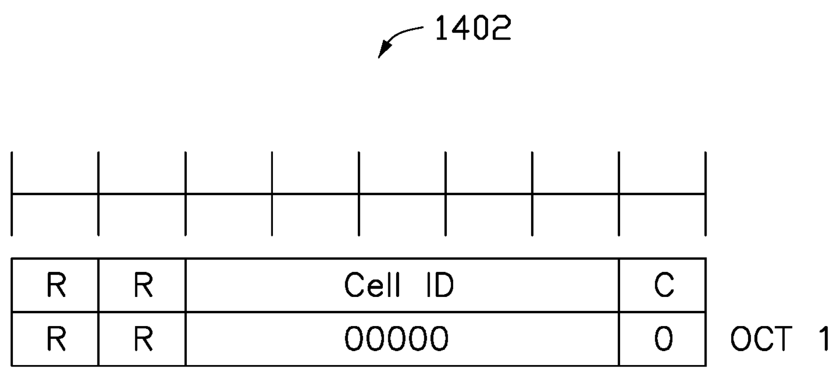


FIG. 14

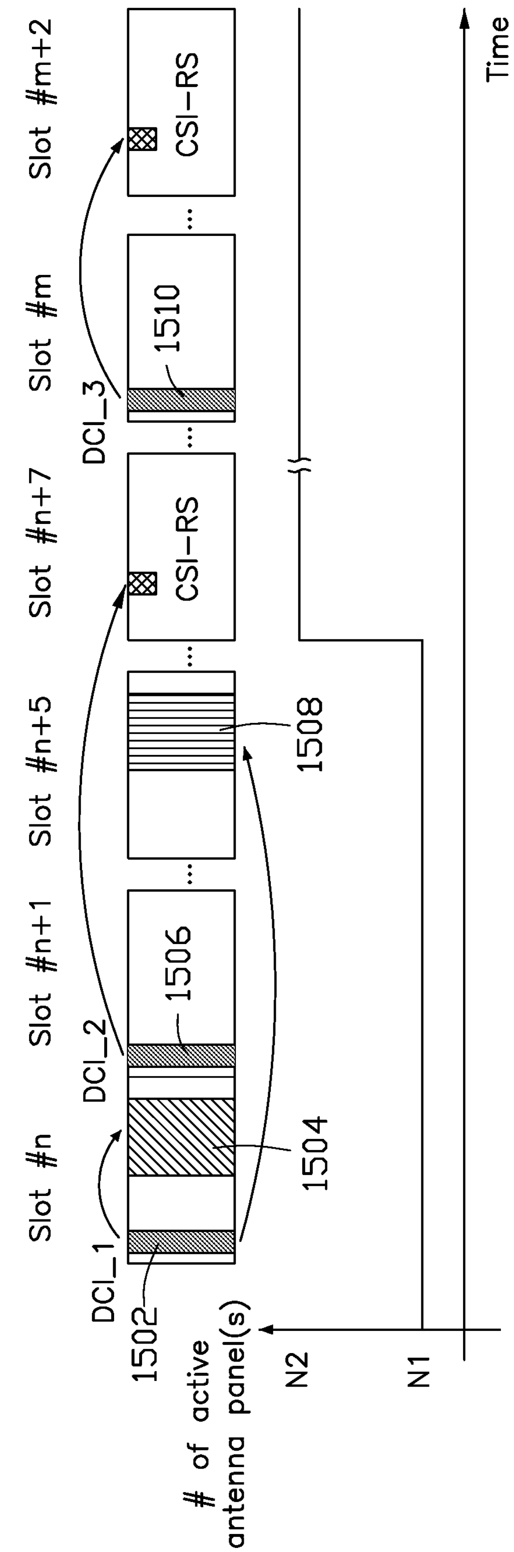

Slot #n
Slot #n+1
Slot #n+5
Slot #n+7
Slot #m
Slot #m+2
DCI_1
DCI_2
DCI_3
CSI-RS
CSI-RS
1502
1504
1506
1508
1510
# of active antenna panel(s)
N2
N1
Time

FIG. 15

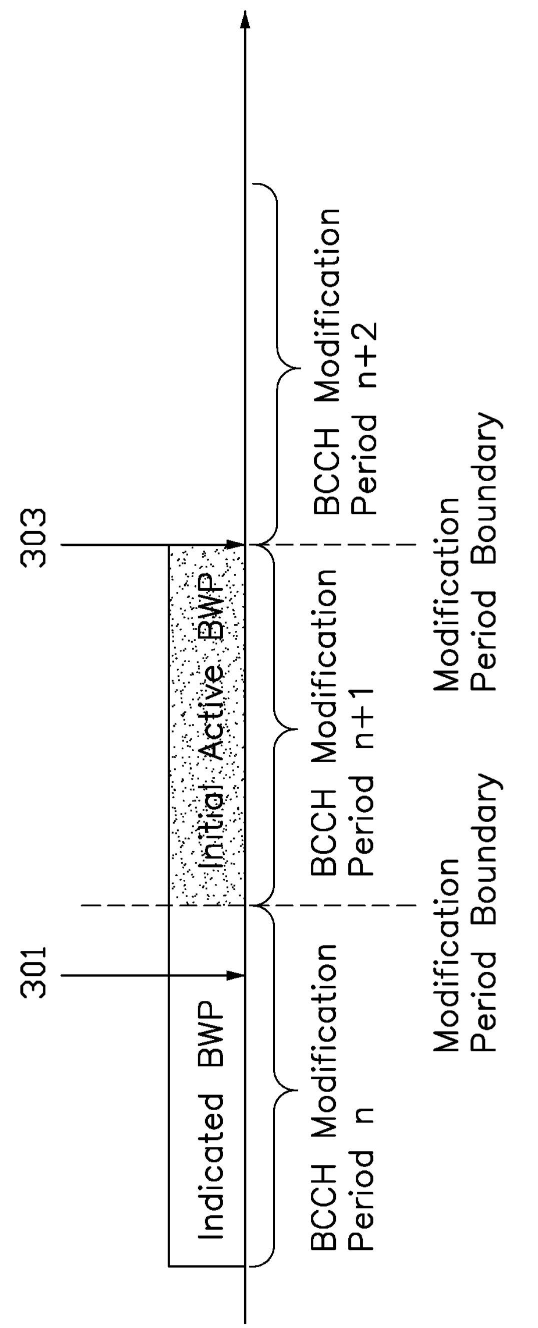

303
301
Initial Active BWP
Indicated BWP
BCCH Modification Period n+2
BCCH Modification Period n+1
BCCH Modification Period n
Modification Period Boundary
Modification Period Boundary

FIG. 3

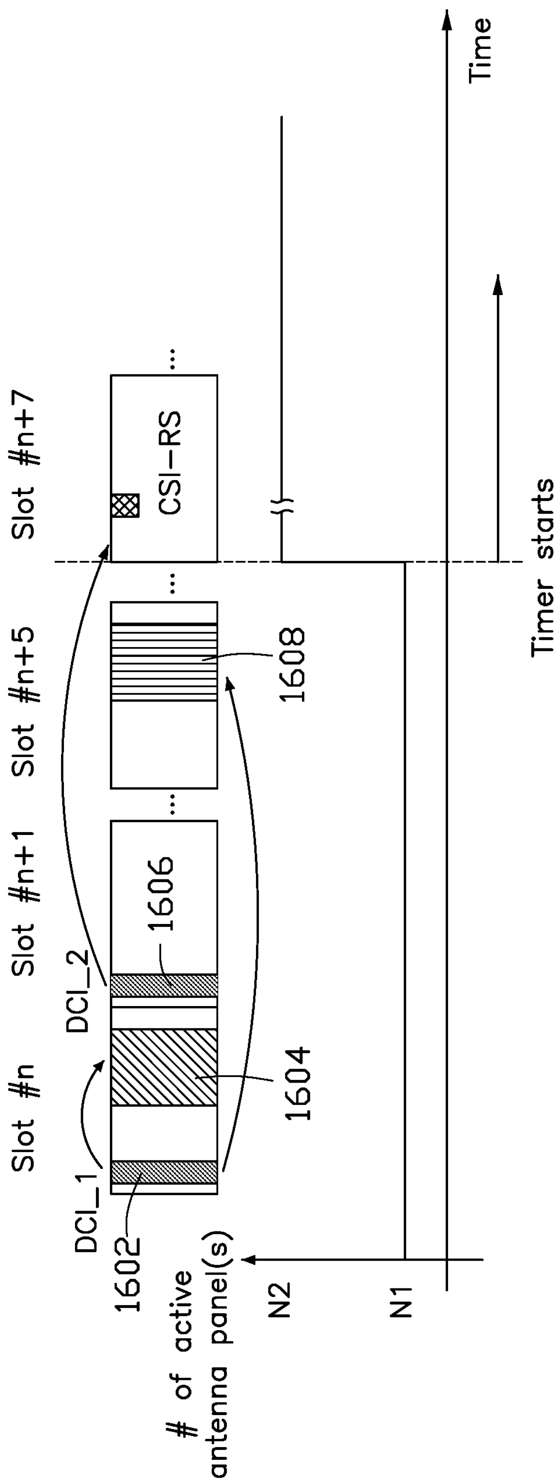
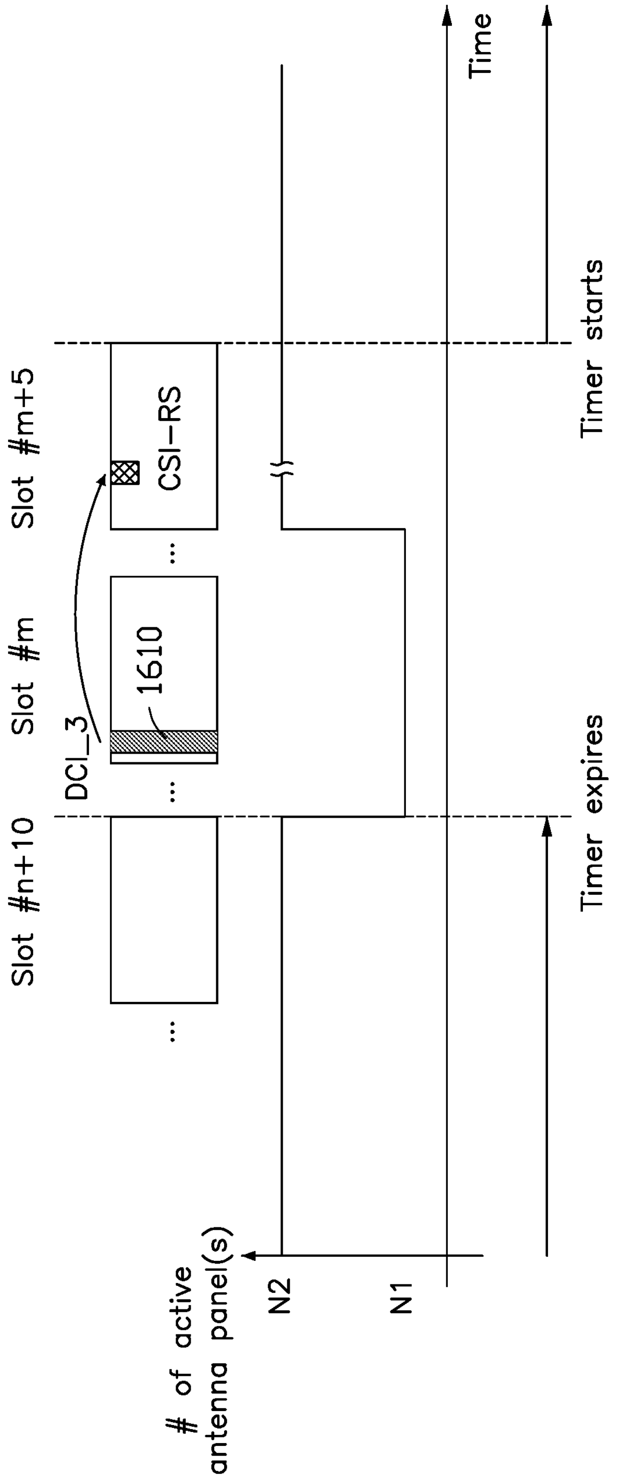

Slot #n
Slot #n+1
Slot #n+5
Slot #n+7
DCI_1
DCI_2
CSI-RS
1602
1604
1606
1608
# of active
antenna panel(s)
N2
N1
Time
Timer starts

FIG. 16A



Slot #n+10
Slot #m
Slot #m+5
DCI_3
1610
CSI-RS
Time
Timer expires
Timer starts
# of active antenna panel(s)
N2
N1

FIG. 16B

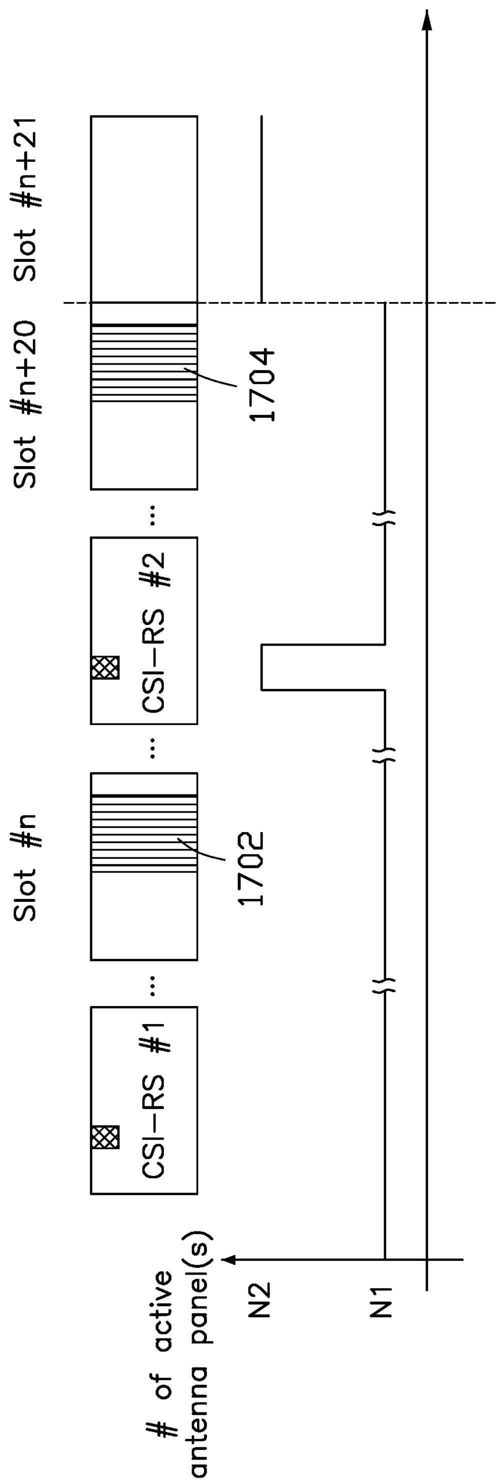

Slot #n+21
Slot #n+20
Slot #n
CSI-RS #2
CSI-RS #1
1704
1702
# of active antenna panel(s)
N2
N1

FIG. 17

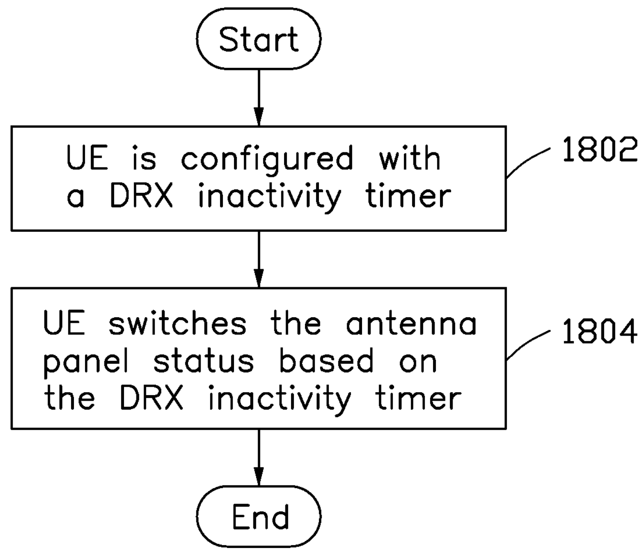

Start
UE is configured with a DRX inactivity timer
1802
UE switches the antenna panel status based on the DRX inactivity timer
1804
End

FIG. 18

1902

- DRX configuration
  - Inactivity timer
    - 2ms
  - DRX cycle
    - 50 ms

⋮
- Antenna panel status
  - Power saving mode
    - false
  - Timer for antenna panel states
    - length
      - 4 slots

⋮

FIG. 19

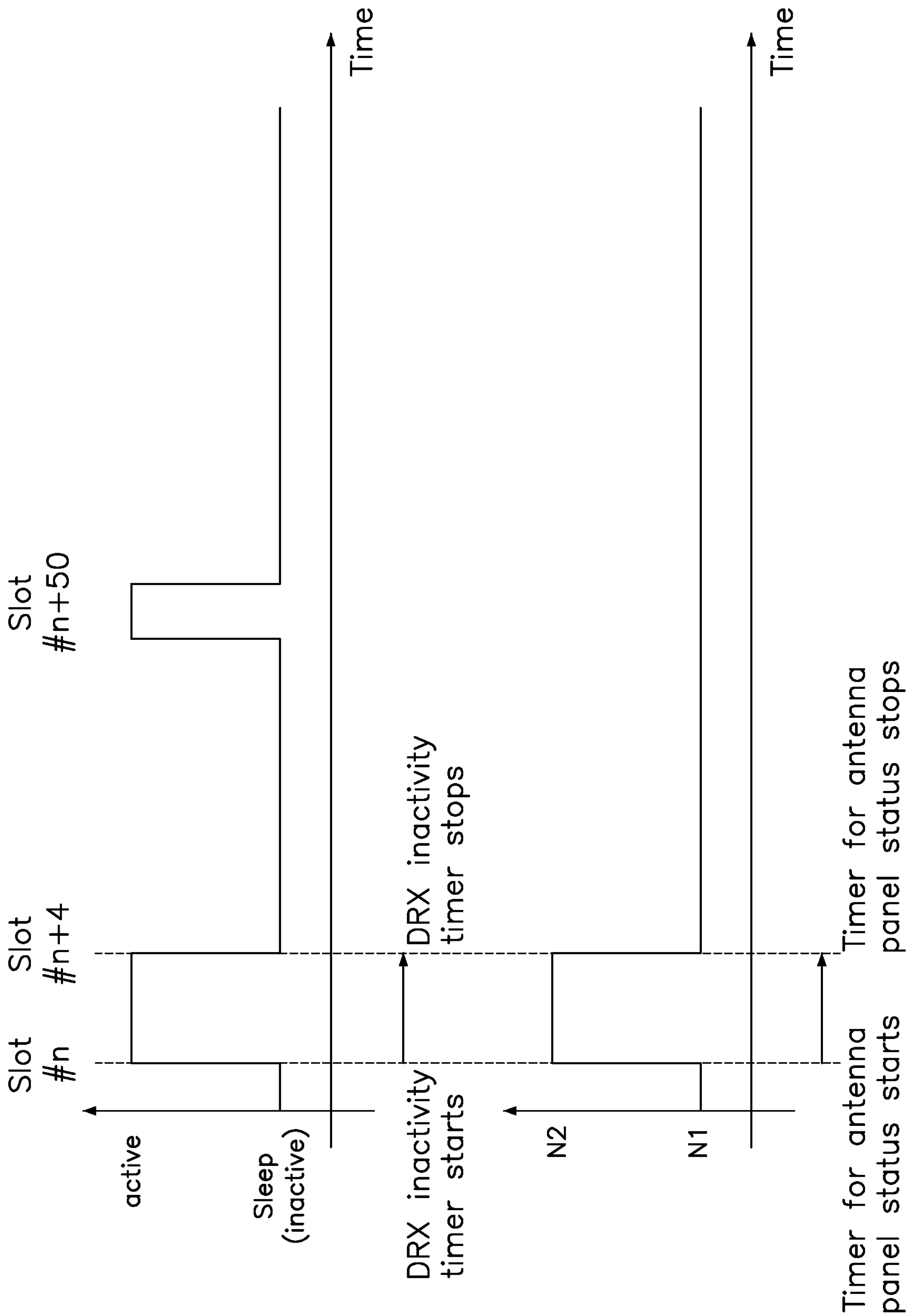

active
Sleep
(inactive)
Slot
#n
Slot
#n+4
Slot
#n+50
Time
DRX inactivity
timer starts
DRX inactivity
timer stops
N2
N1
Time
Timer for antenna
panel status starts
Timer for antenna
panel status stops

FIG. 20

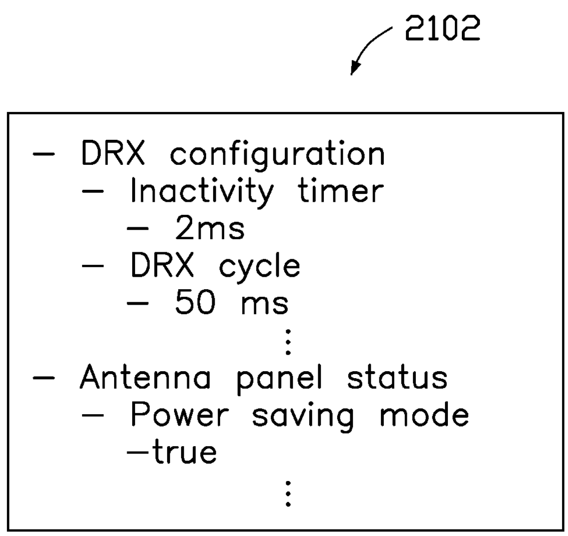

2102
– DRX configuration
– Inactivity timer
– 2ms
– DRX cycle
– 50 ms
⋮
– Antenna panel status
– Power saving mode
–true
⋮

FIG. 21

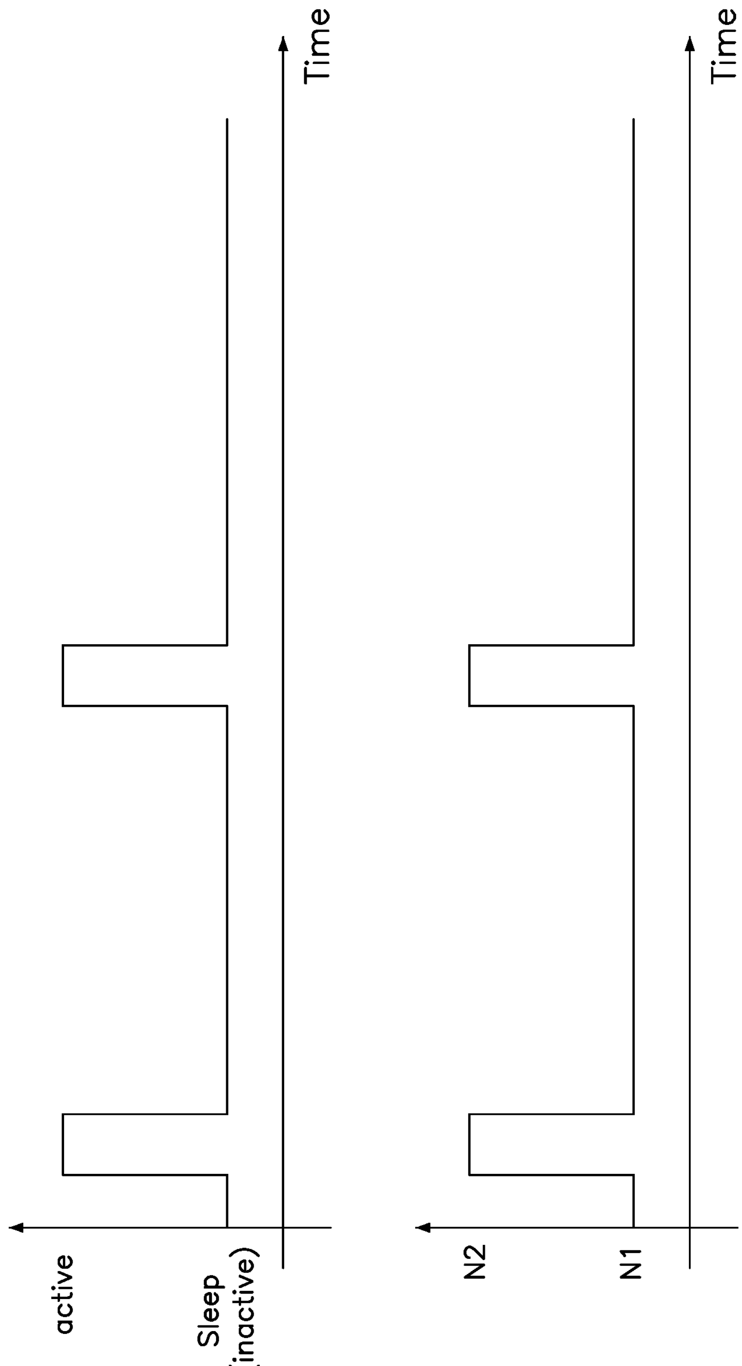


FIG. 22

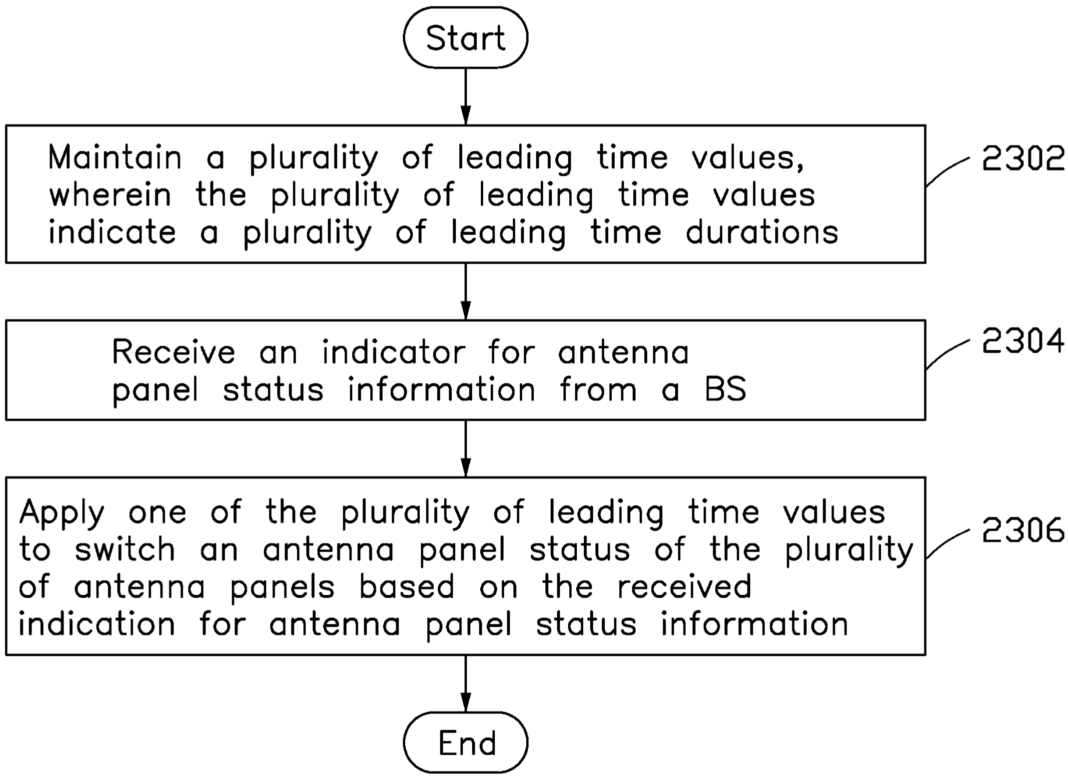

Start
Maintain a plurality of leading time values, wherein the plurality of leading time values indicate a plurality of leading time durations
2302
Receive an indicator for antenna panel status information from a BS
2304
Apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the received indication for antenna panel status information
2306
End

FIG. 23

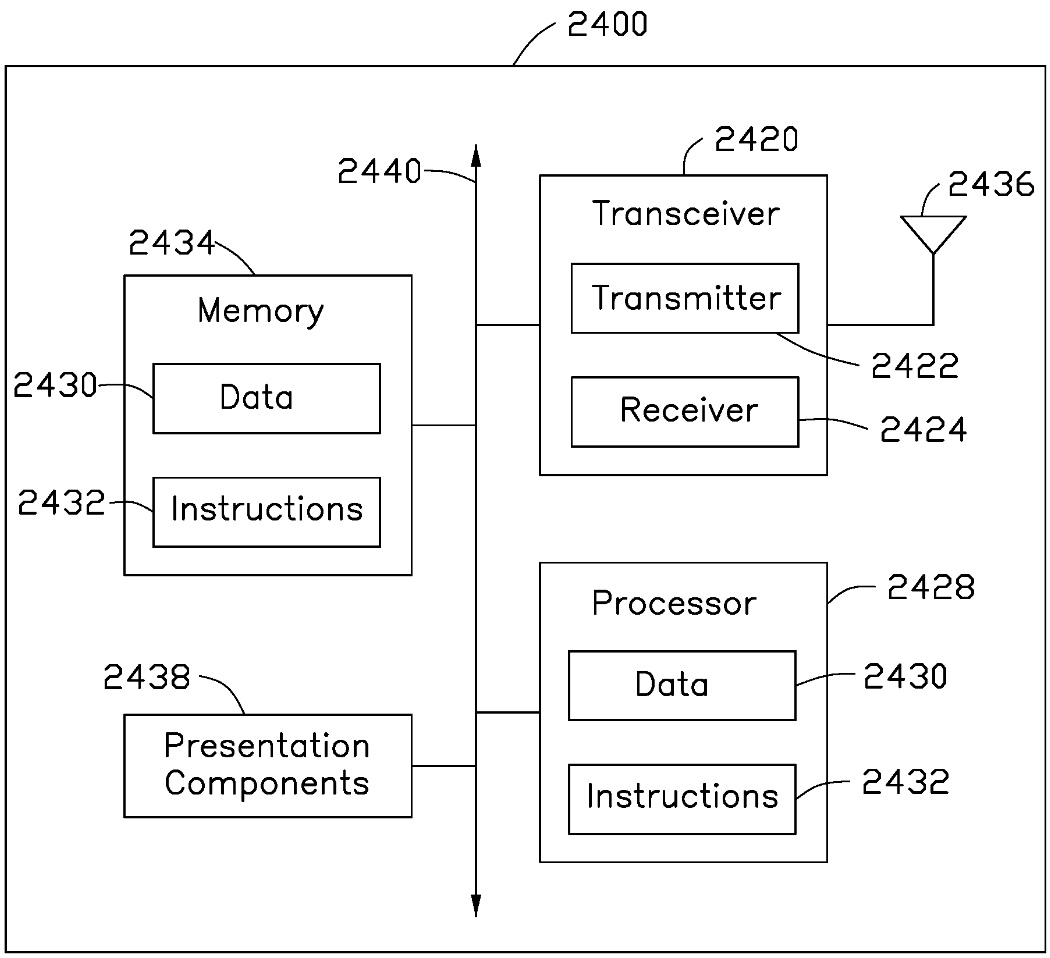

2400
2440
2420
Transceiver
2436
Transmitter
2422
Receiver
2424
2434
Memory
2430
Data
2432
Instructions
2438
Presentation Components
Processor
2428
Data
2430
Instructions
2432

FIG. 24

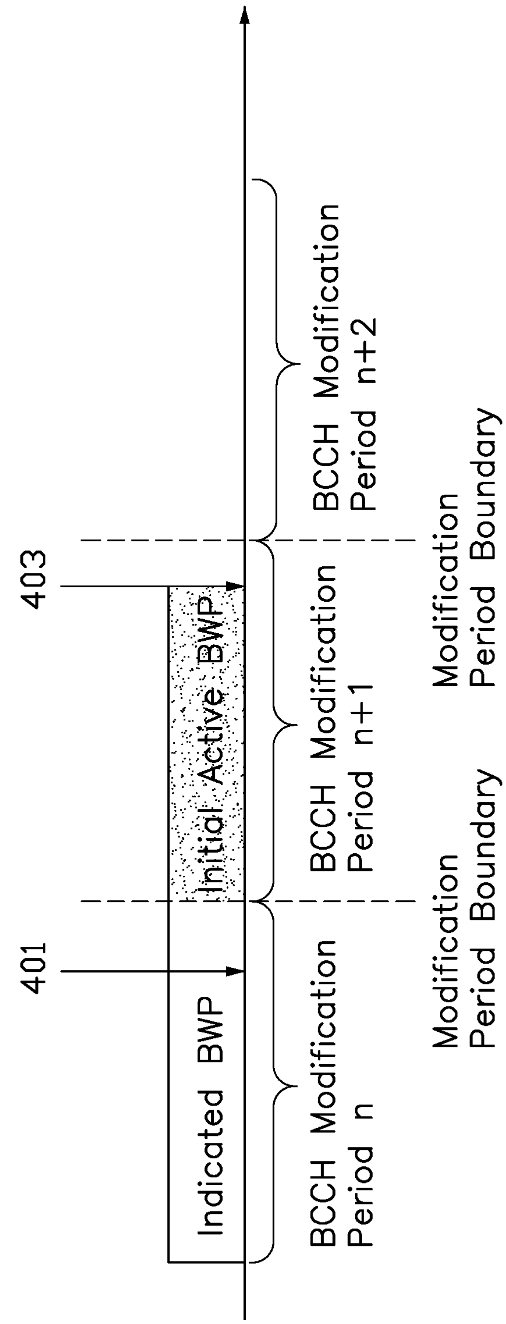

401
403
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 4

METHODS AND APPARATUSES FOR OPERATING MULTIPLE ANTENNA PANELS

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present application claims the benefit of and priority to a provisional U.S. Patent Application Ser. No. 62/699,465 filed on Jul. 17, 2018, entitled "Method and Apparatus for leading time of beam switching for multi-panel transmission,".

FIELD

The present disclosure generally relates to wireless communications, and more particularly, to methods and apparatuses for operating multiple antenna panels.

BACKGROUND

Various efforts have been made to improve different aspects of wireless communications (e.g., data rate, latency, reliability, mobility, etc.) for the next generation (e.g., 5G New Radio (NR)) wireless communication systems. Multi Input Multi Output (MIMO) is one of the key features in the next generation wireless communication systems. With the MIMO technology, a number of antenna panels at the transceiver/receiver can bring extra degrees of freedom to increase the data throughput, beamforming gain and coverage.

However, due to the lack of proper signaling mechanisms, the network may not know the current antenna panel status (e.g., how many and/or which of the antenna panels of the user device is turned on/off) at the UE side, resulting in a reduced scheduling performance.

Hence, there is a need in the art for an improved signaling mechanism for operating multiple antenna panels.

SUMMARY

The present disclosure is directed to methods and apparatuses for operating multiple antenna panels.

According to an aspect of the present disclosure, a wireless communication device is provided. The wireless communication device includes a plurality of antenna panels and a processor coupled to the antenna panels. The processor is configured to maintain a plurality of leading time values. The plurality of leading time values may indicate a plurality of leading time durations. The processor is further configured to receive an indicator for antenna panel status information from a base station (BS), and apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information.

According to another aspect of the present disclosure, a method for operating a plurality of antenna panels is provided. The method includes maintaining, by a wireless communication device, a plurality of leading time values. The plurality of leading time values indicates a plurality of leading time durations. The method further includes receiving, by the wireless communication device, an indicator for antenna panel status information from a BS, and applying, by the wireless communication device, one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale. Dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

FIG. **1** is a schematic diagram illustrating a wireless communication device including a number of antenna panels, in accordance with example implementations of the present disclosure.

FIG. **2** is a schematic diagram illustrating a timeline of an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIG. **3** is a schematic diagram illustrating a timeline of an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIG. **4** is a schematic diagram illustrating a timeline of an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIG. **5** is an example data structure indicating user equipment (UE) capability information, in accordance with example implementations of the present disclosure.

FIG. **6** is an example data structure indicating a configuration of a timer for antenna panel status, in accordance with example implementations of the present disclosure.

FIG. **7** is a flowchart for a method of selecting a scheduling offset value based on a Transmission Configuration Indicator (TCI) state indicated by a BS, in accordance with example implementations of the present disclosure.

FIG. **8** is an example data structure indicating TCI state configuration, in accordance with example implementations of the present disclosure.

FIG. **9** is an example data structure of an indicator for antenna panel status, in accordance with example implementations of the present disclosure.

FIGS. **10**A and **10**B are schematic diagrams illustrating timelines of an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIGS. **11**A and **11**B are schematic diagrams illustrating timelines of an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIG. **12** is a flowchart for a method of selecting an offset value for receiving an aperiodic Channel State Information Reference Signal (CSI-RS), in accordance with example implementations of the present disclosure.

FIG. **13** is an example data structure indicating an aperiodic CSI RS reception configuration, in accordance with example implementations of the present disclosure.

FIG. **14** is an example of a Media Access Control (MAC)-Control Element (CE) message, in accordance with example implementations of the present disclosure.

FIG. **15** is a schematic diagram illustrating that different triggering offset values are applied for the changes in an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIGS. **16**A and **16**B are schematic diagrams illustrating that different triggering offset values are applied for the changes in an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIG. **17** is a schematic diagram illustrating a timeline of an antenna panel status of a wireless communication device, in accordance with example implementations of the present disclosure.

FIG. **18** is flowchart for a method for determining an antenna panel status of a wireless communication device based on a Discontinuous Reception (DRX) operation, in accordance with example implementations of the present disclosure.

FIG. **19** is an example data structure indicating a Radio Resource Control (RRC) configuration for a UE, in accordance with example implementations of the present disclosure.

FIG. **20** is a schematic diagram illustrating a timeline of an antenna panel status of a wireless communication device and a timing diagram of a DRX cycle, in accordance with example implementations of the present disclosure.

FIG. **21** is an example data structure indicating an RRC configuration for a UE, in accordance with example implementations of the present disclosure.

FIG. **22** is a schematic diagram illustrating a timeline of an antenna panel status of a wireless communication device and a timing diagram of a DRX cycle, in accordance with example implementations of the present disclosure.

FIG. **23** is a flowchart for a method of operating multiple antenna panels, in accordance with example implementations of the present disclosure.

FIG. **24** is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present disclosure.

DETAILED DESCRIPTION

The following description contains specific information pertaining to example implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely example implementations. However, the present disclosure is not limited to merely these example implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale and are not intended to correspond to actual relative dimensions.

For the purpose of consistency and ease of understanding, like features are identified (although, in some examples, not shown) by numerals in the example figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, system, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general-purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or algorithm(s). The microprocessors or general-purpose computers may be formed of applications specific integrated circuitry (ASIC), programmable logic arrays, and/or using one or more digital signal processor (DSPs). Although some of the example implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative example implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

The computer readable medium includes but is not limited to random access memory (RAM), read only memory (ROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), flash memory, compact disc read-only memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

A radio communication network architecture (e.g., a long term evolution (LTE) system, an LTE-Advanced (LTE-A) system, an LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network) typically includes at least one BS, at least one UE, and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a core network (CN), an evolved packet core (EPC) network, an Evolved Universal Terrestrial Radio Access network (E-UTRAN), a 5G Core (5GC), or an internet), through a radio access network (RAN) established by one or more BSs.

It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, a vehicle, or a personal digital assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

A BS may be configured to provide communication services according to at least one of the following Radio Access Technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM EDGE radio access Network (GERAN), General Packet Radio Service (GRPS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic Wideband-Code Division Multiple Access (W-CDMA), High-Speed Packet Access (HSPA), LTE, LTE-

A, eLTE (evolved LTE, e.g., LTE connected to 5GC), New Radio (NR, often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above-mentioned protocols.

A BS may include, but is not limited to, a Node B (NB) as in the UMTS, an evolved Node B (eNB) as in the LTE or LTE-A, a Radio Network Controller (RNC) as in the UMTS, a Base Station Controller (BSC) as in the GSM/GERAN, a ng-eNB as in an E-UTRA BS in connection with the 5GC, a next generation Node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The BS may connect to serve the one or more UEs through a radio interface to the network.

The BS is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The BS supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage (e.g., each cell schedules the downlink and optionally uplink resources to at least one UE within its radio coverage for downlink and optionally uplink packet transmissions). The BS can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate Sidelink (SL) resources for supporting Proximity Service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as enhanced Mobile Broadband (eMBB), massive Machine Type Communication (mMTC), Ultra-Reliable and Low-Latency Communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The orthogonal frequency-division multiplexing (OFDM) technology as agreed in the 3rd Generation Partnership Project (3GPP) may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) Low-Density Parity-Check (LDPC) code and (2) polar code. The coding scheme adaption may be configured based on the channel conditions and/or the service applications.

Moreover, it is also considered that in a transmission time interval TX of a single NR frame, a Downlink (DL) transmission data, a guard period, and an uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, SL resource may also be provided in an NR frame to support ProSe services or V2X services.

In addition, the terms "system" and "network" herein may be used interchangeably. The term "and/or" herein is only an association relationship for describing associated objects and represents that three relationships may exist. For example, A and/or B may indicate that: A exists alone, A and B exist at the same time, and B exists alone. In addition, the character "/" herein generally represents that the former and latter associated objects are in an "or" relationship.

NR power saving is an issue which have been identified in the 3GPP meetings. The objective of this issue is to minimize the power consumption with an improved wake up/go-to-sleep mechanism, and to reduce the power consumption during the network access phase when a UE operates in the RRC_CONNECTED mode. In some power saving schemes the focus is on minimizing the dominate factors of power consumption during the network access phase. Such dominate factors may include, for example, the processing of an aggregated bandwidth, the active Radio Frequency (RF) chain number, the active reception/transmission time, and the dynamic transition to a power efficient mode. In the majority cases of LTE scenarios, since little to no data may be transmitted in a Transmission Time Interval (TTI), a power saving scheme which is capable of dynamically adapting different data arrivals in the RRC_CONNECTED mode may be needed. The dynamic adaptation to the data traffic may be implemented in different dimensions, such as carriers, antennas, beamforming mechanisms, and bandwidths.

Furthermore, approaches to enhance the transition between a normal power consumption mode and a power saving mode may be needed to be considered. For example, both the network-assisted and the UE-assisted approaches may be considered for the UE's power saving mechanism.

Issues related to the leading time for beam switching may affect the power consumption. The leading time for beam switching is, or may reflect, the minimum required time for a UE to set up its antenna panel(s) for providing an indicated RX/TX beam to receive or transmit data. For example, the leading time for beam switching may be the time period between the time the UE receives a command that leads to a change(s) in the Rx beam/antenna panel status and the time that the change(s) actually occurs. In some of the present implementations, if a TCI state has not yet activated by a MAC-CE, the indicated mapping (between the TCI states and the codepoints of a Downlink Control Information (DCI) field "Transmission Configuration Indicator") should be applied starting from a specific time point (e.g., slot n+3 ms+1), when a Hybrid Automatic Repeat Request Acknowledgement (HARQ-ACK) (which is corresponding to a Physical Downlink Shared Channel (PDSCH) which carries the activation command) is transmitted in the slot n. In some of such implementations, this specific time point may be used as the starting time point of a leading time for beam switching. In some of the present implementations, if the TCI state has been activated by a MAC-CE, the leading time for beam switching may have the same starting time point as the scheduling offset. The scheduling offset, in some implementations, may be a time duration starting from the end of the last symbol of a Physical Downlink Control Channel (PDCCH) to the beginning of the first symbol of a PDSCH.

In addition, the beam switching delay may affect a UE's power consumption in the Frequency Range 2 (FR2). In order for the UE to optimize the power consumption, the UE may need to be given a sufficient leading time for beam switching. For example, the leading time for beam switching may be two milliseconds (ms) from the time a beam switch command is received (e.g., for a control-channel-based way) or acknowledged (e.g., for a MAC-CE based way) to the time the beam switch is completed.

In some implementations of the present disclosure, there may be at least three ms between two consecutive commands indicating a beam switch. Such time value may be adjusted if a longer time value is needed. In addition, from the time the UE receives the beam switch command to the time the UE switches its beam/antenna panel status, the UE may still use the active Rx beam for data reception, and there may be no interruption in the communication with the BS (e.g., a gNB).

FIG. **1** is a schematic diagram illustrating a wireless communication device (e.g., a UE) including a number of antenna panels, in accordance with example implementations of the present disclosure. As shown in FIG. **1**, a wireless communication device **100** includes four antenna panels **102**, **104**, **106** and **108**. The antenna panels described herein may be referred to antenna arrays or antenna ports. The antenna arrays may include a number of physical antennas, while the antenna ports may not correspond to physical antennas, but rather may be logical entities distinguished by their channel models.

The ON/OFF state of each antenna panel **102**, **104**, **106** and **108** may be switched by the wireless communication device **100**. Depending on the ON/OFF state of each antenna panel **102**, **104**, **106** and **108**, the antenna panels **102**, **104**, **106** and **108** may have different antenna panel status. For example, the antenna panel status of the antenna panels **102**, **104**, **106** and **108** may be determined as a first antenna panel status if only the antenna panel **102** is turned on and the other antenna panels **104**, **106** and **108** are turned off, and determined as a second antenna panel status if all of the antenna panels **102**, **104**, **106** and **108** are turned on. It should be noted that the wireless communication device **100** including four antenna panels **102**, **104**, **106** and **108** in FIG. **1** is for illustrative purposes only, and not intended to limit the scope of the present invention. That is, a wireless communication device (e.g., the wireless communication device **100**) may include a different number of antenna panels than 4 (e.g., 6 panels, 8 panels, etc.) in some of the present implementations. Furthermore, the antenna panel status of the antenna panels of the wireless communication device may be defined arbitrarily based on the ON/OFF states and/or the number of the antenna panels.

In many cases, a BS (e.g., a gNB) may not know the current antenna panel status of the UE, which causes some issues since the BS always have to consider the worst case for the UE to perform the beam switching. For example, the BS may need to configure the UE with a leading time for beam switching which is much longer than a leading time the UE actually needs. As the leading time becomes longer, the efficiency and flexibility of the UE's operations may get lower. Hence, a signaling mechanism that helps the BS to obtain the antenna panel status of the UE may enhance the power consumption.

Another issue is related to the scheduling offset values. From Radio layer 1's (RAN1's) perspective, if a UE is configured with a "tci-PresentInDCI" Information Element (IE) set to "enabled" (for a Coreset Resource Set (CORESET) that schedules a PDSCH), the UE may assume that the TCI field is present in the DCI format 1_1 (which is transmitted over the PDCCH of the CORESET). On the other hand, if the tci-PresentInDCI IE is not configured for the CORESET (or the tci-PresentInDCI IE is set to "disabled"), or the PDSCH is scheduled by a DCI format 1_0 (e.g., for determining the PDSCH antenna port's QCL), the UE may assume that the TCI state applied for receiving the PDSCH is identical to the TCI state applied for receiving the PDCCH of the CORESET. In addition, if the tci-PresentInDCI IE is set to "enabled" and the PDSCH is scheduled by the DCI format 1_1, the UE may apply a TCI state which is indicated by the DCI to determine the QCL of the antenna port for the PDSCH. This is because the TCI state may indicate the QCL type and the QCL Reference Signal (RS) corresponding to the RX beam for receiving the PDSCH. If the time offset between the reception of the DL DCI and the corresponding PDSCH is equal to or greater than a scheduling offset value (e.g., a threshold called "Threshold-Sched-Offset"), the UE may assume that the antenna ports of one Demodulation Reference Signal (DM-RS) port group of a PDSCH of a serving cell may be QCLed with the RS(s) that is associated with the QCL type parameter(s) given by the indicated TCI state. For DL transmissions, the scheduling offset may be referred as a time period starting from the end of a PDCCH to the beginning of a PDSCH. For example, the scheduling offset may be a time period that starts from the first symbol after the end of the PDCCH to the first symbol of the PDSCH scheduled by the PDCCH. In some implementations of the present disclosure, the scheduling offset value may be determined based on the UE's capability.

However, for a scheduling offset value configured for a UE that includes only one antenna panel (or a single-antenna-panel UE), such value may not fulfill the leading time for beam switching required by another UE that includes multiple antenna panels (or a multiple-antenna-panel UE). Thus, a mechanism that is able to deal with how the UE determines which scheduling offset value (e.g., Threshold-Sched-Offset) to be applied may be needed.

Another issue is related to Sounding Reference Signal (SRS) transmission. Specifically, for aperiodic SRS transmissions and aperiodic CSI-RS receptions, the UE may need to follow the aperiodic slot triggering offset configured in the SRS resource set configuration and the CSI-RS resource set configuration, respectively. Considering that a longer leading time may be applied to the power saving operation in the multiple-antenna-panel cases, the required triggering offset configured for the single-antenna-panel cases and the multiple-antenna-panel cases may be different. Although a BS can solve this issue by configuring multiple triggering offset values for one resource set, it might cause overhead that occupies some bitfields of a DCI trigger state for an SRS request and/or a CSI request. Hence, a mechanism for determining the triggering offset of the aperiodic SRS/CSI-RS transmissions may be needed.

In addition, for SRS transmissions, a UE may be configured to switch its antenna panel status for a sounding procedure for a DL CSI acquisition. If the UE is configured with a higher layer parameter such as "SRS-SetUseusage (or SRS-usage)" in an SRS resource set (e.g., SRS-ResourceSet), and the SRS-SetUseusage (or SRS-usage) is set as "antennaSwitching," the UE may be configured with one of the following configurations depending on the UE's capability: 1TX2RX, 2TX4RX, 1TX4RX, 1TX4RX/2TX4RX, and TX=RX. The BS may configure the UEs having different capabilities with different number of SRS resource sets which contain different SRS resources. For example, for a UE configured with the 1TX2RX configuration, the BS may configure one SRS resource set which may contain two SRS resources. Since the UE needs to select and switch to the TX for transmission, there may be a guard period between each SRS transmission. The guard period may be one or two symbols, depending on the numerology of the SRS resource. However, if the UE has multiple antenna panels and at least parts of the antenna panels are turned off for power saving, the guard period for one or two symbols may not fulfill the leading time of at least 2 ms for turning on the antenna panel(s). Hence, a mechanism for the UE to perform antenna switching may be needed.

In accordance with some implementations of the present disclosure, methods and apparatuses provide techniques for addressing the above-noted issues.

For example, techniques are described for determining the scheduling offset value(s). As described above, the leading time for beam switching may be the minimum required time for a UE to set up the antenna panels for providing an indicated RX/TX beam to receive/transmit the data. If the scheduling offset of a DL/UL RSs/channel reception/transmission cannot fulfill the leading time requirement, the UE may not be able to transmit/receive the RSs/channel successfully. In some implementations of the present disclosure, the leading time may be related to the antenna panel status. In addition, different values of the leading time may be predefined in the 3GPP technical specification(s) for each or all of the antenna panel statuses. For example, each antenna panel status may have its own leading time value. In another example, all antenna panel statuses may have the same leading time value. In some implementations of the present disclosure, the UE may report the required leading time for each or all of the antenna panel statuses. In some implementations of the present disclosure, the UE may be configured with the required leading time by the BS for each or all of the antenna panel statuses.

In some implementations of the present disclosure, the antenna panel status may contain information about how many antenna panels at the UE are used for performing the data reception/transmission of the channel/RSs, or how many antenna panels at the UE are used/active/turned on in a particular time period.

In some implementations of the present disclosure, an indicator for antenna panel status may be transmitted by the BS to indicate to a UE whether to enable/disable a power saving mode or a normal power consumption mode. In the power saving mode, the UE may turn on a smaller number of antenna panels than that in the normal power consumption mode. For example, the UE may turn on only one antenna panel when operating in the power saving mode and turn on all of its antenna panels when operating in the normal power consumption mode.

It should be noted that the two operation modes (e.g., the power saving mode and the normal power consumption mode) described herein is for illustrative purposes and not intended to limit the present invention. For example, the UE may be operable in a number of operation modes different than two. In addition, if only the power saving mode and the normal power consumption mode are involved in the power control scheme of the UE, the UE may enter the normal power consumption mode when the power saving mode is disabled. In contrast, the UE may enter the power saving mode when the normal power consumption mode is disabled.

In some implementations of the present disclosure, the indicator for antenna panel status information may include a single-bit IE. The UE may enable the power saving mode when the single-bit IE is set to a first value, and disable the power saving mode when the single-bit IE is set to a second value. The total number of turn-on/active antenna panels when the power saving mode is enabled may be less than that when the power saving mode is disabled.

In some implementations of the present disclosure, the indicator for antenna panel status information may include a multiple-bit IE. The UE may be configured to turn on a particular number of the antenna panels when the multiple-bit IE is set to a particular value.

In some implementations of the present disclosure, the indicator for antenna panel status transmitted by the BS may be used for indicating which antenna panel status the UE is to apply.

In some implementations of the present disclosure, if the UE is instructed by the BS to perform data reception using multiple antenna panels when the UE is in the power saving mode, the UE may need to apply a longer leading time than a normal leading time. Hence, in accordance with the present disclosure, some techniques are provided for ensuring that the BS and the UE have the same understanding on the antenna panel status of the UE. In some implementations of the present disclosure, the antenna panel status may be used for indicating, explicitly or implicitly, how many, or which, of the antenna panels of the UE are turned on (or active, or able to transmit and receive data), and/or how many, or which, of the antenna panels of the UE are turned off (or inactive, or not able to transmit and receive data).

In some implementations of the present disclosure, the antenna panel status of a UE may be affected by Bandwidth Part (BWP) related operations. The UE may enable the power saving mode or the normal power consumption mode based on whether the UE operates in a particular BWP. For example, when the UE operates on a default, an initial, or a first active DL/UL BWP, the UE may always enable the normal power consumption mode or the power saving mode.

In some implementations of the present disclosure, before the UE receives an RRC configuration/a MAC-CE message/a DCI message for setting the UE's antenna panels status, the UE may operate in the power saving mode or the normal power consumption mode. In some implementations of the present disclosure, the UE may apply the power saving mode or the normal power consumption mode for the antenna panels before the UE reports the UE's capability about the antenna panels.

As described above, in some implementations of the present disclosure, the indicator for antenna panel status may be a single bit IE used for indicating whether the UE is in the power saving mode or not. For example, the UE may be configured with an available number of antenna panels for each BWP configuration. Once the UE receives the indicator for antenna panel status (e.g., in the form of a single bit IE) being set to a first value (e.g., the bit value "0"), the UE may turn on only part of the antenna panels to operate in the power saving mode. In contrast, if the indicator for antenna panel status is set to a second value (e.g., the bit value "1"), the UE may turn on all of the antenna panels to enable the normal power consumption mode (or disable the power saving mode).

In some implementations of the present disclosure, the indicator for antenna panel status may be a multiple-bit IE used for indicating the antenna panels status to the UE. For example, if the UE includes four antenna panels (e.g., the antenna panels **102**, **104**, **106** and **108** shown in FIG. **1**), the bit field of the indicator for antenna panel status may be set as "00" to indicate that all of the antenna panels are turned off/inactive, or set as "01" to indicate that only one antenna panel is active, or set as "10" to indicate that only two antenna panels are active, or set as "11" to indicate that all antenna panels are active. While the indicator for antenna panel status described herein is used to indicate to the UE to turn on a particular number of antenna panels, there are other ways to use the indicator for antenna panel status in some implementations of the present disclosure. For example, the indicator for antenna panel status may be used to indicate to the UE to turn on/off which one or ones of the antenna panels. In addition, it should be noted the examples described herein are not intended for limiting the present invention. For example, the indicator for antenna panel status may have a number of bits, with each bit corresponding to a particular antenna panel status.

The indicator for antenna panel status may be transmitted from the BS to the UE via a DCI message, a MAC-CE massage, or through RRC signaling. For example, the indicator for antenna panel status information may be contained in a TCI state ID indicated by the BS. In some implementations of the present disclosure, the value of the indicator for antenna panel status may be updated and transmitted by the UE to the BS via an Uplink Control Information (UCI) message, a MAC-CE massage, or through RRC signaling.

In some implementations of the present disclosure, the RRC configuration that contains the indicator for antenna panel status may be an independent IE configured per UE-basis. For example, the RRC configuration may be the same for one cell or one cell group. In such cases, the RRC configuration may be a cell level or cell group level configuration. In another example, the RRC configuration may be configured in a specific frequency range. For example, the RRC configuration may only exist in the FR2.

In some implementations of the present disclosure, the UE may choose a leading time for beam switching based on the antenna panel status. For example, during an RRC reconfiguration period, or before the UE receives the first RRC configuration (e.g., while the UE attempts to establish an RRC connection after a successful initial access, or while the UE performs an initial access procedure), the UE may apply a default value of the leading time. Such default value may be predefined in the 3GPP technical specification (e.g., "3 ms" defined in NR Release-15) and determined as the UE's capability for beam switching in the power saving mode. In another example, the UE may apply the longest leading time configured in a UE capability list during this period. In another example, the BS may send an indicator to the UE through an RRC configuration (e.g., powerPrefIndicationConfig), and the UE may transmit or report the current antenna panel status to the BS via another indicator (e.g., powerPrefIndication). For example, the UE may transmit an antenna panel status report to inform the BS of a change in the antenna panel status. For example, the antenna panel status report may be contained in a beam report or a Channel State Information (CSI) report. In some implementations of the present disclosure, the antenna panel status report may include a single-bit IE. The UE may set the single-bit IE to a first value to indicate that a power saving mode is enabled and set the single-bit IE to a second value to indicate that the power saving mode is disabled. In some implementations of the present disclosure, the antenna panel status report may include a multiple-bit IE. The UE may set the multiple-bit IE to a particular value when a particular number of the plurality of antenna panels are turned on.

In some implementations of the present disclosure, the BS may keep the antenna panel status report from the UE and adjust the scheduling offset based on the antenna panel status report. In some implementations of the present disclosure, the BS may configure the UE with a prohibit timer to prevent the UE from reporting the antenna panel status too frequently. The prohibit timer may be used when the UE reports the antenna panel status to the BS through the RRC message (s), MAC-CE massage(s) or DCI message(s). In some implementations of the present disclosure, the prohibit timer may start at the first subframe/slot/OFDM symbol after the UE reports the antenna panel status. For example, the prohibit timer may start at the first subframe/slot/OFDM symbol after a physical resource (e.g., a Physical Uplink Control Channel (PUCCH) or a Physical Uplink Share Channel (PUSCH)) that contains of the antenna panel status report of the UE. In addition, in some implementations of the present disclosure, the UE may not report another antenna panel status when the prohibit timer is running.

In some implementations of the present disclosure, the prohibit timer may be bidirectional. For example, the prohibit timer may start when the antenna panel status transition from the normal power consumption mode to the power saving mode, and vice versa. In some implementations of the present disclosure, the prohibit timer may be unidirectional. For example, the prohibit timer may only start when a specific power preference transition occurs (e.g., transitioning from the power saving mode to the normal power consumption mode). In some implementations of the present disclosure, the prohibit timer may be configured separately for different kinds of power preference transitions.

In some implementations of the present disclosure, the BS may configure multiple antenna panel status to a UE via an RRC configuration, and the BS may indicate one of the multiple antenna panel status through a MAC-CE message (e.g., which is called a "MAC-CE approach"). For example, if the UE is configured with four antenna panel statuses by the RRC configuration, the BS may send a MAC-CE message to indicate to the UE to use one of these four antenna panel statuses. In addition, the BS may assume that the UE may follow the leading time for the indicated antenna panel status during the time period between the reception of the MAC-CE message and the reception of another MAC-CE message that contains an indicator for antenna panel status for switching the antenna panel status.

In some implementations of the present disclosure, the UE may maintain multiple leading time values configured by the BS or predefined in the 3GPP technical specification. These leading time values may be cell-specific values or cell group-specific values.

In some implementations of the present disclosure, after the UE receives the RRC configuration, but before receiving a MAC-CE massage for activation, the UE may apply one of the leading time values configured in an RRC configuration (if the leading time values are configured in the RRC configuration by the BS) as a default value of the leading time.

In some implementations of the present disclosure, more than one antenna panel status may be collected in a list of entries. For example, each of the entries may refer to a particular antenna panel status, and each antenna panel status may be associated with a particular leading time value.

In some implementations of the present disclosure, the default value of the leading time may refer to the first entry (e.g., the entry indexed by "0") in the list of entries in the RRC configuration. In some implementations of the present disclosure, the default value of the leading time may refer to an entry for the longest leading time in the RRC configuration (if the leading time value is RRC-configured).

In some implementations of the present disclosure, a MAC-CE massage containing a number of zero bits may be used. This MAC-CE massage may be used for turning on (or "enabling") or turning off (or "disabling") the power saving mode. The UE may distinguish this MAC-CE massage based on, for example, a Logical Channel Identity (LCID).

In some implementations of the present disclosure, at least one of the following items may be included in a MAC-CE massage: a cell Identity (ID), a BWP ID, and an indicator for antenna panel status. The UE may apply an antenna panel status indicated by the MAC-CE message after the UE transmits an HARQ-ACK to the BS.

In some implementations of the present disclosure, the BS may configure multiple antenna panel statuses to a UE via an RRC configuration, and the BS may indicate one of the multiple antenna panel statuses through a DCI message (e.g., which is called a "DCI approach"). For example, if the UE is configured with eight different antenna panel statuses in the RRC configuration, the BS may transmit a DCI message which may contain an indicator for antenna panel status to the UE to indicate to the UE to use one of the eight antenna panel statuses in the RRC configuration.

In some implementations of the present disclosure, if a UE is configured with multiple leading time values by the BS, the UE may apply one of the leading time values contained in an RRC configuration as a default leading time value after the UE receives the RRC configuration (but before receiving the DCI message). Similar to the MAC CE approach, the default leading time value may refer to the first entry of the multiple antenna panel statuses in the RRC configuration (e.g., the entry with an index value of "0"), or an entry with the longest leading time in the RRC configuration.

In some implementations of the present disclosure, the BS may use a MAC-CE message to select a subset of the leading time values from the RRC configuration and indicate one of the selected leading time value(s) by a DCI message. For example, the BS may configure 16 antenna panel statuses in an RRC configuration, and the BS may transmit a MAC-CE massage to select four of these 16 antenna panel statuses in the RRC configuration. The BS may further transmit a DCI message to indicate to the UE to use one of the four selected antenna panel statuses.

In some implementations of the present disclosure, irrespective of where the leading time values are configured, the BS may need to ensure that the triggering/scheduling offset for the DL/UL channels/signals can fulfill the requirement of leading time for switching the antenna panel status. From UE's perspective, the UE may not be expected to receive data from the BS during the scheduling offset period.

In some implementations of the present disclosure, the antenna panel status may be associated with the TCI states. For example, in addition to the QCL information, some TCI states may further contain the antenna panel status (e.g., which is indicated by an explicit bit). In addition, the maximum number of the TCI states in an RRC configuration, or a DCI message, may be expanded since the BS may need more TCI state(s) to indicate different antenna panel statuses for the same QCL information. For example, if the maximum number of TCI states is expanded from 64 to 96, the TCI state #63 may be used to represent a signal-antenna-panel status which is QCLed with the CSI-RS resource #1, and the TCI state #64 may be used to represent a multi-antenna-panel status which is QCLed with the same CSI-RS resource #1. In some implementations of the present disclosure, once the QCL information of a DL/UL RS/channel is configured with a TCI state (e.g., the TCI state #64) for multiple antenna panels, the UE may attempt to receive/transmit the DL/UL RS/channel based on a leading time for beam switching for the multiple antenna panels.

In some implementations of the present disclosure, a TCI state table may be used when the UE performs data reception/transmission by multiple antenna panels. For example, the BS may configure the UE with multiple TCI state tables. The number of entries in each TCI state table may be the same or different. The UE may select a specific TCI state table from these TCI state tables based on a MAC-CE massage (e.g., used in the MAC-CE approach) or a DCI message (e.g., used in the DCI approach). For example, if the UE receives a DCI message which contains an explicit bit (e.g., used as an indicator for antenna panel status) for indicating the UE to enable the power saving mode, the UE may attempt to receive the PDSCH using a single antenna panel, instead of using multiple antenna panels. In addition, the UE may further apply a leading time corresponding to using the single antenna panel.

In some implementations of the present disclosure, a timer may be used to determine the switch of the antenna panel status. For example, the UE may receive a timer from the BS and switch the antenna panel status from a first antenna panel status to a second antenna panel status after the timer expires. For example, when the timer expires, the UE may transition from the normal power consumption mode (e.g., in which the UE turns on N2 antenna panels) to the power saving mode (e.g., in which the UE turns on N1 antenna panel(s), where N1 is less than N2). In another example, the UE may transition from the power saving mode to the normal power consumption mode when the timer expires.

In some implementations of the present disclosure, the timer may expire when a DRX inactivity timer expires or the UE enters a DRX off-period/sleep mode.

FIG. **2** is a schematic diagram illustrating a timeline of the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure.

In the present implementation, a timer for antenna panel status may (re)start at the first symbol after the end of the PDCCH. As shown in FIG. **2**, in the slot # n, the UE receives an indicator for antenna panel status via a DCI message which is transmitted over a PDCCH **202**. The indicator for antenna panel status may indicate to the UE to switch from a power saving mode (in which there are only N1 antenna panel(s) is active/turned on) to a normal power consumption mode (in which there are N2 antenna panels are active/turned on), where N2 is greater than N1.

As shown in FIG. **2**, there is a time gap **21** between the time the UE receives the indicator for antenna panel status from the PDCCH **202** and the time the UE actually turns on the N2 antenna panels. The time gap **21** may reflect the time required for the UE to turn on the antenna panel(s). In some implementations of the present disclosure, the time gap **21** may be deemed as the leading time for beam switching of the UE.

In some implementations of the present disclosure, the UE may start the timer for antenna panel status at the first symbol after the last symbol of the PDCCH **202** monitor occasion. Also, the UE may further receive a PDSCH **204** scheduled by the PDCCH **202** in the same slot # n.

Before the timer expires, the BS may assume that the UE may keep the antenna panel status indicated by the PDCCH **202**, or applied for the PDSCH **204**. Once the timer expires, the BS may assume that the UE may return to the power saving mode. As shown in FIG. **2**, in the slot # n+2, after the timer expires, the UE may transmit a PUCCH **206** indicated by the PDCCH **202** in the power saving mode.

In some implementations of the present disclosure, if the UE is instructed by the BS to operate in the power saving mode, the timer may not start. In addition, the indicator for antenna panel status may be implemented as any implicit/explicit data structure. For example, the indicator for antenna panel status may include a single-bit IE or a multiple-bit IE or may be contained in a beam report or a CSI report.

In some other implementations of the present disclosure, the timer for antenna panel status may start at different time points, as shown in FIGS. **3** and **4**.

FIG. **3** is a schematic diagram illustrating a timeline of the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. In the present implementation, the timer for antenna panel status may start at the first symbol after the end of a PUCCH. As shown in FIG. **3**, in the slot

n, the UE receives an indicator for antenna panel status via a DCI message which is transmitted over a PDCCH **302**. The UE may further receive a PDSCH **304** which is scheduled by the PDCCH **302** in the same slot # n.

The indicator for antenna panel status may indicate to the UE to switch from a power saving mode (in which there are only N1 antenna panel(s) is turned on) to a normal power consumption mode (in which there are N2 antenna panels are turned on, where N2 is greater than N1). As shown in FIG. **3**, there is a time gap **31** between the time the UE receives the indicator for antenna panel status from the PDCCH **302** and the time the UE actually turns on the N2 antenna panels. As described above, the time gap **31** may reflect the time required for the UE to turn on the antenna panel(s). In addition, the time gap **31** may be deemed as the leading time for beam switching of the UE.

In the present implementation, the UE may start the timer at the first symbol after the last symbol of a PUCCH **306** monitor occasion. Similar to the implementations provided with reference to FIG. **2**, before the timer expires, the BS may assume that the UE may keep the antenna panel status indicated by the PDCCH **302**, or applied for the PDSCH **304**. Once the timer expires, the BS may assume that the UE may return to the power saving mode. As shown in FIG. **3**, in the slot # n+4, after the timer expires, the UE may turn off (N2−N1) antenna panels to go back to the power saving mode.

FIG. **4** is a schematic diagram illustrating a timeline of the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. In the present implementation, the timer for antenna panel status may start at the first symbol after the end of a PDSCH. As shown in FIG. **4**, in the slot # n, the UE may receive an indicator for antenna panel status via a DCI message which is transmitted over a PDCCH **402**. The UE may further receive a PDSCH **404**, which is scheduled by the PDCCH **402** in the same slot # n. Then, the UE may transmit a PUCCH **406**, which is indicated by the PDCCH **402**, in the slot # n+2.

The indicator for antenna panel status may indicate to the UE to switch from a power saving mode (in which there are only N1 antenna panel(s) is turned on) to a normal power consumption mode (in which there are N2 antenna panels are turned on, where N2 is greater than N1). As shown in FIG. **4**, there is a time gap **41** between the time the UE receives the indicator for antenna panel status from the PDCCH **402** and the time the UE actually turns on the N2 antenna panels. As noted above, the time gap **41** may reflect the time required for the UE to turn on the antenna panel(s). In addition, the time gap **41** may be deemed as the leading time for beam switching of the UE.

As described above, the UE may start the timer at the first symbol after the last symbol of the PDSCH **404**. Before the timer expires, the BS may assume that the UE may keep the antenna panel status indicated by the PDCCH **402** or applied for the PDSCH **404**. Once the timer expires, the BS may assume that the UE may return to the power saving mode. As shown in FIG. **4**, in the slot # n+4, after the timer expires, the UE may turn off certain antenna panel(s) to transition to the power saving mode.

The timer for antenna panel status may count based on an absolute time unit (e.g., ms), a time slot, a subframe, or an OFDM symbol. In some implementations of the present disclosure, if the timer counts based on a time slot or an OFDM symbol, the numerology of the time unit may be determined based on the PDCCH which carries the scheduling information, or based on the PDSCH/RSs/PUSCH/PUCCH which is scheduled by the PDCCH.

In some implementations of the present disclosure, the timer for antenna panel status may be an optional feature for the UE. For example, the BS may decide whether to configure the timer to the UE based on the UE's capability. In addition, if the UE is not configured with the timer for antenna panel status, the UE may not automatically switch the antenna panel status (e.g., return to the power saving mode automatically). In such a case, the UE may follow the most recently received indicator for antenna panels status (e.g., contained in a DCI message, a MAC-CE massage, or an RRC configuration) from the BS to determine the antenna panels status, until the UE sends a request to the BS and/or receives another indicator for antenna panels status from the BS. In some implementations of the present disclosure, the BS may not configure the UE with the timer for antenna panel status. In such a case, if the BS does not receive a response to the indicator for antenna panel status from the UE, the BS may assume that the UE is in the power saving mode. Hence, the BS may assume that a longer leading time may be adopted by the UE, and the BS may determine a scheduling offset value for the UE based on this assumption.

Some implementations of the present disclosure are described herein for determining the scheduling offset values and the leading time values for different antenna panel statuses.

In some implementations, there is only one leading time value for each DL/UL channel/RSs reception/transmission. Such a leading time value may be defined by the UE's capability for example. However, the above-mentioned mechanism may not be suitable for a situation where the UE needs a longer leading time for beam switching. Although the BS may configure the UE with a scheduling offset that is long enough to fulfill various leading times of different antenna panel statuses, such a configuration may cause some scheduling restrictions (e.g., because the UE may not always need to use a long leading time). Hence, in accordance with some implementations of the present disclosure, some techniques are provided to improve scheduling flexibility and performance of beam switching. For example, all DL/UL channel/RSs may be configured with one or more additional scheduling/triggering offset values for the situations where the UE may need to apply a long leading time value for beam switching, such as a PDSCH scheduling offset, a CSI-RS resource reception, a PUSCH transmission, and an SRS antenna switch.

In some implementations of the present disclosure, multiple scheduling offset values may be predefined for the UE (e.g., based on the 3GPP technical specification) or contained in the RRC configuration. The UE may apply one of the scheduling offset values based on the indicator for antenna panels status received from the BS. For example, the UE may apply a first scheduling offset value for a normal leading time case (e.g., in which the UE may not require to turn on an antenna panel, or only need to turn N1 antenna panel(s)), and apply a second scheduling offset value for a long leading time case (e.g., in which UE may need to turn on all of the antenna panels, or need to turn N2 antenna panels, where N2 is greater than N1).

In some implementations of the present disclosure, the UE may receive a plurality of scheduling offset values (e.g., including the first scheduling offset value and the second scheduling offset value) from the BS. Each of the scheduling offset values may be used for indicating a time duration counting from an end of a PDCCH to a beginning of a PDSCH. The UE may receive a first DCI message for setting the antenna panel status to a first antenna panel status. In response to receiving the first DCI message, the UE may apply the first scheduling offset value to receive first information on a DL channel (e.g., a PDSCH) scheduled by the first DCI message. The UE may further receive a second DCI message for switching the antenna panel status from the first antenna panel status to a second antenna panel status. For example, the second DCI message may include an indicator for antenna panel status information. In response to receiving the second DCI message, the UE may apply the second scheduling offset value to receive second information on a second DL channel (e.g., another PDSCH) scheduled by the second DCI message.

In some implementations of the present disclosure, each DL/UL channel/RS may have its corresponding scheduling offset value. For example, in order to receive an aperiodic CSI-RS resource, the RRC configuration may include two scheduling offset values: one leading time value may be indicated as X1 slot(s) (e.g., one slot) used for a normal leading time case, and another leading time value may be indicated as X2 slots (e.g., three slots) used for a long leading time case, where X2 is greater than X1. The UE may select one of these scheduling offset values based on the indicator for antenna panel status received from the BS. In another example, in order to receive the PDSCH, the RRC configuration may include two scheduling offset values (e.g., the K0 parameters/values in the pdsch-TimeDomainResourceAllocationList IE). For example, one scheduling offset value (K0) may be indicated as X1 slot(s) for the normal leading time case, and another scheduling offset value (K0) may be indicated as X2 slots for the long leading time case. The UE may select one of the scheduling offset values based on the indicator for antenna panel status.

In some implementations of the present disclosure, the UE may receive a scheduling offset value from the BS. The scheduling offset value may include at least one of a K0 parameter/value for a DL channel (e.g., a PDSCH) and a K2 parameter/value for a UL channel (e.g., a PUSCH). If the time duration indicated by the scheduling offset value is less than the leading time duration indicated by a selected leading time value, the UE may further determine that the scheduling offset value is invalid.

In some implementations of the present disclosure, all of the DL/UL channel/RSs may apply the same leading time value for beam switching. For example, when the UE operates in the normal power consumption mode, the PUSCH transmission may be associated with a specific scheduling offset value that is used for the normal leading time case (e.g., a K2 value for determining a PUSCH transmission offset). On the other hand, the PDSCH transmission may be associated with another scheduling offset also for the normal leading time case (e.g., a K0 value for determining a PDSCH reception offset).

In contrast, when the UE operates in the power saving mode, both the PUSCH transmission and the PDSCH reception may apply the same scheduling offset value. This scheduling offset value may be predefined by the 3GPP technical specifications, or configured in the RRC configuration, or determined based on the UE's capability. In some other implementations of the present disclosure, all DL channels/RSs may apply a first scheduling offset value suitable for the long leading time case, while all UL channels/RSs may apply a second scheduling offset value also suitable for the long leading time case, where the first scheduling offset value and the second scheduling offset value may be different. In some of the present implementations, all of the DL/UL channels/RSs may be configured with an additional leading time value for a beam switch case (e.g., a PDSCH scheduling offset, a CSI-RS resource reception, a PUSCH transmission or an SRS antenna switch).

Some implementations of the present disclosure are described herein for providing techniques for helping the BS to acquire information about the antenna panel status of the UE.

In some implementations of the present disclosure, the CSI measurement/report obtained under different antenna panel statuses may be transmitted from the UE to the BS via UCI/MAC-CE messages. In the UCI case, there may be at least two ways for the UE to inform the BS of the antenna panels status. One way is to introduce a particular IE contained in the CSI report, and the other way is to reuse the reserved bit field of an IE contained in the CSI report. In addition, the UE may transmit a CSI parameter to the BS for reporting the antenna panel status. The CSI parameter may include at least one of a Precoding Matrix Indicator (PMI), a Channel Quality Indicator (CQI), a Rank Indication (RI), a Layer Indication (LI), and a Layer 1 Reference Signals Received Power (L1-RSRP).

The information used to help the BS to acquire the antenna panel status of the UE may be referred to as the UE assistance information. In some implementations of the present disclosure, the UE may transmit the UE assistance information to the BS if the UE is not configured with the timer for antenna panel status, or does not have the ability to use the timer. In some implementations of the present disclosure, the UE may transmit the UE assistance information to the BS if the UE is configured to (or have the ability to) switch its antenna panel status only when receiving the indicator for antenna panel status via a MAC-CE massage and/or an RRC message.

An example L1-RSRP report quantized table is shown as follows:

TABLE 1

Bits	RSRP range
0000000	RSRP ≥ −44 dBm
0000001	−44 dBm > RSRP ≥ −45 dBm
0000010	−45 dBm > RSRP ≥ −46 dBm
. . .	. . .
1100000	−139 dBm > RSRP ≥ −140 dBm
1100001	−140 dBm> RSRP
1100011	Antenna panel status #0
1100100	Antenna panel status #1
. . .	. . .
1111111	Reserved

As shown in Table 1, a number of the reserved bit fields (e.g., bit fields "1100011" and "1100100") in the L1-RSRP report quantized table are reused for indicating the antenna panel status. For example, if the UE reports a value of "1100011" as the largest L1 RSRP value in the L1-RSRP report, the BS may assume that the UE is in the power saving mode.

In some implementations of the present disclosure, if the UE is configured to perform a group-based beam reporting procedure (e.g., in which the UE may receive signals simultaneously via a group of RX beams), the antenna panel status of the UE may be indicated by an L1-RSRP related value (e.g., a reserved L1-RSRP value and/or a specific differential L1-RSRP value). For example, if the bit field for the largest L1-RSRP value is a reserved value (e.g., "1100011") and the differential L1-RSRP value is a special value (e.g., "0000"), the BS may assume that the UE is in the power saving mode or in a specific antenna panel status, as shown in Table 1.

In some implementations of the present disclosure, the BS may assume that the indicated antenna panel status will be applied by the UE from the first symbol after the end of the slot at which the UCI or the PUSCH of the MAC-CE massage is transmitted through. For example, if the UE is configured with a timer for antenna panel status (e.g., the timer described with reference to FIGS. **2**, **3** and **4**), this timer may start at the first symbol after the end of the slot at which the UCI or the PUSCH of the MAC-CE massage is transmitted through.

In some implementations of the present disclosure, the mechanisms described above can be applied for the cases that the BS configures the UE to measure the CSI-RS resource/SSB by a single antenna panel, whereas the UE is actually able to (or has to) apply multiple antenna panels in the time resource for receiving the CSI-RS resource/SSB. In some implementations of the present disclosure, the UE may indicate the antenna panel status to the BS via the CSI parameter of the CSI report.

In some implementations of the present disclosure, the UE may report multiple sets of CSI parameters to the BS. For example, among the multiple sets of CSI parameters, one set of the CSI parameters may include CSI parameter(s) received and obtained through a single antenna panel, while another set of the CSI parameters may include CSI parameter(s) received and obtained through multiple antenna panels.

In some implementations of the present disclosure, techniques are described herein for determining the antenna panel status of a UE based on a DRX operation.

The DRX operation is a mechanism that makes a UE discontinuously monitor/receive the PDCCH to reduce the power consumption of the UE. However, when performing the DRX operation, the UE may still need to monitor a number of RSs in a DRX off-duration or a DRX inactive period. Hence, in some implementations of the present disclosure, whether to enable the power saving mode at a UE may be determined based on the DRX operation.

In some implementations of the present disclosure, a UE may decide to operate in the power saving mode when the UE is in a DRX off-duration or a DRX inactive period. For example, a UE may enable the power saving mode when the UE operates in a DRX active time (or a DRX on-duration) and disable the power saving mode when the UE operates in a DRX inactive time (or a DRX off-duration).

In some implementations of the present disclosure, whether to operate in the power saving mode is independent of the DRX operation. For example, a UE may only follow the indicator for antenna panel status received from the BS, without considering whether the UE is currently in a DRX on-duration or the DRX off-duration.

In some implementations of the present disclosure, whether to operate in the power saving mode may be determined based on the length of a DRX cycle (e.g., a time gap between two UE-wake-up instances). For example, the UE may be configured with a particular threshold and determine whether to enable the power saving mode according to a comparison between the threshold and the length of the DRX period. For example, if the threshold is 50 ms and the UE is configured with a DRX period of 40 ms, then the UE may not enable the power saving mode because the length of the DRX period (40 ms) is less than the threshold (50 ms). In the same way, if the UE is configured with a DRX period of 60 ms, the UE may enable the power saving antenna status because the length of the DRX period (60 ms) is greater than the threshold (50 ms). This threshold may be predefined in the 3GPP technical specifications or configured by the BS via an RRC signaling.

In some implementations of the present disclosure, the UE may assume that it will not operate in the power saving mode if the UE is in the active time. For example, the active time may include the time while: 1) a specific timer (e.g., drx-onDurationTimer or drx-InactivityTimer or drx-RetransmissionTimerDL or drx-RetransmissionTimerUL or ra-ContentionResolutionTime) is running; or 2) a scheduling request is sent on a PUCCH and is pending; or 3) a PDCCH indicating a new transmission addressed to the Cell Radio Network Temporary Identifier (C-RNTI) of the MAC entity has not been received after successful reception of a random access response for the random access preamble not selected by the MAC entity among the contention-based random access preamble.

In some implementations of the present disclosure, the UE may automatically enter/stay the normal power consumption mode regardless of the BS's indication. For example, the UE may automatically switch the antenna panel status without further reception of a new indicator for antenna panel status information from the BS.

In some implementations of the present disclosure, if the UE is configured with a timer for antenna panel status, this timer may be affected by the DRX inactivity timer, because from the UE's perspective, whether to operate in the power saving mode may be related to the DRX operations. For example, when the DRX inactivity timer expires while the timer for antenna panel status is still running, the UE may switch to the DRX off duration and enable the power saving mode. In addition, the timer for antenna panel status may then stop. In another example, the operation of the DRX inactivity timer and the timer for antenna panel status are independent.

An illustrative example (denoted as Example 0) will now be provided, where the UE may inform the BS of the UE's capability.

FIG. **5** is an example of a data structure indicating UE capability information, in accordance with example implementations of the present disclosure. As shown in FIG. **5**, UE capability information **502** includes a number of parameters related to the antenna panel status of the UE. The parameters may include at least one of a power saving indicator (which may be used as the indicator for antenna panel status described herein), a timer for antenna panel status (for which the value may be set as "true/support" or "false/not support"), a maximum number of support antenna panels (e.g., one, two, four or eight), a support indication method (e.g., which may indicate whether an RRC, MAC-CE, or DCI approach is supported), a required time for antenna panel status switch (e.g., 1 ms, 2 ms, 3 ms, or 4 ms), and a UE assistance indication (for which the value may be set as "true/support" or "false/not support"). The UE may transmit the UE capability information **502** to the BS after establishing an RRC connection to the BS. If the UE supports the timer for antenna panel status, the BS may configure the length of the timer for antenna panel status to the UE, as shown in FIG. **6**.

FIG. **6** is an example data structure indicating the configuration of the timer for antenna panel status, in accordance with example implementations of the present disclosure. As shown in FIG. **6**, a configuration **602** may indicate that the length/duration of the timer for antenna panel status is four slots.

An illustrative example (Example 1-1) will now be provided, where the scheduling offset value (e.g., K0 value) for

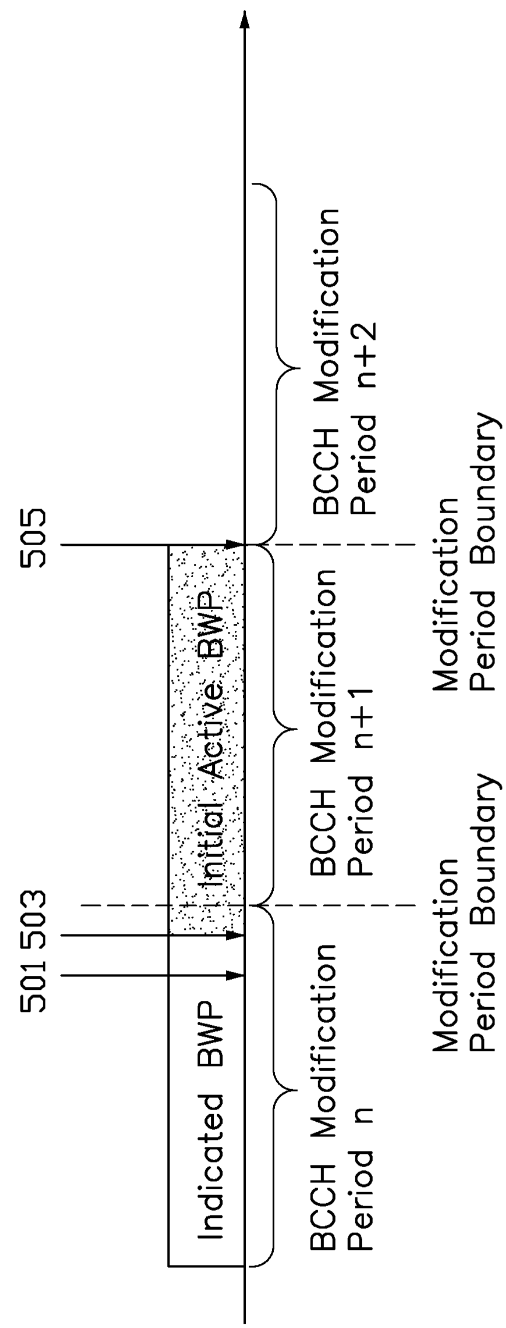

505
501 503
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 5

PDSCH reception may be selected based on an indicator for antenna panel status (e.g., contained in a TCI state) from the BS.

FIG. **7** is a flowchart for a method of selecting a scheduling offset value based on a TCI state indicated by the BS, in accordance with example implementations of the present disclosure.

In action **702**, a UE may be configured with multiple sets of parameters corresponding to different operation modes (e.g., the power saving mode and the normal power consumption mode). For example, the UE may be configured with two different leading time values. One leading time value may be 10 μs, and the other one may be 3 ms. As noted above, the UE may apply a first leading time when the UE needs to turn on a first number of antenna panel(s), and apply a second leading time when the UE needs to turn on a second number of antenna panel(s), where the first leading time is longer than the second leading time if the first number is greater than the second number. Hence, in this example, the shorter leading time, 10 μs, may be applied in the case that the UE does not need to further turn on an antenna panel in response to the indicator for antenna panel status, and the longer leading time, 3 ms, may be applied in the case that the UE needs to turn on one or more antenna panels to change the operation mode (e.g., to switch from the power saving mode to the normal power consumption mode).

The leading time values may be predefined in the 3GPP technical specifications or configured by the BS via an RRC signaling. In addition, the UE may be configured with a set of K0 values in the pdsch-TimeDomainResourceAllocationList IE of an RRC configuration. An example of the K0 configuration is as follows.

TABLE 2

Row index	K0 (normal, long)
0	(0 slot, 3 slots)
1	(0 slot, 3 slots)
.	.
.	.
.	.
15	(1 slot, 4 slots)

For each indexed row of the K0 configuration, the UE may determine which of the normal K0 value and the long K0 value should be applied. In addition, the UE may be configured with a certain number of TCI state(s) in the RRC configuration, and each of the TCI state(s) may be associated with a particular antenna panel status.

FIG. **8** is an example data structure indicating TCI state configuration, in accordance with example implementations of the present disclosure. As shown in FIG. **8**, a TCI state configuration **802** includes 64 TCI states, and each TCI state may include a power saving mode IE for indicating whether to enable the power saving mode when the corresponding TCI state is applied.

In addition, the UE may be configured by the BS to enable the power saving mode via an indicator for antenna panel status. FIG. **9** is an example data structure for an indicator for antenna panel status, in accordance with example implementations of the present disclosure. As shown in FIG. **9**, an indicator for antenna panel status **902** includes a power saving mode IE which is set as "true" to indicate to the UE to enable the power saving mode.

It should be noted that the parameter values, data formats, and configurations provided herein are for illustrative purposes only, and not intended to limit the scope of the present invention. For example, the number of slots for each K0 value (e.g., the normal K0 value or the long K0 value) may be different for different numerologies.

Referring back to FIG. **7**. In action **704**, the UE may receive a DCI message from the BS. In action **706**, the UE may apply a TCI state indicated by the DCI message. In action **708**, the UE may apply a K0 value corresponding to the antenna panel status associated with the TCI state.

FIGS. **10**A and **10**B are schematic diagrams illustrating timelines of the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. It should be noted that the timeline of FIG. **10**B is continued from that of FIG. **10**A. In this example, the total number of turned-on/active antenna panels at the UE is N1 when the power saving mode is enabled and is N2 when the power saving mode is disabled, where N1 is less than N2. For example, N1 may be "1" and N2 may be the number of the antenna panels the UE has.

As shown in FIG. **10**A, the UE may receive and decode a first DCI message DCI_1 which is transmitted over a PDCCH **1002** in the slot # n. The first DCI message DCI_1 may indicate to the UE to apply a particular TCI state (e.g., the TCI state #1 contained in the TCI state configuration **802** in FIG. **8**) for a scheduling PDSCH **1004**. According to FIG. **8**, because the TCI state #1 includes a power saving mode IE which is configured with a "true" value, the UE may follow the TCI state #1 to monitor the scheduling PDSCH **1004** in the power saving mode. In some implementations of the present disclosure, the UE may apply a normal K0 value when the UE does not need to further turn on an antenna panel in response to the indicator for antenna panel status from the BS, and may apply a long K0 value when the UE needs to turn on at least one antenna panel in response to the indicator for antenna panel status. In this example, because the UE has already in the power saving mode before receiving the first DCI message DCI_1, the UE may refer to the K0 configuration in Table 2 to apply a normal K0 value (e.g., 0 slot) contained in the row entry which is indexed by "1" and associated with the TCI state #1. Once the normal K0 value (e.g., 0 slot) is applied, the UE is expected to receive the PDSCH **1004** in the same slot as the PDCCH **1002**, as shown in FIG. **10**A.

After successfully receiving and decoding the PDSCH **1004**, the UE may transmit a HARQ-ACK over a PUCCH **1006** in the slot # n+1 based on the HARQ resource indicator (ARI) contained in the first DCI message DCI_1. Then, the UE may further receive and decode a second DCI message DCI_2 which is transmitted over a PDCCH **1008** in the slot # m. In this example, the second DCI message DCI_2 may indicate to the UE to apply the TCI state #64 for a scheduling PDSCH **1010**. According to FIG. **8**, because the TCI state #64 includes a power saving mode IE which is configured with a "false" value, the TCI state #64 may indicate to the UE to receive the scheduling PDSCH **1010** in the normal power consumption mode, in which there are N2 antenna panels turned on by the UE. As noted above, because the UE needs to turn on a number of antenna panels to enter the normal power consumption mode, the UE may apply a long K0 value for receiving the PDSCH **1010**. For example, the UE may refer to the K0 configuration in Table 2 to apply a long K0 value (e.g., 4 slots) contained in the row entry which is indexed by "15" and associated with the TCI state #64. Once the long K0 value (e.g., 4 slots) is applied, the UE will expect to receive the PDSCH **1010** in the slot m+4, which is the fourth slot after the slot # m, as shown in FIG. **10**A.

After successfully receiving and decoding the PDSCH **1010**, the UE may transmit a HARQ-ACK over a PUCCH **1012** in the slot # m+6 based on the ARI contain in the second DCI message DCI_2, as shown in FIG. **10**B.

Then, the UE may receive and decode a third DCI message DCI_3 which is transmitted over a PDCCH **1014** in the slot # m+7. In this example the third DCI message DCI_3 may indicate to the UE to apply the same TCI state #64 as indicated in second DCI message DCI_2 for a scheduling PDSCH **1016**. Although the TCI state #64 may indicate to the UE to receive the scheduling PDSCH **1016** in the normal power consumption mode, the UE has already operated in the normal power consumption mode before receiving the third DCI message DCI_3. Thus, the UE does not need to further turn on an antenna panel at this moment, and the UE may apply the normal K0 value (e.g., 0 slot) to determine when to receive the PDSCH **1016** (e.g., in the same slot # m+7 as the PDCCH **1014**). After successfully receiving and decoding the PDSCH **1016**, the UE may transmit a HARQ-ACK over a PUCCH **1018** in the slot # k based on the ARI contained in the third DCI message DCI_3, as shown in FIG. **10**B.

An illustrative example (denoted as Example 1-2) will now be provided, where the scheduling offset value (e.g., K0 value) for PDSCH reception may be selected based on the TCI state and the timer for antenna panel status.

In Example 1-2, the UE may be further configured with a timer for antenna panel status in addition to the multiple sets of parameters configured in action **702** of FIG. **7**. For example, the configuration of the timer for antenna panel status may be, but not limited to, the configuration **602** in FIG. **6**. In some implementations of the present disclosure, the numerology of the timer for antenna panel status may be determined based on the scheduling PDSCH of the active DL BWP.

FIGS. **11**A and **11**B are schematic diagrams illustrating timelines of the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. It should be noted that the timeline of FIG. **11**B is continued from that of FIG. **11**A. In this example, the total number of turned-on/active antenna panels at the UE is N1 when the power saving mode is enabled and is N2 when the power saving mode is disabled, where N1 is less than N2. For example, N1 may be "1" and N2 may be the number of the antenna panels the UE has.

As shown in FIG. **11**A, the UE may receive and decode a first DCI message DCI_1 which is transmitted over a PDCCH **1102** in the slot # n. The first DCI message DCI_1 may indicate to the UE to apply a particular TCI state (e.g., the TCI state #1 contained in the TCI state configuration **802** in FIG. **8**) for a scheduling PDSCH **1104**. According to FIG. **8**, because the TCI state #1 includes a power saving mode IE which is configured with a "true" value, the UE may follow the TCI state #1 to monitor the scheduling PDSCH **1004** in the power saving mode. As noted above, because the UE has already in the power saving mode before receiving the first DCI message DCI_1, the UE may refer to the K0 configuration in Table 2 to apply a normal K0 value (e.g., 0 slot) contained in the row entry which is indexed by "1" and associated with the TCI state #1. Once the normal K0 value (e.g., 0 slot) is applied, the UE is expected to receive the PDSCH **1104** in the same slot as the PDCCH **1002**, as shown in FIG. **11**A.

After successfully receiving and decoding the PDSCH **1104**, the UE may transmit an HARQ-ACK over a PUCCH **1106** in the slot # n+1 based on the ARI contained in the first DCI message DCI_1. Then, the UE may further receive and decode a second DCI message DCI_2 which is transmitted over a PDCCH **1108** in the slot # m. In this example, the second DCI message DCI_2 may indicate to the UE to apply the TCI state #64 for a scheduling PDSCH **1110**. According to FIG. **8**, because the TCI state #64 includes a power saving mode IE which is configured with a "false" value, the TCI state #64 may indicate to the UE to receive the scheduling PDSCH **1110** in the normal power consumption mode, in which there are N2 antenna panels turned on by the UE. As noted above, because the UE needs to turn on a number of antenna panels to enter the normal power consumption mode, the UE may apply a long K0 value for receiving the PDSCH **1110**. For example, the UE may refer to the K0 configuration in Table 2 to apply a long K0 value (e.g., 4 slots) contained in the row entry which is indexed by "15" and associated with the TCI state #64. Once the long K0 value (e.g., 4 slots) is applied, the UE will expect to receive the PDSCH **1110** in the slot m+4, which is the fourth slot after the slot # m, as shown in FIG. **11**A. In addition, the timer for antenna panel status may start at the end of the slot # m+4.

After successfully receiving and decoding the PDSCH **1110**, the UE may transmit an HARQ-ACK over a PUCCH **1112** in the slot # m+6 based on the ARI contain in the second DCI message DCI_2, as shown in FIG. **11**B.

Then, UE may successfully receive and decode a third DCI message DCI_3 which is transmitted over a PDCCH **1114** in the slot # m+9. The third DCI message DCI_3 may indicate to the UE to apply the TCI state #64 for a scheduling PDSCH **1116**. Because the timer for antenna panel status expires in the end of the slot # m+8, the UE has already switched to the power saving mode when receiving the third DCI message DCI_3. In addition, according to FIG. **8**, the TCI state #64 may indicate to the UE to receive the PDSCH **1116** in the normal power consumption mode. Because the UE needs to turn on at least N2-N1 antenna panels to switch from the power saving mode to the normal power consumption mode, the UE may apply a long K0 value (e.g., 4 slots) based on the K0 configuration (e.g., the K0 configuration shown in Table 2), and receive the PDSCH **1116** in the slot m+13 which is the fourth slot after the slot # m+9. After successfully receiving and decoding the PDSCH **1116**, the UE may transmit an HARQ-ACK in the slot # k based on the ARI in the scheduling DCI (e.g., the third DCI message DCI_3), as shown in FIG. **11**B.

An illustrative example (denoted as Example 2-1) will now be provided, where an RRC-configured offset value for receiving an aperiodic CSI RS may be selected based on a CSI request from the BS.

FIG. **12** is a flowchart for a method of selecting an offset value (e.g. a K0 value) for receiving an aperiodic CSI-RS, in accordance with example implementations of the present disclosure.

In action **1202**, the UE may be configured with multiple sets of parameters corresponding to different operation modes (e.g., the power saving mode and the normal power consumption mode). For example, two different leading times may be predefined in the 3GPP technical specifications for the UE. One may be a shorter leading (e.g., 10 microseconds) to be used in the case that the UE does not need to further turn on an antenna panel, and the other one may be a longer leading time (e.g., 3 ms) to be used in the case that the UE needs to turn on one or more antenna panels to change the operation mode. In addition, the UE may be configured with a set of offset values (e.g., aperiodicTriggeringOffset) in an RRC configuration for receiving an aperiodic CSI-RS, as shown in FIG. **13**.

FIG. **13** is an example data structure indicating an aperiodic CSI RS reception configuration, in accordance with example implementations of the present disclosure. As shown in FIG. **13**, in the aperiodic CSI RS reception configuration (e.g., NZP-CSI-ResourceSet) **1302**, the aperiodicTriggeringOffset may refer to a specific row entry (e.g., indexed by "10") in the K0 configuration **1304**, which is associated with a normal K0 value of 2 slots and a long K0 value of 6 slots. The UE may be further configured in the power saving mode based on an initial indicator for antenna panel status (e.g., the indicator for antenna panel status **902** in FIG. **9**). In addition, the numerology applied in this example may be, but not limited to, 15 KHz.

Referring back to FIG. **12**. In action **1204**, the UE may receive a DCI message containing a CSI request from BS. In action **1206**, the UE may apply a K0 value corresponding to the antenna panel status indicated by the CSI request.

FIG. **14** is an example of a MAC-CE message, in accordance with example implementations of the present disclosure. As shown in FIG. **14**, a MAC-CE message **1402** includes several reserved bits (which are denoted as "R" in FIG. **14**), a cell ID, and a control bit (which is denoted as "C" in FIG. **14**). The cell ID may contain the serving cell ID (e.g., "00000" in this example). The control bit "C" may be used for indicating to the UE to enable/disable the power saving mode. For example, the UE may be indicated to enable the power saving mode when the control bit is set to a first value (e.g., "1"), or indicated to disable the power saving mode when the control bit is set to a second value (e.g., "0"). As shown in FIG. **14**, the MAC-CE message **1402** of which the control bit is set to "0" may be used for indicating to the UE to disable the power saving mode (or to operate in the normal power consumption mode).

FIG. **15** is a schematic diagram illustrating that different triggering offset values (e.g., K0 values) are applied for the changes in the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. In this example, the total number of turned-on/active antenna panels at the UE is N1 when the UE is in the power saving mode and is N2 when the UE is the normal power consumption mode, where N1 is less than N2. For example, N1 may be "1" and N2 may be the number of the antenna panels the UE has.

As shown in FIG. **15**, in the slot # n, the UE may receive a first DCI message DCI_1 which is transmitted over a PDCCH **1502**, and obtain a MAC-CE message (e.g., the MAC-CE message **1402** in FIG. **14**) based on the first DCI message DCI_1. The MAC-CE message may include an indicator for antenna panel status (e.g., the control bit of the MAC-CE message **1402** in FIG. **14**) used for indicating the UE to operate in the normal power consumption mode (or disable the power saving mode). Then, the UE may monitor a scheduling PDSCH **1504** based on the first DCI message DCI_1 and transmit a HARQ-ACK over a PUCCH **1508** for the MAC-CE message in the slot # n+5.

In this example, the UE may receive a second DCI message DCI_2 which is transmitted over a PDCCH **1506** in the slot # n+1. The second DCI message DCI_2 may contain a CSI request for triggering an aperiodic CSI report. For example, the CSI request for triggering the CSI-RS resource may be indicated by the BS, through the QCL information associated with the CSI-RS resource, to be received by the multiple antenna panels at the UE. In some implementations of the present disclosure, the UE may apply a normal triggering offset value when the UE does not need to further turn on an antenna panel in response to the indicator for antenna panel status obtained from the BS, and apply a long triggering offset value when the UE needs to turn on at least one antenna panel in response to the indicator for antenna panel status received from the BS. Thus, in this example, the UE may apply a long triggering offset value (e.g., aperiodicTriggeringOffset) for the CSI request to switch from the power saving mode to the normal power consumption mode. As shown in FIG. **15**, the BS may transmit the CSI-RS resource in the slot #n+7, which is the sixth time slot after the slot #n+1.

In addition, the UE may further receive a third DCI message DCI_3 which is transmitted over a PDCCH **1510** in the slot # m. The third DCI message DCI_3 may contain a CSI request for triggering an aperiodic CSI report, and the CSI request may indicate the same aperiodic CSI-RS trigger state as indicated by the CSI request contained in the second DCI message DCI_2. Since the CSI-RS resource (which is triggered by the CSI request contained in the third DCI message DCI_3) is indicated to be received by the multiple antenna panels of the UE by the BS (e.g., through the QCL information which is associated with the CSI-RS resource), the UE may decide to apply a normal triggering offset value (e.g., aperiodicTriggeringOffset) of two slots for this CSI request based on the current antenna panel status (e.g., with N2 antenna panels being turned-on). Thus, as shown in FIG. **15**, the UE may receive the corresponding aperiodic CSI-RS resource from the BS in the slot # m+2, which is the first time slot after the slot # m+1.

An illustrative example (denoted as Example 2-2) will now be provided, where an RRC-configured offset value for an aperiodic CSI RS reception may be selected based on a CSI request from the BS and a timer for antenna panel status.

In Example 2-2, the UE may be further configured with a timer for antenna panel status in addition to the multiple sets of parameters configured in action **1202** of FIG. **12**. For example, the configuration of the timer for antenna panel status may be, but not limited to, the configuration **602** in FIG. **6**. In some implementations of the present disclosure, the numerology of the timer for antenna panel status may be determined based on the scheduling PDSCH of the active DL BWP.

FIGS. **16**A and **16**B are schematic diagrams illustrating that different triggering offset values (e.g., K0 values) are applied for the changes in the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. It should be noted that FIG. **16**B is continued from the FIG. **16**A. In this example, the total number of turned-on/active antenna panels at the UE is N1 when the UE is in the power saving mode and is N2 when the UE is the normal power consumption mode, where N1 is less than N2. For example, N1 may be "1" and N2 may be the number of the antenna panels the UE has.

As shown in FIG. **16**A, in the slot # n, the UE may receive a first DCI message DCI_1 which is transmitted over a PDCCH **1602**, and obtain a MAC-CE message (e.g., the MAC-CE message **1402** in FIG. **14**) based on the first DCI message DCI_1. The MAC-CE message may include an indicator for antenna panel status (e.g., the control bit of the MAC-CE message **1402** in FIG. **14**) that may indicate to the UE to operate in the normal power consumption mode. The UE may monitor a scheduling PDSCH **1604** based on the first DCI message DCI_1 and transmit an HARQ-ACK over a PUCCH **1608** for the MAC-CE message in the slot # n+5.

In addition, the UE may receive a second DCI message DCI_2 which is transmitted over a PDCCH **1606** in the slot

n+1. The second DCI message DCI_2 may contain a CSI request for triggering an aperiodic CSI report. For example, the CSI request for triggering the CSI-RS resource may be indicated by the BS, through the QCL information associated with the CSI-RS resource, to be received by the multiple antenna panels at the UE. As described above, the UE may apply a long triggering offset value (e.g., aperiodicTriggeringOffset) for the CSI request because the UE may need to turn on at least one antenna panel in response to the indicator for antenna panel status obtained from the BS. As shown in FIG. **16**A, the BS may transmit the CSI-RS resource in the slot #n+7, which is the sixth time slot after the slot #n+1. In this example, the timer for antenna panel status may also start at the beginning of the slot #n+7.

Referring to FIG. **16**B. The timer may then expire at the end of the slot n+10, and the UE may switch from the normal power consumption mode to the power saving mode. In addition, the UE may then receive a third DCI message DCI_3 which is transmitted over a PDCCH **1610** in the slot # m, where m>n+10. The third DCI message DCI_3 may contain a CSI request for triggering an aperiodic CSI report, and the CSI request may indicate the same aperiodic CSI-RS trigger state as indicated by the second DCI message DCI_2. Since the CSI-RS resource triggered by the CSI request is indicated by the BS, through the QCL information associated to the CSI-RS resource, to be received by multiple antenna panels of the UE, the UE may decide to apply a long triggering offset value (e.g., aperiodicTriggeringOffset) for this CSI request based on current antenna panels status (e.g., with N1 antenna panels being turned-on). Thus, as shown in FIG. **16**B, the BS may transmit the aperiodic CSI-RS resource in the slot # m+5, which is the fifth time slot after the slot # m.

An illustrative example (denoted as Example 3-1) will now be provided, where a UE may indicate its antenna panel status through at least one explicit bit in a CSI report.

FIG. **17** is a schematic diagram illustrating a timeline of the antenna panel status of a wireless communication device (e.g., a UE), in accordance with example implementations of the present disclosure. In this example, the total number of turned-on/active antenna panels at the UE is N1 when the UE is in the power saving mode and is N2 when the UE is the normal power consumption mode, where N1 is less than N2.

In this example, the UE may be configured with a periodic CSI report and the periodicity for the CSI report may be 20 slots. In addition, the UE may be configured with a timer for antenna panel status. The configuration of the timer for antenna panel status may be, but not limited to, the configuration **602** shown in FIG. **6**. In some implementations of the present disclosure, the numerology of the timer for antenna panel status may be determined based on the scheduling PDSCH of active DL BWP.

Referring back to FIG. **17**, the UE may use N1 antenna panel(s) to receive a CSI-RS #1 for calculating a CSI report which is to be transmitted over a PUCCH **1702** in the slot # n. Hence, the bit field in the CSI report may be set to a first value (e.g., "1") to indicate that the UE is in the power saving mode.

On the other hand, if the UE changes to use multiple antenna panels to receive the CSI-RS #2 for calculating a CSI report which is to be transmitted over a PUCCH **1704** in the slot # n+20, the bit field in this CSI report may be set to a second value (e.g., "0") to indicate that the UE is in normal power consumption mode (e.g., by disabling the power saving mode).

An illustrative example (denoted as Example 4-1) will now be provided, where the antenna panel status may be switched based on a DRX operation.

FIG. **18** is a flowchart for a method for determining the antenna panel status of a wireless communication device (e.g., a UE) based on a DRX operation, in accordance with example implementations of the present disclosure. As shown in FIG. **18**, in action **1802**, the UE may be configured with a DRX inactivity timer by the BS. In action **1804**, the UE may switch the antenna panel status based on the DRX inactivity timer.

In some implementations of the present disclosure, the DRX inactivity timer may be used to define how long a UE should remain in the ON state after the reception of a PDCCH. For example, while the DRX inactivity timer is running, the UE may remain in the ON state.

In Example 4-1, the UE may be configured with a DRX period and a timer for antenna panel status. In addition, the BS may indicate to the UE to operate in the normal power consumption mode, as shown in FIG. **19**.

FIG. **19** is an example data structure indicating an RRC configuration for the UE, in accordance with example implementations of the present disclosure. As shown in FIG. **19**, an RRC configuration **1902** may include a DRX configuration and an antenna panel status configuration. The DRX configuration may be configured with a DRX inactivity timer for 2 ms and a DRX cycle of 50 ms. The antenna panel status configuration may indicate that the power saving mode is to be disabled (e.g., with a "false" value) and the length of the timer for the antenna panel status is four slots.

FIG. **20** is a schematic diagram illustrating a timeline of the antenna panel status of a wireless communication device (e.g., a UE) and a timing diagram of a DRX cycle, in accordance with example implementations of the present disclosure. In the present implementation, the timer for antenna panel status may have the same operation as the DRX inactivity timer. In addition, the total number of turned-on/active antenna panels at the UE is N1 when the UE is in the power saving mode and is N2 when the UE is the normal power consumption mode, where N1 is less than N2.

As shown in FIG. **20**, the UE may receive a DCI message in the slot # n at which the UE is in a DRX on-duration. In response to receiving the DCI message, the UE may start both the DRX inactivity timer and the timer for antenna panel status, if the DCI message is used for indicating to the UE to operate in the normal power consumption mode. Then, if the timer for antenna panel status is going to stop/expire at the beginning of the slot # n+4 (e.g., according to the RRC configuration **1902** in FIG. **19**), the DRX inactivity timer may follow the timer for antenna panel status to stop/expire at the same timing (e.g., at the beginning of the slot # n+4). Thus, the UE may enter a DRX off-duration and operate in the power saving mode at the same time.

An illustrative example (denoted as Example 4-2) will now be provided, where the antenna panel status may be switched based on a DRX operation.

In Example 4-2, the UE may be configured with a DRX inactivity timer by the BS. In addition, the UE may be indicated by the BS to operate in the normal power consumption mode based on an RRC configuration, as shown in FIG. **21**.

FIG. **21** is an example data structure indicating an RRC configuration for the UE, in accordance with example implementations of the present disclosure. As shown in FIG. **21** an RRC configuration **2102** may include a DRX configuration and an antenna panel status configuration. The DRX configuration may be configured with a DRX inactivity timer for 2 ms and a DRX cycle of 50 ms. Furthermore, the antenna panel status configuration may indicate that the power saving mode is to be disabled (e.g., with a "False" value).

FIG. **22** is a schematic diagram illustrating a timeline of the antenna panel status of a wireless communication device (e.g., a UE) and a timing diagram of a DRX cycle, in accordance with example implementations of the present disclosure. In the present implementation, the antenna panel status of a UE may follow the DRX cycles. In addition, the total number of turned-on/active antenna panels at the UE is N1 when the UE is in the power saving mode, and is N2 when the UE is the normal power consumption mode, where N1 is less than N2.

As shown in FIG. **22**, the UE may at first operate in the normal power consumption mode based on the most recently received BS instruction (e.g., received through an RRC configuration, a MAC-CE message or a DCI message). If the UE does not receive a PDCCH in the DRX on-duration (at which the UE is in an active state), the UE may then switch to the power saving mode after the UE enters the DRX off-duration (at which the UE is in an inactive/sleep state).

FIG. **23** is a flowchart for a method of operating multiple antenna panels, in accordance with example implementations of the present disclosure.

In action **2302**, a wireless communication device (e.g., a UE) may maintain a plurality of leading time values, wherein the plurality of leading time values may indicate a plurality of leading time durations.

In action **2304**, the wireless communication device may receive an indicator for antenna panel status information from a BS.

In action **2306**, the wireless communication device may apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the received indicator for antenna panel status information.

FIG. **24** is a block diagram illustrating a node for wireless communication, in accordance with various aspects of the present application. As shown in FIG. **24**, a node **2400** may include a transceiver **2420**, a processor **2428**, a memory **2434**, one or more presentation components **2438**, and at least one antenna **2436**. The node **2400** may also include an RF spectrum band module, a BS communications module, a network communications module, and a system communications management module, Input/Output (I/O) ports, I/O components, and power supply (not explicitly shown in FIG. **24**). Each of these components may be in communication with each other, directly or indirectly, over one or more buses **2440**. In one implementation, the node **2400** may be a UE or a BS that performs various functions described herein, for example, with reference to FIGS. **1** through **23**.

The transceiver **2420** having a transmitter **2422** (e.g., transmitting/transmission circuitry) and a receiver **2424** (e.g., receiving/reception circuitry) may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, the transceiver **2420** may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. The transceiver **2420** may be configured to receive data and control channels.

The node **2400** may include a variety of computer-readable media. Computer-readable media may be any available media that may be accessed by the node **2400** and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data.

Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, Digital Versatile Disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

The memory **2434** may include computer-storage media in the form of volatile and/or non-volatile memory. The memory **2434** may be removable, non-removable, or a combination thereof. Example memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in FIG. **24**, The memory **2434** may store computer-readable, computer-executable instructions **2432** (e.g., software codes) that are configured to, when executed, cause the processor **2428** to perform various functions described herein, for example, with reference to FIGS. **1** through **23**. Alternatively, the instructions **2432** may not be directly executable by the processor **2428** but be configured to cause the node **2400** (e.g., when compiled and executed) to perform various functions described herein.

The processor **2428** (e.g., having processing circuitry) may include an intelligent hardware device, e.g., a Central Processing Unit (CPU), a microcontroller, an ASIC, and etc. The processor **2428** may include memory. The processor **2428** may process the data **2430** and the instructions **2432** received from the memory **2434**, and information through the transceiver **2420**, the base band communications module, and/or the network communications module. The processor **2428** may also process information to be sent to the transceiver **2420** for transmission through the antenna **2436**, to the network communications module for transmission to a core network.

One or more presentation components **2438** presents data indications to a person or other device. Examples of presentation components **2438** may include a display device, speaker, printing component, vibrating component, etc.

From the above description, it is manifested that various techniques may be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes may be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

What is claimed is:

1. A wireless communication device comprising:

a plurality of antenna panels;

a processor coupled to the plurality of antenna panels and configured to:

maintain a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations;

receive an indicator for antenna panel status information from a base station (BS);

apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information;

receive a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel; and

determine that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than a leading time duration indicated by the applied leading time value.

2. The wireless communication device of claim 1, wherein the processor is further configured to:

receive a timer from the BS; and

switch the antenna panel status from a first antenna panel status to a second antenna panel status after the timer expires.

3. The wireless communication device of claim 2, wherein the timer expires when one of a Discontinuous Reception (DRX) inactivity timer expires and the wireless communication device enters one of a DRX off-period and a sleep mode.

4. The wireless communication device of claim 1, wherein the processor is further configured to:

transmit an antenna panel status report to inform the BS of the switch of the antenna panel status.

5. The wireless communication device of claim 4, wherein the antenna panel status report is contained in one of a beam report and a Channel State Information (CSI) report.

6. The wireless communication device of claim 4, wherein the antenna panel status report comprises a single-bit Information Element (IE), and the processor is further configured to:

set the single-bit IE to a first value to indicate that a power saving mode is enabled; and

set the single-bit IE to a second value to indicate that the power saving mode is disabled,

wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

7. The wireless communication device of claim 4, wherein the antenna panel status report comprises a multiple-bit Information Element (IE), and the processor is further configured to:

set the multiple-bit IE to a particular value associated with a particular number of the plurality of antenna panels being turned on.

8. The wireless communication device of claim 1, wherein the indicator for antenna panel status information comprises a single-bit Information Element (IE), and the processor is further configured to:

enable a power saving mode when the single-bit IE is set to a first value; and

disable the power saving mode when the single-bit IE is set to a second value,

wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

9. The wireless communication device of claim 1, wherein the indicator for antenna panel status information comprises a multiple-bit Information Element (IE), and the processor is further configured to:

turn on a particular number of the plurality of antenna panels when the multiple-bit IE is set to a particular value.

10. The wireless communication device of claim 1, wherein the indicator for antenna panel status information is contained in a Transmission Configuration Indicator (TCI) state Identity (ID) indicated by the BS.

11. The wireless communication device of claim 1, wherein the plurality of leading time values is one of cell-specific values and cell group-specific values.

12. The wireless communication device of claim 1, wherein the processor is further configured to:

switch the antenna panel status from a first antenna panel status to a second antenna panel status in response to receiving the indicator for antenna panel status information; and

automatically switch the antenna panel status from the second antenna panel status to a third antenna panel status without further reception of an indicator for antenna panel status information from the BS.

13. The wireless communication device of claim 1, wherein the processor is further configured to:

enable a power saving mode when the wireless communication device operates in a Discontinuous Reception (DRX) active time; and

disable the power saving mode when the wireless communication device operates in a DRX inactive time,

wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

14. The wireless communication device of claim 1, wherein the processor is further configured to:

enable a power saving mode based on whether the wireless communication device operates in a particular Bandwidth Part (BWP),

wherein:

a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled; and

the particular BWP is one of a default BWP, an initial BWP, and a first active BWP.

15. A method performed by a wireless communication device for operating a plurality of antenna panels, the method comprising:

maintaining a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations;

receiving an indicator for antenna panel status information from a base station (BS);

applying one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information;

receiving a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel; and

determining that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than a leading time duration indicated by the applied leading time value.

16. The method of claim **15**, further comprising:

receiving a timer from the BS; and

switching the antenna panel status from a first antenna panel status to a second antenna panel status after the timer expires.

17. The method of claim **16**, wherein the timer expires when one of a Discontinuous Reception (DRX) inactivity timer expires and the wireless communication device enters one of a DRX off-period and a sleep mode.

18. The method of claim **15**, further comprising:

transmitting an antenna panel status report to inform the BS of the switch of the antenna panel status.

19. The method of claim **18**, wherein the antenna panel status report is contained in one of a beam report and a Channel State Information (CSI) report.

20. The method of claim **18**, wherein the antenna panel status report comprises a single-bit Information Element (IE), and the method further comprises:

setting the single-bit IE to a first value to indicate that a power saving mode is enabled; and

setting the single-bit IE to a second value to indicate that the power saving mode is disabled;

wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

21. The method of claim **18**, wherein the antenna panel status report comprises a multiple-bit Information Element (IE), and the method further comprises:

setting the multiple-bit IE to a particular value associated with a particular number of the plurality of antenna panels being turned on.

22. The method of claim **15**, wherein the indicator for antenna panel status information comprises a single-bit Information Element (IE), and the method further comprises:

enabling a power saving mode when the single-bit IE is set to a first value; and

disabling the power saving mode when the single-bit IE is set to a second value,

wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

23. The method of claim **15**, wherein the indicator for antenna panel status information comprises a multiple-bit Information Element (IE), and the method further comprises:

turning on a particular number of the plurality of antenna panels when the multiple-bit IE is set to a particular value.

24. The method of claim **15**, wherein the indicator for antenna panel status information is contained in a Transmission Configuration Indicator (TCI) state Identity (ID) indicated by the BS.

25. The method of claim **15**, wherein the plurality of leading time values is one of cell-specific values and cell group-specific values.

26. The method of claim **15**, further comprising:

switching the antenna panel status from a first antenna panel status to a second antenna panel status in response to receiving the indicator for antenna panel status information; and

automatically switch the antenna panel status from the second antenna panel status to a third antenna panel status without further reception of an indicator for antenna panel status information from the BS.

27. The method of claim **15**, further comprising:

enabling a power saving mode when the wireless communication device operates in a Discontinuous Reception (DRX) active time; and

disabling the power saving mode when the wireless communication device operates in a DRX inactive time,

wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

28. The method of claim **15**, further comprising:

enabling a power saving mode based on whether the wireless communication device operates in a particular Bandwidth Part (BWP),

wherein:

a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels when the power saving mode is disabled; and

the particular BWP is one of a default BWP, an initial BWP, and a first active BWP.

* * * * *

Exhibit 4

US011115165B2

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Tsai et al.

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(54) **METHOD AND APPARATUS FOR MULTIPLE TRANSMIT/RECEIVE POINT (TRP) OPERATIONS**

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See application file for complete search history.

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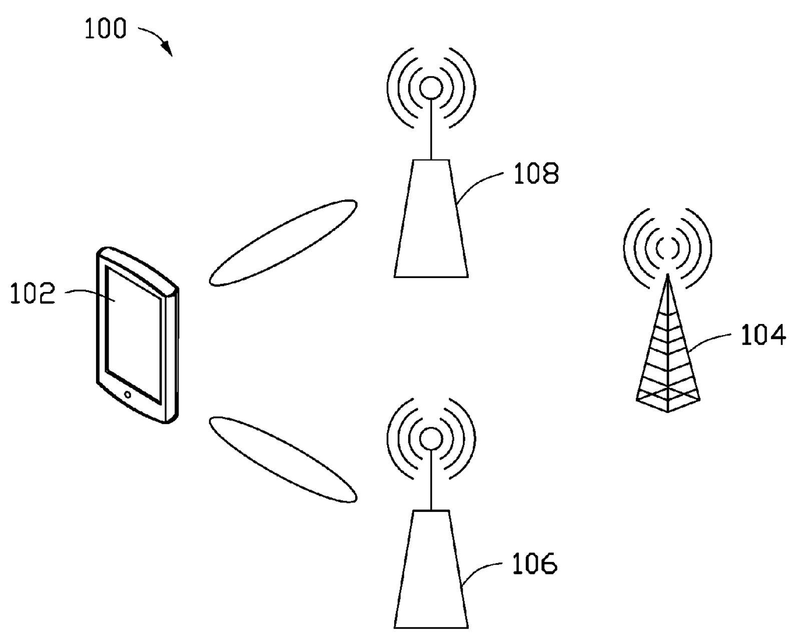
(57) **ABSTRACT**

A method includes receiving, by a User Equipment (UE), Transmission Configuration Indicator (TCI) state data in a Physical Download Control Channel (PDCCH) determining multiple Physical Downlink Shared Channels (PDSCHs), where the TCI state data is associated with multiple Demodulation Reference Signal (DMRS) port groups, and obtaining, by the UE, multiple Quasi Co-Location (QCL) assumptions for receiving the PDSCHs based on the DMRS port groups associated with the TCI state data.

12 Claims, 6 Drawing Sheets



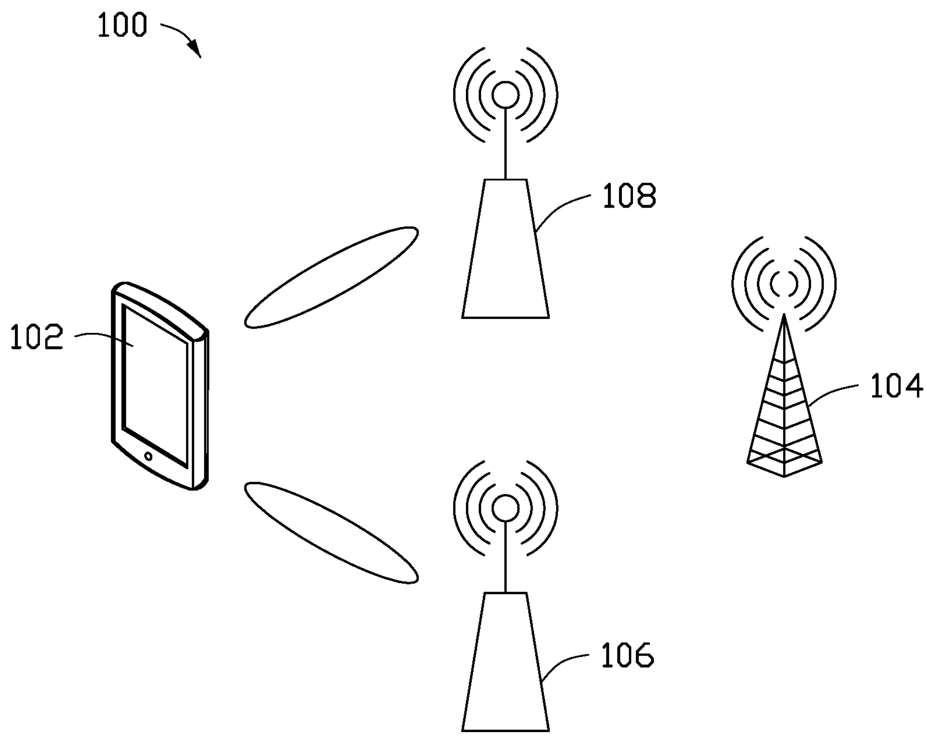


FIG. 1

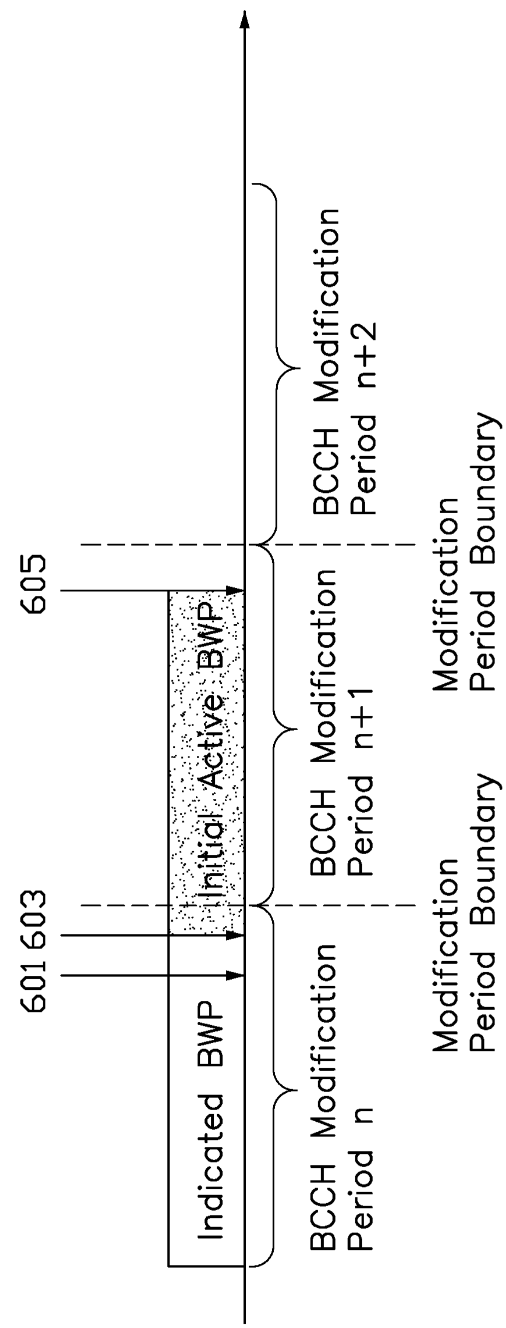

605
601
603
Indicated BWP
Initial Active BWP
BCCH Modification Period n
BCCH Modification Period n+1
BCCH Modification Period n+2
Modification Period Boundary
Modification Period Boundary

FIG. 6

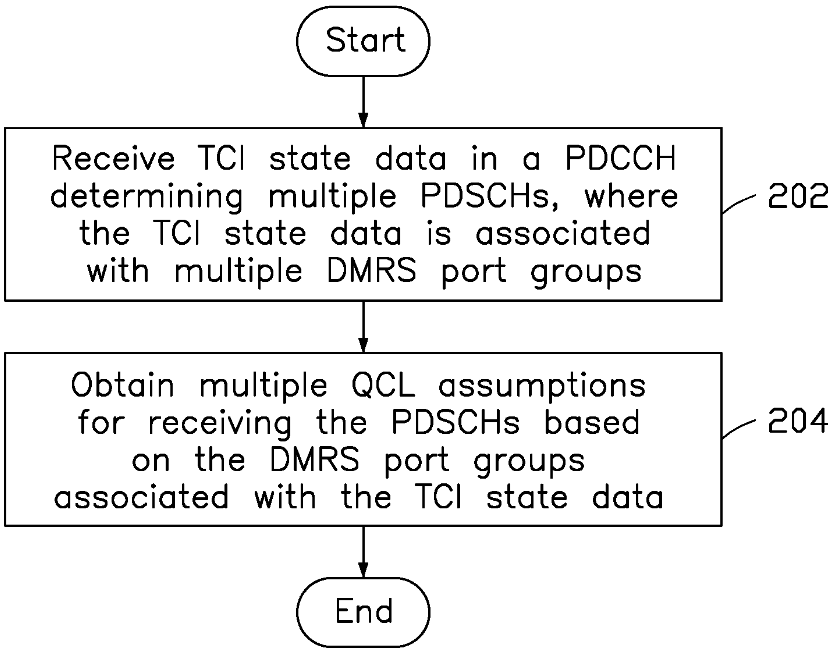

Start
Receive TCI state data in a PDCCH determining multiple PDSCHs, where the TCI state data is associated with multiple DMRS port groups
202
Obtain multiple QCL assumptions for receiving the PDSCHs based on the DMRS port groups associated with the TCI state data
204
End

FIG. 2

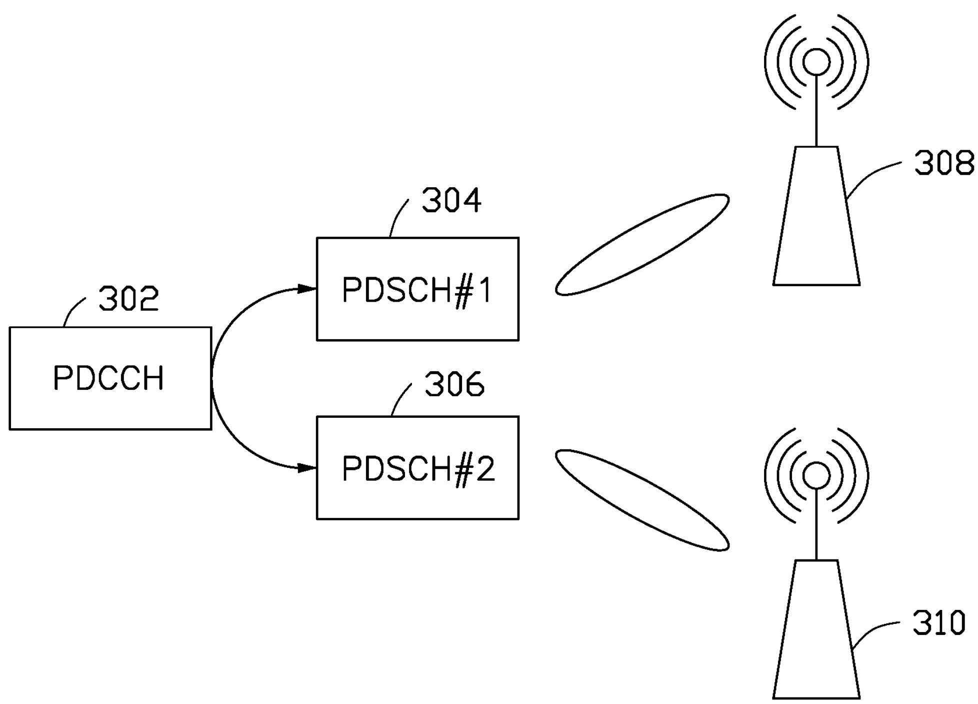


FIG. 3

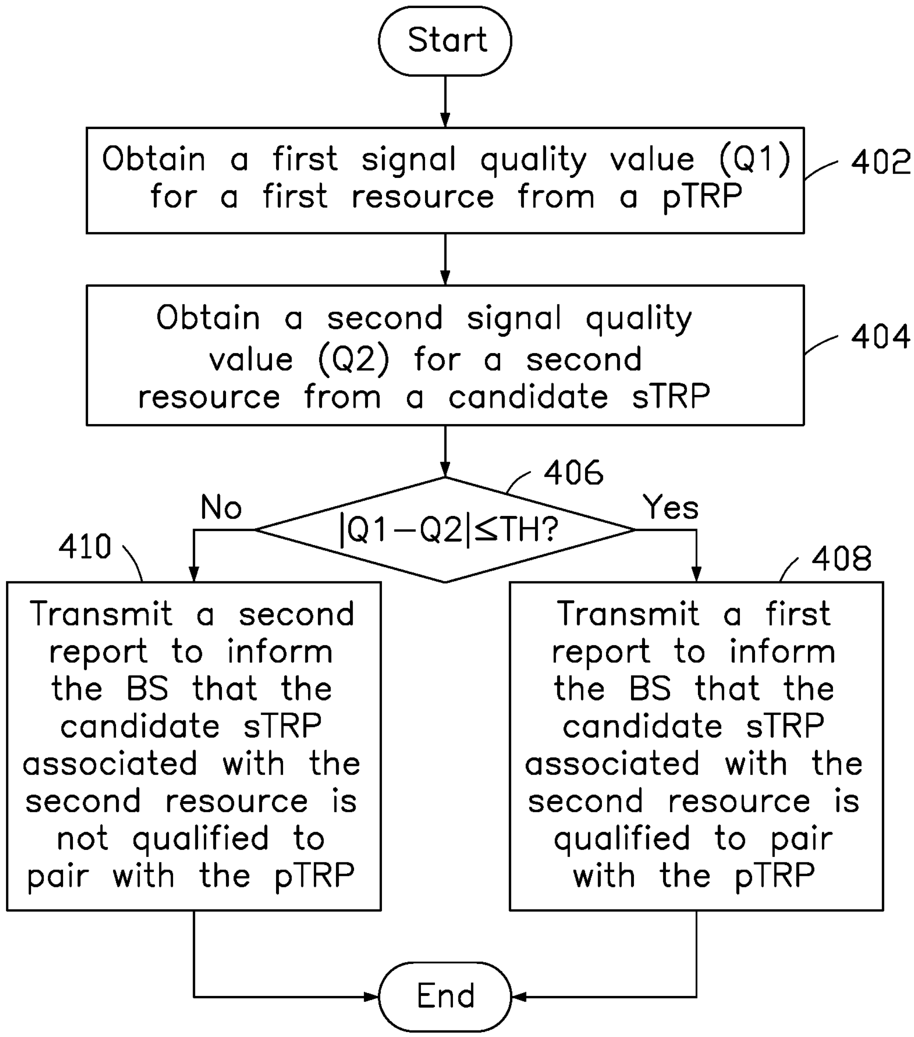

Start
Obtain a first signal quality value (Q1) for a first resource from a pTRP
402
Obtain a second signal quality value (Q2) for a second resource from a candidate sTRP
404
406
No
|Q1−Q2|≤TH?
Yes
410
408
Transmit a second report to inform the BS that the candidate sTRP associated with the second resource is not qualified to pair with the pTRP
Transmit a first report to inform the BS that the candidate sTRP associated with the second resource is qualified to pair with the pTRP
End

FIG. 4

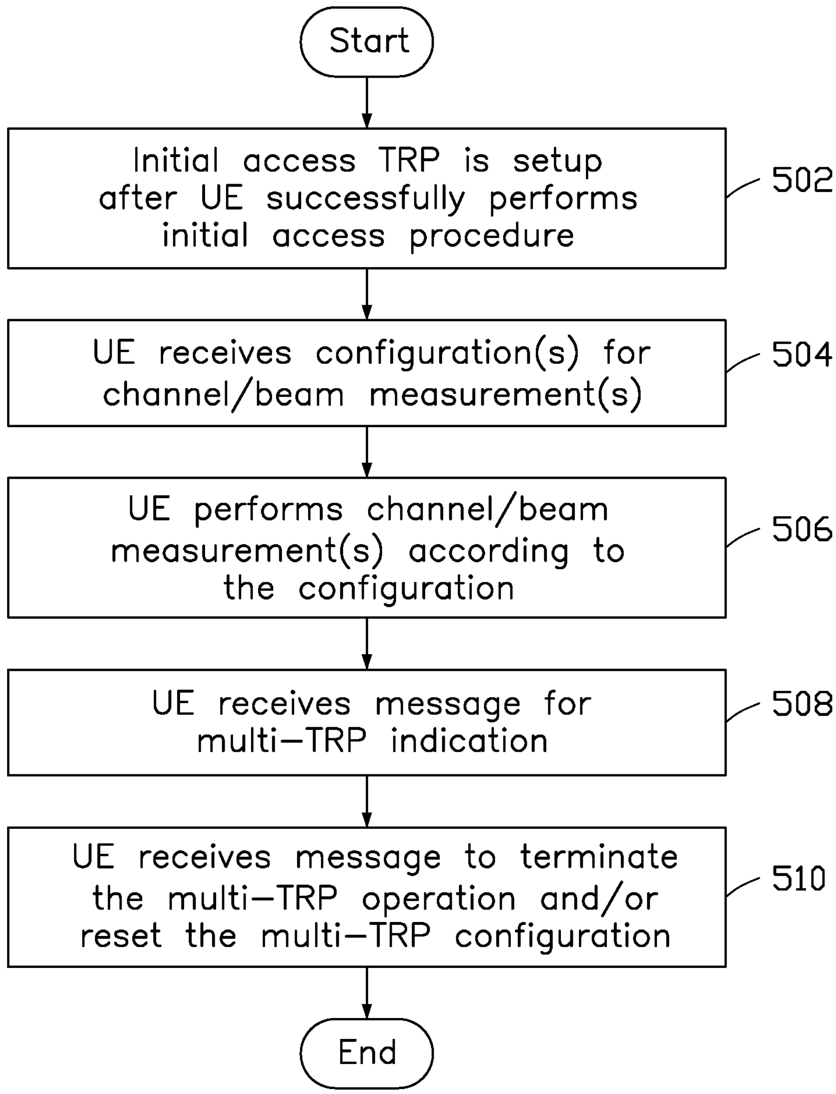

Start
Initial access TRP is setup after UE successfully performs initial access procedure
502
UE receives configuration(s) for channel/beam measurement(s)
504
UE performs channel/beam measurement(s) according to the configuration
506
UE receives message for multi-TRP indication
508
UE receives message to terminate the multi-TRP operation and/or reset the multi-TRP configuration
510
End

FIG. 5

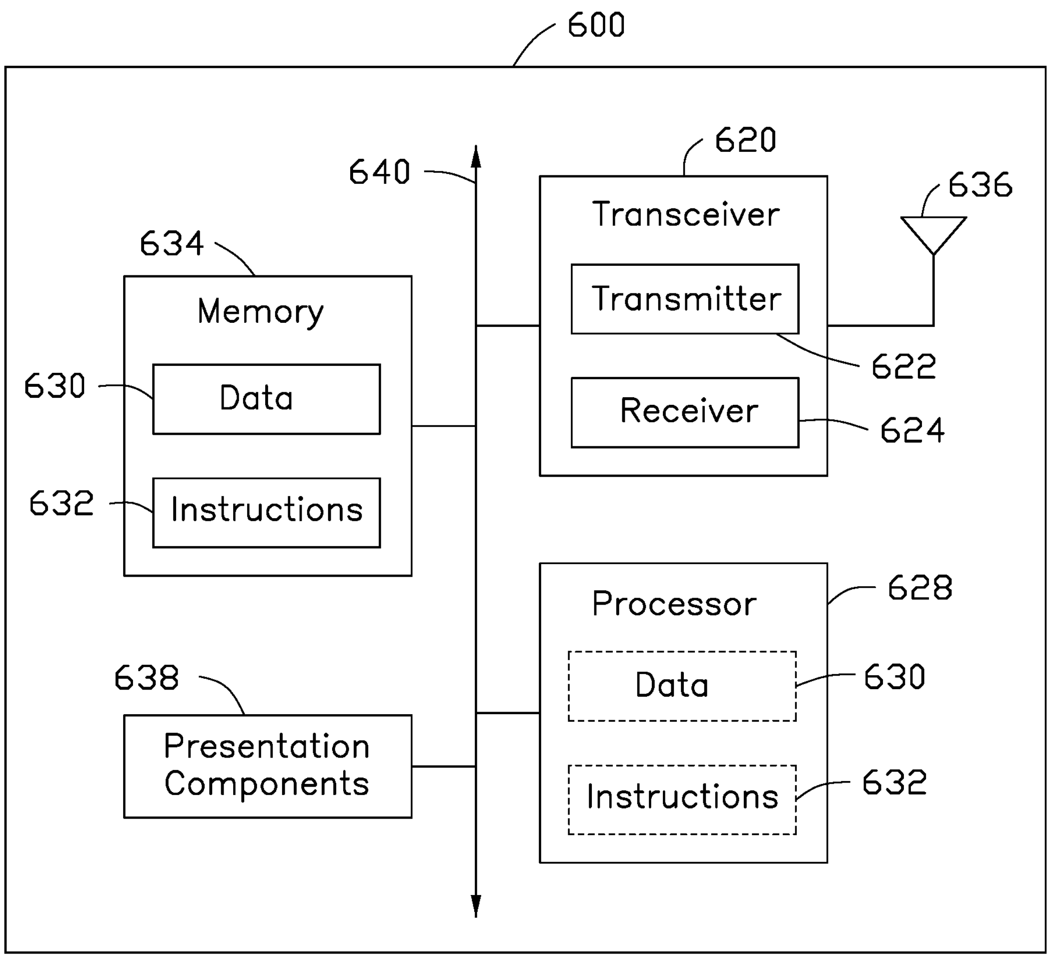

600
640
620
Transceiver
Transmitter
Receiver
636
622
624
634
Memory
630
Data
632
Instructions
628
Processor
Data
630
Instructions
632
638
Presentation Components

FIG. 6

METHOD AND APPARATUS FOR MULTIPLE TRANSMIT/RECEIVE POINT (TRP) OPERATIONS

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present application claims the benefit of and priority to a provisional U.S. Patent Application Ser. No. 62/754,706 filed on Nov. 2, 2018, entitled "Procedure for Multiple Transmit/Receive Point," (hereinafter referred to as "US75391 application"). The disclosure of the US75391 application is hereby incorporated fully by reference into the present application.

FIELD

The present disclosure generally relates to wireless communications, and more particularly, to methods and apparatuses for multiple Transmit/Receive Point (TRP) operations.

BACKGROUND

Various efforts have been made to improve different aspects of wireless communications (e.g., data rate, latency, reliability, mobility, etc.) for the next generation (e.g., Fifth Generation (5G) New Radio (NR)) wireless communication systems. Among the new concepts in the next generation wireless communication systems, leveraging multiple TRPs may be vital to improve coverage, reliability, and capacity performance of the system. For example, in order to support the growth in data traffic in 5G and to enhance the coverage, the wireless devices may be expected to access networks composed of multiple TRPs.

However, in the current multi-TRP environment, all TRPs in a cell may have the same cell Identity (ID), which means a User Equipment (UE) may not be able to distinguish these TRPs from each other if there is no further identification or information for each TRP.

Therefore, there is a need in the art for an improved communication mechanism for multiple TRP operations.

SUMMARY

The present disclosure is directed to methods and apparatuses for multi-TRP operations.

According to an aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to receive Transmission Configuration Indicator (TCI) state data in a Physical Download Control Channel (PDCCH) determining multiple Physical Downlink Shared Channels (PDSCHs), where the TCI state data is associated with multiple Demodulation Reference Signal (DMRS) port groups. The processor is further configured to obtain multiple Quasi Co-Location (QCL) assumptions for receiving the PDSCHs based on the DMRS port groups associated with the TCI state data.

According to another aspect of the present disclosure, a method of wireless communications is provided. The method includes receiving, by a UE, TCI state data in a PDCCH determining multiple PDSCHs, where the TCI state data is associated with a multiple DMRS port groups. The method further includes obtaining, by the UE, multiple QCL assumptions for receiving the PDSCHs based on the DMRS port groups associated with the TCI state data.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale. Dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

FIG. **1** is a schematic diagram illustrating a multi-TRP system, in accordance with example implementations of the present application.

FIG. **2** is a flowchart for a process of multi-TRP operations, in accordance with example implementations of the present application.

FIG. **3** is a schematic diagram illustrating multiple PDSCHs determined from a single PDCCH, in accordance with example implementations of the present application.

FIG. **4** is a flowchart for a process of identifying a secondary TRP (sTRP), in accordance with example implementations of the present application.

FIG. **5** is a flowchart for a process of multi-TRP operations, in accordance with example implementations of the present application.

FIG. **6** is a block diagram illustrating a node for wireless communication, in accordance with example implementations of the present application.

DETAILED DESCRIPTION

The following description contains specific information pertaining to example implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely example implementations. However, the present disclosure is not limited to merely these example implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale and are not intended to correspond to actual relative dimensions.

For the purpose of consistency and ease of understanding, like features may be identified (although, in some examples, not shown) by the same numerals in the example figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, systems, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules which may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general-purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or algorithm(s). The microprocessors or general-purpose computers may be formed of Applications Specific Integrated Circuitry (ASIC), programmable logic arrays, and/or using one or more Digital Signal Processor (DSPs). Although some of the example implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative example implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

The computer readable medium includes but is not limited to Random Access Memory (RAM), Read Only Memory (ROM), Erasable Programmable Read-Only Memory (EPROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory, Compact Disc Read-Only Memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

A radio communication network architecture (e.g., a Long Term Evolution (LTE) system, an LTE-Advanced (LTE-A) system, an LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network (RAN)) typically includes at least one Base Station (BS), at least one User Equipment (UE), and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a Core Network (CN), an Evolved Packet Core (EPC) network, an Evolved Universal Terrestrial Radio Access Network (E-UTRAN), a 5G Core (5GC), or an internet), through a RAN established by one or more BSs.

It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, a vehicle, or a Personal Digital Assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

A BS may be configured to provide communication services according to at least one of the following Radio Access Technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM Enhanced Data rates for GSM Evolution (EDGE) Radio Access Network (GERAN), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic Wideband-Code Division Multiple Access (W-CDMA), High-Speed Packet Access (HSPA), LTE, LTE-A, eLTE (evolved LTE, e.g., LTE connected to 5GC), NR (often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above-mentioned protocols.

A BS may include, but is not limited to, a node B (NB) as in the UMTS, an evolved Node B (eNB) as in the LTE or LTE-A, a Radio Network Controller (RNC) as in the UMTS, a Base Station Controller (BSC) as in the GSM/GERAN, a ng-eNB as in an Evolved Universal Terrestrial Radio Access (E-UTRA) BS in connection with the 5GC, a next generation Node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The BS may serve one or more UEs through a radio interface.

The BS is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The BS supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage (e.g., each cell schedules the downlink and optionally uplink resources to at least one UE within its radio coverage for downlink and optionally uplink packet transmissions). The BS can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate Sidelink (SL) resources for supporting Proximity Service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as Enhanced Mobile Broadband (eMBB), Massive Machine Type Communication (mMTC), Ultra-Reliable and Low-Latency Communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The Orthogonal Frequency-Division Multiplexing (OFDM) technology as agreed in the 3^{rd} Generation Partnership Project (3GPP) may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) Low-Density Parity-Check (LDPC) code and (2) Polar Code. The coding scheme adaptation may be configured based on the channel conditions and/or the service applications.

Moreover, it is also considered that in a transmission time interval TX of a single NR frame, a Downlink (DL) transmission data, a guard period, and an Uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, SL resources may also be provided in an NR frame to support ProSe services or V2X services.

In addition, the terms "system" and "network" herein may be used interchangeably. The term "and/or" herein is only an association relationship for describing associated objects, and represents that three relationships may exist. For example, A and/or B may indicate that: A exists alone, A and B exist at the same time, or B exists alone. In addition, the character "/" herein generally represents that the former and latter associated objects are in an "or" relationship.

FIG. **1** is a schematic diagram illustrating a multi-TRP system **100**, in accordance with example implementations of the present application. As shown in FIG. **1**, the multi-TRP system **100** includes a UE **102**, a BS **104**, and TRPs **106** and **108**. It should be noted that even though two TRPs are included in the example implementation illustrated in FIG. **1**, any number of TRPs may communicate with the UE in some other implementations. In addition, each TRP may communicate with the BS **104** through a wired or wireless connection.

The TRPs **106** and **108** may be macro-cells, small-cells, pico-cells, femto-cells, Remote Radio Heads (RRHs), relay nodes or antenna panels, which may be deployed anywhere such as in the interior of a room, in/on a building, on top of a house or streetlamps. The UE **102** may connect to the BS **104** through the TRPs **106** and **108**.

Each of the TRPs **106** and **108** may have one or more antenna panels to provide directional beams towards the UE **102**. The antenna panels distributed on the TRPs may be jointly used in the data transmissions to the UE, thereby forming a Multi-Input Multi-Output (MIMO) system.

FIG. **2** is a flowchart for a process of multi-TRP operations, in accordance with example implementations of the present application.

In action **202**, the UE may receive TCI state data in a PDCCH determining multiple PDSCHs. The TCI state data may be associated with multiple DMRS port groups. In action **204**, the UE may obtain multiple QCL assumptions for receiving the PDSCHs based on the DMRS port groups associated with the TCI state data.

The QCL assumptions may include different parameters, such as the spatial-domain QCL parameters (e.g., QCL TypeD parameter), or other QCL parameters such as, at least one of the average delay, the delay spread, the Doppler shift, and the Doppler spread. For example, each QCL assumption may include at least one of a time-domain QCL parameter, a frequency-domain QCL parameter, and a spatial-domain QCL parameter.

In some of the present implementations, the UE may identify different TRPs (e.g., the TRPs **106** and **108** in FIG. **1**) based on the QCL assumptions.

In some of the present implementations, each QCL assumption may correspond to one of the DMRS port groups associated with the TCI state data. For example, the QCL assumptions and the DMRS port groups may have a one-to-one mapping relationship. In some of the present implementations, the UE may receive the DMRS port groups corresponding to the PDSCHs via a Radio Resource Control (RRC) signaling.

In some of the present implementations, the mapping relationship between the QCL assumptions and the DMRS port groups may be modified. For example, the UE may receive an instruction for indicating a relationship (e.g., a mapping relationship) between the QCL assumptions and the DMRS port groups via a Medium Access Control (MAC) Control Element (CE), Downlink Control Information (DCI), or an RRC signaling. In some of the present implementations, indicating the relationship between the QCL assumptions and the DMRS port groups may include at least one of modifying, adding, deleting, and selecting the relationship between the QCL assumptions and the DMRS port groups. In some other implementations, the UE may be configured with a timer, and the mapping relationship between the QCL assumptions and the DMRS port groups may be modified when the timer expires.

In some of the present implementations, the TCI state of a DL channel (e.g., a PDCCH or a PDSCH) may include multiple QCL Reference Signal (RS) sets, and each QCL RS set may correspond to one DMRS port group. For example, the TCI state data may correspond to a TCI state configuration that includes multiple QCL RS sets, and each of the QCL RS sets may correspond to one of the DMRS port groups associated with the TCI state data.

FIG. **3** is a schematic diagram illustrating multiple PDSCHs determined from a single PDCCH, in accordance with example implementations of the present application. As shown in FIG. **3**, the UE may receive DCI that contains a TCI state data (e.g., a TCI code point) from the PDCCH **302**. After successfully decoding the TCI code point, the UE may obtain multiple TCI states each being associated with one DMRS port group. For example, each TCI state may contain parameters for configuring the QCL relationship between the DL/UL RS(s) and the DM-RS port(s) of a corresponding PDSCH. The QCL relationship may be configured by higher layer parameters, such as qcl-Type1 and qcl-Type2. In addition, the QCL type (e.g., QCL-TypeA, QCL-TypeB, QCL-TypeC and QCL-TypeD) corresponding to each DL RS may be given by a higher layer parameter (e.g., qcl-Type) in the QCL assumption/information. In some other implementations, the TCI state data may be a TRP index that is configured per a cell/Component Carrier (CC), or Bandwidth Part (BWP) basis.

In the example implementation, the UE may derive multiple PDSCHs based on the DMRS port groups associated with the TCI state data in the DCI, because each DMRS port group may correspond to one PDSCH. As shown in FIG. **3**, if the TCI state data is associated with DMRS port group #1 and DMRS port group #2, which are configured by the BS via an RRC signaling, the UE may then determine the QCL assumptions for PDSCH #1 **304** and PDSCH #2 **306** based on the DMRS port group #1 and DMRS port group #2, respectively. Each of the PDSCHs (e.g., PDSCH #1 **304** and PDSCH #2 **306**) derived from the PDCCH **302** may correspond to a TRP. As shown in FIG. **3**, the PDSCH #1 **304** and PDSCH #2 **306** may be associated with TRPs **308** and **310**, respectively. In some of the present implementations, after determining the QCL assumptions for the PDSCH #1 **304** and the PDSCH #2 **306**, the UE may use them to identify the TRPs **308** and **310**.

In some other implementations, the DCI in the PDCCH **302** may schedule a single PDSCH (not illustrated in FIG. **3**), and the TRPs **308** and **310** may correspond to different transmission layers of this PDSCH. Each transmission layer may correspond to a data stream from a TRP.

In some of the present implementations, when a UE performs an initial access procedure successfully, the UE may obtain the resource(s) of a Downlink (DL)/Uplink (UL) channel/beam for communicating with the BS through a certain TRP. This TRP may be referred to as an initial access TRP. In some of the present implementations, the resource of a DL channel/beam may be a Synchronization Signal (SS)/Physical Broadcast Channel (PBCH) Block (SSB), and the UL channel/beam may be a Physical Random Access Channel (PRACH). The UE may select the SSB through a random access procedure, and use the corresponding resources (e.g., which are configured with the same spatial QCL (sQCL) assumption as the selected SSB) to perform channel/beam measurements.

In some of the present implementations, the UE may be configured with resources that are orthonormal to the SSB to perform the channel/beam measurements.

In some of the present implementations, a TRP may be classified as a primary TRP (pTRP) or a secondary TRP (sTRP) for further operations. For example, the UE may adopt different time-domain behaviors (e.g., the aperiodic/semi-persistent/periodic reporting behavior) to report Channel State Information (CSI)/beam measurement results to the pTRP(s) and sTRP(s). For example, the UE may adopt a periodic or semi-persistent reporting process with respect to the RS resource(s) coming from the pTRP, and apply an aperiodic reporting process with respect to the RS resource(s) coming from the sTRP.

In some of the present implementations, the UE may perform Beam Management (BM) procedures based on the network-configured resources. The UE may report the measurement results to the BS to help the BS to determine the primary communication link (e.g., including the pTRP) to the UE. For example, the BS may schedule a qualified resource (e.g., a beam/channel with a quality value exceeding a predetermined threshold) as the primary communication link to the UE. In this case, the TRP transmitting the qualified resource may be deemed as the pTRP.

In some of the present implementations, the UE may be notified to change its pTRP if the quality of the resource from the original pTRP changes. It should be noted that the number of the qualified resources and the pTRPs may be arbitrary.

In some of the present implementations, one or more antenna panels may be embedded in a single TRP. Each antenna panel may transmit at least one resource (beam/channel) in a time unit.

In some of the present implementations, the pTRP may be determined in an implicit way. For example, a TRP at which a specific resource is transmitted may be determined as a pTRP. The specific resource may include at least one of an SSB, a Channel State Information Reference Signal (CSI-RS), a Sounding Reference Signal (SRS), a PDCCH, a PDCCH that Control Resource Set (CORESET) #0 or search space #0 is located, a broadcast signal (e.g., a PBCH), a PDSCH of Remaining Minimum System Information (RMSI), and a beam/channel having a quality that exceeds a predetermined threshold. In some other implementations, the pTRP for the UE may be determined in an explicit way. For example, the BS may indicate one or more pTRPs to the UE via an RRC signaling, a MAC-CE or DCI.

In some of the present implementations, for those TRPs that are not selected as the pTRP(s), they may be determined as sTRPs for the UE if these TRPs satisfy certain condition(s), as shown in FIG. **4**.

FIG. **4** is a flowchart for a process of identifying an sTRP, in accordance with example implementations of the present application. In action **402**, the UE may obtain a first signal quality value (Q1) for a first resource from a pTRP. In action **404**, the UE may obtain a second signal quality value (Q2) for a second resource from a candidate sTRP. The values, Q1 and Q2, may be (but not limited to) Layer 1 (L1)-Reference Signals Received Power (RSRP) values, L1-Reference Signals Received Quality (RSRQ) values, L1-Signal to Interference plus Noise Ratio (SINR) values, RSRP values, RSRQ values, SINR values, or any combination thereof.

In action **406**, the UE may determine whether the difference between Q1 and Q2 is less than, or equal to, a predetermined threshold (TH). In some of the present implementations, the predetermined threshold TH may be configured by the BS.

If the outcome of action **406** is "yes", the UE, in action **408**, may transmit a first report to inform the BS that the candidate sTRP associated with the second resource is qualified to pair with the pTRP. In response to the first report, the BS may add this candidate sTRP as an sTRP for the UE, and inform the UE of the information of the pTRP(s) and/or sTRP(s). Conversely, if the outcome of action **406** is "no", the UE, in action **410**, may transmit a second report to inform the BS that the candidate sTRP associated with the

second resource is not qualified to pair with the pTRP. In this case, the BS may decide not to add this candidate sTRP as an sTRP for the UE.

In some of the present implementations, the first and second resources described in actions **402** and **404** may be composite resources. A composite resource may be the first one (or a predetermined one) of the resources in a resource set that is configured for the TRP, or a union resource among all the resource(s) in the resource set, or a resource corresponding to a statistical average beam direction of the TRP. The UE may receive the composite resource of a composite beam/channel from each TRP based on a corresponding QCL assumption. In some of the present implementations, the composite resource may be a TRP-specific resource or a cell-specific resource if the composite resource is composited by at least one SSB resource. Conversely, if the composite resource is not composited by any SSB resource, the composite resource may be a UE-specific resource. In some of the present implementations, the composite resource may be transmitted in a broadcast manner, and compared to a resource that is used in a single-TRP BM procedure, the composite resource may correspond to a wider beam.

Using the composite resources may help the UE perform multi-TRP measurements more efficiently, because the UE may only need to measure one resource (composite resource) for each TRP at the beginning of the measurement.

In some of the present implementations, when several TRPs are distributed around the UE, the UE may be configured with a composite resource set. Each composite resource in the composite resource set may represent an average beam direction of an individual TRP. In this manner, the UE may report suitable TRP pairs to the BS quickly.

In some of the present implementations, once the pTRP(s) and sTRP(s) are determined, the BS may collect these pTRP(s) and sTRP(s) in a serving TRP set, and inform the UE of this serving TRP set via RRC signaling, a MAC CE, DCI, or any combination thereof.

In some of the present implementations, a variation in beam/channel quality may lead to a change in the configuration of the pTRP(s) and/or sTRP(s). For example, when the BS detects that the TRP with the best/qualified beam quality has changed, the BS may instruct the UE to modify/select the related configurations of the pTRP(s) and/or sTRP(s) to change the pTRP(s) and/or sTRP(s).

In some of the present implementations, the UE may receive a trigger event with a predetermined offset from the BS. The UE may determine whether the difference between the beam/channel quality of the pTRP and that of the sTRP exceeds this predetermined offset. If the determination's result is positive, the UE may transmit a report to request the BS to modify/select the related configurations of the pTRP(s) and/or sTRP(s).

In some of the present implementations, the UE may monitor the CORESET of a TRP based on a QCL assumption that is made for monitoring a PDCCH that schedules multiple PDSCHs. In this case, each PDSCH may be transmitted from a separate TRP. In some other implementations, the UE may monitor the CORESET of a TRP based on a QCL assumption that is made for monitoring a PDCCH that schedules a single PDSCH. In this case, different transmission layers of this PDSCH may be transmitted by the respective TRPs. In some other implementations, the UE may monitor the CORESET of a TRP based on multiple QCL assumptions that are made for monitoring multiple PDCCHs, each scheduling a PDSCH, and each NR-PDSCH may be transmitted from a separate TRP. In some other implementations, the UE may monitor the CORESET of a

TRP based on multiple QCL assumptions that are made for monitoring multiple PDCCHs, each scheduling a PDSCH, and each NR-PDSCH may be transmitted from a separate TRP.

FIG. **5** is a flowchart for a process of multi-TRP operations, in accordance with example implementations of the present disclosure.

In action **502**, an initial access TRP is setup after the UE successfully performs an initial access procedure. For example, after successfully performing the initial access procedure, the UE may get a DL/UL resource (e.g., channel/beam) to communicate with the BS through a TRP. This TRP may be set as the initial access TRP for the UE. The initial access TRP may be used as a pTRP from the UE's perspective.

In action **504**, the UE may receive configuration(s) for channel/beam measurement(s). For example, the UE may receive the configurations of K (e.g., K=0, 1, 2, . . .) resource(s) and/or L (e.g., L=0, 1, 2, . . .) resource for channel/beam measurements. The UE may apply the same QCL assumption as the SSB on which the UE camps during the random access procedure to receive the K resource(s). In addition, the L resource(s) may be orthonormal to the SSB on which the UE camps during the random access procedure. In some of the present implementations, the resources in the same resource set may have the same time-domain behavior, and each RS may correspond to a channel/beam of a TRP.

In action **506**, the UE may perform channel/beam measurement(s) according to the configuration. For example, the UE may perform the channel/beam measurement(s) according to the configuration(s) of the K and/or L resource(s). The UE may obtain the channel/beam statues/quality information (e.g. L1-RSRP, L1-RSRQ, L1-SINR, RSRP, RSRQ, SINR, or any combination thereof) from the channel/beam measurement. In some of the present implementations, the spatial domain filter information for receiving each DL resource may be obtained from the measurement. The spatial domain information may include at least one Receive (RX) radiation pattern and/or RX panel.

In some of the present implementations, the UE may report at least one of the resource indicator (or beam index), the measurement metric information, and the correlation information according to the configuration(s) obtained in action **504**. The resource indicator may be, but not limited to, an SSB resource indicator (if the resource is an SSB), a CSI-RS resource indicator (if the resource is a CSI-RS), a DMRS resource indicator (if the resource is a DMRS), or an SRS resource indicator. The measurement metric information may be, but not limited to, an L1-RSRP, an L1-RSRQ, an L1-SINR, a RSRP, a RSRQ, an SINR, or any combination thereof. In some of the present implementations, the measurement metric information that is related to a resource may be differentially encoded with respective to another resource. For example, a differential L1-RSRP offset level for the 2^{nd} measured resource may be obtained by subtracting L1-RSRP #1 from L1-RSRP #2, where L1-RSRP #1 is an L1-RSRP obtained from the 1^{st} resource measurement, and L1-RSRP #2 is an L1-RSRP obtained from the 2^{nd} resource measurement. The correlation information may include a correlation factor/indicator that indicates the spatial correlation between two or more observed resources. In some of the present implementations, the UE may compare the spatial correlation factor/indicator with a correlation threshold to determine whether the spatial correlation between the observed resources is high or not. The correlation threshold may be configured by the BS or determined based on the UE's implementations. The UE may be instructed to report the highest and/or lowest spatial correlation factor/indicator. In some of the present implementations, the correlation information may include at least one of a high/low correlation indicator and the indicators of the observed resources. The high/low correlation indicator may be used for indicating that the spatial correlation between the observed resources is high/low.

In some of the present implementations, the BS may determine compatible resources for serving the TRPs, based on the correlation information received from the UE, to improve the spatial diversity/multiplexing performance. In some of the present implementations, the correlation factor/indicator may be obtained by calculating the Angle-of-Arrival (AoA) related parameters for the channel/beams of the RS resources from the TRPs.

In action **508**, the UE may receive a message of a multi-TRP indication (e.g., indicating the information of pTRP(s) and/or sTRP(s)). For example, the message for indicating the information of pTRP(s) may contain at least one TCI-state indication that indicates a reference RS resource for a DL control channel and/or an SSB selected through the random access procedure. In this case, CORESET #0 or search space #0 may be located in the reference RS resource. In addition, the message for indicating the information of sTRP(s) may include at least one TCI-state indication that indicates at least one reference resource(s) for the DL shared channel(s). In this case, the UE may know that the TRP transmitting the indicated reference resource is an sTRP. In some of the present implementations, the TCI-state indication may correspond to one or more DMRS port groups, and each DMRS port group ID may correspond to a TRP ID.

In some of the present implementations, the target RS port/resource group (e.g., the DMRS port group of a PDSCH/PDCCH) may have the same QCL assumption as that of the source TRP-RS resource, which means the UE may assume that all ports/resources in the same target RS port/resource group may be from the same TRP, while the ports/resources in different target RS port/resource groups may be from different TRPs.

In action **510**, the UE may receive a message to terminate the multi-TRP operation and/or reset the multi-TRP configuration. For example, after receiving the message, the UE may terminate, cancel, or reset at least one of the correlation information of the reference RS resources among the TRPs, the TRP setting (e.g., including the resource setting and/or reporting setting), and the correspondence among the DMRS ports, DMRS port groups, TCI states, and QCL assumptions. In some of the present implementations, if there is no UE-specific scheduling for a while (e.g., before a timer expires), or a BWP switching happens, the UE may release the previous setting/configuration.

In some of the present implementations, the configuration that the UE receives in action **504** may be the composite resource configuration for the composite beam/channel from each TRP. The UE may perform channel/beam measurements on the composite resources of the respective TRPs. In this manner, the channel/beam measurements may be performed more efficiently, because the UE may only need to measure one resource (composite resource) for each TRP.

In some of the present implementations, the BS may indicate at least one pTRP resource set to the UE through at least one of the configuration of the pTRP, the predetermined resource(s) associated with the pTRP ID, and the best channel quality determined by the BS or UE.

AO 120 (Rev. 08/10)

TO: **Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450**	**REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK**

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED 3/28/2022	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF TOGAIL TECHNOLOGIES LTD.		DEFENDANT APPLE INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,743,238	8/11/2020	TOGAIL TECHNOLOGIES LTD.
2 10,791,502	9/29/2020	TOGAIL TECHNOLOGIES LTD.
3 10,972,972	4/6/2021	TOGAIL TECHNOLOGIES LTD.
4 11,115,165	9/7/2021	TOGAIL TECHNOLOGIES LTD.
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

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Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

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AO 120 (Rev. 08/10)

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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED 3/28/2022	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF TOGAIL TECHNOLOGIES LTD.		DEFENDANT GOOGLE INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,743,238	8/11/2020	TOGAIL TECHNOLOGIES LTD.
2 10,791,502	9/29/2020	TOGAIL TECHNOLOGIES LTD.
3 10,972,972	4/6/2021	TOGAIL TECHNOLOGIES LTD.
4 11,115,165	9/7/2021	TOGAIL TECHNOLOGIES LTD.
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

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Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

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AO 120 (Rev. 08/10)

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☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED 3/28/2022	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF TOGAIL TECHNOLOGIES LTD.		DEFENDANT SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS AMERICA, INC.

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,743,238	8/11/2020	TOGAIL TECHNOLOGIES LTD.
2 10,791,502	9/29/2020	TOGAIL TECHNOLOGIES LTD.
3 10,972,972	4/6/2021	TOGAIL TECHNOLOGIES LTD.
4 11,115,165	9/7/2021	TOGAIL TECHNOLOGIES LTD.
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/372,389	09/29/2020	10791502	US76468	2472

54000 7590 09/09/2020

ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

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 0 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):

HUNG-CHEN CHEN, Hsinchu, TAIWAN;
FG Innovation Company Limited, Tuen Mun, HONG KONG;
CHIE-MING CHOU, Hsinchu, TAIWAN;
YUNG-LAN TSENG, Hsinchu, TAIWAN;

IR103 (Rev. 10/09)

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16372389
	Filing Date	2019-04-01
	First Named Inventor	HUNG-CHEN CHEN
	Art Unit	2642
	Examiner Name	Marcos Batista
	Attorney Docket Number	US76468

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code1	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

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Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
Change(s) applied to document, /J.T./ 8/18/2020	1	20150140999	A1	2015-05-21	~~HUAWEI TECHNOLOGY CO., LTD.~~ Zhang et al.	description, paragraphs [0154]-[0170]

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Examiner Initial*	Cite No	Foreign Document Number3	Country Code2 i	Kind Code4	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T5
	1	107690200	CN	A	2018-02-13	CHINA ACADEMY TELECOMMUNICATIONS TECHNOLOGY	the whole document	☒
	2	107809753	CN	A	2018-03-16	ZTE CORPORATION	the whole document	☒
	3	107223353	CN	A	2017-09-29	BEIJING XIAOMI MOBILE SOFTWARE CO., LTD.	the whole document	☒

EFS Web 2.1.17

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.B/

PART B – FEE(S) TRANSMITTAL

Complete and send this form, together with the applicable fee(s), to: Mail | **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22314-1450
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)

54000 7590 07/07/2020
ScienBiziP, P.C.
550 S. Hope Street, Suite 2825
Los Angeles, CA 90071

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.

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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, EFS-Web transmitted, or facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's Name)
(S-signature)
(Date)

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
16/372389	04/01/2019	HUNG-CHEN CHEN	US76468	2472

TITLE OF INVENTION:

APPLN: TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	Undiscounted	1000			1000	10/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS

1. Change of correspondence address or indication of "Fee Address" (37CFR 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 attorney or agent. If no name is listed, no name will be printed

1. ScienBiziP, 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 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.

1a. NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
FG Innovation Company Limited	Tuen Mun, HONG KONG

Please check the appropriate assignee 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 Fees(s): **(Please first reapply and previously paid fee shown above)**
☐ A check is enclosed
☐ Payment be 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 602615 (enclose an extra copy of this form)

5. Change of 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 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 /Alvin Koan/ Date 08/21/2020

Typed or printed name Alvin Koan Registration No. 68468

PTOL-85 Part B (06-17) Approved for use through 1/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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 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, 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.

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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.

Electronic Patent Application Fee Transmittal

Application Number:	16372389
Filing Date:	01-Apr-2019
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Filer:	Alvin Sean Koan
Attorney Docket Number:	US76468

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:	40356423
Application Number:	16372389
International Application Number:	
Confirmation Number:	2472
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Customer Number:	54000
Filer:	Alvin Sean Koan
Filer Authorized By:	
Attorney Docket Number:	US76468
Receipt Date:	21-AUG-2020
Filing Date:	01-APR-2019
Time Stamp:	21:12:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1000
RAM confirmation Number	E20208KL12442383
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	Issue Fee Payment (PTO-85B)	US7646820200821FIF.pdf	158590 585a4185ddb0e0f994d72753d5454a3741f031a9	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30204 c3cc6af6ef8e9153762f1bd51ceeea9b46215c8e	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	188794	

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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.
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.

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

54000 7590 07/07/2020
ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

EXAMINER	
BATISTA, MARCOS	
ART UNIT	PAPER NUMBER
2642	

DATE MAILED: 07/07/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/372,389	04/01/2019	HUNG-CHEN CHEN	US76468	2472

TITLE OF INVENTION: ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

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	10/07/2020

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.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 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.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

54000 7590 07/07/2020

ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

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 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.
16/372,389	04/01/2019	HUNG-CHEN CHEN	US76468	2472

TITLE OF INVENTION: ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

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	10/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
BATISTA, MARCOS	2642	455-434000

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 ____________________

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

(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. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies ____________

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. __________

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. ____________________

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/372,389	04/01/2019	HUNG-CHEN CHEN	US76468	2472

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EXAMINER	
BATISTA, MARCOS	
ART UNIT	**PAPER NUMBER**
2642	

DATE MAILED: 07/07/2020

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)

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 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, 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.** 16/372,389	**Applicant(s)** CHEN et al.	
	Examiner MARCOS BATISTA	**Art Unit** 2642	**AIA (FITF) 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 amendment filed on June 17, 2020.
☐ 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 See Continuation Sheet . 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 _____.

/MARCOS BATISTA/
Primary Examiner, Art Unit 2642

U.S. Patent and Trademark Office
PTOL-37 (Rev. 08-13) **Notice of Allowability** Part of Paper No./Mail Date 20200624

Continuation of 3. The allowed claim(s) is/are: 1-3,8-9,11-13,18-19 and 21-30

Detailed Action

1. This Action is in response to Applicant's on amendment filed June 17, 2020. **Claims 4-7, 10, 14-17 and 20** have been canceled, **claims 21-30** have been newly added, therefore, **claims 1-3, 8, 9, 11-13, 18, 19 and 21-30** are now pending in the present application.

America Invents Act (AIA) Information

2. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

3. **Claims 1-3, 8, 9, 11-13, 18, 19 and 21-30** are allowed.

4. The following is an Examiner's statement of reasons for allowance:

Consider claims 1-3, 8, 9, 11-13, 18, 19 and 21-30, the newly found reference of TURTINEN; Samuli et al. (US 20180376375 A1), made of record herein, teaches a method and apparatus comprising transmitting, by a user device to a base station in a wireless network, a system information request for on-demand system information during a random access procedure, where the system information request is a request for one or more parameters that enable the user device to communicate in the wireless network, receiving, by the user device from the base station, an indication of a wait period in which the user device waits before obtaining the on-demand system information, waiting, by the user device, a time duration during the wait period, and monitoring, by the user device after expiration of the wait period, a system information window in which a system information message having the on-demand system information is broadcasted by the base station.

However, after the amendment to claims 1 and 11, Applicant's remarks have been considered and found to be persuasive. In agreement with the Applicant's remarks, the prior art failed to disclose or suggest each and every limitation recited in claims 1-3, 8, 9, 11-13, 18, 19 and 21-30 of the claimed invention when considered as a whole. And further in view of Applicant's arguments and remarks regarding the transmitting the SI request message and determining that the UE is in a connected state, presented on pages 9 of response filed on June 17, 2020.

Any comments considered necessary by Applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

5. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Marcos Batista, whose telephone number is (571) 270-5209. The Examiner can normally be reached on Monday-Thursday from 8:00am to 5:00pm.

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, Rafael Pérez-Gutiérrez can be reached at (571) 272-7915. 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.

/MARCOS BATISTA/
Primary Examiner, Art Unit 2642

June 24, 2020

Notice of References Cited	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.	
	Examiner MARCOS BATISTA	Art Unit 2642	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-20180376375-A1	12-2018	TURTINEN; Samuli	H04W48/14	1/1
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.
	Examiner MARCOS BATISTA	**Art Unit** 2642

CPC						
Symbol					**Type**	**Version**
H04W	/	48	/	14	F	2013-01-01
H04W	/	48	/	16	I	2013-01-01
H04W	/	76	/	18	I	2018-02-01
H04W	/	36	/	305	I	2018-08-01
H04W	/	76	/	15	I	2018-02-01
H04W	/	36	/	08	I	2013-01-01
H04W	/	74	/	0833	A	2013-01-01
H04W	/	76	/	28	A	2018-02-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/MARCOS BATISTA/ 24 June 2020 Primary Examiner, Art Unit 2642 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 6

Issue Classification	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.
	Examiner MARCOS BATISTA	Art Unit 2642

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04W	/	4	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
455	434

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					
370	338					

NONE (Assistant Examiner) (Date)	Total Claims Allowed: 20	
/MARCOS BATISTA/ Primary Examiner, Art Unit 2642 24 June 2020 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 6

U.S. Patent and Trademark Office Part of Paper No.: 20200624

Issue Classification	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.
	Examiner MARCOS BATISTA	Art Unit 2642

☐ 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	-	10	20	19	16	28								
2	2	11	11	-	20	17	29								
9	3	12	12	4	21	18	30								
-	4	19	13	5	22										
-	5	-	14	6	23										
-	6	-	15	7	24										
-	7	-	16	8	25										
3	8	-	17	14	26										
10	9	13	18	15	27										

NONE (Assistant Examiner) (Date)	Total Claims Allowed: 20	
/MARCOS BATISTA/ Primary Examiner, Art Unit 2642 24 June 2020 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 6

Search Notes	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.
	Examiner MARCOS BATISTA	Art Unit 2642

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04W48/14 or H04W48/16 or H04W76/18 or H04W36/305 or H04W76/15 or H04W36/08 or H04W74/0833 or H04W76/28	02/12/2020	mb

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
455	434	02/12/2020	mb
370	338	02/12/2020	mb

* 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**
Inventor's Name Search	02/12/2020	mb
EAST Text Search	02/12/2020	mb
IDS Search	02/12/2020	mb
European Patent Search	02/12/2020	mb
Updated East Search	06/24/2020	mb

/MARCOS BATISTA/
Primary Examiner, Art Unit 2642

Search Notes	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.
	Examiner MARCOS BATISTA	Art Unit 2642

Interference Search

US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
455	all	06/24/2020	mb
370	all	06/24/2020	mb

/MARCOS BATISTA/
Primary Examiner, Art Unit 2642

Index of Claims	**Application/Control No.** 16/372,389	**Applicant(s)/Patent Under Reexamination** CHEN et al.
	Examiner MARCOS BATISTA	**Art Unit** 2642

✓	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	02/12/2020	06/24/2020							
1	1	✓	=							
2	2	✓	=							
9	3	✓	=							
-	4	✓	-							
-	5	✓	-							
-	6	✓	-							
-	7	✓	-							
3	8	✓	=							
10	9	✓	=							
-	10	✓	-							
11	11	✓	=							
12	12	✓	=							
19	13	✓	=							
-	14	✓	-							
-	15	✓	-							
-	16	✓	-							
-	17	✓	-							
13	18	✓	=							
20	19	✓	=							
-	20	✓	-							
4	21		=							
5	22		=							
6	23		=							
7	24		=							
8	25		=							
14	26		=							
15	27		=							
16	28		=							
17	29		=							
18	30		=							

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L5	0	(on$demand same system information same cell same prohibit timer same base station).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/06/24 11:29
L6	0	(on$demand same system information same message same prohibit timer same base station).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/06/24 11:30
S1	1	16/372389	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:42
S2	155,217	(H04W48/14 or H04W48/16 or H04W76/18 or H04W36/305 or H04W76/15 or H04W36/08 or H04W74/0833 or H04W76/28).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:43
S3	0	us-2015140999-a1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:44
S4	0	us-2015140999-a$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:45

S5	127	((("CHEN") near3 ("HUNG-CHEN"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/02/11 07:47
S6	159	((("CHOU") near3 ("CHIE-MING"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/02/11 07:47
S7	42	((("TSENG") near3 ("YUNG-LAN"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/02/11 07:47
S8	3	("20150140999").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:47
S9	273	S5 or S6 or S7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:49
S11	0	S9 and (on$demand same system information same cell same error stor$3 same failure).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:50
S12	20,443	((455/434) or (370/338)).CCLS.	US-PGPUB; USPAT	OR	OFF	2020/02/11 08:51
S14	0	S2 and (on$demand same system information same cell same error stor$3 same failure)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:51
S18	1	S12 and (system information same cell same error same stor$3 same failure)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:53
S20	1	S9 and (on$demand same system information same cell same error same stor$3 same failure).clm.	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2020/02/11 08:53

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S21	3	S2 and (on$demand same system information same cell same error same stor$3 same failure)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:53
S22	6,891,135	((on$demand or ondemand) same system information or "SI")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 09:49
S23	1,039	((on$demand or ondemand) same system information)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 09:49
S24	42	(on$demand or ondemand) same system information same (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 09:51
S25	22	S24 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 09:52
S26	2	wo-2018014728-a$	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 10:03
S28	244	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2020/02/11 15:09

		terminal or station or hand$set or equipment))) near2 (stor$3 or saving or receiv$3 or acquir$3)) with (system information or sib) with (fail$4 or unsuccessful$4 or error)	DERWENT; IBM_TDB			
S29	237	S28 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 15:41
S30	67	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (stor$3 or saving or acquir$3)) with (system information or sib) with (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:03
S31	63	S30 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:10
S32	29	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (stor$3 or saving)) with (system information or sib) with (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:18
S33	27	S32 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:20
S34	27	(system information or sib or sim) with (signaling radio bearer "0" or SRB0 or SRBO)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2020/02/12 15:45

			DERWENT; IBM_TDB			
S35	18	S34 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 15:46
S36	4	((dual connectivity) adj2 (mode or scheme or state or status or configuration)) same (system information) same (master or slave or secondary)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:04
S37	2	S36 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:05
S38	583	((dual connectivity) near2 (mode or scheme or state or status or configuration)) same (master or slave or secondary)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:08
S39	246	((dual connectivity) near2 (mode or scheme or state or status or configuration)) same ((master or slave or secondary)near2 (node or access point or node$b or base station))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:08
S40	228	S39 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:09
S41	1	((dual connectivity) near2 (mode or scheme or state or status or configuration)) same ((master or slave or secondary)near2 (node or access point or node$b or base station)) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:10

S42	2	((dual connectivity)) same ((master or slave or secondary)near2 (node or access point or node$b or base station)) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:11
S43	1	((dual connectivity)) same ((transmit$3 or send$3)near2 ((system information or sib or mib))) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:14
S44	7	((dual connectivity)) same (transmit$3 or send$3) same ((system information or sib or mib)) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:14
S45	7	S44 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:15
S46	221	((dual connectivity)) and ((transmit$3 or send$3) near2(system information or sib or mib)) and (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:24
S47	191	S46 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:24
S48	113	((dual connectivity)) and ((transmit$3 or send$3) near2(system information or sib or mib)) and (on$demand or ondemand) and ((master or slave or secondary)near2 (node or access point or node$b or base station))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:27
S49	93	S48 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO;	ADJ	ON	2020/02/12 16:27

			JPO; DERWENT; IBM_TDB				
S50	113	((dual connectivity or dual connect$3 or multiy connect$3 or multi connectivity or dual$connectivity or dual$connect$3 or multiy$connect$3 or multi$connectivity)) and ((transmit$3 or send$3) near2(system information or sib or mib)) and (on$demand or ondemand) and ((master or slave or secondary)near2 (node or access point or node$b or base station))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:31
S51	2	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (request$3 or ask$3)) with (system information or sib) with ((inhibit$3 or prohibit$3)near2 (period or time))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:03
S52	2	S51 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:08
S53	4	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (request$3 or ask$3)) same (system information or sib) same ((inhibit$3 or prohibit$3)near2 (period or time))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:13
S54	4	S53 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:14
S55	11	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or	US-PGPUB; USPAT;	ADJ	ON	2020/06/23 10:16

		cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (send$3 or transmit$4)) same (system information or sib) same ((inhibit$3 or prohibit$3)near2 (period or time))	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S56	10	S55 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:33
S57	81	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (send$3 or transmit$4)) same (system information or sib) same ((inhibit$3 or prohibit$3 or wait$3 or refrain$3 or prevent)near2 (period or time))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:42
S58	76	S57 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/06/23 10:47

6/24/2020 11:52:45 AM
C:\Users\mbatista\Documents\EAST\Workspaces\16372389 ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING.wsp

Bibliographic Data

Application No: 16/372,389

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /MARCOS BATISTA/

Examiner's Signature Initials

Title: ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
04/01/2019	455	2642	US76468
RULE			

APPLICANTS

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CHIE-MING CHOU Hsinchu, TAIWAN

YUNG-LAN TSENG Hsinchu, TAIWAN

CONTINUING DATA

This application has PRO of 62651312 04/02/2018

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

04/16/2019

STATE OR COUNTRY

TAIWAN

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Suite 2825
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FILING FEE RECEIVED

$1,720

Electronic Patent Application Fee Transmittal

Application Number:	16372389
Filing Date:	01-Apr-2019
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Filer:	Alvin Sean Koan
Attorney Docket Number:	US76468

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:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	1251	1	200	200
Miscellaneous:				
		Total in USD ($)		**200**

Electronic Acknowledgement Receipt

EFS ID:	39745663
Application Number:	16372389
International Application Number:	
Confirmation Number:	2472
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Customer Number:	54000
Filer:	Alvin Sean Koan
Filer Authorized By:	
Attorney Docket Number:	US76468
Receipt Date:	17-JUN-2020
Filing Date:	01-APR-2019
Time Stamp:	13:44:31
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$200
RAM confirmation Number	E20206GD45229607
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	Amendment/Req. Reconsideration-After Non-Final Reject	US76468200617R1.pdf	168544 7b098f272680eb098c906b38930abf0dc1d149fb	no	12
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30801 eb9681eb80d54a444662dd8c0fb49c7fcda62ecb	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	199345	

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	16/372,389
Application Filing Date	:	April 1, 2019
Examiner	:	BATISTA, MARCOS
Art Unit	:	2642
Confirmation No.	:	2472
Attorney Docket No.	:	US76468
First Inventor	:	HUNG-CHEN CHEN
Customer No.	:	54000

AMENDMENT AND RESPONSE TO *NON-FINAL* OFFICE ACTION

Mail Stop Amendment
Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Dear Sir/Madam:

This is in response to the *Non-Final* Office Action dated February 20, 2020 in the above-referenced patent application. Please kindly enter and consider the following amendments and remarks.

Listing of Claims begin on page **2** of this paper.

Remarks begin on page **7** of this response.

Listing of Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. **(Currently amended)** A method of ~~wireless communications~~ an on-demand system information (SI) request procedure performed by a user equipment (UE), the method comprising:

transmitting a first SI request message to a base station (BS) after determining that the UE is in a connected state, the first SI request message including at least one requested system information block (SIB);

activating a prohibit timer; and

transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires.

~~performing an on-demand system information (SI) request procedure in a first cell; and~~

~~performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful, wherein the error handling procedure comprises:~~

~~storing SI request failure information.~~

2. **(Original)** The method of claim 1, wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met:

a number of times the UE transmits a random access preamble reaches a threshold; and

the UE receives SI request rejection information.

3. **(Currently amended)** The method of claim [[1]]25, wherein the SI request failure information comprises at least one of the following:

~~an on-demand system information block (SIB) requested by the UE;~~

~~an on-demand SI message requested by the UE;~~

the at least one requested SIB;

the at least one requested SI message;

a cell identifier (ID) ~~of the first cell~~ associated with the BS;

a synchronization signal block (SSB) index for performing the on-demand SI request procedure;

a message type of the on-demand SI request procedure; and

a timestamp for performing the on-demand SI request procedure.

4-7. (Canceled)

8. (Currently amended) The method of claim 1, wherein when the UE is in a dual connectivity mode, the ~~on-demand SI request procedure~~ method further comprises:

transmitting [[an]] a third SI request message to a master node when the UE requires on-demand system information of a [[second]] cell belonging to a secondary node.

9. (Currently amended) The method of claim [[1]]25, ~~wherein the error handling procedure further comprises~~ further comprising:

transmitting the SI request failure information;

wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode.

10. (Canceled)

11. (Currently amended) A user equipment (UE), comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to perform operations for an on-demand system information (SI) request procedure, the operations comprising:

transmitting a first SI request message to a base station (BS) after determining that the UE is in a connected state, the first SI request message including at least one requested system information block (SIB);

activating a prohibit timer; and

transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires.

~~perform an on-demand system information (SI) request procedure in a first cell; and~~

~~perform an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful, wherein the error handling procedure comprises:~~

~~storing SI request failure information.~~

12. **(Original)** The UE of claim 11, wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met:

a number of times the UE transmits a random access preamble reaches a threshold; and

the UE receives SI request rejection information.

13. **(Currently amended)** The UE of claim [[11]]30, wherein the SI request failure information comprises at least one of the following:

~~an on-demand system information block (SIB) requested by the UE;~~

~~an on-demand SI message requested by the UE;~~

the at least one requested SIB;

the at least one requested SI message;

a cell identifier (ID) ~~of the first cell~~ associated with the BS;

a synchronization signal block (SSB) index for performing the on-demand SI request procedure;

a message type of the on-demand SI request procedure; and

a timestamp for performing the on-demand SI request procedure.

14-17. **(Canceled)**

18. **(Currently Amended)** The UE of claim 11, wherein when the UE is in a dual connectivity mode, ~~the on-demand SI request procedure comprises~~ the operations further comprise:

transmitting [[an]] a third SI request message to a master node when the UE requires on-demand system information of a [[second]] cell belonging to a secondary node.

19. **(Currently Amended)** The UE of claim [[11]]30, wherein ~~the error handling procedure further comprise~~ the operations further comprise:

transmitting the SI request failure information;

wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode.

20. **(Canceled)**

21. **(New)** The method of claim 1, wherein the first SI request message is transmitted on signaling radio bearer 1 (SRB1).

22. **(New)** The method of claim 1, further comprising:

receiving, from the BS, the at least one requested SIB via dedicated signaling that is transmitted in response to the first SI request message.

23. **(New)** The method of claim 1, further comprising:

transmitting a fourth SI request message to the BS after determining that the UE is not in the connected state, the fourth SI request message including at least one requested SI message.

24. **(New)** The method of claim 23, wherein the fourth SI request message is transmitted on signaling radio bearer 0 (SRB0).

25. **(New)** The method of claim 1, further comprising:

storing SI request failure information after determining that the on-demand SI request procedure is unsuccessful.

26. **(New)** The UE of claim 11, wherein the first SI request message is transmitted on signaling radio bearer 1 (SRB1).

27. **(New)** The UE of claim 11, wherein the operations further comprise:

receiving, from the BS, the at least one requested SIB via dedicated signaling that is transmitted in response to the first SI request message.

28. **(New)** The UE of claim 11, wherein the operations further comprise:

transmitting a fourth SI request message to the BS after determining that the UE is not in the connected state, the fourth SI request message including at least one requested SI message.

29. **(New)** The UE of claim 28, wherein the fourth SI request message is transmitted on signaling radio bearer 0 (SRB0).

30. **(New)** The UE of claim 11, wherein the operations further comprise:

storing SI request failure information after determining that the on-demand SI request procedure is unsuccessful.

REMARKS

Prior to the present Amendment and Response, claims 1-20 were pending in the present application. By the present Amendment and Response, claims 1, 3, 8, 9, 11, 13, 18 and 19 are amended, claims 4-7, 10, 14-17 and 20 are canceled without prejudice and disclaimer, and claims 21-30 are newly added. Support for the amendments can be found, at least, in paragraphs [0041], [0063] and [0068] of the originally filed application. No new matter has been introduced. After the present Amendment and Response, claims 1-3, 8-9, 11-13, 18-19 and 21-30 remain pending in the present application.

Applicant respectfully requests reconsideration and allowance of the claims in view of the above amendments. As Applicant's remarks and/or amendments are sufficient to overcome the cited art of record, Applicant's silence as to assertions by the Examiner in the Office Action or certain requirements that may be applicable to such rejections (for example, assertions regarding dependent claims, whether a reference constitutes prior art, and whether references are legally combinable for obviousness purposes) is not a concession by Applicant that such assertions are accurate or such requirements have been met, and Applicant reserves the right to analyze and dispute such in the future.

A. Examiner's Note

In the *Non-Final* Office Action dated February 20, 2020 (hereinafter "Office Action"), the Examiner states that the original claims 1, 10, 11 and 20 recite optional features and the associated limitations do not hold patentable weight. *See* page 2, item 4 of the Office Action. Without addressing the validity of the Examiner's assertions, Applicant has amended claims 1 and 11 and canceled claims 10 and 20 without prejudice and disclaimer.

B. Rejection of Claims 1-6, 10-16 and 20 under 35 U.S.C. § 103

In the Office Action, the Examiner rejects claims 1-6, 10-16 and 20 under 35 U.S.C. 103 as being unpatentable for purported obviousness over Ishii (U.S. Patent Application Publication 2019/0215858) (hereinafter "Ishii") in view of Miyata (U.S. Patent Application Publication 2006/0189336) (hereinafter "Miyata"). *See*, page 4, item 9.

Applicant respectfully traverses the rejections, and each finding of fact, including each assertion regarding what the references show or teach, any rationales for modifying and/or combining the references, and any implicit and/or explicit reliance on the Office Action, and Applicant does not acquiesce in the validity of the rejections. In addition, Applicant is not conceding in this application that the previously pending claims are not patentable. Rather, any alterations are without conceding to the Examiner's positions, and being made only to expedite prosecution of the present application, and are without prejudice to the presentation or assertion, in the future, of claims relating to the same or similar subject matter as the previously pending claims.

By the present Amendment and Response, Applicant has amended independent claim 1 to recite:

> A method of an on-demand system information (SI) request procedure performed by a user equipment (UE), the method comprising:
> transmitting a first SI request message to a base station (BS) after determining that the UE is in a connected state, the first SI request message including at least one requested system information block (SIB);
> activating a prohibit timer; and
> transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires. *See* claim 1 above.

Support for the amendments can be found in the originally filed application.

In the Office Action, the Examiner asserts that paragraph [0118] of Ishii discloses the feature "activating a prohibit timer; and avoiding initiating another on-demand SI request procedure until the prohibit timer expires" recited in the original claim 4. *See* page 7 of the Office Action.

Turning to Ishii, Ishii describes a method for on-demand system information in wireless communications. Ishii, in paragraph [0118], states:

> In one configuration, the wireless terminal may use a counter, which is incremented at every SI window of a particular SIB (e.g. SIB#k). In this configuration, the SIB reception procedure may end when the requested SIB(s) are successfully received, or when the counter reaches a maximum counter value. In another configuration the wireless terminal starts a timer at the beginning of the SIB reception procedure. In this configuration, **the SIB reception procedure may end** when the requested SIB(s) are successfully received, or **when the timer expires**. The maximum counter value, or the timer value, which may be common for all SIB types or per-SIB type basis, may be pre-configured or configured by network via system information. The conditions for the wireless terminal to end the SIB reception process is referred as "termination conditions" herein. *See* paragraph [0118] of Ishii (emphases added by Applicant).

As cited above, Ishii merely describes that the **SIB reception** procedure ends when the timer expires. That is, the timer in Ishii is related to SIB reception. The timer value determines the duration in which the UE receives the SIB. However, Ishii does not disclose a timer for controlling the **transmission of an SI request message**. Thus, Ishii fails to disclose, teach or suggest, at least, "activating a prohibit timer; and ***transmitting a second SI request message to the BS only when the at least one requested SIB is not received and the prohibit timer expires***," as recited in amended independent claim 1.

Moreover, Ishii also fails to disclose, teach or suggest the feature, "transmitting a first SI request message to a base station (BS) ***after determining that the UE is in a connected state,*** the first SI request message including at least one ***requested system information block (SIB),***" recited in amended independent claim 1.

Since Miyata fails to teach the features missing in Ishii, Applicant respectfully submits that amended independent claim 1 is patentably distinguishable over Ishii even when combined with Miyata.

As such, claims 2-3 depending from and further limiting independent claim 1 are, *a fortiori*, also patentably distinguishable over Ishii and Miyata, for at least the reasons discussed above, and also for the additional features contained in each dependent claim.

By the present Amendment and Response, Applicant has also amended independent claim 11 to include features similar to those in amended independent claim 1. It is noted that the Examiner, at page 8 of the Office Action, asserts the same portions of Ishii and Miyata with regard to the similar limitations recited in independent claim 11. Therefore, for at least similar reasons presented above with regard to amended independent claim 1, Applicant respectfully submits that amended independent claim 11 is also patentably distinguishable over Ishii in combination with Miyata. As such, claims 12-13 depending from claim 11 are, *a fortiori*, also patentably distinguishable over Ishii and Miyata, for at least the reasons discussed above, and also for the additional features contained in each dependent claim.

Withdrawal of the pending rejection is therefore respectfully requested.

C. <u>Rejection of Claims 7 and 17 under 35 U.S.C. § 103</u>

In the Office Action, the Examiner rejects claims 7 and 17 under 35 U.S.C. 103 as being unpatentable over Ishii in view of Miyata and further in view of Chen et al. (U.S. Patent Application Publication 2019/0124715) (hereinafter "Chen"). *See*, page 9, item 10 of the Office Action.

By the present Amendment and Response, Applicant has canceled claims 7 and 17 without prejudice or disclaimer, thus rendering the rejection moot. Withdrawal of the pending rejection is therefore respectfully requested.

D. Rejection of Claims 8, 9, 18 and 19 under 35 U.S.C. § 103

In the Office Action, the Examiner rejects claims 8, 9, 18 and 19 under 35 U.S.C. 103 as being unpatentable over Ishii in view of Miyata and further in view of Park et al. (U.S. Patent Application Publication 2018/0270792) (hereinafter "Park"). *See*, page 10, item 11 of the Office Action.

The Examiner cites Figs. 9A and 9B and paragraphs [0111]-[0116] of Park in rejecting claims 8, 9, 18 and 19. *See id.* At pages 10-11.

Turning to Park, Park describes a radio access network paging area configuration. However, in Figs. 9A and 9B and paragraphs [0111]-[0116], Park merely describes an architecture and package flows for multi connectivity, such as dual connectivity. Park introduces the concept of master base station, master cell group, secondary base station, and secondary cell group. However, Park does not disclose or suggest **an SI request procedure** that takes place in the dual connectivity scenario. Specifically, Park does not disclose how an SI request message is transmitted when the UE is in the dual connectivity mode. Furthermore, nowhere does Park disclose **SI request failure information**, let alone how the SI request failure information is transmitted when the UE is in the dual connectivity mode.

As such, Park fails to disclose, teach or suggest, at least, "***transmitting a third SI request message to a master node*** when the UE requires ***on-demand system information of a cell belonging to a secondary node***," as recited in claims 8 and 18. Park also fails to disclose, teach or suggest, at least, "***transmitting the SI request failure information;*** wherein the SI request failure information is ***transmitted to a master node*** when the UE is in a dual connectivity mode," as recited in claims 9 and 19.

E. Newly Added Claims 21-30

By the present Amendment and Response, Applicant has added new claims 21-30. Support for newly added claims can be found in the originally filed application. Because claim 1 is patentably novel and inventive over the cited references, Applicant respectfully submits that claims 21-25 depending from and further limiting independent claim 1 are, *a fortiori*, also patentably distinguishable over the cited references. In addition, claims 26-30 depending from claim 11 are, *a fortiori*, also patentably distinguishable over the cited references, for at least the reasons discussed above, and also for the additional features contained in each dependent claim.

In particular, claims 25 and 30 recite the feature "**storing SI request failure information** after determining that the on-demand SI request procedure is unsuccessful."

In the Office Action, the Examiner concedes that Ishii does not explicitly teach the feature, "the error handling procedure comprises: **storing SI request failure information,**" as recited in the original claim 1. The Examiner further relies on Miyata (paragraphs [0030] and [0031]) for teaching the above-quoted feature. *See* pages 5-6 of the Office Action.

Turning to Miyata, Miyata describes a multimode access control method. Miyata, in paragraphs [0030] and [0031], states:

> **[0030]** The **access-failure information** mentioned here includes any one of or the combination of access-failure information, such as an access-system type, access time information, access-location information, an access-failure reason, the number of access failures, etc. The access-system type refers to information for identifying the cellular system to which access has been failed. In this case, the information indicating "the cellular system A". The access time information refers to the time information at the time (any one of: at determination start time, at determination completion time, or at any time during the determination processing) of determining that an access is not available. The access time information uses standard time obtained from a base station, local time information, or the number of clocks inside of the mobile communication terminal, and a counter value.
>
> **[0031]** In this regard, for obtaining information from a base station in the case of an access failure, if a response indicating abnormal completion such as access unavailability, etc., is returned, that time information and the reason of the access failure should be stored as access-failure information. If some information is obtained in the case of an access failure, that information should be used. Even if that information cannot be obtained, it is at least possible to obtain time information from the clock inside of the mobile communication terminal.

As quoted above, Miyata merely describes **access failure information**. The access failure information may include a cellular system to which access has been failed, the time of determining that an access is not available, and the reason of the access failure. However, nowhere does Miyata disclose **SI request failure information** related to an **unsuccessful on-demand SI request procedure**. Applicant respectfully submits that Miyata does not disclose the feature "***storing SI request failure information after determining that the on-demand SI request procedure is unsuccessful***," recited in claims 25 and 30. Applicant also respectfully submits that claims 25 and 30, depending from and further limiting claims 1 and 11, respectively, are, *a fortiori*, also patentably distinguishable over Ishii and Miyata, either alone or in combination.

CONCLUSION

In view of the above, the undersigned representative respectfully submits that the foregoing Amendment and Response places this application in condition for allowance and a Notice to that effect is earnestly solicited. If the Examiner believes that there are any issues that can be resolved by a telephone conference, or that there are any informalities that can be corrected by an Examiner's amendment, please call the undersigned representative at the number given below.

The undersigned representative requests any extension of time that may be deemed necessary to further the prosecution of this application.

The undersigned representative authorizes the Commissioner to charge any additional fees under 37 C.F.R. 1.16 or 1.17 that may be required, or credit any overpayment, to Deposit Account No. 602615, referencing Attorney Docket No.: US76468.

Respectfully submitted,

By /Alvin S. Koan, Reg.# 68468/

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/372,389	Filing Date 04/01/2019	☐ 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 $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ 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	06/17/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 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	0

		(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".	/ANTJUAN M RIVERA/
*** 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.	

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/372,389	04/01/2019	HUNG-CHEN CHEN	US76468	2472

54000 7590 02/20/2020

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EXAMINER	
BATISTA, MARCOS	
ART UNIT	**PAPER NUMBER**
2642	
NOTIFICATION DATE	**DELIVERY MODE**
02/20/2020	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):

eoa-cbd@scienbizip.com
eoa-procc@scienbizippc.com
eoa-proce@scienbizip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 16/372,389	**Applicant(s)** CHEN et al.	
	Examiner MARCOS BATISTA	**Art Unit** 2642	**AIA (FITF) 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 April 1, 2019.
☐ 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 April 1, 2019 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 ______.

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date ______.

4) ☐ Other: ______.

Detailed Action

1. This Action is in response to Applicant's Patent Application filed on April 1, 2019. **Claims 1-20** are currently pending in the present application. This Action is made **Non-Final.**

America Invents Act (AIA) Information

2. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

3. The information disclosure statement(s) submitted on 09/19/2019 (has/have) been considered by the Examiner and made of record in the application file.

Examiner's Note

4. In claim 8 the features "performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful ..." are optional features, so the associated limitations do not hold patentable weight (see MPEP 2111.04).

In claim 10 the features "if the requested system information is considered essential for the UE, the error handling procedure further comprises at least one of the following ..." are optional features, so the associated limitations do not hold patentable weight (see MPEP 2111.04).

In claim 11 the features "performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful ..." are optional features, so the associated limitations do not hold patentable weight (see MPEP 2111.04).

In claim 20 the features "if the requested system information is considered essential for the UE, the error handling procedure further comprises at least one of the following ..." are optional features, so the associated limitations do not hold patentable weight (see MPEP 2111.04).

Claim Rejections - 35 USC § 103

5. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to

point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

9. **Claims 1-6, 10-16 and 20** are rejected under 35 U.S.C. 103 as being unpatentable over ISHII; Atsushi US 20190215858 A1), hereafter "ISHII," in view of Miyata; Katsuya (US 20060189336 A1), hereafter "Miyata."

Consider **claim 1**. ISHII discloses method of wireless communications performed by a user equipment (UE), the method comprising: performing an on-demand system information (SI) request procedure in a first cell (**see fig. 5, par. 0073**; [0073] As used herein, "system information" ("SI") may include a Master Information Block (MIB) and several System Information Blocks (SIBs) which are provided on downlink radio resources allocated to a access node. The system information may be broadcast, and some types of system information may be provided on demand, e.g., upon receipt of a request for system information from a wireless terminal.); and performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful (**see par. 0192**; [0192] FIG. 38 thus shows that, upon acquiring the Paging message, wherein after checking an incoming call for this wireless terminal, an extra step (act 38-5) is added to check if the Paging message indicates upcoming changes on the Minimum SI from the next modification period. If not, then similar to the sixth embodiment, the flow may proceed to the step "SIB updates for on-demand SIB?" as shown in an appropriate one of FIG. 16, 19, 23, 27, or 31. Otherwise, the wireless terminal 26-36 further check if there is any SIB reception process currently ongoing for on-demand SIB(s) (act 38-7). If not, the wireless terminal may simply wait for the next modification period (act 38-9) and then start to acquire the Minimum SI (act 38-10) as shown in FIG. 10. Otherwise, the wireless terminal 26-36 may continue the ongoing SIB reception procedure, in which, one new termination condition (act 38-8A) is now added to the aforementioned termination conditions; the SIB reception procedure ends at the next modification period boundary. As a result, if the wireless terminal 26-36 fails to receive the requested SIB(s) before the modification period boundary, it may terminate the ongoing SIB reception procedure unsuccessfully. After the termination of the (successful or unsuccessful) SIB reception procedure, the wireless terminal may wait for the next modification period boundary (act 38-9) if it is before the boundary and proceed to the Minimum SI acquisition shown in FIG. 9, or directly proceed to the Minimum SI acquisition if already after the boundary (act 38-10).).

ISHII, however, does not particular refer to the following limitation taught by Miyata, in analogous art; wherein the error handling procedure comprises: storing SI request failure information (**see pars. 0030 and 0031**; [0030] The access-failure information mentioned here includes any one of or the combination of access-failure information, such as an access-system type, access time information, access-location information, an access-failure reason, the number of access failures, etc. The access-system type refers to information for identifying the cellular system to which access has been failed. In this case, the information indicating "the cellular system A". The access time information refers to the time information at the time (any one of: at determination start time, at determination completion time, or at any time during the determination processing) of determining that an access is not available. The access time information uses standard time obtained from a base station, local time information, or the number of clocks inside of the mobile communication terminal, and a counter value. [0031] In this regard, for obtaining information from a base station in the case of an access failure, if a response indicating abnormal completion such as access unavailability, etc., is returned, that time information and the reason of the access failure should be stored as access-failure information. If some information is obtained in the case of an access failure, that information should be used. Even if that information cannot be obtained, it is at least possible to obtain time information from the clock inside of the mobile communication terminal.).

It would have been obvious to a person of ordinary skill in the art before the effective filing date of the claimed invention to modify the invention of ISHII and have it include the teachings of Miyata. The motivation would have been in order to manage system resources (see pars. 0030 and 0031).

Consider **claim 2** in view of claim 1 above. ISHII further discloses wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met: a number of times the UE transmits a random access preamble reaches a threshold; and the UE receives SI request rejection information (see par. 0118).

Consider **claim 3** in view of claim 1 above. ISHII further discloses wherein the SI request failure information comprises at least one of the following: an on-demand system information block (SIB) requested by the UE; **an on-demand SI message requested by the UE**; a cell identifier (ID) of the first cell; a synchronization signal block (SSB) index for performing the on-demand SI request procedure; a message type of the on-demand SI request procedure; and a timestamp for performing the on-demand SI request procedure (see par. 0108).

Consider **claim 4** in view of claim 1 above. ISHII further discloses wherein the error handling procedure further comprises: activating a prohibit timer; and avoiding initiating another on-demand SI request procedure until the prohibit timer expires (see par. 0118).

Consider **claim 5** in view of claim 1 above. ISHII further discloses wherein when the UE is in an idle state or an inactive state, the error handling procedure further comprises: considering the first cell as barred; and performing a cell re-selection procedure (see par. 0118).

Consider **claim 6** in view of claim 1 above. ISHII further discloses wherein when the UE is in a connected state, the error handling procedure further comprises at least one of the following: performing a re-establishment procedure to another qualified cell; and switching to an idle state and performing a cell re-selection procedure (see pars. 0077-0083 and 0122).

Consider **claim 10** in view of claim 1 above. ISHII further discloses considering whether or not requested system information in the on-demand SI request procedure is essential for the UE; and if the requested system information is considered essential for the UE, the error handling procedure further comprises at least one of the following: performing a cell re-selection procedure if the UE is in an idle state or an inactive state; and switching to the idle state and performing the cell re-selection procedure if the UE is in a connected state (see pars. 00074, 0077-0083 and 0122).

Consider **claim 11**, the subject matter recited in this claim has already been addressed in rejection to claim 1. Therefore, it has been analyzed and rejected based upon the rejection to claim 1. Additionally, Lin discloses at paragraphs 197 and 198 computer-readable media including executable instruction to carry out the tasks as in claim 1 above.

Consider **claim 12**, the subject matter recited in this claim has already been addressed in rejection to claim 2. Therefore, it has been analyzed and rejected based upon the rejection to claim 2.

Consider **claim 13**, the subject matter recited in this claim has already been addressed in rejection to claim 3. Therefore, it has been analyzed and rejected based upon the rejection to claim 3.

Consider **claim 14**, the subject matter recited in this claim has already been addressed in rejection to claim 4. Therefore, it has been analyzed and rejected based upon the rejection to claim 4.

Consider **claim 15**, the subject matter recited in this claim has already been addressed in rejection to claim 5. Therefore, it has been analyzed and rejected based upon the rejection to claim 5.

Consider **claim 16**, the subject matter recited in this claim has already been addressed in rejection to claim 6. Therefore, it has been analyzed and rejected based upon the rejection to claim 6.

Consider **claim 20**, the subject matter recited in this claim has already been addressed in rejection to claim 10. Therefore, it has been analyzed and rejected based upon the rejection to claim 10.

10. **Claim(s) 7 and 17** (is/are) rejected under 35 U.S.C. 103 as being unpatentable over ISHII in view of Miyata as applied to claim 1 above, and further in view of Chen; Wei-Yu et al. (US 20190124715 A1), hereafter "Chen."

Consider claim 7 in view of claim 1 above. ISHII, as modified by Miyata, discloses all the limitations that this claim depends upon, but does not particularly refer to the following limitation, as taught by Chen, in analogous art; wherein the on-demand SI request procedure comprises: transmitting an SI request message on signaling radio bearer 0 (SRB0) if the UE is in a connected state or an inactive state (see par. 0414).

It would have been obvious to a person of ordinary skill in the art before the effective filing date of the claimed invention to modify the invention of ISHII, as modified by Miyata and have it include the teachings of Chen. The motivation would have been in order to speed up control information exchange (see par. 0414).

Consider **claim 17**, the subject matter recited in this claim has already been addressed in rejection to claim 7. Therefore, it has been analyzed and rejected based upon the rejection to claim 7.

11. **Claim(s) 8, 9, 18 and 19** (is/are) rejected under 35 U.S.C. 103 as being unpatentable over ISHII in view of Miyata as applied to claim 1 above, and further in view of Park; Kyungmin et al. (US 20180270792 A1), hereafter “Park.”

Consider **claim 8** in view of claim 1 above. ISHII, as modified by Miyata, discloses all the limitations that this claim depends upon, but does not particularly refer to the following limitation, as taught by Park, in analogous art; wherein when the UE is in a dual connectivity mode, the on-demand SI request procedure comprises: transmitting an SI request message to a master node when the UE requires on-demand system information of a second cell belonging to a secondary node (see figs. 9A and 9B, pars. 0111-0116).

It would have been obvious to a person of ordinary skill in the art before the effective filing date of the claimed invention to modify the invention of ISHII, as modified by Miyata and have it include the teachings of Park. The motivation would have been in order to acquire control information from neighboring nodes (see figs. 9A and 9B, pars. 0111-0116).

Consider **claim 9** in view of claim 1 above. ISHII, as modified by Miyata, discloses all the limitations that this claim depends upon, but does not particularly refer to the following limitation, as taught by Park, in analogous art; wherein the error handling procedure further comprises: transmitting the SI request failure information; wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode (see figs. 9A and 9B, pars. 0111-0116). The motivation would have been in order to acquire control information from neighboring nodes (see figs. 9A and 9B, pars. 0111-0116).

Consider **claim 18**, the subject matter recited in this claim has already been addressed in rejection to claim 8. Therefore, it has been analyzed and rejected based upon the rejection to claim 8.

Consider **claim 19**, the subject matter recited in this claim has already been addressed in rejection to claim 9. Therefore, it has been analyzed and rejected based upon the rejection to claim 9.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Marcos Batista, whose telephone number is (571) 270-5209. The Examiner can normally be reached on Monday-Friday from 8:00am to 5:00pm.

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, Rafael Pérez-Gutiérrez can be reached at (571) 272-7915. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

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/MARCOS BATISTA/
Primary Examiner, Art Unit 2642

February 12, 2020

Notice of References Cited	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.	
	Examiner MARCOS BATISTA	Art Unit 2642	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-20060189336-A1	08-2006	Miyata; Katsuya	H04W48/18	455/515
*	B	US-20190215858-A1	07-2019	ISHII; Atsushi	H04W76/25	1/1
*	C	US-20190124715-A1	04-2019	Chen; Wei-Yu	H04W76/11	1/1
*	D	US-20180270792-A1	09-2018	Park; Kyungmin	H04W76/27	1/1
	E					
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	**Application/Control No.** 16/372,389	**Applicant(s)/Patent Under Reexamination** CHEN et al.
	Examiner MARCOS BATISTA	**Art Unit** 2642

✓	**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	02/12/2020								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

Search Notes	Application/Control No. 16/372,389	Applicant(s)/Patent Under Reexamination CHEN et al.
	Examiner MARCOS BATISTA	Art Unit 2642

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04W48/14 or H04W48/16 or H04W76/18 or H04W36/305 or H04W76/15 or H04W36/08 or H04W74/0833 or H04W76/28	02/12/2020	mb

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
455	434	02/12/2020	mb
370	338	02/12/2020	mb

* 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**
Inventor's Name Search	02/12/2020	mb
EAST Text Search	02/12/2020	mb
IDS Search	02/12/2020	mb
European Patent Search	02/12/2020	mb

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

Bibliographic Data

Application No: 16/372,389

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No | ☐ Met After Allowance

Verified and Acknowledged: /MARCOS BATISTA/ — Examiner's Signature | Initials

Title: ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
04/01/2019	455	2642	US76468
RULE			

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CHIE-MING CHOU Hsinchu, TAIWAN

YUNG-LAN TSENG Hsinchu, TAIWAN

CONTINUING DATA

This application has PRO of 62651312 04/02/2018

FOREIGN APPLICATIONS

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$1,720

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	27	(system information or sib or sim) with (signaling radio bearer "0" or SRB0 or SRBO)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 15:45
L2	18	1 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 15:46
L3	4	((dual connectivity) adj2 (mode or scheme or state or status or configuration)) same (system information) same (master or slave or secondary)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:04
L4	2	3 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:05
L5	583	((dual connectivity) near2 (mode or scheme or state or status or configuration)) same (master or slave or secondary)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:08
L6	246	((dual connectivity) near2 (mode or scheme or state or status or configuration)) same ((master or slave or secondary)near2 (node or access point or node$b or base station))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:08
L7	228	6 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:09
L8	1	((dual connectivity) near2 (mode or scheme or state or status or configuration)) same ((master or slave or secondary)near2 (node or access	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2020/02/12 16:10

		point or node$b or base station)) same (on$demand or ondemand)	EPO; JPO; DERWENT; IBM_TDB			
L9	2	((dual connectivity)) same ((master or slave or secondary)near2 (node or access point or node$b or base station)) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:11
L10	1	((dual connectivity)) same ((transmit$3 or send$3)near2 ((system information or sib or mib))) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:14
L11	7	((dual connectivity)) same (transmit$3 or send$3) same ((system information or sib or mib)) same (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:14
L12	7	11 and (@rlad< "20180402" or @ad< "20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:15
L13	221	((dual connectivity)) and ((transmit$3 or send$3) near2(system information or sib or mib)) and (on$demand or ondemand)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:24
L14	191	13 and (@rlad< "20180402" or @ad< "20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/12 16:24
L15	113	((dual connectivity)) and ((transmit$3 or send$3) near2(system information or sib or mib)) and (on$demand or ondemand) and ((master or slave or secondary)near2 (node or access point or node$b or base station))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/12 16:27
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L17	113	((dual connectivity or dual connect$3 or multiy connect$3 or multi connectivity or dual$connectivity or dual$connect$3 or multiy$connect$3 or multi$connectivity)) and ((transmit$3 or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	OFF	2020/02/12 16:31

		send$3) near2(system information or sib or mib)) and (on$demand or ondemand) and ((master or slave or secondary)near2 (node or access point or node$b or base station))	DERWENT; IBM_TDB			
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S2	155217	(H04W48/14 or H04W48/16 or H04W76/18 or H04W36/305 or H04W76/15 or H04W36/08 or H04W74/0833 or H04W76/28).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:43
S3	0	us-2015140999-a1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:44
S4	0	us-2015140999-a$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 07:45
S5	127	((("CHEN") near3 ("HUNG-CHEN"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/02/11 07:47
S6	159	((("CHOU") near3 ("CHIE-MING"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/02/11 07:47
S7	42	((("TSENG") near3 ("YUNG-LAN"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/02/11 07:47
S8	3	("20150140999").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:47
S9	273	S5 or S6 or S7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:49
S11	0	S9 and (on$demand same system information same cell same error stor$3 same failure).clm.	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2020/02/11 08:50

			EPO; JPO; DERWENT; IBM_TDB			
S12	20443	((455/434) or (370/338)).CCLS.	US-PGPUB; USPAT	OR	OFF	2020/02/11 08:51
S14	0	S2 and (on$demand same system information same cell same error stor$3 same failure)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:51
S18	1	S12 and (system information same cell same error same stor$3 same failure)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:53
S20	1	S9 and (on$demand same system information same cell same error same stor$3 same failure).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:53
S21	3	S2 and (on$demand same system information same cell same error same stor$3 same failure)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 08:53
S22	6891135	((on$demand or ondemand) same system information or "SI")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2020/02/11 09:49
S23	1039	((on$demand or ondemand) same system information)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 09:49
S24	42	(on$demand or ondemand) same system information same (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 09:51
S25	22	S24 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 09:52

S26	2	wo-2018014728-a$	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 10:03
S28	244	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (stor$3 or saving or receiv$3 or acquir$3)) with (system information or sib) with (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 15:09
S29	237	S28 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 15:41
S30	67	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (stor$3 or saving or acquir$3)) with (system information or sib) with (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:03
S31	63	S30 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:10
S32	29	((UE or WTRU or subscriber or ((radio or mobile or wireless or cell or cellular or portable or hand$held or remote or user or communication) adj2 (apparatus or phone or telephone or device or unit or terminal or station or hand$set or equipment))) near2 (stor$3 or saving)) with (system information or sib) with (fail$4 or unsuccessful$4 or error)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:18
S33	27	S32 and (@rlad<"20180402" or @ad<"20180402")	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2020/02/11 16:20

2/12/2020 5:28:50 PM
C:\Users\mbatista\Documents\EAST\Workspaces\16372389 ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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	Application Number	16372389
	Filing Date	2019-04-01
	First Named Inventor	HUNG-CHEN CHEN
	Art Unit	2642
	Examiner Name	Marcos Batista
	Attorney Docket Number	US76468

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	1	20150140999	A1	2015-05-21	HUAWEI TECHNOLOGY CO., LTD.	description, paragraphs [0154]-[0170]

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	1	107690200	CN	A	2018-02-13	CHINA ACADEMY TELECOMMUNICATIONS TECHNOLOGY	the whole document	☒
	2	107809753	CN	A	2018-03-16	ZTE CORPORATION	the whole document	☒
	3	107223353	CN	A	2017-09-29	BEIJING XIAOMI MOBILE SOFTWARE CO., LTD.	the whole document	☒

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	16372389
	Filing Date	2019-04-01
	First Named Inventor	HUNG-CHEN CHEN
	Art Unit	2642
	Examiner Name	Marcos Batista
	Attorney Docket Number	US76468

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Examiner Signature	/MARCOS BATISTA/	Date Considered	02/11/2020

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16/372,389	04/01/2019	HUNG-CHEN CHEN	US76468

CONFIRMATION NO. 2472

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Los Angeles, CA 90071

PUBLICATION NOTICE

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	Filing Date	2019-04-01
	First Named Inventor	HUNG-CHEN CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	US76468

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16372389
	Filing Date	2019-04-01
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	US76468

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Signature	/Alvin Koan/	Date (YYYY-MM-DD)	2019-09-17
Name/Print	Alvin Koan	Registration Number	68468

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English Translation of Abstract of China Patent Application No. CN107690200A

The invention provides a random access method and a terminal and relates to the technical field of communication. The method comprises the steps of obtaining replaced access configuration employed when the terminal randomly accesses a network again after a process of randomly accessing the network; and randomly accessing the network again according to the replaced access configuration employed when the terminal randomly accesses the network again after the terminal accesses the network unsuccessfully in the process of randomly accessing the network. According to the scheme provided by the invention, a retransmission access success rate of random access sequence can be improved, and the whole random access delay is reduced.

(19)中华人民共和国国家知识产权局

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H04W 74/08(2009.01)

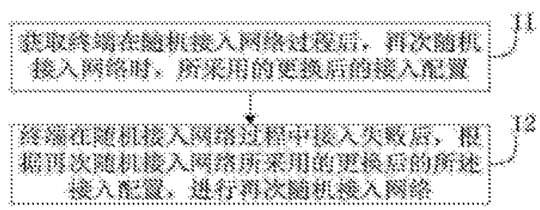
权利要求书5页 说明书16页 附图6页

(54)发明名称

一种随机接入方法及终端

(57)摘要

本发明提供了一种随机接入方法及终端，涉及通信技术领域，该方法包括：获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。本发明的方案可以提高随机接入序列重传的接入成功率，从而缩短整个随机接入的时延。



CN 107690200 A

1.一种随机接入方法，其特征在于，包括：

获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；

终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。

2.根据权利要求1所述的随机接入方法，其特征在于，终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后所述接入配置，进行再次随机接入网络的步骤包括：

终端在随机接入网络过程中，N次接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

其中，1≤N≤M，N、M均为正整数，且M为整个随机接入过程中最大接入次数。

3.根据权利要求1所述的随机接入方法，其特征在于，终端接入网络过程中的接入失败包括：终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

4.根据权利要求1所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入资源配置或者随机接入过程中的回退参数。

5.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括：同一网络接入点下的其它随机接入资源配置时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者

获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源；

其中，第一随机接入配置资源与第二随机接入配置资源不同。

6.根据权利要求5所述的随机接入方法，其特征在于，获取再次随机接入网络所采用的第二随机接入配置资源的步骤包括：

获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源。

7.根据权利要求6所述的随机接入方法，其特征在于，终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后所述接入配置，进行再次随机接入网络的步骤包括：

终端在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者

终端在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

8.根据权利要求7所述的随机接入方法，其特征在于，再次随机接入网络成功后，还包括：

丢弃所述第二随机接入配置资源，恢复第一随机接入配置资源的配置。

9.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的频点时，获取终端在随机接入网络

过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；

其中，所述第一频率为高频区域采用的频率范围内的频率，所述第二频率为低频区域采用的频率范围内的频率；或者

所述第一频率为低频区域采用的频率范围内的频率，所述第二频率为高频区域采用的频率范围内的频率。

10.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

终端驻留在一个单频点由多个网络接入点组成的网络中，并在所述网络中的第一小区进行随机接入网络过程，并接入失败后，触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区；其中，一个网络接入点是一个小区。

11.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

终端驻留在一个单频点由多个网络接入点组成的网络中，且所述多个网络接入点中至少一个网络接入点形成一个小区，从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源。

12.根据权利要求11所述的随机接入方法，其特征在于，终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络的步骤包括：

终端在其驻留的网络接入点，根据第一随机接入配置资源进行随机接入过程中接入失败后，根据所述第二随机接入配置资源，进行再次随机接入网络；

或者

终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，根据所述第一随机接入配置资源，进行再次随机接入网络。

13.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者

终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数。

14.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

监听网络发送的负荷指示；

在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数。

15.根据权利要求4所述的随机接入方法，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入过程中的回退参数时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

获取网络通过系统消息块携带的第一随机接入配置资源；

根据所述第一随机接入配置资源进行初次随机接入过程失败后，获取回退时间参数指示；

根据回退时间参数指示，获得回退时间。

16.根据权利要求15所述的随机接入方法，其特征在于，获取回退时间参数指示的步骤包括：

通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示，获取回退时间参数指示。

17.根据权利要求15或16所述的随机接入方法，其特征在于，根据回退时间参数指示，获得回退时间的步骤包括：

根据回退时间参数指示与传输次数的对应关系，获得当前传输次数对应的回退时间；或者

根据回退时间参数指示、传输次数以及叠加系数，得到回退时间；或者

根据回退时间参数指示与不同时延需求属性的业务的对应关系，获得当前业务对应的回退时间。

18.一种终端，其特征在于，包括：

获取模块，用于获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；

接入模块，用于在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。

19.根据权利要求18所述的终端，其特征在于，所述接入模块在随机接入网络过程中，N次接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

其中，1≤N≤M，N、M均为正整数，且M为整个随机接入过程中最大接入次数。

20.根据权利要求18所述的终端，其特征在于，终端接入网络过程中的接入失败包括：终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

21.根据权利要求18所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入资源配置或者随机接入过程中的回退参数。

22.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括：同一网络接入点下的其它随机接入资源配置时，所述获取模块包括：

第一获取单元，用于获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者

第二获取单元，用于获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源；

其中，第一随机接入配置资源与第二随机接入配置资源不同。

23.根据权利要求22所述的终端，其特征在于，所述第二获取单元获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源。

24.根据权利要求23所述的终端，其特征在于，所述接入模块具体用于：

在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者

在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

25.根据权利要求24所述的终端，其特征在于，所述接入模块还用于：再次随机接入网络成功后，丢弃所述第二随机接入配置资源，恢复第一随机接入配置资源的配置。

26.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的频点时，所述获取模块具体用于：

终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；

其中，所述第一频率为高频区域采用的频率范围内的频率，所述第二频率为低频区域采用的频率范围内的频率；或者

所述第一频率为低频区域采用的频率范围内的频率，所述第二频率为高频区域采用的频率范围内的频率。

27.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，所述获取模块具体用于：

终端驻留在一个单频点由多个网络接入点组成的网络中，并在所述网络中的第一小区进行随机接入网络过程，并接入失败后，触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区；其中，一个网络接入点是一个小区。

28.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，所述获取模块具体用于：

终端驻留在一个单频点由多个网络接入点组成的网络中，且所述多个网络接入点中至少一个网络接入点形成一个小区，从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源。

29.根据权利要求28所述的终端，其特征在于，所述接入模块具体用于：

终端在其驻留的网络接入点，根据第一随机接入配置资源进行随机接入过程中接入失败后，根据所述第二随机接入配置资源，进行再次随机接入网络；

或者

终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，

根据所述第一随机接入配置资源，进行再次随机接入网络。

30.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，所述获取模块具体用于：

终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者

终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数。

31.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，所述获取模块具体用于：

监听网络发送的负荷指示；

在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数。

32.根据权利要求21所述的终端，其特征在于，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入过程中的回退参数时，所述获取模块具体用于：

获取网络通过系统消息块携带的第一随机接入配置资源；

根据所述第一随机接入配置资源进行初次随机接入过程失败后，获取回退时间参数指示；

根据回退时间参数指示，获得回退时间。

33.根据权利要求32所述的终端，其特征在于，获取回退时间参数指示具体通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示，获取回退时间参数指示。

34.根据权利要求32或33所述的终端，其特征在于，所述获取模块根据回退时间参数指示获得回退时间时，具体用于：

根据回退时间参数指示与传输次数的对应关系，获得当前传输次数对应的回退时间；或者

根据回退时间参数指示、传输次数以及叠加系数，得到回退时间；或者

根据回退时间参数指示与不同时延需求属性的业务的对应关系，获得当前业务对应的回退时间。

一种随机接入方法及终端

技术领域

[0001]　本发明涉及通信技术领域，特别涉及一种随机接入方法及终端。

背景技术

[0002]　在5G NR(New RAT，新无线接入技术)中，由于其拥有超大小区和超大用户密度的特征，当UE(终端)根据内部高层业务触发或高层信令触发的需求而要接入网络时候，由于用户密度很大，会导致随机接入的碰撞概增加。而多次尝试的碰撞，将会导致接入时延的进一步增加；如果将随机接入的回退因子加大，尽管可以一定程度上降低本次传输的失败概率，但也会导致时延增加。

[0003]　同时在5G系统中将会支持不同类型的切片或业务，即需要体现不同的时延需求，有的切片或业务有很苛刻的接入时延需求。因此需要考虑在初始随机接入过程中，当本次随机接入失败后，用以保证业务所需的接入时延要求。

[0004]　当前LTE系统中，随机接入的原因主要有如下几种：

[0005]　1)从RRC_IDLE(无线资源控制_空闲)状态接入(也称为初始接入，initial access)；

[0006]　2)无线链路失败发起RRC(无线资源控制)连接重建(也是初始接入的一种)；

[0007]　3)切换过程需要随机接入；

[0008]　4)UE处于RRC_CONNECTED(无线资源控制_连接态)时有下行数据到达；

[0009]　5)UE处于RRC_CONNECTED(无线资源控制_连接态)时有上行数据到达。

[0010]　当前LTE系统在随机接入过程中，没有不同业务时延要求的体现的，因此无法很好的保证不同时延需求的业务的接入过程的不同的时延保证。同时由于随机接入过程的初传和重传的资源基本是相同的，在这种情况下由于冲突导致初次传输失败的情况，在重传的时候也无法很好的改善。

发明内容

[0011]　本发明要解决的技术问题是提供一种随机接入方法及终端，可以提高随机接入序列重传的接入成功率，从而缩短整个随机接入的时延。

[0012]　为解决上述技术问题，本发明的实施例提供一种随机接入方法，包括：

[0013]　获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；

[0014]　终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。

[0015]　终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后所述接入配置，进行再次随机接入网络的步骤包括：

[0016]　终端在随机接入网络过程中，N次接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

[0017]　其中，1≤N≤M，N、M均为正整数，且M为整个随机接入过程中最大接入次数。

[0018]　终端接入网络过程中的接入失败包括：终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

[0019]　所述再次随机接入网络所采用的更换后的接入配置包括：随机接入资源配置或者随机接入过程中的回退参数。

[0020]　所述再次随机接入网络所采用的更换后的接入配置包括：同一网络接入点下的其它随机接入资源配置时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0021]　获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者

[0022]　获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源；

[0023]　其中，第一随机接入配置资源与第二随机接入配置资源不同。

[0024]　获取再次随机接入网络所采用的第二随机接入配置资源的步骤包括：

[0025]　获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源。

[0026]　终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后所述接入配置，进行再次随机接入网络的步骤包括：

[0027]　终端在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者

[0028]　终端在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

[0029]　再次随机接入网络成功后，还包括：

[0030]　丢弃所述第二随机接入配置资源，恢复第一随机接入配置资源的配置。

[0031]　所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的频点时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0032]　终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；

[0033]　其中，所述第一频率为高频区域采用的频率范围内的频率，所述第二频率为低频区域采用的频率范围内的频率；或者

[0034]　所述第一频率为低频区域采用的频率范围内的频率，所述第二频率为高频区域采用的频率范围内的频率。

[0035]　所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0036]　终端驻留在一个单频点由多个网络接入点组成的网络中，并在所述网络中的第一小区进行随机接入网络过程，并接入失败后，触发小区重选过程获取重新选择的所述网络

中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区；其中，一个网络接入点是一个小区。

[0037]　所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0038]　终端驻留在一个单频点由多个网络接入点组成的网络中，且所述多个网络接入点中至少一个网络接入点形成一个小区，从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源。

[0039]　终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络的步骤包括：

[0040]　终端在其驻留的网络接入点，根据第一随机接入配置资源进行随机接入过程中接入失败后，根据所述第二随机接入配置资源，进行再次随机接入网络；

[0041]　或者

[0042]　终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，根据所述第一随机接入配置资源，进行再次随机接入网络。

[0043]　所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0044]　终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者

[0045]　终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数。

[0046]　所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0047]　监听网络发送的负荷指示；

[0048]　在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数。

[0049]　所述再次随机接入网络所采用的更换后的接入配置包括：随机接入过程中的回退参数时，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置的步骤包括：

[0050]　获取网络通过系统消息块携带的第一随机接入配置资源；

[0051]　根据所述第一随机接入配置资源进行初次随机接入过程失败后，获取回退时间参数指示；

[0052]　根据回退时间参数指示，获得回退时间。

[0053]　获取回退时间参数指示的步骤包括：

[0054]　通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示，获取回退时间参数指示。

[0055] 根据回退时间参数指示，获得回退时间的步骤包括：

[0056] 根据回退时间参数指示与传输次数的对应关系，获得当前传输次数对应的回退时间；或者

[0057] 根据回退时间参数指示、传输次数以及叠加系数，得到回退时间；或者

[0058] 根据回退时间参数指示与不同时延需求属性的业务的对应关系，获得当前业务对应的回退时间。

[0059] 本发明的实施例还提供一种终端，包括：

[0060] 获取模块，用于获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；

[0061] 接入模块，用于在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。

[0062] 其中，所述接入模块在随机接入网络过程中，N次接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

[0063] 其中，$1 \leq N \leq M$，N、M均为正整数，且M为整个随机接入过程中最大接入次数。

[0064] 其中，终端接入网络过程中的接入失败包括：终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

[0065] 其中，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入资源配置或者随机接入过程中的回退参数。

[0066] 其中，所述再次随机接入网络所采用的更换后的接入配置包括：同一网络接入点下的其它随机接入资源配置时，所述获取模块包括：

[0067] 第一获取单元，用于获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者

[0068] 第二获取单元，用于获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源；

[0069] 其中，第一随机接入配置资源与第二随机接入配置资源不同。

[0070] 其中，所述第二获取单元获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源。

[0071] 其中，所述接入模块具体用于：

[0072] 在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者

[0073] 在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

[0074] 其中，所述接入模块还用于：再次随机接入网络成功后，丢弃所述第二随机接入配置资源，恢复第一随机接入配置资源的配置。

[0075] 其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的频点时，所述获取模块具体用于：

[0076]　终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；

[0077]　其中，所述第一频率为高频区域采用的频率范围内的频率，所述第二频率为低频区域采用的频率范围内的频率；或者

[0078]　所述第一频率为低频区域采用的频率范围内的频率，所述第二频率为高频区域采用的频率范围内的频率。

[0079]　其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，所述获取模块具体用于：

[0080]　终端驻留在一个单频点由多个网络接入点组成的网络中，并在所述网络中的第一小区进行随机接入网络过程，并接入失败后，触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区；其中，一个网络接入点是一个小区。

[0081]　其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，所述获取模块具体用于：

[0082]　终端驻留在一个单频点由多个网络接入点组成的网络中，且所述多个网络接入点中至少一个网络接入点形成一个小区，从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源。

[0083]　其中，所述接入模块具体用于：终端在其驻留的网络接入点，根据第一随机接入配置资源进行随机接入过程中接入失败后，根据所述第二随机接入配置资源，进行再次随机接入网络；

[0084]　或者

[0085]　终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，根据所述第一随机接入配置资源，进行再次随机接入网络。

[0086]　其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，所述获取模块具体用于：终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者

[0087]　终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数。

[0088]　其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，所述获取模块具体用于：

[0089]　监听网络发送的负荷指示；

[0090]　在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数。

[0091]　其中，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入过程中的回退参数时，所述获取模块具体用于：获取网络通过系统消息块携带的第一随机接入配置资源；根据所述第一随机接入配置资源进行初次随机接入过程失败后，获取回退时间参数指示；根据回退时间参数指示，获得回退时间。

[0092] 其中，获取回退时间参数指示具体通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示，获取回退时间参数指示。

[0093] 其中，所述获取模块根据回退时间参数指示获得回退时间时，具体用于：根据回退时间参数指示与传输次数的对应关系，获得当前传输次数对应的回退时间；或者根据回退时间参数指示、传输次数以及叠加系数，得到回退时间；或者根据回退时间参数指示与不同时延需求属性的业务的对应关系，获得当前业务对应的回退时间。

[0094] 本发明的上述技术方案的有益效果如下：

[0095] 本发明的实施例通过获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。从而提高终端随机接入网络时，重传的成功率和实时性，从而保证特定业务的随机接入传输时延需求，以及整体随机接入的时延需求。

附图说明

[0096] 图1为本发明的第一实施的随机接入方法流程图；

[0097] 图2为本发明的第二实施例的随机接入方法流程图；

[0098] 图3为图2所示实施例的具体信令流程图；

[0099] 图4为图2所示实施例的具体信令流程图；

[0100] 图5为本发明的第三实施例的随机接入方法流程图；

[0101] 图6为通信系统部署场景图；

[0102] 图7为高低频异构场景图；

[0103] 图8为本发明的第四实施例的随机接入方法流程图；

[0104] 图9为同一个频率层有多个TRP组成，每个TRP为一个小区的部署场景；

[0105] 图10为本发明的第五实施例的随机接入方法流程图；

[0106] 图11为UE驻留在一个单频点由多个TRP组成的网络中，多个TRP形成一个小区，由NB(节点B)统一管理的场景；

[0107] 图12为图10所示实施例的具体实现流程图；

[0108] 图13为本发明的第六实施例的随机接入方法流程图；

[0109] 图14为本发明的第七实施例的随机接入方法流程图；

[0110] 图15为本发明的第八实施例的随机接入方法流程图；

[0111] 图16为图15所示实施例的具体实现流程图；

[0112] 图17为本发明的第十实施例的终端的结构框架图。

具体实施方式

[0113] 为使本发明要解决的技术问题、技术方案和优点更加清楚，下面将结合附图及具体实施例进行详细描述。

[0114] 本发明的实施例给出了一种随机接入失败后的处理方法。其核心思想是当初始随机接入失败后，采用新的接入方式发起后续的随机接入过程。

[0115] 第一实施例

[0116] 如图1所示，本发明的第一实施例提供的随机接入方法，包括：

[0117] 步骤11，获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；

[0118] 当前LTE机制中，随机接入过程的初传和重传的资源基本是相同的，在这种情况下由于冲突导致初次传输失败的情况，在重传的时候也无法很好的改善；这里在再次随机接入网络时，采用更换后的接入配置，提高终端随机接入网络时，重传的成功率和实时性；

[0119] 步骤12，终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

[0120] 这里的终端接入网络过程中的接入失败包括：终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

[0121] 另外，终端在随机接入网络过程中，N次接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

[0122] 其中，1≤N≤M，N、M均为正整数，且M为整个随机接入过程中最大接入次数。

[0123] 也就是说，随机接入过程失败后采用更换后的接入配置发起随机接入网络包括：

[0124] (1)1次随机接入过程中前N次接入失败(N>=1)，采用新的方式进行Msg1重传；或

[0125] (2)1次完整的随机接入失败，之后采用新的方式重新发起随机接入过程。

[0126] 本发明的该实施例通过获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。从而提高终端随机接入网络时，重传的成功率和实时性，从而保证特定业务的随机接入传输时延需求，以及整体随机接入的时延需求。

[0127] 第二实施例

[0128] 如图2所示，本发明的第二实施例提供的随机接入方法包括：

[0129] 所述再次随机接入网络所采用的更换后的接入配置包括：同一网络接入点下的其它随机接入资源配置时，

[0130] 步骤21，获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源；

[0131] 具体的，获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源；其中，第一随机接入配置资源与第二随机接入配置资源不同；

[0132] 步骤22，终端在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者终端在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

[0133] 具体的信令流程，如图3所示：

[0134] 步骤1，网络通过广播将本小区内的随机接入过程通知给UE，其中初次传输配置为Cfg-1，重传配置为Cfg-2；(同样，网络侧可以为UE配置每个重传次数的随机接入配置，也可

以设置初始X次传输采用Cfg-1，后续Y次传输采用Cfg-2，再后Z次采用Cfg-3…)；

[0135] 步骤2，UE用Cfg-1配置发起随机接入；

[0136] 步骤3，随机接入失败后，后续重传采用Cfg-2配置发起随机接入。

[0137] 具体的信令流程，如图4所示：

[0138] 步骤1，UE通过系统信息获取RACH(随机接入信道)配置cfg-1，并存储；

[0139] 步骤2，UE用Cfg-1配置发起随机接入过程；

[0140] 步骤3，网络侧直接通过L1/L2信令通知重传使用的RACH配置为Cfg-2；其中该信息也可以直接通过Msg2消息携带，也可以是独立于Msg2消息的新的L1/L2信令携带；UE根据该信令指示的Cfg-2配置发起后续的重传；

[0141] 步骤4，当RA过程失败，则用Cfg-2的配置重新发送随机接入序列，这里可以停止之前的RA过程重新发起一个新的随机接入过程，也可以不中断当前的随机接入过程，直接应用更新的配置进行重传；

[0142] 步骤5，当随机接入成功后，UE丢弃随机接入配置Cfg-2，恢复原有的Cfg-1的配置。即丢弃所述第二随机接入配置资源，恢复第一随机接入配置资源的配置。

[0143] 本发明的该实施例通过获取同一网络接入点的其它接入配置，使终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。从而提高终端随机接入网络时，重传的成功率和实时性，从而保证特定业务的随机接入传输时延需求，以及整体随机接入的时延需求。

[0144] 第三实施例

[0145] 如图5所示，本发明的第三实施例提供一种随机接入方法，包括：

[0146] 步骤51，终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；

[0147] 步骤52，终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的第二频率，进行再次随机接入网络。

[0148] 其中，所述第一频率为高频区域采用的频率范围内的频率，所述第二频率为低频区域采用的频率范围内的频率；或者所述第一频率为低频区域采用的频率范围内的频率，所述第二频率为高频区域采用的频率范围内的频率。

[0149] 如图6所示，未来移动通信系统的网络部署部署场景，超密集组网是未来移动通信系统发展的一个趋势，在超密集组网情况下，为了实现对大量分布式处理节点的统一控制面管理，需要将部分协议功能进行集中式处理。这样就形成了集中处理节点和分布式处理节点的双层结构，分布式处理节点也称为TRP(Transmission Reception Point，发送接收节点)，集中处理节点也成为CU(Central Unit，集中处理节点)或者NR eNB(New RAT eNB，新接入技术基站)。对于集中处理节点，根据功能不同，还可以进一步划分为集中处理节点的控制面和集中处理节点的用户面。

[0150] 如图7所示，部署场景：高低频异构场景，在同一个覆盖范围内，即存在高频点的TRP(HF)，又存在低频点的TRP(LF)，终端若驻留在该覆盖范围内时，即可以接入低频点TRP，也可以接入高频点TRP，在此场景中，终端在网络的高低频重叠覆盖区采用低频率接入低频点TRP时，接入失败后，可以采用高频率接入高频点TRP进行再次随机接入；当然也可以是采

用高频率接入高频点TRP失败后，采用低频率接入低频点TRP进行再次随机接入。

[0151] 本发明的该实施例通过终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的第二频率，进行再次随机接入网络；从而在低频点接入失败后，可以采用高频点随机接入；当然也可以是高频点接入失败后，采用低频点随机接入。从而提高终端随机接入网络时，重传的成功率和实时性，从而保证特定业务的随机接入传输时延需求，以及整体随机接入的时延需求。

[0152] 第四实施例

[0153] 如8所示，本发明的第四实施例提供一种随机接入方法，包括：

[0154] 步骤81，终端驻留在一个单频点由多个网络接入点组成的网络中，并在所述网络中的第一小区进行随机接入网络过程，并接入失败后，触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区；其中，一个网络接入点是一个小区；

[0155] 步骤82，终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的第二小区，进行再次随机接入网络。

[0156] 如图9所示的场景部署，同一个频率层有多个TRP组成，每个TRP为一个小区。

[0157] 该方法的具体实现流程1包括：

[0158] UE驻留在一个单频点由多个TRP组成的网络中，每个TRP是一个小区；

[0159] 步骤1，UE首先驻留在小区1，并通过小区1发起随机接入；

[0160] 步骤2，若随机接入前N次失败，或整个随机接入过程接入失败，则UE触发小区选择重选过程，选择到小区2；

[0161] 步骤3，UE直接到小区2发起后续的随机接入过程(对应于前N次失败)，或者重新发起随机接入过程(对应于整个随机接入过程接入失败)。

[0162] 该方法的具体实现流程2包括：

[0163] UE驻留在一个单频点由多个TRP组成的网络中，每个TRP是一个小区；

[0164] 步骤1，UE首先驻留在小区1，并通过小区1发起随机接入；

[0165] 步骤2，若随机接入前N次失败，或随机接入整个失败，则UE直接切到信号强度为次强小区2；

[0166] 步骤3，UE直接在小区2发起后续的随机接入过程(对应于前N次失败)，或者重新发起随机接入过程(对应于整个随机接入过程接入失败)。

[0167] 本发明的该第四实施例通过更换另一个网络接入点，从而可以提高终端随机接入网络时，重传的成功率和实时性，从而保证特定业务的随机接入传输时延需求，以及整体随机接入的时延需求。

[0168] 第五实施例

[0169] 如图10所示，本发明的第五实施例提供一种随机接入方法，包括：

[0170] 步骤101，终端驻留在一个单频点由多个网络接入点组成的网络中，且所述多个网络接入点中至少一个网络接入点形成一个小区，从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的

第二随机接入配置资源；
[0171] 步骤102，终端在其驻留的网络接入点，根据第一随机接入配置资源进行随机接入过程中接入失败后，根据所述第二随机接入配置资源，进行再次随机接入网络；或者终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，根据所述第一随机接入配置资源，进行再次随机接入网络。
[0172] 如图11所示的场景部署，UE驻留在一个单频点由多个TRP组成的网络中，多个TRP形成一个小区，由NB(节点B)统一管理。
[0173] 如图12所示，该方法的具体实现流程包括：
[0174] 步骤1，网络通过SIB(系统信息块)将两级RACH(随机接入信道)资源配置给UE；
[0175] 步骤2，UE首先驻留在TRP，并通过TRP级别RACH资源发起随机接入；该随机接入过程是通过TRP相关的参考信号用于传输和接收；
[0176] 步骤3，TRP级别随机接入失败后，通过小区级别的RACH资源发起随机接入过程；该随机接入过程是通过小区级参考信号用于传输和接收。
[0177] 当然，如果UE先采用了小区级RACH资源发起随机接入过程，在接入失败后，也可以转为采用TRP级别RACH资源发起随机接入。
[0178] 本发明的该实施例实现了在UE驻留在一个单频点由多个TRP组成的网络中，多个TRP形成一个小区，由NB(节点B)统一管理的场景中，在TRP级别随机接入失败后，通过小区级别的RACH资源发起随机接入过程；也可以在采用了小区级RACH资源发起随机接入过程，在接入失败后，也可以转为采用TRP级别RACH资源发起随机接入；从而可以提高终端随机接入网络时，重传的成功率和实时性，从而保证特定业务的随机接入传输时延需求，以及整体随机接入的时延需求。
[0179] 第六实施例
[0180] 如图13，本发明的第六实施例提供一种随机接入方法，包括：
[0181] 步骤131，终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数；
[0182] 步骤132，终端回退一段时间后，再发起随机接入过程。
[0183] 该方法的具体实现流程包括：初次随机接入失败后，
[0184] UE在发起随机接入过程前先在Msg1或特别信道上监听信号强度或其他用户发送的Msg1；
[0185] 当预定义时间长度内的检测到的Msg1个数低于预定义取值或者信道强度低于预配置取值，则直接发起随机接入过程，否则回退一段时间，发起随机接入过程，或继续LBT监听发起随机接入过程。
[0186] 第七实施例
[0187] 如图14所示，本发明的第七实施提供一种随机接入方法，包括：
[0188] 步骤141，监听网络发送的负荷指示，在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数；
[0189] 步骤142，终端回退一段时间后，再发起随机接入过程。

[0190]　该方法的具体实现流程包括:初次随机接入失败后,

[0191]　网络显示给UE网络负荷(load)指示,UE根据该指示判断是否发起随机接入,如果不行回退T时间再次读取load信息。

[0192]　该实施例中,终端通过监听机制,从而在接入失败后,回退一段时间,再进行随机接入,从而可以提高终端随机接入网络时,重传的成功率和实时性,从而保证特定业务的随机接入传输时延需求,以及整体随机接入的时延需求。

[0193]　第八实施例

[0194]　如图15所示,本发明的第八实施例提供一种随机接入的方法,包括:

[0195]　步骤151,获取网络通过系统消息块携带的第一随机接入配置资源;

[0196]　步骤152,根据所述第一随机接入配置资源进行初次随机接入过程失败后,获取回退时间参数指示;

[0197]　具体的,可以通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示,获取回退时间参数指示;

[0198]　步骤153,根据回退时间参数指示,获得回退时间;

[0199]　具体的,可以根据回退时间参数指示与传输次数的对应关系,获得当前传输次数对应的回退时间;或者根据回退时间参数指示、传输次数以及叠加系数,得到回退时间;或者根据回退时间参数指示与不同时延需求属性的业务的对应关系,获得当前业务对应的回退时间;

[0200]　步骤154,终端回退一段时间后,再次进入随机接入网络。

[0201]　如图16所示,具体的随机接入流程包括:

[0202]　步骤1,UE通过系统信息获取RACH(随机接入信道)配置Cfg-1;

[0203]　步骤2,UE用Cfg-1配置发起随机接入过程;

[0204]　步骤3,若UE可以提前通过系统信息或通过监听空口的信息,或者初次传输的BI参数,则直接用该BI参数进行回退处理后再发起随机接入过程;

[0205]　步骤4,UE收到Msg2,其中携带BI;

[0206]　步骤5,UE根据当前传输次数,根据次数查找BI对应的实际取值,并进行backoff回退;其中查找过程可以是根据不同传输次数不同的对应表格查找,也可以是根据回退时间参数指示、传输次数以及叠加系数叠加计算而成,也可以是根据回退时间参数指示与不同时延需求属性的业务的对应关系,得到BI对应的实际取值;

[0207]　步骤6,回退一定时间后UE重新发起随机接入过程;其中,不同传输次数对应的表格或系数是可以通过信令配置给UE的。

[0208]　本发明的该实施例中,不同传输次数对应不同的回退时间长度,是指,1次传输失败,则对应一个回退时间长度为A,2次传输失败,对应一个回退时间长度为B,3次传输失败,对应一个回退时间长度为C,其中,A、B、C互不相同。

[0209]　该实施例中,终端通过回退机制,从而在接入失败后,回退一段时间,再进行随机接入,从而可以提高终端随机接入网络时,重传的成功率和实时性,从而保证特定业务的随机接入传输时延需求,以及整体随机接入的时延需求。

[0210]　本发明的上述实施例中,更换后的接入配置为接入配置资源时,该接入配置资源可以包括随机接入信道的时频资源、所归属网络传输点、上行同步码或preamble前导序列

等码分资源;其中接入配置资源可以通过Msg2携带,其中Msg2携带的重传所需的随机接入资源可以是在任意一条Msg2消息中携带。

[0211]　本发明的上述实施例中,采用不同的回退参数(控制UE进行前导重传的时间)进行回退,再发起随机接入;eNodeB通过随机接入响应告知UE一个回退值,UE如果需要进行前导重传,则在0到这个回退值之间随机选择一个值作为退避时间,在退避时间结束后再进行前导重传。

[0212]　其中不同的回退参数可以是:1)不同的backoff(回退)参数给不同的业务;2)不同传输次数给不同的backoff参数;Backoff参数可以是显示给具体取值,也可以是同一个BI,不同的业务或不同传输次数映射为不同的取值;

[0213]　当backoff参数是和传输次数相关,则需要UE初始接入时候也需要知道初次接入的backoff取值,该取值可以通过L1/L2/L3信令通知UE;

[0214]　在LTE系统中,RACH的过载控制要求相对于以前的移动通信系统要宽松,这是因为在LTE中,随机接入占用单独的时频资源,不会对其它上行信道产干扰。一般情况下RACH的碰撞概率处在一个相对较低的水平,但也会因为在一个PRACH上接入的UE过多,导致UE发生前导碰撞而接入失败。

[0215]　为了降低这种情况发生的可能性,LTE中引入回退机制,控制UE进行前导重传的时间。

[0216]　eNodeB通过随机接入响应告知UE一个回退值,UE如果需要进行前导重传,则在0到这个回退值之间随机选择一个值作为退避时间,在退避时间结束后再进行前导重传。

[0217]　本发明的上述实施例中,在随机接入失败后,采用新的接入方式进行再次随机接入网络时,可以采用更换后的随机接入配置或者回退一段时间后,再次进行接入,从而提高终端随机接入网络时重传的成功率和实时性,保证特定业务的随机传输时延需求,以及整体随机接入的时延需求。

[0218]　第九实施例

[0219]　本发明的第九实施例还提供一种终端,包括:

[0220]　获取模块,用于获取终端在随机接入网络过程后,再次随机接入网络时,所采用的更换后的接入配置;

[0221]　接入模块,用于在随机接入网络过程中接入失败后,根据再次随机接入网络所采用的更换后的所述接入配置,进行再次随机接入网络。

[0222]　其中,所述接入模块在随机接入网络过程中,N次接入失败后,根据再次随机接入网络所采用的更换后的所述接入配置,进行再次随机接入网络;

[0223]　其中,1≤N≤M,N、M均为正整数,且M为整个随机接入过程中最大接入次数。

[0224]　其中,终端接入网络过程中的接入失败包括:终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

[0225]　其中,所述再次随机接入网络所采用的更换后的接入配置包括:随机接入资源配置或者随机接入过程中的回退参数。

[0226]　其中,所述再次随机接入网络所采用的更换后的接入配置包括:同一网络接入点下的其它随机接入资源配置时,所述获取模块包括:

[0227]　第一获取单元,用于获取网络接入点通过广播消息发送的终端在随机接入网络过

程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源;或者

[0228] 第二获取单元,用于获取网络接入点通过系统消息块携带的第一随机接入配置资源,根据所述第一随机接入配置资源进行随机接入网络过程失败后,获取再次随机接入网络所采用的第二随机接入配置资源;

[0229] 其中,第一随机接入配置资源与第二随机接入配置资源不同。

[0230] 其中,所述第二获取单元获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源。

[0231] 其中,所述接入模块具体用于:

[0232] 在随机接入网络过程中接入失败后,停止随机接入过程,根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程;或者

[0233] 在随机接入网络过程中接入失败后,将所述第一随机接入配置资源替换为第二随机接入配置资源,并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

[0234] 其中,所述接入模块还用于:再次随机接入网络成功后,丢弃所述第二随机接入配置资源,恢复第一随机接入配置资源的配置。

[0235] 其中,所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的频点时,所述获取模块具体用于:

[0236] 终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络,并在随机接入网络过程中接入失败后,获取再次随机接入网络所采用的第二频率;

[0237] 其中,所述第一频率为高频区域采用的频率范围内的频率,所述第二频率为低频区域采用的频率范围内的频率;或者

[0238] 所述第一频率为低频区域采用的频率范围内的频率,所述第二频率为高频区域采用的频率范围内的频率。

[0239] 其中,所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时,所述获取模块具体用于:

[0240] 终端驻留在一个单频点由多个网络接入点组成的网络中,并在所述网络中的第一小区进行随机接入网络过程,并接入失败后,触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区;其中,一个网络接入点是一个小区。

[0241] 其中,所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时,所述获取模块具体用于:

[0242] 终端驻留在一个单频点由多个网络接入点组成的网络中,且所述多个网络接入点中至少一个网络接入点形成一个小区,从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源。

[0243] 其中,所述接入模块具体用于:

[0244] 终端在其驻留的网络接入点,根据第一随机接入配置资源进行随机接入过程中接入失败后,根据所述第二随机接入配置资源,进行再次随机接入网络;

[0245] 或者

[0246] 终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，根据所述第一随机接入配置资源，进行再次随机接入网络。

[0247] 其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，所述获取模块具体用于：

[0248] 终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者

[0249] 终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数。

[0250] 其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时，所述获取模块具体用于：

[0251] 监听网络发送的负荷指示；

[0252] 在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数。

[0253] 其中，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入过程中的回退参数时，所述获取模块具体用于：

[0254] 获取网络通过系统消息块携带的第一随机接入配置资源；

[0255] 根据所述第一随机接入配置资源进行初次随机接入过程失败后，获取回退时间参数指示；

[0256] 根据回退时间参数指示，获得回退时间。

[0257] 其中，获取回退时间参数指示具体通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示，获取回退时间参数指示。

[0258] 其中，所述获取模块根据回退时间参数指示获得回退时间时，具体用于：

[0259] 根据回退时间参数指示与传输次数的对应关系，获得当前传输次数对应的回退时间；或者

[0260] 根据回退时间参数指示、传输次数以及叠加系数，得到回退时间；或者

[0261] 根据回退时间参数指示与不同时延需求属性的业务的对应关系，获得当前业务对应的回退时间。

[0262] 该终端的实施例是与上述方法对应的装置，上述方法实施例所有实现方式均适用于该装置的实施例中，也能达到相同的技术效果。

[0263] 第十实施例

[0264] 如图17所示，本发明的第十实施例提供一种终端，包括：

[0265] 收发机，用于获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；

[0266] 处理器，用于在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。

[0267] 该实施例中，处理器与存储器连接；存储器用于存储所述处理器在执行操作时所使用的程序和数据；获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置；当处理器调用并执行所述存储器中所存储的程序和数据时，在随机接入网

络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络。

[0268] 总线架构可以包括任意数量的互联的总线和桥，总线架构还可以将诸如外围设备、稳压器和功率管理电路等之类的各种其他电路链接在一起，这些都是本领域所公知的，因此，本文不再对其进行进一步描述。收发机可以是多个元件，即包括发送机和接收机，提供用于在传输介质上与各种其他装置通信的单元。处理器负责管理总线架构和通常的处理，存储器可以存储处理器在执行操作时所使用的数据。

[0269] 其中，所述处理器在随机接入网络过程中，N次接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络；

[0270] 其中，1≤N≤M，N、M均为正整数，且M为整个随机接入过程中最大接入次数。

[0271] 其中，终端接入网络过程中的接入失败包括：终端发送的随机接入序列发送失败或者随机接入网络过程中的冲突解决过程失败。

[0272] 其中，所述再次随机接入网络所采用的更换后的接入配置包括：随机接入资源配置或者随机接入过程中的回退参数。

[0273] 其中，所述再次随机接入网络所采用的更换后的接入配置包括：同一网络接入点下的其它随机接入资源配置时，所述收发机具体用于：获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源；其中，第一随机接入配置资源与第二随机接入配置资源不同。

[0274] 其中，所述收发机获取网络接入点通过MSG2消息或者L1/L2信令发送的第二随机接入配置资源。

[0275] 其中，所述处理器具体用于：在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程。

[0276] 其中，所述处理器还用于：再次随机接入网络成功后，丢弃所述第二随机接入配置资源，恢复第一随机接入配置资源的配置。

[0277] 其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的频点时，所述收发机具体用于：终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率；

[0278] 其中，所述第一频率为高频区域采用的频率范围内的频率，所述第二频率为低频区域采用的频率范围内的频率；或者所述第一频率为低频区域采用的频率范围内的频率，所述第二频率为高频区域采用的频率范围内的频率。

[0279] 其中，所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时，所述收发机具体用于：终端驻留在一个单频点由多个网络接

入点组成的网络中,并在所述网络中的第一小区进行随机接入网络过程,并接入失败后,触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区;其中,一个网络接入点是一个小区。

[0280] 其中,所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为更换后的网络接入点时,所述收发机具体用于:终端驻留在一个单频点由多个网络接入点组成的网络中,且所述多个网络接入点中至少一个网络接入点形成一个小区,从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源。

[0281] 其中,所述处理器具体用于:终端在其驻留的网络接入点,根据第一随机接入配置资源进行随机接入过程中接入失败后,根据所述第二随机接入配置资源,进行再次随机接入网络;或者终端在其驻留的小区,根据第二随机接入配置资源进行随机接入过程中接入失败后,根据所述第一随机接入配置资源,进行再次随机接入网络。

[0282] 其中,所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时,所述收发机具体用于:终端随机接入网络过程接入失败后,在预定时间长度内检测到的MSG1个数大于预设值时,获取再次随机接入网络所采用的回退时间参数;或者终端随机接入网络过程接入失败后,在预设信道上监听信号强度,并在所述信号强度高于预设信号强度值时,获取再次随机接入网络所采用的回退时间参数。

[0283] 其中,所述再次随机接入网络所采用的更换后的接入配置包括的随机接入资源配置为监听机制下的接入配置时,所述收发机具体用于:监听网络发送的负荷指示;在所述负荷指示表示网络负荷超过一预设负荷值时,获取再次随机接入网络所采用的回退时间参数。

[0284] 其中,所述再次随机接入网络所采用的更换后的接入配置包括:随机接入过程中的回退参数时,所述收发机具体用于:获取网络通过系统消息块携带的第一随机接入配置资源;根据所述第一随机接入配置资源进行初次随机接入过程失败后,获取回退时间参数指示;根据回退时间参数指示,获得回退时间。

[0285] 其中,获取回退时间参数指示具体通过MSG2消息或者通过系统消息块或者通过监听到的空口消息或者通过初次传输的回退时间参数指示,获取回退时间参数指示。

[0286] 其中,所述收发机根据回退时间参数指示获得回退时间时,具体用于:根据回退时间参数指示与传输次数的对应关系,获得当前传输次数对应的回退时间;或者

[0287] 根据回退时间参数指示、传输次数以及叠加系数,得到回退时间;或者根据回退时间参数指示与不同时延需求属性的业务的对应关系,获得当前业务对应的回退时间。

[0288] 本发明的上述实施例,在随机接入失败后,采用新的接入方式进行再次随机接入网络时,可以采用更换后的随机接入配置或者回退一段时间后,再次进行接入,从而提高终端随机接入网络时重传的成功率和实时性,保证特定业务的随机传输时延需求,以及整体随机接入的时延需求。

[0289] 以上所述是本发明的优选实施方式,应当指出,对于本技术领域的普通技术人员来说,在不脱离本发明所述原理的前提下,还可以作出若干改进和润饰,这些改进和润饰也应视为本发明的保护范围。

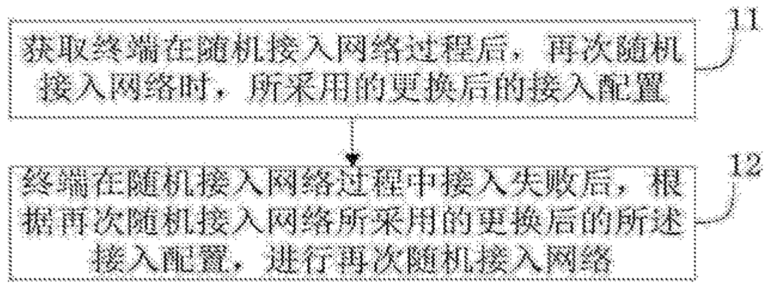

获取终端在随机接入网络过程后，再次随机接入网络时，所采用的更换后的接入配置
11
终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的所述接入配置，进行再次随机接入网络
12

图1

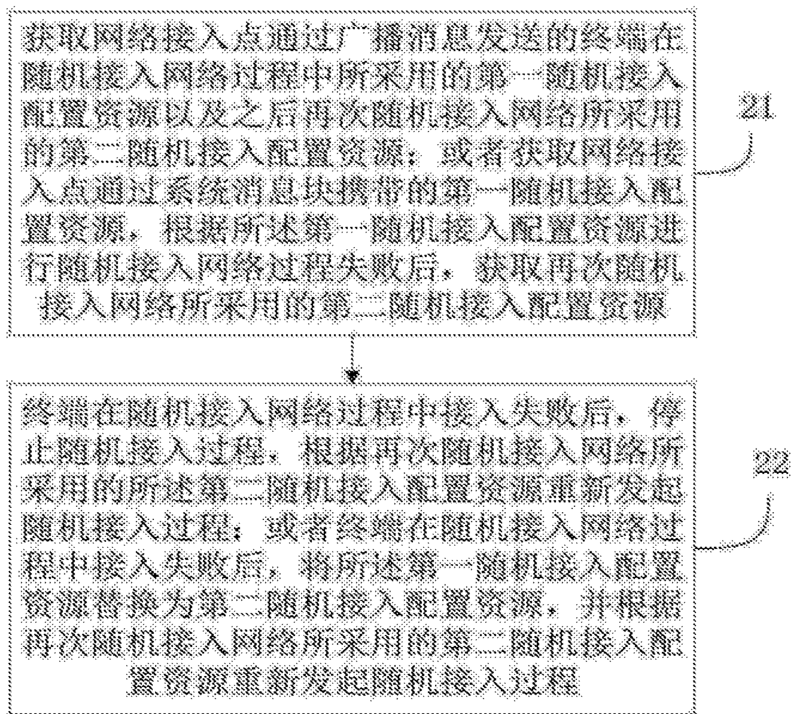

获取网络接入点通过广播消息发送的终端在随机接入网络过程中所采用的第一随机接入配置资源以及之后再次随机接入网络所采用的第二随机接入配置资源；或者获取网络接入点通过系统消息块携带的第一随机接入配置资源，根据所述第一随机接入配置资源进行随机接入网络过程失败后，获取再次随机接入网络所采用的第二随机接入配置资源
21
终端在随机接入网络过程中接入失败后，停止随机接入过程，根据再次随机接入网络所采用的所述第二随机接入配置资源重新发起随机接入过程；或者终端在随机接入网络过程中接入失败后，将所述第一随机接入配置资源替换为第二随机接入配置资源，并根据再次随机接入网络所采用的第二随机接入配置资源重新发起随机接入过程
22

图2

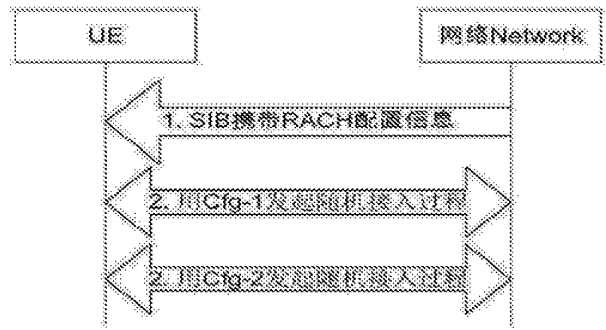

UE
网络Network
1. SIB携带RACH配置信息
2. 用Cfg-1发起随机接入过程
2. 用Cfg-2发起随机接入过程

图3

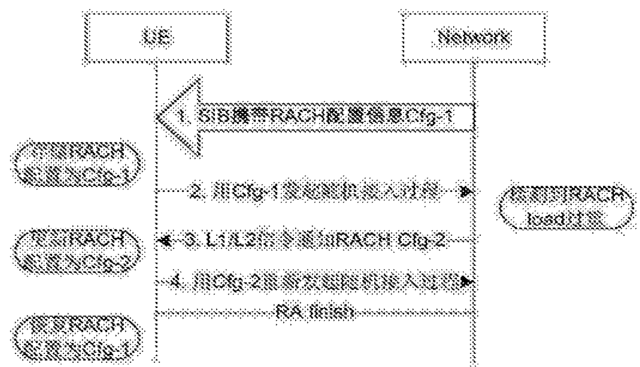

UE
Network
RA finish

图4

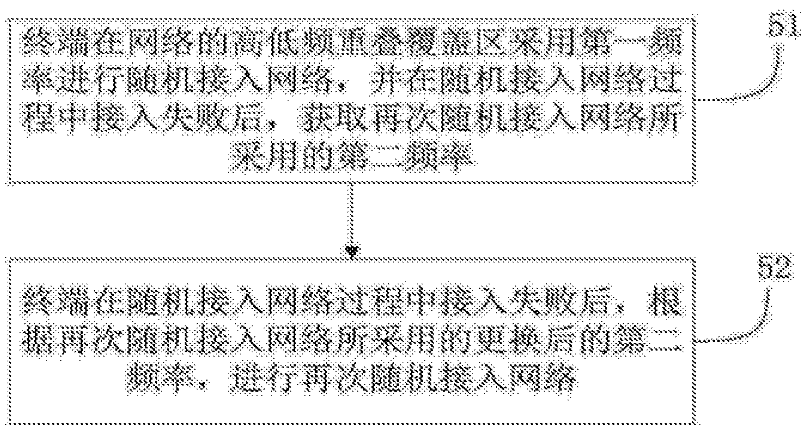

终端在网络的高低频重叠覆盖区采用第一频率进行随机接入网络，并在随机接入网络过程中接入失败后，获取再次随机接入网络所采用的第二频率
51
终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的第二频率，进行再次随机接入网络
52

图5

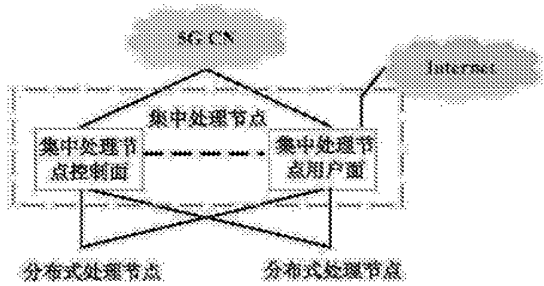

5G CN
Internet
集中处理节点
集中处理节点控制面
集中处理节点用户面
分布式处理节点
分布式处理节点

图6

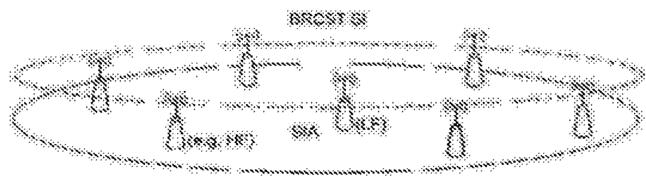

BRCST SI

图7

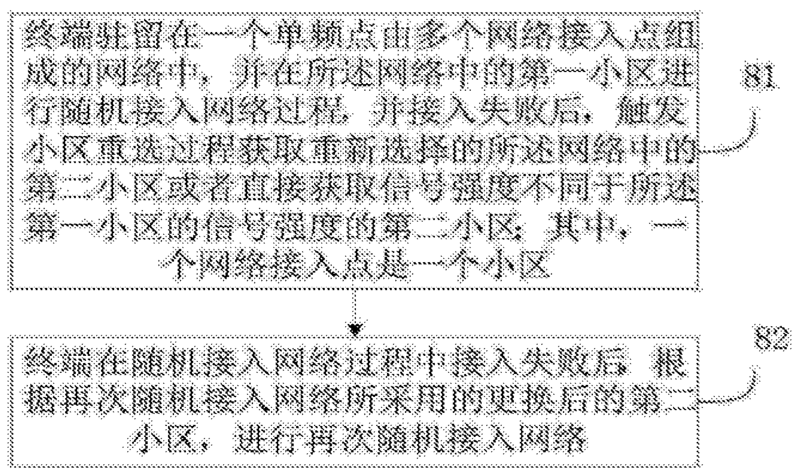

终端驻留在一个单频点由多个网络接入点组成的网络中，并在所述网络中的第一小区进行随机接入网络过程，并接入失败后，触发小区重选过程获取重新选择的所述网络中的第二小区或者直接获取信号强度不同于所述第一小区的信号强度的第二小区；其中，一个网络接入点是一个小区
81
终端在随机接入网络过程中接入失败后，根据再次随机接入网络所采用的更换后的第二小区，进行再次随机接入网络
82

图8

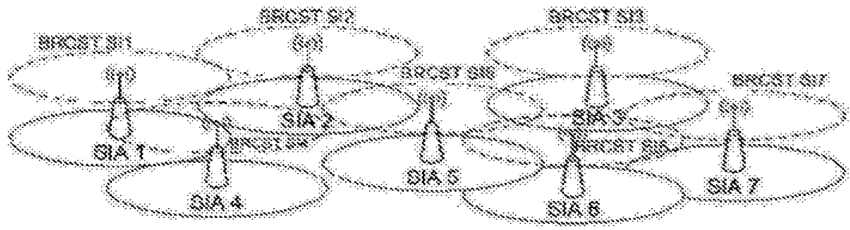

BRCST SI1
BRCST SI2
BRCST SI3
BRCST SI5
BRCST SI7
BRCST SI4
BRCST SI6
SIA 1
SIA 2
SIA 3
SIA 4
SIA 5
SIA 6
SIA 7

图9

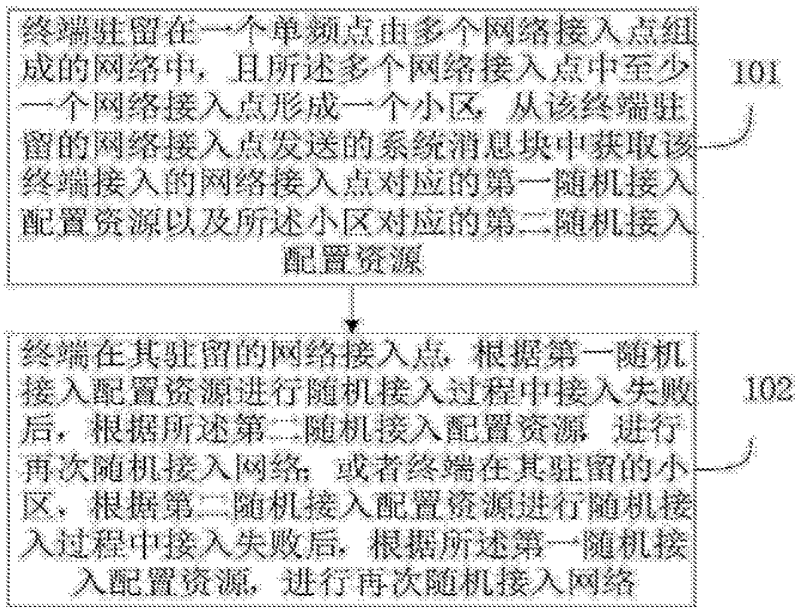

终端驻留在一个单频点由多个网络接入点组成的网络中，且所述多个网络接入点中至少一个网络接入点形成一个小区，从该终端驻留的网络接入点发送的系统消息块中获取该终端接入的网络接入点对应的第一随机接入配置资源以及所述小区对应的第二随机接入配置资源
101
终端在其驻留的网络接入点，根据第一随机接入配置资源进行随机接入过程中接入失败后，根据所述第二随机接入配置资源，进行再次随机接入网络；或者终端在其驻留的小区，根据第二随机接入配置资源进行随机接入过程中接入失败后，根据所述第一随机接入配置资源，进行再次随机接入网络
102

图10

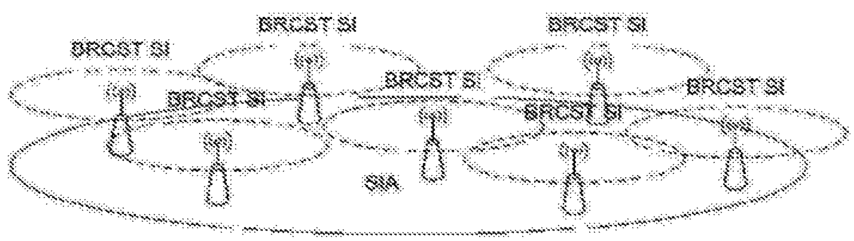

BRCST SI
BRCST SI
BRCST SI
BRCST SI
BRCST SI
BRCST SI
BRCST SI
SIA

图11

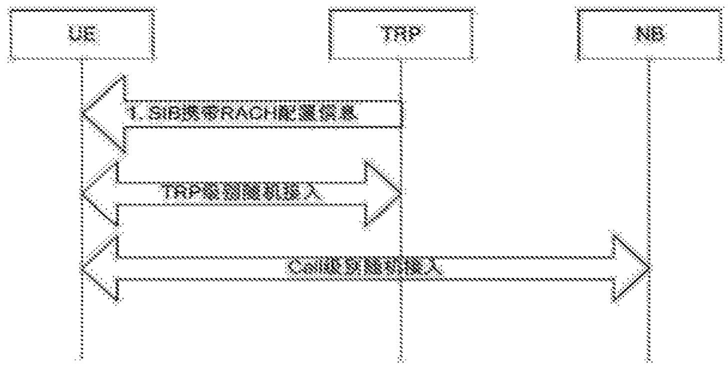

UE
TRP
NB
1. SIB携带RACH配置信息

图12

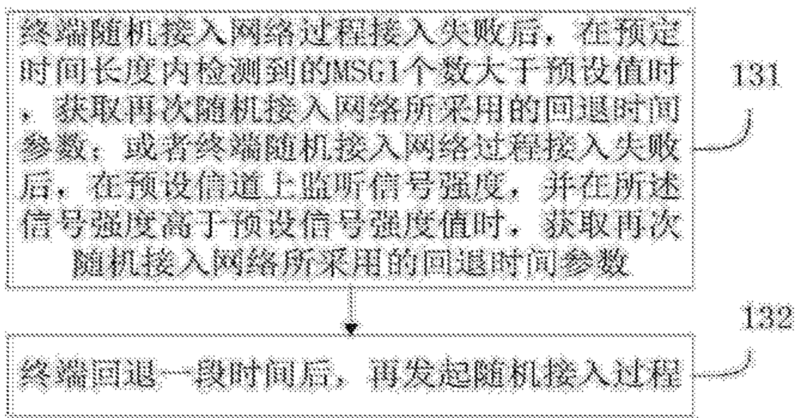

终端随机接入网络过程接入失败后，在预定时间长度内检测到的MSG1个数大于预设值时，获取再次随机接入网络所采用的回退时间参数；或者终端随机接入网络过程接入失败后，在预设信道上监听信号强度，并在所述信号强度高于预设信号强度值时，获取再次随机接入网络所采用的回退时间参数
131
终端回退一段时间后，再发起随机接入过程
132

图13

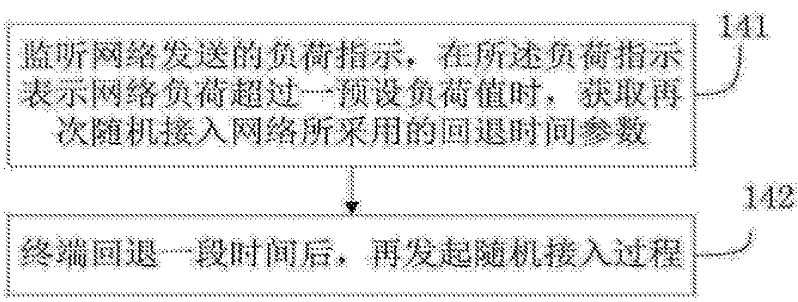

监听网络发送的负荷指示，在所述负荷指示表示网络负荷超过一预设负荷值时，获取再次随机接入网络所采用的回退时间参数
141
终端回退一段时间后，再发起随机接入过程
142

图14

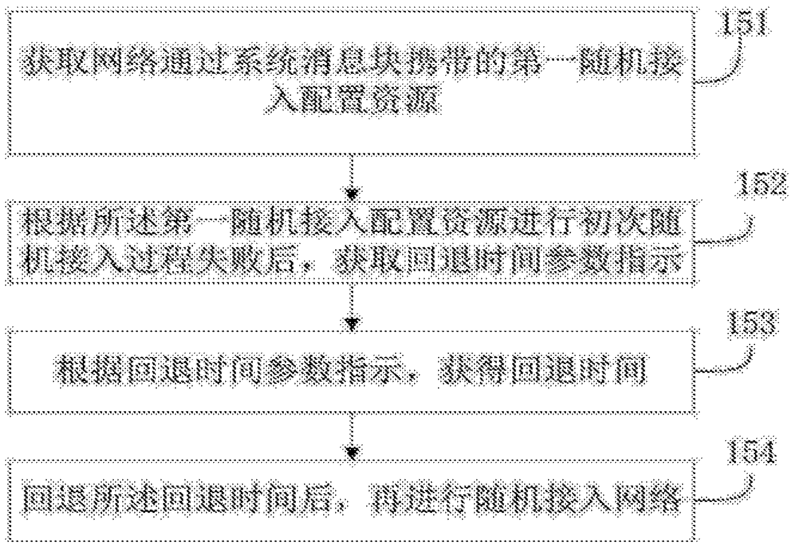

获取网络通过系统消息块携带的第一随机接入配置资源
151
根据所述第一随机接入配置资源进行初次随机接入过程失败后，获取回退时间参数指示
152
根据回退时间参数指示，获得回退时间
153
回退所述回退时间后，再进行随机接入网络
154

图15

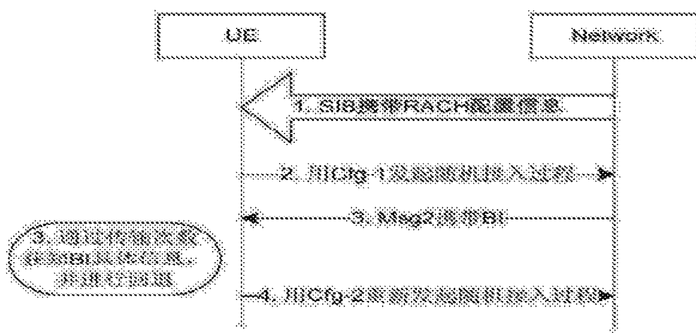

UE
Network
1. SIB携带RACH配置信息
2. 用Cfg-1发起随机接入过程
3. Msg2携带BI
4. 用Cfg-2重新发起随机接入过程

图16


处理器
存储器
总线架构
收发机

图17

English Translation of Abstract of China Patent Application No. CN107809753A

The invention provides a control method and device for connecting an eMTC terminal to a base station. The method comprises the steps of: when the base station of an eMTC system is prepared to be accessed randomly, randomly generating the first connection time; and, after the first connection time is delayed, sending a random access request to the base station of the eMTC system. By means of the method, the signalling storm due to the fact that a large number of eMTC terminals simultaneously initiate random access requests can be avoided; therefore, the eMTC network congestion probability is reduced; the success rate of randomly accessing the eMTC terminal to the base station is effectively increased; and the control method and device provided by the invention have relatively low complexity, and have better optimization and improvement effects on congestion control of the eMTC system.

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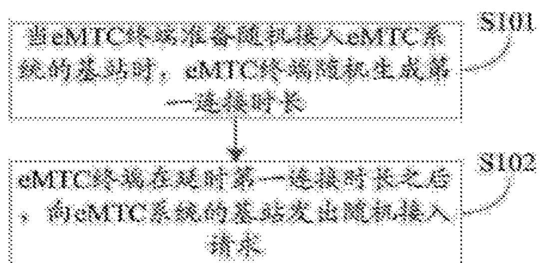
权利要求书2页 说明书8页 附图5页

(54)发明名称

一种eMTC终端连接基站的控制方法及装置

(57)摘要

本发明提出了一种eMTC终端连接基站的控制方法及装置，该方法包括：当准备随机接入所述eMTC系统的基站时，随机生成第一连接时长；延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。该方法能够避免大量eMTC终端同时发起随机接入请求导致的信令风暴，从而降低eMTC网络拥塞的概率，有效提高eMTC终端随机接入基站的成功率；本发明具有较低的复杂度，能够对eMTC系统的拥塞控制起到较好的优化和改进效果。



CN 107809753 A

1.一种增强型机器类通信eMTC终端连接基站的控制方法，应用于eMTC系统中的任一eMTC终端，其特征在于，所述方法，包括：

当准备随机接入所述eMTC系统的基站时，随机生成第一连接时长；

延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。

2.根据权利要求1所述的eMTC终端连接基站的控制方法，其特征在于，所述当准备随机接入所述eMTC系统的基站时，具体包括：

当准备主动向所述eMTC系统的基站发出随机接入时；

或者，当接收到所述eMTC系统的基站发送的寻呼信息时。

3.根据权利要求1所述的eMTC终端连接基站的控制方法，其特征在于，所述方法，还包括：

在准备随机接入所述eMTC系统的基站之前，先根据所述eMTC终端的类型，设置最长连接时长；所述第一连接时长小于所述最长连接时长。

4.根据权利要求3所述的eMTC终端连接基站的控制方法，其特征在于，所述方法，还包括：

当向eMTC系统的基站发出的随机接入请求失败之后，

若接收到的所述基站的反馈信息包括避让指示，则延时预置的时间之后，随机生成第二连接时长，并延时第二连接时长之后，重复发起向eMTC系统的基站的随机接入请求；

若接收到的所述基站的反馈信息不包括避让指示，则随机生成第三连接时长，并延时第三连接时长之后，重复发起向eMTC系统的基站的随机接入请求；

所述第二连接时长小于最长连接时长；所述第三连接时长小于最长连接时长。

5.根据权利要求4所述的eMTC终端连接基站的控制方法，其特征在于，所述重复发起向eMTC系统的基站的随机接入请求，具体包括：

通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

6.一种增强型机器类通信eMTC终端连接基站的控制装置，设置于eMTC系统中的任一eMTC终端，其特征在于，所述装置，包括：

延时模块，用于当准备随机接入所述eMTC系统的基站时，随机生成第一连接时长；

连接请求模块，用于延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。

7.根据权利要求6所述的eMTC终端连接基站的控制装置，其特征在于，所述当准备随机接入所述eMTC系统的基站时，具体包括：

当准备主动向所述eMTC系统的基站发出随机接入时；

或者，当接收到所述eMTC系统的基站发送的寻呼信息时。

8.根据权利要求6所述的eMTC终端连接基站的控制装置，其特征在于，所述装置，还包括：

设置模块，用于根据所述eMTC终端的类型，设置最长连接时长，并将所述最长连接时长发送至所述延时模块；所述第一连接时长小于所述最长连接时长。

9.根据权利要求8所述的eMTC终端连接基站的控制装置，其特征在于，所述装置，还包括：

再次连接请求模块，用于当所述连接请求模块发送的随机接入请求失败之后，

若接收到的所述基站的反馈信息包括避让指示，则延时预置的时间之后，随机生成第

二连接时长，并延时第二连接时长之后，重复发起向eMTC系统的基站的随机接入请求；

若接收到的所述基站的反馈信息不包括避让指示，则随机生成第三连接时长，并延时第三连接时长之后，重复发起向eMTC系统的基站的随机接入请求；

所述第二连接时长小于最长连接时长；所述第三连接时长小于最长连接时长。

10.根据权利要求9所述的eMTC终端连接基站的控制方法，其特征在于，所述重复发起向eMTC系统的基站的随机接入请求，具体包括：

通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

一种eMTC终端连接基站的控制方法及装置

技术领域

[0001] 本发明涉及物联网技术领域，尤其涉及一种eMTC终端连接基站的控制方法及装置。

背景技术

[0002] eMTC(enhanced Machine-Type Communications，增强型机器类通信)技术是Rel-13MTC增强(eMTC)，WI(Work Item，工作项)主要包含三部分的目标：低复杂度(UE，Low Cost User Equipment)，覆盖增强(Enhanced Coverage)和节电(Power Saving)。3GPP TS 22.368(The 3rd Generation Partnership Project TECHNICAL SPECIFICATION 22.368，第三代伙伴关系计划技术规范22.368)根据MTC(Machine-Type Communications，机器类通信)技术在移动性、业务量特征等方面的不同，定义了低移动性、时延容忍度、优先告警、低功耗、小数据包业务等14种特征。具有典型场景有：智能交通、智能电网、智慧社区、智能环保等。

[0003] 基于eMTC技术的应用场景，eMTC终端在某一小区的数量会特别巨大，甚至达到海量连接。因此eMTC系统需要能够支持短时间突发海量用户的小数据包业务特点。当eMTC终端从关闭状态恢复到打开状态时、当eMTC终端从一个基站切换到另一个基站时或当eMTC终端丢失上行定时同步信息时，都会首先进行随机接入过程，它的作用是实现eMTC终端和eMTC系统网络侧的同步，解决接入冲突以及获得基站分配的上行通信资源。eMTC终端只有通过随机接入过程，与基站建立上行同步后，才能被基站调度来进行上行资源的传输。

[0004] 目前根据3GPP的标准来看，并没有对eMTC终端和Legacy LTE(Long Term Evolution)终端在PRACH(Physical Random Access Channel，物理随机接入信道)的资源划分上有明确的规定，是否采用资源复用(RO，Resource Overlap)与基站侧的实现方式有关，但是无论何种方式，海量的eMTC终端在有限的PRACH的资源在发起接入时，都有可能发生信令拥塞，主要区别在于：

[0005] 若对eMTC系统划分专用PRACH资源，那么一旦eMTC系统独享的PRACH资源发生拥塞，则会导致网络服务对eMTC终端不可用，无法接入，大大降低服务质量；

[0006] 若eMTC系统采用与legacy系统共享PRACH资源，那么eMTC终端海量连接发起随机接入时导致的“信令风暴”很有可能会引发WB-EUTRAN用户无法正常接入；

[0007] 由此可见，由于eMTC终端的随机接入信道资源受限，且eMTC系统业务特点是海量连接，即在任一时刻均有可能存在多个，甚至是大量eMTC终端通过随机接入信道向基站发起随机接入过程，由此引发的冲突问题不可避免。在它们同时向所在基站请求RRC(Radio Resource Control，无线资源控制)连接建立时，极有可能会导致随机接入信道拥塞，引起严重的访问碰撞和时延问题，甚至导致网络服务不可用，从而大大降低网络服务质量。因此，eMTC系统中有效的拥塞控制策略，对于整个网络服务质量显得尤为重要。

发明内容

[0008] 本发明要解决的技术问题是，提供一种eMTC终端连接基站的控制方法及装置，克服现有技术中大量eMTC终端同时通过随机接入信道向基站发起随机接入过程中，导致的随机接入信道拥塞缺陷。
[0009] 本发明采用的技术方案是，所述一种增强型机器类通信eMTC终端连接基站的控制方法，应用于eMTC系统中的任一eMTC终端，所述方法，包括：
[0010] 当准备随机接入所述eMTC系统的基站时，随机生成第一连接时长；
[0011] 延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。
[0012] 进一步地，所述当准备随机接入所述eMTC系统的基站时，具体包括：
[0013] 当准备主动向所述eMTC系统的基站发出随机接入时；
[0014] 或者，当接收到所述eMTC系统的基站发送的寻呼信息时。
[0015] 进一步地，所述方法，还包括：
[0016] 在准备随机接入所述eMTC系统的基站之前，先根据所述eMTC终端的类型，设置最长连接时长；所述第一连接时长小于所述最长连接时长。
[0017] 进一步地，所述方法，还包括：
[0018] 当向eMTC系统的基站发出的随机接入请求失败之后，
[0019] 若接收到的所述基站的反馈信息包括避让指示，则延时预置的时间之后，随机生成第二连接时长，并延时第二连接时长之后，重复发起向eMTC系统的基站的随机接入请求；
[0020] 若接收到的所述基站的反馈信息不包括避让指示，则随机生成第三连接时长，并延时第三连接时长之后，重复发起向eMTC系统的基站的随机接入请求；
[0021] 所述第二连接时长小于最长连接时长；所述第三连接时长小于最长连接时长。
[0022] 进一步地，所述重复发起向eMTC系统的基站的随机接入请求，具体包括：
[0023] 通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。
[0024] 本发明还提供一种增强型机器类通信eMTC终端连接基站的控制装置，设置于eMTC系统中的任一eMTC终端，所述装置，包括：
[0025] 延时模块，用于当准备随机接入所述eMTC系统的基站时，随机生成第一连接时长；
[0026] 连接请求模块，用于延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。
[0027] 进一步地，所述当准备随机接入所述eMTC系统的基站时，具体包括：
[0028] 当准备主动向所述eMTC系统的基站发出随机接入时；
[0029] 或者，当接收到所述eMTC系统的基站发送的寻呼信息时。
[0030] 进一步地，所述装置，还包括：
[0031] 设置模块，用于根据所述eMTC终端的类型，设置最长连接时长，并将所述最长连接时长发送至所述延时模块；所述第一连接时长小于所述最长连接时长。
[0032] 进一步地，所述装置，还包括：
[0033] 再次连接请求模块，用于当所述连接请求模块发送的随机接入请求失败之后，
[0034] 若接收到的所述基站的反馈信息包括避让指示，则延时预置的时间之后，随机生成第二连接时长，并延时第二连接时长之后，重复发起向eMTC系统的基站的随机接入请求；
[0035] 若接收到的所述基站的反馈信息不包括避让指示，则随机生成第三连接时长，并延时第三连接时长之后，重复发起向eMTC系统的基站的随机接入请求；

[0036] 所述第二连接时长小于最长连接时长;所述第三连接时长小于最长连接时长。

[0037] 进一步地,所述重复发起向eMTC系统的基站的随机接入请求,具体包括:

[0038] 通过功率攀升的方式,重复发起向eMTC系统的基站的随机接入请求。

[0039] 采用上述技术方案,本发明至少具有下列优点:

[0040] 本发明所述eMTC终端连接基站的控制方法及装置,能够避免大量eMTC终端同时发起随机接入请求导致的信令风暴,从而降低eMTC网络拥塞的概率,有效提高eMTC终端随机接入基站的成功率;对于与Legacy LTE系统共享PRACH资源的eMTC系统来说,有效降低由于大量eMTC终端发起随机接入请求导致PRACH信道发生拥塞的概率,进而提高正常的WB-EUTRAN(WideBand-Evolved Universal Terrestrial Radio Access Network)用户的正常接入概率;本发明具有相对较低的复杂度,能够对eMTC系统的拥塞控制起到较好的优化和改进效果。

附图说明

[0041] 图1为本发明第一实施例的eMTC终端连接基站的控制方法流程图;

[0042] 图2为本发明第二实施例的eMTC终端连接基站的控制方法流程图;

[0043] 图3为本发明第三实施例的eMTC终端连接基站的控制方法流程图;

[0044] 图4为本发明第四实施例的eMTC终端连接基站的控制装置组成结构示意图;

[0045] 图5为本发明第五实施例的eMTC终端连接基站的控制装置组成结构示意图;

[0046] 图6为本发明第六实施例的eMTC终端连接基站的控制装置组成结构示意图;

[0047] 图7为本发明第七实施例的eMTC终端连接基站的控制方法流程图;

[0048] 图8为本发明第八实施例的eMTC终端连接基站的控制方法流程图。

具体实施方式

[0049] 为更进一步阐述本发明为达成预定目的所采取的技术手段及功效,以下结合附图及较佳实施例,对本发明进行详细说明如后。

[0050] 本发明第一实施例,一种eMTC终端连接基站的控制方法,如图1所示,包括以下具体步骤:

[0051] 步骤S101,当eMTC终端准备随机接入eMTC系统的基站时,eMTC终端随机生成第一连接时长。

[0052] 具体的,步骤S101,包括:

[0053] 当eMTC终端处于IDLE(空闲)状态,并准备主动向eMTC系统的基站发出随机接入时,eMTC终端随机生成第一连接时长;

[0054] 或者,当eMTC终端处于IDLE(空闲)状态,并接收到所述eMTC系统的基站发送的寻呼信息时,eMTC终端随机生成第一连接时长。

[0055] 例如:当eMTC终端处于IDLE(空闲)状态,并准备主动向eMTC系统的基站发出随机接入时,eMTC终端随机生成第一连接时长t_{10}=10.2ms。

[0056] 或者,当eMTC终端处于IDLE(空闲)状态,并接收到所述eMTC系统的基站发送的寻呼信息时,eMTC终端随机生成第一连接时长t_{10}=10.2ms。

[0057] 步骤S102,eMTC终端在延时第一连接时长之后,向eMTC系统的基站发出随机接入

请求。
[0058] 例如，eMTC终端在延时第一连接时长t_{10}＝10.2ms之后，向eMTC系统的基站发出随机接入请求。
[0059] 本发明第二实施例，一种eMTC终端连接基站的控制方法，如图2所示，本实施例的所述方法，包括以下具体步骤：
[0060] 步骤S201，根据eMTC终端的类型，设置最长连接时长。
[0061] 例如，根据eMTC终端的类型，设置最长连接时长t_x＝20ms。
[0062] 由于不同类型的eMTC终端承载的业务对随机接入时延有不同要求，因此根据eMTC终端的类型不同，对不同类型的eMTC终端设置不同的最长连接时长。
[0063] 步骤S202，当eMTC终端准备随机接入eMTC系统的基站时，eMTC终端随机生成第一连接时长。其中，第一连接时长小于最长连接时长。
[0064] 具体的，步骤S202，包括：
[0065] 当eMTC终端处于IDLE(空闲)状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成第一连接时长；
[0066] 或者，当eMTC终端处于IDLE(空闲)状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成第一连接时长。其中，第一连接时长小于最长连接时长。
[0067] 例如：当eMTC终端处于IDLE(空闲)状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。
[0068] 或者，当eMTC终端处于IDLE(空闲)状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。
[0069] 步骤S203，eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。
[0070] 例如，eMTC终端在延时第一连接时长t_{10}＝10.2ms之后，向eMTC系统的基站发出随机接入请求。
[0071] 本发明第三实施例，一种eMTC终端连接基站的控制方法，如图3所示，本实施例的所述方法，包括以下具体步骤：
[0072] 步骤S301，根据eMTC终端的类型，设置最长连接时长。
[0073] 例如：根据eMTC终端的类型，设置最长连接时长t_x＝20ms。
[0074] 由于不同类型的eMTC终端承载的业务对随机接入时延有不同要求，因此根据eMTC终端的类型不同，对不同类型的eMTC终端设置不同的最长连接时长。
[0075] 步骤S302，当eMTC终端准备随机接入eMTC系统的基站时，eMTC终端随机生成小于最长连接时长的第一连接时长。
[0076] 具体的，步骤S302，包括：
[0077] 当eMTC终端处于IDLE(空闲)状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长的第一连接时长；
[0078] 或者，当eMTC终端处于IDLE(空闲)状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成小于最长连接时长的第一连接时长。
[0079] 例如：当eMTC终端处于IDLE(空闲)状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。

[0080]　或者，当eMTC终端处于IDLE(空闲)状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。

[0081]　步骤S303，eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。

[0082]　例如，eMTC终端在延时第一连接时长t_{10}＝10.2ms之后，向eMTC系统的基站发出随机接入请求。

[0083]　步骤S304，当eMTC终端向eMTC系统的基站发出的随机接入请求失败之后，eMTC终端重复发起向eMTC系统的基站的随机接入请求。

[0084]　具体的，步骤S304，包括：

[0085]　若eMTC终端接收到的基站的反馈信息判定为包括避让指示，则延时预置的时间之后，随机生成小于最长连接时长的第二连接时长，并延时第二连接时长之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求；

[0086]　例如：若eMTC终端接收到的基站的反馈信息判定为包括避让指示，则延时t_d＝30ms之后，随机生成小于最长连接时长t_x＝20ms的第二连接时长t_{20}＝13.5ms，并延时第二连接时长t_{20}＝13.5ms之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

[0087]　若eMTC终端接收到的所述基站的反馈信息判定为不包括避让指示，则随机生成小于最长连接时长的第三连接时长，并延时第三连接时长之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

[0088]　例如：若eMTC终端接收到的基站的反馈信息判定为不包括避让指示，则随机生成小于最长连接时长t_x＝20ms的第三连接时长t_{30}＝13.9ms，并延时第三连接时长t_{30}＝13.9ms之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

[0089]　直至eMTC终端随机接入eMTC系统的基站。

[0090]　本发明第四实施例，与第一实施例对应，本实施例介绍一种eMTC终端连接基站的控制装置，如图4所示，包括以下组成部分：

[0091]　1)延时模块200，用于当eMTC终端准备随机接入eMTC系统的基站时，随机生成第一连接时长。

[0092]　具体的，延时模块200，用于：

[0093]　当eMTC终端处于IDLE(空闲)状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成第一连接时长；

[0094]　或者，当eMTC终端处于IDLE(空闲)状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成第一连接时长。

[0095]　例如：延时模块200，用于当eMTC终端处于IDLE(空闲)状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成第一连接时长t_{10}＝10.2ms。

[0096]　或者，当eMTC终端处于IDLE(空闲)状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成第一连接时长t_{10}＝10.2ms。

[0097]　2)连接请求模块300，用于eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。

[0098]　例如，连接请求模块300，用于eMTC终端在延时第一连接时长t_{10}＝10.2ms之后，向

eMTC系统的基站发出随机接入请求。

[0099] 本发明第五实施例，与第二实施例对应，本实施例介绍一种eMTC终端连接基站的控制装置，如图5所示，包括以下组成部分：

[0100] 1）设置模块100，用于根据eMTC终端的类型，设置最长连接时长。

[0101] 例如，设置模块100，用于根据eMTC终端的类型，设置最长连接时长t_x＝20ms。

[0102] 由于不同类型的eMTC终端承载的业务对随机接入时延有不同要求，因此根据eMTC终端的类型不同，对不同类型的eMTC终端设置不同的最长连接时长。

[0103] 2）延时模块200，用于当eMTC终端准备随机接入eMTC系统的基站时，随机生成小于最长连接时长的第一连接时长。

[0104] 具体的，延时模块200，用于当eMTC终端处于IDLE（空闲）状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长的第一连接时长；

[0105] 或者，当eMTC终端处于IDLE（空闲）状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成小于最长连接时长的第一连接时长。

[0106] 例如：延时模块200，用于当eMTC终端处于IDLE（空闲）状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。

[0107] 或者，当eMTC终端处于IDLE（空闲）状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。

[0108] 3）连接请求模块300，用于eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。

[0109] 例如，连接请求模块300，用于eMTC终端在延时第一连接时长t10＝10.2ms之后，向eMTC系统的基站发出随机接入请求。

[0110] 本发明第六实施例，与第三实施例对应，本实施例介绍一种eMTC终端连接基站的控制装置，如图6所示，包括以下组成部分：

[0111] 1）设置模块100，用于根据eMTC终端的类型，设置最长连接时长。

[0112] 例如，设置模块100，用于根据eMTC终端的类型，设置最长连接时长t_x＝20ms。

[0113] 由于不同类型的eMTC终端承载的业务对随机接入时延有不同要求，因此根据eMTC终端的类型不同，对不同类型的eMTC终端设置不同的最长连接时长。

[0114] 2）延时模块200，用于当eMTC终端准备随机接入eMTC系统的基站时，随机生成小于最长连接时长的第一连接时长。

[0115] 具体的，延时模块200，用于：

[0116] 当eMTC终端处于IDLE（空闲）状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长的第一连接时长；

[0117] 或者，当eMTC终端处于IDLE（空闲）状态，并接收到所述eMTC系统的基站发送的寻呼信息时，eMTC终端随机生成小于最长连接时长的第一连接时长。

[0118] 例如：延时模块200，用于当eMTC终端处于IDLE（空闲）状态，并准备主动向eMTC系统的基站发出随机接入时，eMTC终端随机生成小于最长连接时长t_x＝20ms的第一连接时长t_{10}＝10.2ms。

[0119] 或者，当eMTC终端处于IDLE（空闲）状态，并接收到所述eMTC系统的基站发送的寻

呼信息时，eMTC终端随机生成小于最长连接时长t_x=20ms的第一连接时长t_{10}=10.2ms。

[0120] 3)连接请求模块300，用于eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求。

[0121] 例如，连接请求模块300，用于eMTC终端在延时第一连接时长t_{10}=10.2ms之后，向eMTC系统的基站发出随机接入请求。

[0122] 4)再次连接请求模块400，用于当向eMTC系统的基站发出的随机接入请求失败之后，eMTC终端重复发起向eMTC系统的基站的随机接入请求。

[0123] 具体的，再次连接请求模块400，用于：

[0124] 若eMTC终端接收到的基站的反馈信息判定为包括避让指示，则延时预置的时间之后，随机生成小于最长连接时长的第二连接时长，并延时第二连接时长之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求；

[0125] 例如：若eMTC终端接收到的基站的反馈信息判定为包括避让指示，则延时t_d=30ms之后，随机生成小于最长连接时长t_x=20ms的第二连接时长t_{20}=13.5ms，并延时第二连接时长t_{20}=13.5ms之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

[0126] 若eMTC终端接收到的所述基站的反馈信息判定为不包括避让指示，则随机生成小于最长连接时长的第三连接时长，并延时第三连接时长之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

[0127] 例如：若eMTC终端接收到的基站的反馈信息判定为不包括避让指示，则随机生成小于最长连接时长t_x=20ms的第三连接时长t_{30}=13.9ms，并延时第三连接时长t_{30}=13.9ms之后，通过功率攀升的方式，重复发起向eMTC系统的基站的随机接入请求。

[0128] 直至eMTC终端随机接入eMTC系统的基站。

[0129] 本发明第七实施例，本实施例是在上述实施例的基础上，以eMTC终端连接基站的控制方法为例，结合附图7介绍一个本发明的应用实例。

[0130] 步骤S801，在eMTC终端内设置定时器，设置定时器的最长时长T，例如T=100ms。

[0131] 步骤S802，当eMTC终端处于IDLE(空闲)状态时，并且eMTC终端有主叫业务或者接收到来自基站的寻呼消息时，eMTC终端根据均匀分布函数在[0,T]内随机生成一个时间种子t_1，例如：t_1=12.1ms，并向上取整得到t_1=13ms。

[0132] 步骤S803，当eMTC终端获得时间种子t_1后，启动定时器开始计时，定时器进入激活状态。

[0133] 步骤S804，eMTC终端在定时器启动后，定时器延迟时间种子t_1时长，例如：定时器延迟13ms时长，向基站发起随机接入请求；同时定时器归零，并进入非激活态。

[0134] 步骤S805，对eMTC终端是否接入基站进行判断，若eMTC终端向基站发起的随机接入失败，执行步骤S806。

[0135] 步骤S806，若eMTC终端向基站发起的随机接入失败，则eMTC终端会再次采用均匀分布的函数在[0,T]内生成随机时间种子t_2，例如t_2=7.8ms，并向上取整得到t_2=8ms；eMTC终端获得随机时间种子t_2后，再次启动定时器开始计时，定时器进入激活状态。eMTC终端在定时器启动后，定时器延迟8ms时长，通过功率攀升的方式向基站发起随机接入请求；同时定时器归零，并进入非激活态。

[0136] 步骤S807，对eMTC终端是否接入基站进行判断，若eMTC终端向基站发起的随机接入失败，执行步骤S806。

[0137] 步骤S808，eMTC终端接入基站。

[0138] 本发明第八实施例，本实施例是在上述实施例的基础上，以eMTC终端连接基站的控制方法为例，结合附图8介绍一个本发明的应用实例。

[0139] 步骤S901，在eMTC终端内设置定时器，设置定时器的最长时长T，例如T＝100ms。

[0140] 步骤S902，当eMTC终端处于IDLE(空闲)状态时，并且eMTC终端有主叫业务或者接收到来自基站的寻呼消息时，eMTC终端根据均匀分布函数在[0,T]内随机生成一个时间种子t_3，例如：t_3＝13.1ms，并向上取整得到t_3＝14ms。

[0141] 步骤S903，当eMTC终端获得时间种子t_3后，启动定时器开始计时，定时器进入激活状态。

[0142] 步骤S904，eMTC终端在定时器启动后，定时器延迟14ms时长，向基站发起随机接入请求；同时定时器归零，并进入非激活态。

[0143] 步骤S905，对eMTC终端是否接入基站进行判断，若eMTC终端向基站发起的随机接入失败，执行步骤S906。

[0144] 步骤S906，对接收到基站反馈的RAR(Random Access Response，随机接入相应)消息中是否包含BI(Backoff Indicator，退避指示)进行判断。

[0145] 若接收到基站反馈的RAR消息中判定为包含BI，则执行步骤S907；

[0146] 若接收到基站反馈的RAR消息中判定为不包含BI，则执行步骤S908。

[0147] 步骤S907，eMTC终端发生前导碰撞而随机接入失败，eMTC终端主动进行避让，等待一段时长，例如等待20ms后，执行步骤S908。

[0148] 步骤S908，eMTC终端会再次采用均匀分布的函数在[0,T]内生成随机时间种子t_4，例如t_4＝9.8ms，并向上取整得到t_4＝10ms；eMTC终端获得随机时间种子t_4后，再次启动定时器开始计时，定时器进入激活状态。eMTC终端在定时器启动后，定时器延迟10ms时长，通过功率攀升的方式向基站发起随机接入请求；同时定时器归零，并进入非激活态。

[0149] 步骤S909，对eMTC终端是否接入基站进行判断，若eMTC终端向基站发起的随机接入失败，执行步骤S906。

[0150] 步骤S910，eMTC终端接入基站。

[0151] 通过具体实施方式的说明，应当可对本发明为达成预定目的所采取的技术手段及功效得以更加深入且具体的了解，然而所附图示仅是提供参考与说明之用，并非用来对本发明加以限制。

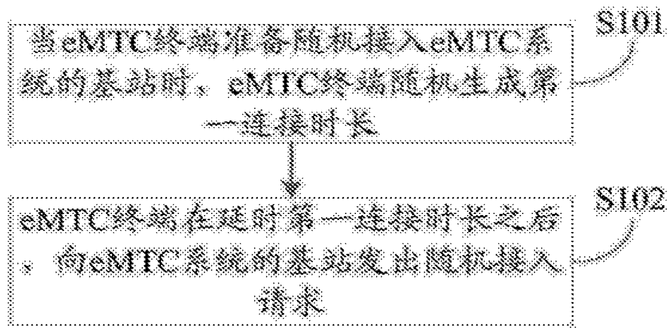

当eMTC终端准备随机接入eMTC系统的基站时，eMTC终端随机生成第一连接时长
S101
eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求
S102

图1

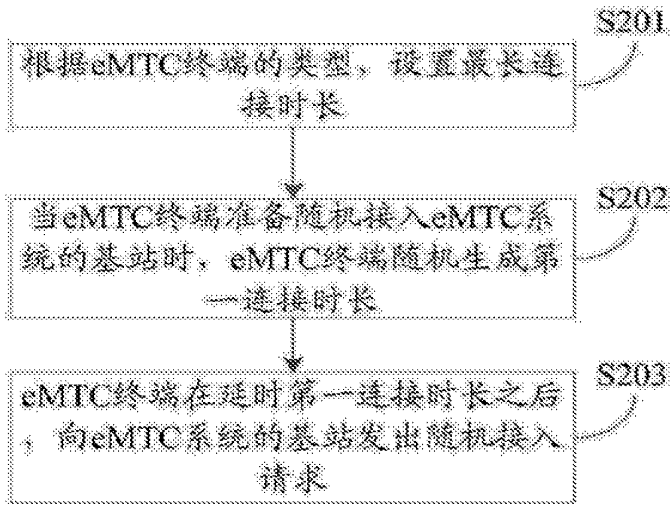

S201
根据eMTC终端的类型，设置最长连接时长
当eMTC终端准备随机接入eMTC系统的基站时，eMTC终端随机生成第一连接时长
S202
eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求
S203

图2

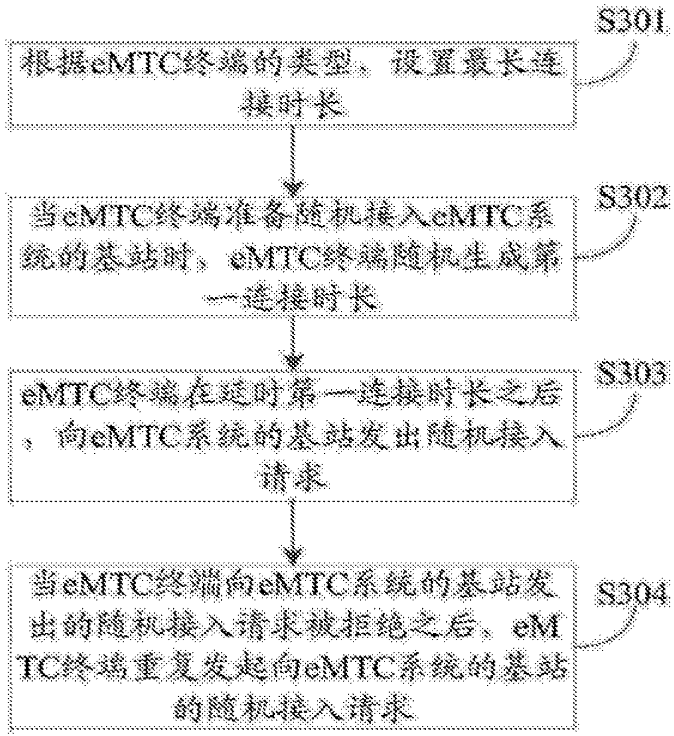

S301
根据eMTC终端的类型，设置最长连接时长
S302
当eMTC终端准备随机接入eMTC系统的基站时，eMTC终端随机生成第一连接时长
S303
eMTC终端在延时第一连接时长之后，向eMTC系统的基站发出随机接入请求
S304
当eMTC终端向eMTC系统的基站发出的随机接入请求被拒绝之后，eMTC终端重复发起向eMTC系统的基站的随机接入请求

图3

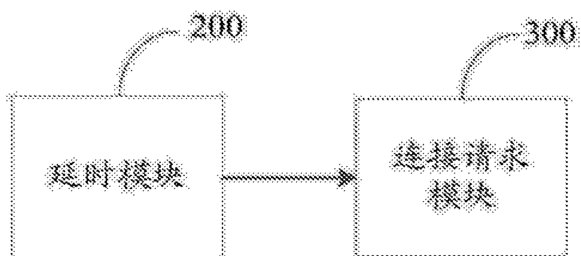

200
延时模块
300
连接请求模块

图4

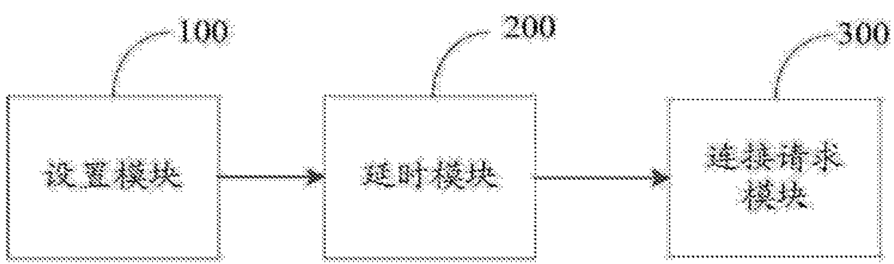

100
设置模块
200
延时模块
300
连接请求模块

图5

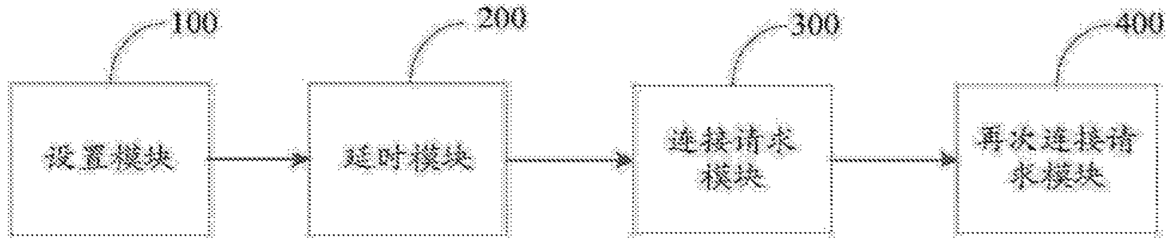


图6

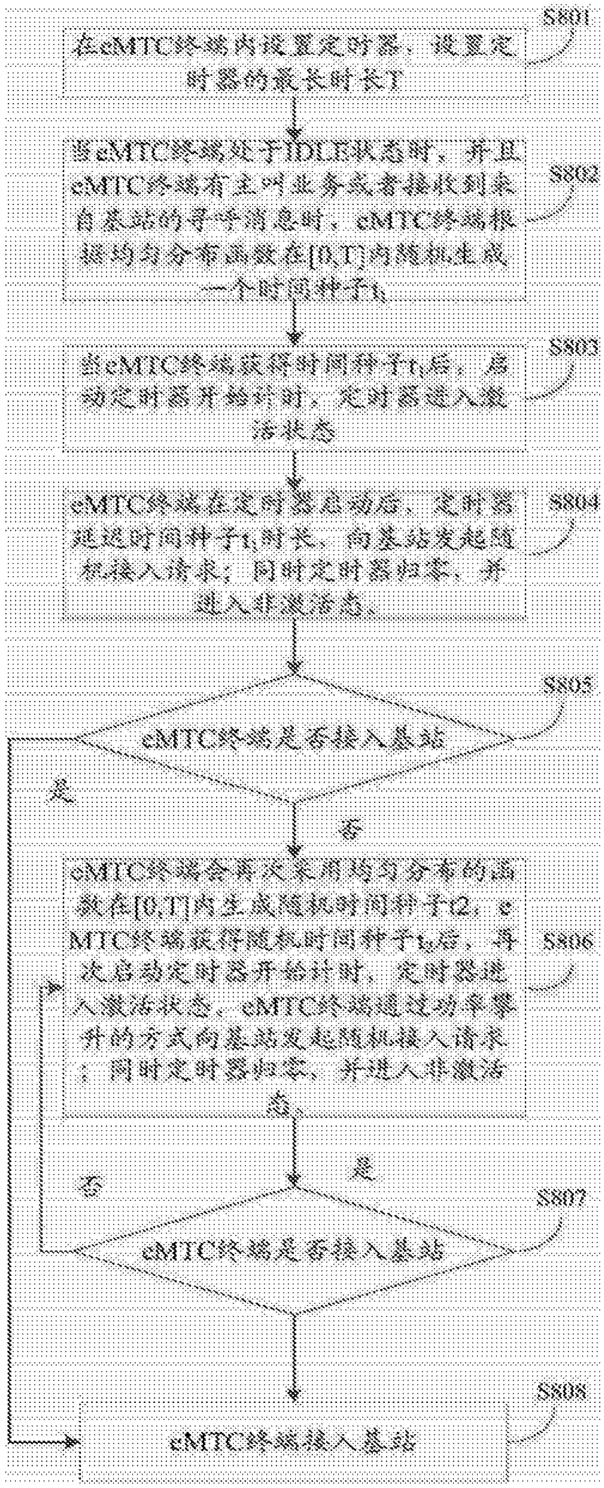

S801
在eMTC终端内设置定时器，设置定时器的最长时长T
S802
当eMTC终端处于IDLE状态时，并且eMTC终端有主叫业务或者接收到来自基站的寻呼消息时，eMTC终端根据均匀分布函数在[0,T]内随机生成一个时间种子t_1
S803
当eMTC终端获得时间种子t_1后，启动定时器开始计时，定时器进入激活状态
S804
eMTC终端在定时器启动后，定时器延迟时间种子t_1时长，向基站发起随机接入请求；同时定时器归零，并进入非激活态。
S805
eMTC终端是否接入基站
是
否
eMTC终端会再次采用均匀分布的函数在[0,T]内生成随机时间种子t2，eMTC终端获得随机时间种子t_2后，再次启动定时器开始计时，定时器进入激活状态，eMTC终端通过功率攀升的方式向基站发起随机接入请求；同时定时器归零，并进入非激活态。
S806
是
否
S807
eMTC终端是否接入基站
S808
eMTC终端接入基站

图7

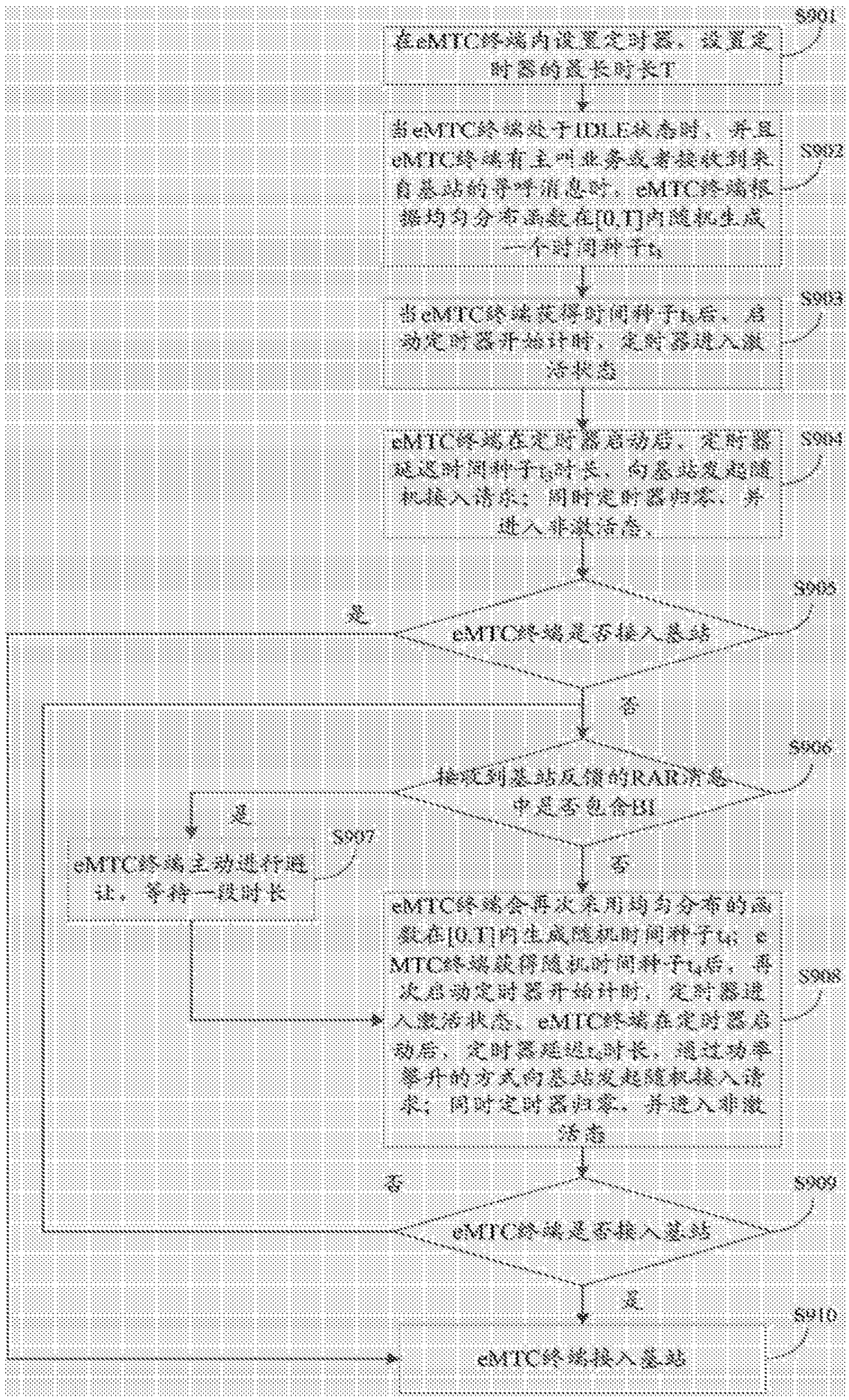

在eMTC终端内设置定时器，设置定时器的最长时长T
S901
当eMTC终端处于IDLE状态时，并且eMTC终端有主叫业务或者接收到来自基站的寻呼消息时，eMTC终端根据均匀分布函数在[0,T]内随机生成一个时间种子t_1
S902
当eMTC终端获得时间种子t_1后，启动定时器开始计时，定时器进入激活状态
S903
eMTC终端在定时器启动后，定时器延迟时间种子t_1时长，向基站发起随机接入请求；同时定时器归零，并进入非激活态。
S904
eMTC终端是否接入基站
S905
是
否
接收到基站反馈的RAR消息中是否包含BI
S906
是
否
eMTC终端主动进行避让，等待一段时长
S907
eMTC终端会再次采用均匀分布的函数在[0,T]内生成随机时间种子t_4；eMTC终端获得随机时间种子t_4后，再次启动定时器开始计时，定时器进入激活状态，eMTC终端在定时器启动后，定时器延迟t_4时长，通过功率攀升的方式向基站发起随机接入请求；同时定时器归零，并进入非激活态
S908
否
eMTC终端是否接入基站
S909
是
eMTC终端接入基站
S910

图8

Electronic Acknowledgement Receipt

EFS ID:	37215500
Application Number:	16372389
International Application Number:	
Confirmation Number:	2472
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Customer Number:	54000
Filer:	Alvin Sean Koan
Filer Authorized By:	
Attorney Docket Number:	US76468
Receipt Date:	19-SEP-2019
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Time Stamp:	15:15:26
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	Foreign Reference	US76468190916IDS-OT.pdf	7686665 cd825bfd8bc57aeae051a7691f142ef40b1c8360	no	26

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	US76468__IDS.pdf	532749 3dd9e627078ca67f24bc3ee2390b4a48a7797021	no	4
Warnings:					
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3	Foreign Reference	US76468190915IDS-OT.pdf	10421796 b07668a8df40889565191fa049a3aacc9fd53239	no	29
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4	Foreign Reference	US76468190917IDS-OT.pdf	4788783 22ece24ea19b096ed7bd8b8978ddceac1f0a978a	no	17
Warnings:					
Information:					
			Total Files Size (in bytes):	23429993	

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English Translation of Abstract of China Patent Application No. CN107223353A

The invention discloses a method, apparatus, user equipment and base station for requesting a system message. The method herein includes the following steps: transmitting a first random access request which carries at least one lead code which marks a to-be-requested system message; within a preset time period, monitoring a response message which corresponds to the first random access request, the response message carrying information for responding to the lead code; when the response message is monitored, based on the lead code marker contained in the response message, in a transmitting window of the to-be-requested system message which corresponds to the lead code marker, monitoring and receiving the to-be-requested system message. According to the technical solution of the invention, the method herein can prevent the failure of the base station to broadcast second type system messages due to the failure of requesting the to-be-requested system message by the UE through the random access request, and can prevent the subsequent long time delay of obtaining the system message by the UE.

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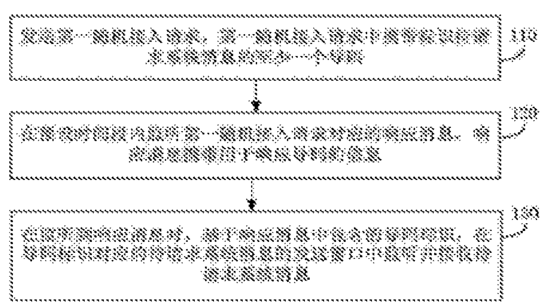
权利要求书3页 说明书13页 附图8页

(54)发明名称

用于请求系统消息的方法、装置、用户设备及基站

(57)摘要

本公开是关于一种用于请求系统消息的方法、装置、用户设备及基站。方法包括：发送第一随机接入请求，第一随机接入请求中携带标识待请求系统消息的至少一个导码；在预设时间段内监听第一随机接入请求对应的响应消息，响应消息携带用于响应导码的信息；在监听到所述响应消息时，基于所述响应消息中包含的导码标识，在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。本公开技术方案可以避免由于UE通过随机接入请求请求待请求系统消息失败使得基站不能及时广播第二类系统消息，所导致的UE获取系统消息的时延长的问题。



CN 107223353 A

1.一种用于请求系统消息的方法，其特征在于，所述方法包括：

发送第一随机接入请求，所述第一随机接入请求中携带标识待请求系统消息的至少一个导码；

在预设时间段内监听所述第一随机接入请求对应的响应消息，所述响应消息携带用于响应导码的信息；

在监听到所述响应消息时，基于所述响应消息中包含的导码标识，在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

2.根据权利要求1所述的方法，其特征在于，所述方法还包括：

基于所述响应消息中包含的导码标识以及所述第一随机接入请求中携带标识待请求系统消息的至少一个导码，确定请求结果为失败的待请求系统消息；

发送第二随机接入请求，所述第二随机接入请求携带所述请求失败的待请求系统消息的导码。

3.根据权利要求2所述的方法，其特征在于，所述方法还包括：

统计每一个待请求系统消息的请求次数；

在有待请求系统消息的请求次数大于预设次数时，向无线资源控制RRC层指示所述待请求系统消息的请求次数已达最大次数。

4.根据权利要求1所述的方法，其特征在于，所述方法还包括：

在没有监听到所述响应消息时，确定没有待请求系统消息请求成功。

5、一种用于请求系统消息的方法，其特征在于，所述方法包括：

接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求；

基于所述请求消息，生成预设格式的响应消息；

发送所述响应消息。

6.根据权利要求5所述的方法，其特征在于，所述基于所述请求消息，生成预设格式的响应消息，包括：

从所述请求消息中解析所述待请求系统消息的导码；

将确定要响应的待请求系统消息的导码的导码标识添加至所述响应消息的子包头中，得到所述预设格式的响应消息。

7.根据权利要求5所述的方法，其特征在于，所述基于所述请求消息，生成预设格式的响应消息，包括：

从所述请求消息中解析所述待请求系统消息的导码；

在所述响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者所述响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至所述响应消息的包体中，得到所述预设格式的响应消息。

8.根据权利要求7所述的方法，其特征在于，所述响应消息的包头中还包括用于指示所述响应消息的结构类型的指示信息。

9.根据权利要求5所述的方法，其特征在于，所述方法还包括：

在所述待请求系统消息的发送窗口内发送所响应的待请求系统消息。

10.一种用于请求系统消息的装置，其特征在于，所述装置包括：

第一发送模块，被配置为发送第一随机接入请求，所述第一随机接入请求中携带标识

待请求系统消息的至少一个导码；

第一监听模块，被配置为在预设时间段内监听所述第一随机接入请求对应的响应消息，所述响应消息携带用于响应导码的信息；

第二监听模块，被配置为在监听到所述响应消息时，基于所述响应消息中包含的导码标识，在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

11.根据权利要求10所述的装置，其特征在于，所述装置包括：

第一确定模块，被配置为基于所述响应消息中包含的导码标识以及所述第一随机接入请求中携带标识待请求系统消息的至少一个导码，确定请求结果为失败的待请求系统消息；

第二发送模块，被配置为发送第二随机接入请求，所述第二随机接入请求携带所述请求失败的待请求系统消息的导码。

12.根据权利要求10所述的装置，其特征在于，所述装置还包括：

统计模块，被配置为统计每一个待请求系统消息的请求次数；

问题报告模块，被配置为在有待请求系统消息的请求次数大于预设次数时，向无线资源控制RRC层指示所述待请求系统消息的请求次数已达最大次数。

13.根据权利要求10所述的装置，其特征在于，所述装置还包括：

第二确定模块，被配置为在没有监听到所述响应消息时，确定没有待请求系统消息请求成功。

14.一种用于请求系统消息的装置，其特征在于，所述装置包括：

第一接收模块，被配置为接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求；

消息生成模块，被配置为基于所述第一接收模块接收到的所述请求消息，生成预设格式的响应消息；

第三发送模块，被配置为发送所述消息生成模块生成的所述响应消息。

15.根据权利要求14所述的装置，其特征在于，所述消息生成模块包括：

第一解析子模块，被配置为从所述请求消息中解析所述待请求系统消息的导码；

第一生成子模块，被配置为将确定要响应的待请求系统消息的导码的导码标识添加至所述响应消息的子包头中，得到所述预设格式的响应消息。

16.根据权利要求14所述的装置，其特征在于，所述消息生成模块包括：

第二解析子模块，被配置为从所述请求消息中解析所述待请求系统消息的导码；

第二生成子模块，被配置为在所述响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者所述响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至所述响应消息的包体中，得到所述预设格式的响应消息。

17.根据权利要求16所述的装置，其特征在于，所述响应消息的包头中还包括用于指示所述响应消息的结构类型的指示信息。

18.根据权利要求14所述的装置，其特征在于，所述装置还包括：

第四发送模块，被配置为在所述待请求系统消息的发送窗口内所响应的所述待请求系统消息。

19.一种用户设备,其特征在于,包括:

处理器;

用于存储处理器可执行指令的存储器;

其中,所述处理器被配置为:

发送第一随机接入请求,所述第一随机接入请求中携带标识待请求系统消息的至少一个导码;

在预设时间段内监听所述第一随机接入请求对应的响应消息,所述响应消息携带用于响应导码的信息;

在监听到所述响应消息时,基于所述响应消息中包含的导码标识,在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

20.一种基站,其特征在于,包括:

处理器;

用于存储处理器可执行指令的存储器;

其中,所述处理器被配置为:

接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求;

基于所述请求消息,生成预设格式的响应消息;

发送所述响应消息。

21.一种非临时计算机可读存储介质,所述存储介质上存储有计算机指令,其特征在于,所述指令被处理器执行时实现以下步骤:

发送第一随机接入请求,所述第一随机接入请求中携带标识待请求系统消息的至少一个导码;

在预设时间段内监听所述第一随机接入请求对应的响应消息,所述响应消息携带用于响应导码的信息;

在监听到所述响应消息时,基于所述响应消息中包含的导码标识,在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

22.一种非临时计算机可读存储介质,所述存储介质上存储有计算机指令,其特征在于,所述指令被处理器执行时实现以下步骤:

接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求;

基于所述请求消息,生成预设格式的响应消息;

发送所述响应消息。

用于请求系统消息的方法、装置、用户设备及基站

技术领域

[0001] 本公开涉及通信技术领域,尤其涉及一种用于请求系统消息的方法、装置、用户设备及基站。

背景技术

[0002] 随着无线通信技术的飞速发展,长期演进(Long Term Evolution,简称为LTE)的系统消息(System Information,简称为SI)数目增多,采用周期性广播的方式发送LTE的系统消息使得基站的功耗较大,频谱资源利用率较低。对于接入的用户设备(User Equipment,简称为UE)数目比较少的情况,周期性广播发送LTE的系统消息存在资源浪费的问题。为了缓解广播发送LTE的系统消息所带来的资源浪费和基站功耗较大的问题,运营商开始考虑通过分类发送系统消息的方式来解决上述问题。

[0003] 在第五代移动通信技术(5th Generation,简称为5G)项目的研究讨论中,可将系统消息分为第一类系统消息和第二类系统消息,第一类系统消息可包含小区选择与接入的相关系统消息,第二类系统消息可包含除第一类系统消息之外的其他系统消息。相关技术中,仍可通过广播发送第一类系统消息,而对于第二类系统消息,则可在接收到UE通过MSG1(随机接入过程的第一个消息)发送特定前序导码(preamble码)请求第二类系统消息时,在UE所请求的第二类系统消息的发送窗口中广播第二类系统消息,但是相关技术中UE可能由于发送MSG1的功率低导致MSG1发送失败,进而导致基站因没有接收到UE发送的请求消息而不进行第二类系统消息的广播,UE只能等下一个系统消息周期重新通过MSG1请求第二类系统消息,造成UE获取系统消息的时延长,严重影响性能。

发明内容

[0004] 为克服相关技术中存在的问题,本公开实施例提供一种用于请求系统消息的方法、装置、用户设备及基站,用以提高用户设备通过随机接入请求请求待请求系统消息的效率,避免在请求失败时不能接收到所请求的待请求系统消息或者获取系统消息的时延长。

[0005] 根据本公开实施例的第一方面,提供一种用于请求系统消息的方法,包括:

[0006] 发送第一随机接入请求,所述第一随机接入请求中携带标识待请求系统消息的至少一个导码;

[0007] 在预设时间段内监听所述第一随机接入请求对应的响应消息,所述响应消息携带用于响应导码的信息;

[0008] 在监听到所述响应消息时,基于所述响应消息中包含的导码标识,在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

[0009] 在一实施例中,方法包括:

[0010] 基于所述响应消息中包含的导码标识以及所述第一随机接入请求中携带标识待请求系统消息的至少一个导码,确定请求结果为失败的待请求系统消息;

[0011] 发送第二随机接入请求,所述第二随机接入请求携带所述请求失败的待请求系统

消息的导码。

[0012] 在一实施例中，方法还包括：

[0013] 统计每一个待请求系统消息的请求次数；

[0014] 在有待请求系统消息的请求次数大于预设次数时，向无线资源控制RRC层指示所述待请求系统消息的请求次数已达最大次数。

[0015] 在一实施例中，方法还包括：

[0016] 在没有监听到所述响应消息时，确定没有待请求系统消息请求成功。

[0017] 根据本公开实施例的第二方面，提供一种用于请求系统消息的方法，包括：

[0018] 接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求；

[0019] 基于所述请求消息，生成预设格式的响应消息；

[0020] 发送所述响应消息。

[0021] 在一实施例中，于所述请求消息，生成预设格式的响应消息，包括：

[0022] 从所述请求消息中解析所述待请求系统消息的导码；

[0023] 将确定要响应的待请求系统消息的导码的导码标识添加至所述响应消息的子包头中，得到所述预设格式的响应消息。

[0024] 在一实施例中，基于所述请求消息，生成预设格式的响应消息，包括：

[0025] 从所述请求消息中解析所述待请求系统消息的导码；

[0026] 在所述响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者所述响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至所述响应消息的包体中，得到所述预设格式的响应消息。

[0027] 在一实施例中，响应消息的包头中还包括用于指示所述响应消息的结构类型的指示信息。

[0028] 在一实施例中，方法还包括：

[0029] 在所述待请求系统消息的发送窗口内发送所响应的待请求系统消息。

[0030] 根据本公开实施例的第三方面，提供一种用于请求系统消息的装置，包括：

[0031] 第一发送模块，被配置为发送第一随机接入请求，所述第一随机接入请求中携带标识待请求系统消息的至少一个导码；

[0032] 第一监听模块，被配置为在预设时间段内监听所述第一随机接入请求对应的响应消息，所述响应消息携带用于响应导码的信息；

[0033] 第二监听模块，被配置为在监听到所述响应消息时，基于所述响应消息中包含的导码标识，在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

[0034] 在一实施例中，装置包括：

[0035] 第一确定模块，被配置为基于所述响应消息中包含的导码标识以及所述第一随机接入请求中携带标识待请求系统消息的至少一个导码，确定请求结果为失败的待请求系统消息；

[0036] 第二发送模块，被配置为发送第二随机接入请求，所述第二随机接入请求携带所述请求失败的待请求系统消息的导码。

[0037] 在一实施例中，装置还包括：

[0038] 统计模块，被配置为统计每一个待请求系统消息的请求次数；

[0039] 问题报告模块，被配置为在有待请求系统消息的请求次数大于预设次数时，向无线资源控制RRC层指示所述待请求系统消息的请求次数已达最大次数。

[0040] 在一实施例中，装置还包括：

[0041] 第二确定模块，被配置为在没有监听到所述响应消息时，确定没有待请求系统消息请求成功。

[0042] 根据本公开实施例的第四方面，提供一种用于请求系统消息的装置，包括：

[0043] 第一接收模块，被配置为接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求；

[0044] 消息生成模块，被配置为基于所述第一接收模块接收到的所述请求消息，生成预设格式的响应消息；

[0045] 第三发送模块，被配置为发送所述消息生成模块生成的所述响应消息。

[0046] 在一实施例中，消息生成模块包括：

[0047] 第一解析子模块，被配置为从所述请求消息中解析所述待请求系统消息的导码；

[0048] 第一生成子模块，被配置为将确定要响应的待请求系统消息的导码的导码标识添加至所述响应消息的子包头中，得到所述预设格式的响应消息。

[0049] 在一实施例中，消息生成模块包括：

[0050] 第二解析子模块，被配置为从所述请求消息中解析所述待请求系统消息的导码；

[0051] 第二生成子模块，被配置为在所述响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者所述响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至所述响应消息的包体中，得到所述预设格式的响应消息。

[0052] 在一实施例中，响应消息的包头中还包括用于指示所述响应消息的结构类型的指示信息。

[0053] 在一实施例中，装置还包括：

[0054] 第四发送模块，被配置为在所述待请求系统消息的发送窗口内发送所响应的待请求系统消息。

[0055] 根据本公开实施例的第五方面，提供一种用户设备，包括：

[0056] 处理器；

[0057] 用于存储处理器可执行指令的存储器；

[0058] 其中，所述处理器被配置为：

[0059] 发送第一随机接入请求，所述第一随机接入请求中携带标识待请求系统消息的至少一个导码；

[0060] 在预设时间段内监听所述第一随机接入请求对应的响应消息，所述响应消息携带用于响应导码的信息；

[0061] 在监听到所述响应消息时，基于所述响应消息中包含的导码标识，在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

[0062] 根据本公开实施例的第六方面，提供一种基站，包括：

[0063] 处理器；

[0064] 用于存储处理器可执行指令的存储器；

[0065] 其中，所述处理器被配置为：

[0066] 接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求；

[0067] 基于所述请求消息，生成预设格式的响应消息；

[0068] 发送所述响应消息。

[0069] 根据本公开实施例的第七方面，提供一种非临时计算机可读存储介质，所述存储介质上存储有计算机指令，所述指令被处理器执行时实现以下步骤：

[0070] 发送第一随机接入请求，所述第一随机接入请求中携带标识待请求系统消息的至少一个导码；

[0071] 在预设时间段内监听所述第一随机接入请求对应的响应消息，所述响应消息携带用于响应导码的信息；

[0072] 在监听到所述响应消息时，基于所述响应消息中包含的导码标识，在所述导码标识对应的待请求系统消息的发送窗口中监听并接收所述待请求系统消息。

[0073] 根据本公开实施例的第八方面，提供一种非临时计算机可读存储介质，所述存储介质上存储有计算机指令，所述指令被处理器执行时实现以下步骤：

[0074] 接收用户设备发送的携带所述待请求系统消息的导码的随机接入请求；

[0075] 基于所述请求消息，生成预设格式的响应消息；

[0076] 发送所述响应消息。

[0077] 本公开的实施例提供的技术方案可以包括以下有益效果：

[0078] 当UE向基站发送携带有待请求系统消息的导码的随机接入请求时，通过上述技术方案，可以控制UE在有待请求系统消息请求成功时在请求成功的待请求系统消息的发送窗口中监听待请求系统消息；此外，在确定确定有待请求系统消息的请求结果为请求失败时能够通过随机接入请求重复请求待请求系统消息直至请求成功，以提高基站与用户设备之间的系统消息发送和接收的效率，避免用户设备获取系统消息的时延长，降低基站发送系统消息的功率消耗，增加频谱资源的利用率。

[0079] 应当理解的是，以上的一般描述和后文的细节描述仅是示例性和解释性的，并不能限制本公开。

附图说明

[0080] 此处的附图被并入说明书中并构成本说明书的一部分，示出了符合本发明的实施例，并与说明书一起用于解释本发明的原理。

[0081] 图1A是根据一示例性实施例示出的一种用于请求系统消息的方法的流程图。

[0082] 图1B是根据一示例性实施例示出的一种用于请求系统消息的方法的场景图。

[0083] 图2是根据一示例性实施例示出的另一种用于请求系统消息的方法的流程图。

[0084] 图3是根据一示例性实施例示出的一种用于请求系统消息的方法的流程图。

[0085] 图4是根据一示例性实施例示出的另一种用于发送系统消息的方法的流程图。

[0086] 图5是根据一示例性实施例示出的另一种用于发送系统消息的方法的流程图。

[0087] 图6是根据一示例性实施例示出的一种用于接收系统消息的装置的框图。

[0088] 图7是根据一示例性实施例示出的另一种用于接收系统消息的装置的框图。

[0089] 图8是根据一示例性实施例示出的一种用于发送系统消息的装置的框图。

[0090] 图9是根据一示例性实施例示出的另一种用于发送系统消息的装置的框图。

[0091] 图10是根据一示例性实施例示出的一种适用于用于请求系统消息的装置的框图。

[0092] 图11是根据一示例性实施例示出的一种适用于用于请求系统消息的装置的框图。

具体实施方式

[0093] 这里将详细地对示例性实施例进行说明，其示例表示在附图中。下面的描述涉及附图时，除非另有表示，不同附图中的相同数字表示相同或相似的要素。以下示例性实施例中所描述的实施方式并不代表与本发明相一致的所有实施方式。相反，它们仅是与如所附权利要求书中所详述的、本发明的一些方面相一致的装置和方法的例子。

[0094] 图1A是根据一示例性实施例示出的一种用于接收系统消息的方法的流程图，图1B是根据一示例性实施例示出的一种用于请求系统消息的方法的场景图；该用于接收系统消息的方法可以应用在UE上，如图1A所示，该用于请求系统消息的方法包括以下步骤110-130：

[0095] 在步骤110中，发送第一随机接入请求，第一随机接入请求中携带标识待请求系统消息的至少一个导码。

[0096] 在一实施例中，第一随机接入请求为随机接入流程的第一个消息MSG1。

[0097] 在一实施例中，随机接入请求的时频资源可以通过基站广播的第一类系统消息，如系统信息块2(SystemInformationBlock2，简称为SIB2)中的物理随机接入信道(Physical Random Access Channel，简称为PRACH)的配置信息得到，随机接入请求的时频资源可通过相关技术确定，这里不再详述。

[0098] 在一实施例中，待请求系统消息属于第二类系统消息，例如：系统信息块12(SystemInformationBlock12，简称为SIB12)。

[0099] 在一实施例中，待请求系统消息的导码用于标识待请求的系统消息，其可以为前序导码，也可以为其他形式的正交码，本公开对此不作限定。

[0100] 在一实施例中，第一随机接入请求中可以携带一个或者两个以上的导码。

[0101] 在步骤120中，在预设时间段内监听第一随机接入请求对应的响应消息，响应消息携带用于响应导码的信息。

[0102] 在一实施例中，预设时间段可以为基站和用户设备之间协商设置的一个时间长度，在发送MSG1之后会在这个预设时间段内返回响应消息。如果用户设备在预设时间段内有接收到响应消息，则其可以认为不会再收到响应消息。

[0103] 在步骤130中，在监听到响应消息时，基于响应消息中包含的导码标识，在导码标识对应的待请求系统消息的发送窗口中监听并接收待请求系统消息。

[0104] 在一实施例中，基于响应消息中所包含的导码标识，可以确定出请求成功的待请求系统消息。例如，第一随机接入请求中携带有待请求系统消息1对应的导码1、待请求系统消息2对应的导码2、待请求系统消息3对应的导码3，而第一随机接入请求对应的响应消息中只包含导码1对应的导码标识和导码2对应的导码标识，则可以确定出请求成功的待请求系统消息为待请求系统消息1和待请求系统消息2。

[0105] 在一实施例中，第一随机接入请求对应的响应消息为随机接入响应(Random Access Response，简称为RAR)消息。

[0106] 在一实施例中，UE可通过基站广播的第一类系统消息携带的调度信息确定每一个待请求系统消息的发送窗口。

[0107] 在一示例性场景中，如图1B所示，以移动网络为LTE网络并且基站为演进型基站(eNB)为例进行示例性说明，在图1B所示的场景中，包括eNB10、UE20，其中，eNB10周期性广播第一类系统消息，UE20接收到第一类系统消息时可确定随机接入请求的时域资源以及待请求系统消息的发送窗口和导码。UE20可随机接入请求的时域资源上发送携带待请求系统消息的导码的第一随机接入请求，如果基于第一随机接入请求的响应消息确定有待请求系统消息请求成功，则可在请求成功的待请求系统消息的发送窗口中监听待请求系统消息，如果基于第一随机接入请求的响应消息确定待请求系统消息请求失败，则可继续在随机接入请求的时域资源上发送第二随机接入请求，直到待请求系统消息请求成功或者时域资源被用完为止。

[0108] 本实施例中，通过上述步骤110-步骤130，当UE向基站发送携带有待请求系统消息的导码的随机接入请求时，通过上述技术方案，可以控制UE在有待请求系统消息请求成功时在请求成功的待请求系统消息的发送窗口中监听待请求系统消息，以提高基站与用户设备之间的系统消息发送和接收的效率，避免用户设备获取系统消息的时延长，降低基站发送系统消息的功率消耗，增加频谱资源的利用率。

[0109] 在一实施例中，用于请求系统消息的方法进一步还可以包括：

[0110] 响应于所确定的待请求系统消息中的未请求成功的至少一部分为空，在待请求系统消息的发送窗口中接收待请求系统消息。

[0111] 在一实施例中，用于请求系统消息的方法进一步还可以包括：

[0112] 统计待请求系统消息的请求次数；

[0113] 当请求次数大于预设次数时，向无线资源控制层发送网络问题报告消息，网络问题报告消息用于指示已通过随机接入请求预设次数的待请求系统消息。

[0114] 在一实施例中，基于在预设时间段内的监听结果，确定待请求系统消息中的未请求成功的至少一部分，包括：

[0115] 响应于预设时间段内没有收到随机接入请求对应的响应消息，确定待请求系统消息中的未请求成功的至少一部分是待请求系统消息的全部；

[0116] 响应于预设时间段内收到随机接入请求对应的响应消息，确定待请求系统消息中的未请求成功的至少一部分是待请求系统消息中未被响应消息携带用于响应导码的信息所响应的部分。

[0117] 具体如何请求系统消息的，请参考后续实施例。

[0118] 至此，本公开实施例提供的上述方法，可以提高基站与用户设备之间的系统消息发送和接收的效率，避免用户设备获取系统消息的时延长，降低基站发送系统消息的功率消耗，增加频谱资源的利用率。

[0119] 下面以具体实施例来说明本公开实施例提供的技术方案。

[0120] 图2是根据一示例性实施例示出的另一种用于请求系统消息的方法的流程图；本实施例利用本公开实施例提供的上述方法，UE通过随机接入请求请求待请求系统消息为例进行示例性说明，如图2所示，包括如下步骤：

[0121] 在步骤210中，确定随机接入请求的时域资源。

[0122]　在步骤220中，通过随机接入请求的时频资发送第一随机接入请求，第一随机接入请求中携带有待请求系统消息的导码。

[0123]　在步骤230中，在预设时间段内监听是否有第一随机接入请求对应的响应消息。

[0124]　在步骤240中，在监听到响应消息时，基于响应消息中携带的导码标识，确定请求成功的待请求系统消息和请求失败的待请求系统消息，执行步骤250和步骤260。

[0125]　在一实施例中，监听结果可以为没有监听到，如果没有监听到，则待请求系统消息中的未请求成功的至少一部分为待请求系统消息的全部。

[0126]　在一实施例中，监听结果为监听到响应消息时，则未请求成功的至少一部分为待请求系统消息中为被响应消息携带用于响应导码的信息所响应的部分，如果响应消息中携带了用于响应全部待请求系统消息的导码的信息，则未请求成功的至少一部分的值为空，如果响应消息中携带了响应部分待请求系统消息的导码的信息，则未请求成功的至少一部分的值不为空。

[0127]　在步骤250中，如果有待请求系统消息请求成功，在请求成功的待请求系统消息的发送窗口中监听并接收待请求系统消息，流程结束。

[0128]　在步骤260中，如果有待请求系统消息请求失败，发送第二随机接入请求，第二随机接入请求中携带标识请求失败的待请求系统消息的导码。

[0129]　在一实施例中，每一个待请求系统消息可以对应多个导码，例如待请求系统消息1可以对应导码11、或者导码12、或者导码13。

[0130]　在一实施例中，第二随机接入请求中携带的请求失败的待请求系统消息的导码可以与第一随机接入请求中携带的对应的待请求系统消息的导码不一致，也可以一致。例如，在待请求系统消息1请求失败时，如果第一随机接入请求中携带的待请求系统消息1的导码为导码11，则第二随机接入请求中携带的待请求系统消息1的导码可以为导码12，也可以为11。

[0131]　在一实施例中，UE可基于第二随机接入请求的响应消息确定第二随机接入请求所请求的待请求系统消息是否还有未请求成功的待请求系统消息，过程与基于第一随机接入请求的响应消息确定第一随机接入请求所请求的待请求系统消息的未请求成功的一部分的过程相同，这里不再赘述。

[0132]　在一实施例中，如果UE发送第二随机接入请求之后，还有待请求系统消息没有请求成功，则可继续发送第二随机接入请求，后面发送的第二随机接入请求中携带的导码为没有请求成功的待请求系统消息的导码，直到所有的待请求系统消息都请求成功或者随机接入请求的时域资源被用完为止。

[0133]　在步骤270中，统计每一个待请求系统消息的请求次数。

[0134]　在步骤280中，当有待请求系统消息的请求次数大于预设次数时，向无线资源控制层指示有待请求系统消息的请求次数已达最大次数以及已达最大次数的待请求系统消息。

[0135]　在一实施例中，预设次数可以为系统约定值，如3次。

[0136]　本实施例中，可以控制UE在确定有待请求系统消息的请求结果为请求失败时，能够通过随机接入请求重复请求待请求系统消息直至请求成功，以提高基站与用户设备之间的系统消息发送和接收的效率，避免用户设备获取系统消息的时延长，降低基站发送系统消息的功率消耗，增加频谱资源的利用率。

[0137] 图3是根据一示例性实施例示出的一种用于请求系统消息的方法的流程图；该用于请求系统消息的方法可以应用在eNB上，本实施例结合图1B进行示例性说明，如图3所示，该用于请求系统消息的方法包括以下步骤310-330：

[0138] 在步骤310中，接收用户设备发送的携带待请求系统消息的导码的随机接入请求。

[0139] 在步骤320中，基于请求消息，生成预设格式的响应消息。

[0140] 在一实施例中，预设格式可以为只含有一个或者多个子包头，但是不包含包体的格式，也即不包含UE的小区无线网络临时标识(CellRadioNetworkTemporaryIdentifier，C-RNTI)等信息，响应消息所要携带的导码通过子包头携带，生成此预设格式的响应消息的方法参见图4所示实施例，这里先不详述。

[0141] 在一实施例中，预设格式可以为包头+包体的格式，包头中包含用于指示包体中导码的数目或者或指示包体的长度的指示信息；在一实施例中，包头中还可以包含用于指示响应消息的结构的类型指示信息，包体中可以包含一个或多个导码，生成此预设格式的响应消息的方法参见图5所示实施例，这里先不详述。

[0142] 在步骤330中，发送响应消息。

[0143] 在一示例性场景中，如图1B所示，以移动网络为LTE网络并且基站为演进型基站(eNB)为例进行示例性说明，在图1B所示的场景中，包括eNB10、UE20，其中，eNB10周期性广播第一类系统消息，UE20接收到第一类系统消息时可确定随机接入请求的时域资源以及待请求系统消息的发送窗口和导码。UE20可随机接入请求的时域资源上发送携带待请求系统消息的导码的第一随机接入请求，如果基于第一随机接入请求的响应消息确定待请求系统消息请求成功，则可在待请求系统消息的发送窗口中监听待请求系统消息，如果基于第一随机接入请求的响应消息确定待请求系统消息请求失败，则可继续在随机接入请求的时域资源上发送第二随机接入请求，直到待请求系统消息请求成功或者时域资源被用完为止。

[0144] 本实施例中，通过上述步骤310-330，基站在接收到UE通过随机接入请求的时频资源发送的请求消息时可生成预设格式的响应消息，以指示UE是否会在待请求系统消息的发送窗口中发送待请求系统消息，以提高基站与用户设备之间的系统消息发送和接收的效率。

[0145] 在一实施例中，基于请求消息，生成预设格式的响应消息，包括：

[0146] 从请求消息中解析待请求系统消息的导码；

[0147] 将确定要响应的待请求系统消息的导码的导码标识添加至响应消息的子包头中，得到预设格式的响应消息。

[0148] 在一实施例中，基于请求消息，生成预设格式的响应消息，包括：

[0149] 从请求消息中解析待请求系统消息的导码；

[0150] 在响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至响应消息的包体中，得到预设格式的响应消息。

[0151] 在一实施例中，响应消息的包头中还包括用于指示响应消息的结构类型的指示信息。

[0152] 在一实施例中，用于请求系统消息的方法还可以进一步包括：

[0153] 在待请求系统消息的发送窗口内发送所响应的待请求系统消息。

[0154] 具体如何发送系统消息的，请参考后续实施例。

[0155] 下面以具体实施例来说明本公开实施例提供的技术方案。

[0156] 图4是根据一示例性实施例示出的另一种用于发送系统消息的方法的流程图；本实施例利用本公开实施例提供的上述方法，以如何生成预设格式的响应消息为例进行示例性说明，如图4所示，包括如下步骤：

[0157] 在步骤410中，接收用户设备在随机接入请求的时频资源上发送的携带待请求系统消息的导码的请求消息。

[0158] 在步骤420中，从请求消息中解析待请求系统消息的导码。

[0159] 在步骤430中，将确定要响应的待请求系统消息的导码的导码标识添加至响应消息的子包头中，得到预设格式的响应消息。

[0160] 在一实施例中，基站可确定当前要相应的待请求系统消息，并且确定要响应的待请求系统消息的导码的导码标识。在一实施例中，可以在每一个子包头中添加一个导码标识；在又一实施例中，可以在一个子包头中添加多个导码标识。

[0161] 在一实施例中，由于该预设格式中不包括包体，因此基于待请求系统消息的导码确定响应消息的子包头后，即可得到预设格式的响应消息。

[0162] 在步骤440中，发送响应消息，并且在待请求系统消息的发送窗口内发送待请求系统消息。

[0163] 在一实施例中，基站可在待请求系统消息的发送窗口中发送一次以上的所响应的待请求系统消息。

[0164] 本实施例中，基站可根据预先约定的格式生成响应消息，以实现待请求系统消息的请求，进而提高基站与用户设备之间的系统消息发送和接收的效率。

[0165] 图5是根据一示例性实施例示出的另一种用于发送系统消息的方法的流程图；本实施例利用本公开实施例提供的上述方法，以如何生成预设格式的响应消息为例进行示例性说明，如图5所示，包括如下步骤：

[0166] 在步骤510中，接收用户设备在随机接入请求的时频资源上发送的携带待请求系统消息的导码的请求消息。

[0167] 在步骤520中，从请求消息中解析待请求系统消息的导码。

[0168] 在步骤530中，在响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至响应消息的包体中，得到预设格式的响应消息。

[0169] 在一实施例中，基站可确定当前要相应的待请求系统消息，并且确定要响应的待请求系统消息的导码的数目或者响应消息的包体长度。

[0170] 在一实施例中，响应消息的包头中还包括用于指示响应消息的结构类型的指示信息。

[0171] 在步骤540中，发送响应消息，并且在待请求系统消息的发送窗口内发送待请求系统消息。

[0172] 本实施例中，基站可根据预先约定的格式生成响应消息，以实现待请求系统消息的请求，进而提高基站与用户设备之间的系统消息发送和接收的效率。

[0173] 图6是根据一示例性实施例示出的一种用于请求系统消息的装置的框图，如图6所

示，用于请求系统消息的装置包括：
[0174] 第一发送模块610，被配置为发送第一随机接入请求，第一随机接入请求中携带标识待请求系统消息的至少一个导码。
[0175] 第一监听模块620，被配置为在预设时间段内监听第一随机接入请求对应的响应消息，响应消息携带用于响应导码的信息；
[0176] 第二监听模块630，被配置为在监听到响应消息时，基于响应消息中包含的导码标识，在导码标识对应的待请求系统消息的发送窗口中监听并接收待请求系统消息。
[0177] 图7是根据一示例性实施例示出的另一种用于请求系统消息的装置的框图，如图7所示，在上述图6所示实施例的基础上，在一实施例中，装置包括：
[0178] 第一确定模块640，被配置为基于响应消息中包含的导码标识以及第一随机接入请求中携带标识待请求系统消息的至少一个导码，确定请求结果为失败的待请求系统消息；
[0179] 第二发送模块650，被配置为发送第二随机接入请求，第二随机接入请求携带请求失败的待请求系统消息的导码。
[0180] 在一实施例中，装置还包括：
[0181] 统计模块660，被配置为统计每一个待请求系统消息的请求次数；
[0182] 问题报告模块670，被配置为在有待请求系统消息的请求次数大于预设次数时，向无线资源控制RRC层指示待请求系统消息的请求次数已达最大次数。
[0183] 在一实施例中，装置还包括：
[0184] 第二确定模块680，被配置为在没有监听到响应消息时，确定没有待请求系统消息请求成功。
[0185] 图8是根据一示例性实施例示出的一种用于请求系统消息的装置的框图，应用在基站上，如图8所示，用于请求系统消息的装置包括：
[0186] 第一接收模块810，被配置为接收用户设备发送的携带待请求系统消息的导码的随机接入请求；
[0187] 消息生成模块820，被配置为基于第一接收模块920接收到的请求消息，生成预设格式的响应消息；
[0188] 第三发送模块830，被配置为发送消息生成模块920生成的响应消息。
[0189] 图9是根据一示例性实施例示出的另一种用于请求系统消息的装置的框图，如图9所示，在上述图8所示实施例的基础上，在一实施例中，消息生成模块820包括：
[0190] 第一解析子模块821，被配置为从请求消息中解析待请求系统消息的导码；
[0191] 第一生成子模块822，被配置为将确定要响应的待请求系统消息的导码的导码标识添加至响应消息的子包头中，得到预设格式的响应消息。
[0192] 在一实施例中，消息生成模块820包括：
[0193] 第二解析子模块823，被配置为从请求消息中解析待请求系统消息的导码；
[0194] 第二生成子模块824，被配置为在响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至响应消息的包体中，得到预设格式的响应消息。
[0195] 在一实施例中，响应消息的包头中还包括用于指示响应消息的结构类型的指示信

息。

[0196] 在一实施例中，装置还包括：

[0197] 第四发送模块840，被配置为在待请求系统消息的发送窗口内发送所响应的待请求系统消息。

[0198] 关于上述实施例中的装置，其中各个模块执行操作的具体方式已经在有关该方法的实施例中进行了详细描述，此处将不做详细阐述说明。

[0199] 图10是根据一示例性实施例示出的一种适用于用于请求系统消息的装置的框图。例如，装置1000可以是移动电话，计算机，数字广播终端，消息收发设备，游戏控制台，平板设备，医疗设备，健身设备，个人数字助理等用户设备。

[0200] 参照图10，装置1000可以包括以下一个或多个组件：处理组件1002，存储器1004，电源组件1006，多媒体组件1008，音频组件1012，输入/输出(I/O)的接口1012，传感器组件1014，以及通信组件1016。

[0201] 处理组件1002通常控制装置1000的整体操作，诸如与显示，电话呼叫，数据通信，相机操作和记录操作相关联的操作。处理元件1002可以包括一个或多个处理器1020来执行指令，以完成上述的方法的全部或部分步骤。此外，处理组件1002可以包括一个或多个模块，便于处理组件1002和其他组件之间的交互。例如，处理部件1002可以包括多媒体模块，以方便多媒体组件1008和处理组件1002之间的交互。

[0202] 存储器1004被配置为存储各种类型的数据以支持在设备1000的操作。这些数据的示例包括用于在装置1000上操作的任何应用程序或方法的指令，联系人数据，电话簿数据，消息，图片，视频等。存储器1004可以由任何类型的易失性或非易失性存储设备或者它们的组合实现，如静态随机存取存储器(SRAM)，电可擦除可编程只读存储器(EEPROM)，可擦除可编程只读存储器(EPROM)，可编程只读存储器(PROM)，只读存储器(ROM)，磁存储器，快闪存储器，磁盘或光盘。

[0203] 电力组件1006为装置1000的各种组件提供电力。电力组件1006可以包括电源管理系统，一个或多个电源，及其他与为装置1000生成、管理和分配电力相关联的组件。

[0204] 多媒体组件1008包括在装置1000和用户之间的提供一个输出接口的屏幕。在一些实施例中，屏幕可以包括液晶显示器(LCD)和触摸面板(TP)。如果屏幕包括触摸面板，屏幕可以被实现为触摸屏，以接收来自用户的输入信号。触摸面板包括一个或多个触摸传感器以感测触摸、滑动和触摸面板上的手势。触摸传感器可以不仅感测触摸或滑动动作的边界，而且还检测与触摸或滑动操作相关的持续时间和压力。在一些实施例中，多媒体组件1008包括一个前置摄像头和/或后置摄像头。当设备1000处于操作模式，如拍摄模式或视频模式时，前置摄像头和/或后置摄像头可以接收外部的多媒体数据。每个前置摄像头和后置摄像头可以是一个固定的光学透镜系统或具有焦距和光学变焦能力。

[0205] 音频组件1012被配置为输出和/或输入音频信号。例如，音频组件1012包括一个麦克风(MIC)，当装置1000处于操作模式，如呼叫模式、记录模式和语音识别模式时，麦克风被配置为接收外部音频信号。所接收的音频信号可以被进一步存储在存储器1004或经由通信组件1016发送。在一些实施例中，音频组件1012还包括一个扬声器，用于输出音频信号。

[0206] I/O接口1012为处理组件1002和外围接口模块之间提供接口，上述外围接口模块可以是键盘，点击轮，按钮等。这些按钮可包括但不限于：主页按钮、音量按钮、启动按钮和

锁定按钮。

[0207] 传感器组件1014包括一个或多个传感器，用于为装置1000提供各个方面的状态评估。例如，传感器组件1014可以检测到设备1000的打开/关闭状态，组件的相对定位，例如组件为装置1000的显示器和小键盘，传感器组件1014还可以检测装置1000或装置1000一个组件的位置改变，用户与装置1000接触的存在或不存在，装置1000方位或加速/减速和装置1000的温度变化。传感器组件1014可以包括接近传感器，被配置用来在没有任何的物理接触时检测附近物体的存在。传感器组件1014还可以包括光传感器，如CMOS或CCD图像传感器，用于在成像应用中使用。在一些实施例中，该传感器组件1014还可以包括加速度传感器，陀螺仪传感器，磁传感器，压力传感器或温度传感器。

[0208] 通信组件1016被配置为便于装置1000和其他设备之间有线或无线方式的通信。装置1000可以接入基于通信标准的无线网络，如WiFi，2G或3G，或它们的组合。在一个示例性实施例中，通信部件1016经由广播信道接收来自外部广播管理系统的广播信号或广播相关信息。在一个示例性实施例中，通信部件1016还包括近场通信(NFC)模块，以促进短程通信。例如，在NFC模块可基于射频识别(RFID)技术，红外数据协会(IrDA)技术，超宽带(UWB)技术，蓝牙(BT)技术和其他技术来实现。

[0209] 在示例性实施例中，装置1000可以被一个或多个应用专用集成电路(ASIC)、数字信号处理器(DSP)、数字信号处理设备(DSPD)、可编程逻辑器件(PLD)、现场可编程门阵列(FPGA)、控制器、微控制器、微处理器或其他电子元件实现，用于执行上述方法。

[0210] 在示例性实施例中，还提供了一种包括指令的非临时性计算机可读存储介质，例如包括指令的存储器1004，上述指令在被执行时可配置装置1000的处理器1020以执行上述方法，包括：

[0211] 发送第一随机接入请求，第一随机接入请求中携带标识待请求系统消息的至少一个导码；

[0212] 在预设时间段内监听第一随机接入请求对应的响应消息，响应消息携带用于响应导码的信息；

[0213] 在监听到响应消息时，基于响应消息中包含的导码标识，在导码标识对应的待请求系统消息的发送窗口中监听并接收待请求系统消息。

[0214] 图11是根据一示例性实施例示出的一种适用于用于请求系统消息的装置的框图。装置1100可以被提供为一基站。参照图11，装置1100包括处理组件1122、无线发射/接收组件1124、天线组件1126、以及无线接口特有的信号处理部分，处理组件1122可进一步包括一个或多个处理器。

[0215] 处理组件1122中的其中一个处理器可以被配置为：

[0216] 接收用户设备发送的携带待请求系统消息的导码的随机接入请求；

[0217] 基于请求消息，生成预设格式的响应消息；

[0218] 发送响应消息。

[0219] 在示例性实施例中，基站中还提供了一种包括指令的非临时性计算机可读存储介质，存储介质上存储有计算机指令，其特征在于，指令被处理器执行时实现以下步骤：

[0220] 接收用户设备发送的携带待请求系统消息的导码的随机接入请求；

[0221] 基于请求消息，生成预设格式的响应消息；

[0222] 发送响应消息。

[0223] 本领域技术人员在考虑说明书及实践这里公开的公开后，将容易想到本公开的其它实施方案。本请求旨在涵盖本公开的任何变型、用途或者适应性变化，这些变型、用途或者适应性变化遵循本公开的一般性原理并包括本公开未公开的本技术领域中的公知常识或惯用技术手段。说明书和实施例仅被视为示例性的，本公开的真正范围和精神由下面的权利要求指出。

[0224] 应当理解的是，本公开并不局限于上面已经描述并在附图中示出的精确结构，并且可以在不脱离其范围进行各种修改和改变。本公开的范围仅由所附的权利要求来限制。

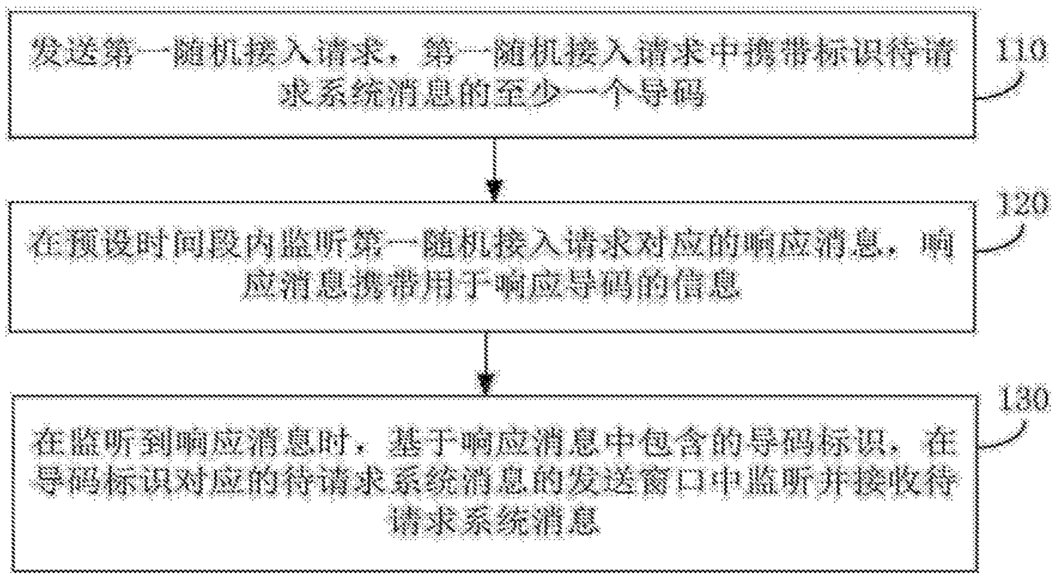

发送第一随机接入请求，第一随机接入请求中携带标识待请求系统消息的至少一个导码
110
在预设时间段内监听第一随机接入请求对应的响应消息，响应消息携带用于响应导码的信息
120
在监听到响应消息时，基于响应消息中包含的导码标识，在导码标识对应的待请求系统消息的发送窗口中监听并接收待请求系统消息
130

图1A


10
20

图1B

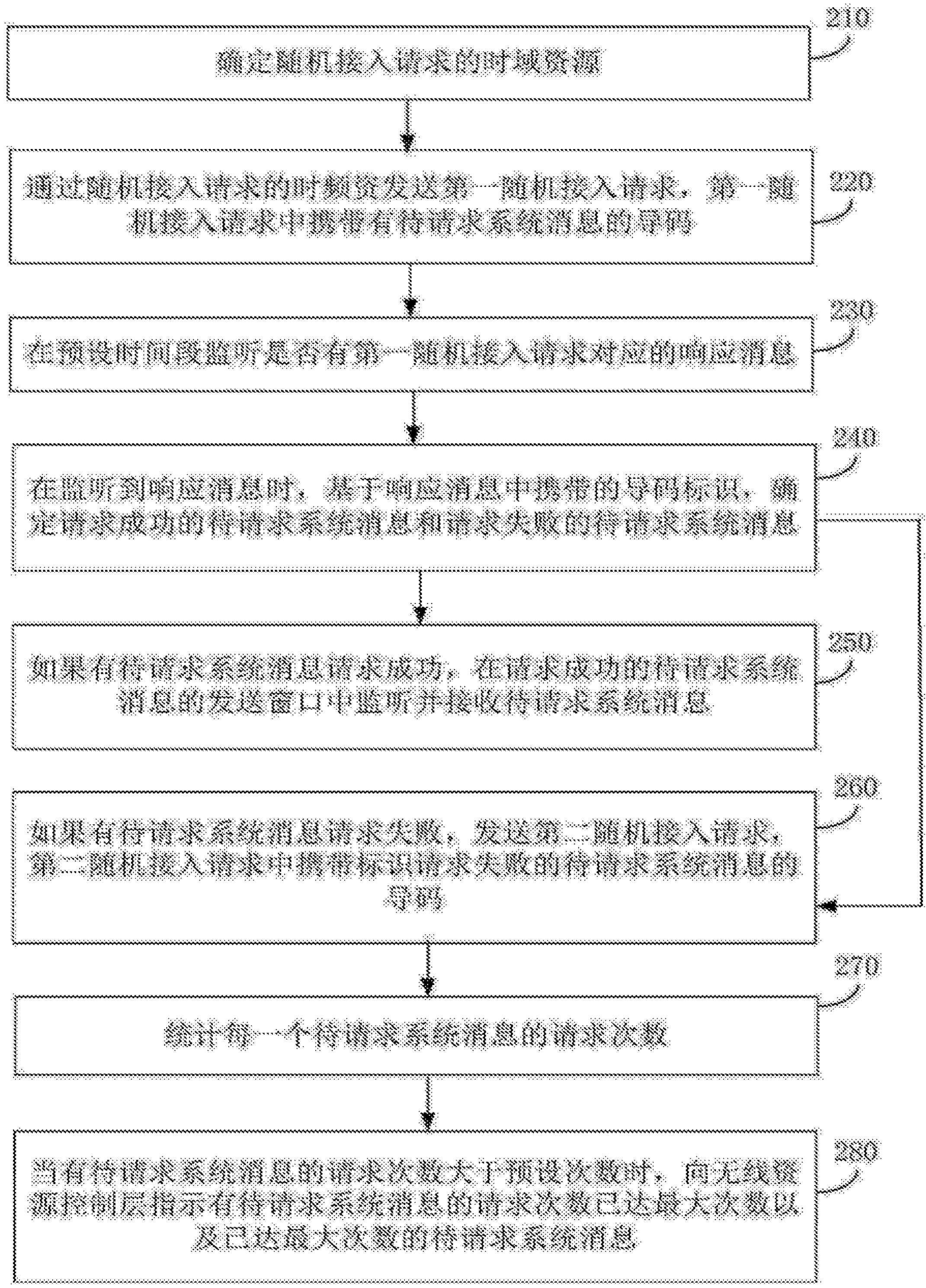

210
确定随机接入请求的时域资源
220
通过随机接入请求的时频资发送第一随机接入请求，第一随机接入请求中携带有待请求系统消息的导码
230
在预设时间段监听是否有第一随机接入请求对应的响应消息
240
在监听到响应消息时，基于响应消息中携带的导码标识，确定请求成功的待请求系统消息和请求失败的待请求系统消息
250
如果有待请求系统消息请求成功，在请求成功的待请求系统消息的发送窗口中监听并接收待请求系统消息
260
如果有待请求系统消息请求失败，发送第二随机接入请求，第二随机接入请求中携带标识请求失败的待请求系统消息的导码
270
统计每一个待请求系统消息的请求次数
280
当有待请求系统消息的请求次数大于预设次数时，向无线资源控制层指示有待请求系统消息的请求次数已达最大次数以及已达最大次数的待请求系统消息

图2

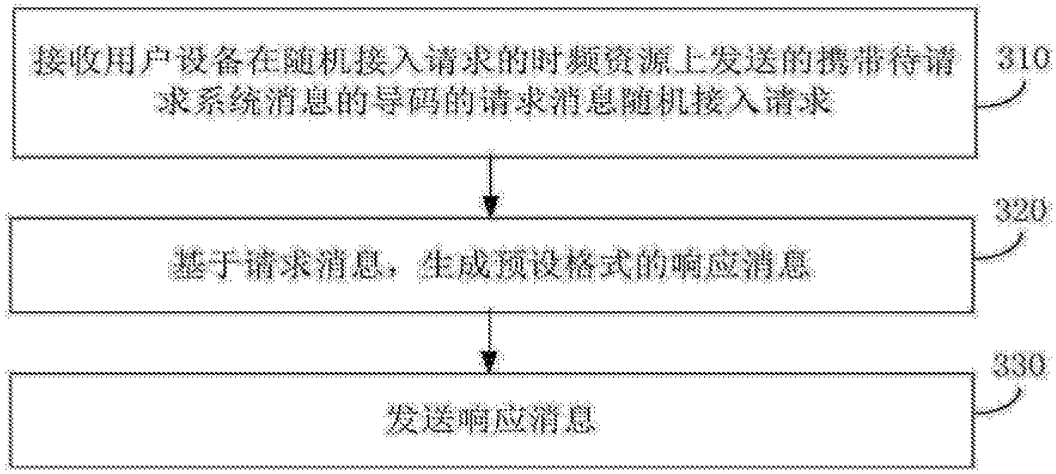

接收用户设备在随机接入请求的时频资源上发送的携带待请求系统消息的导码的请求消息随机接入请求
310
基于请求消息，生成预设格式的响应消息
320
发送响应消息
330

图3

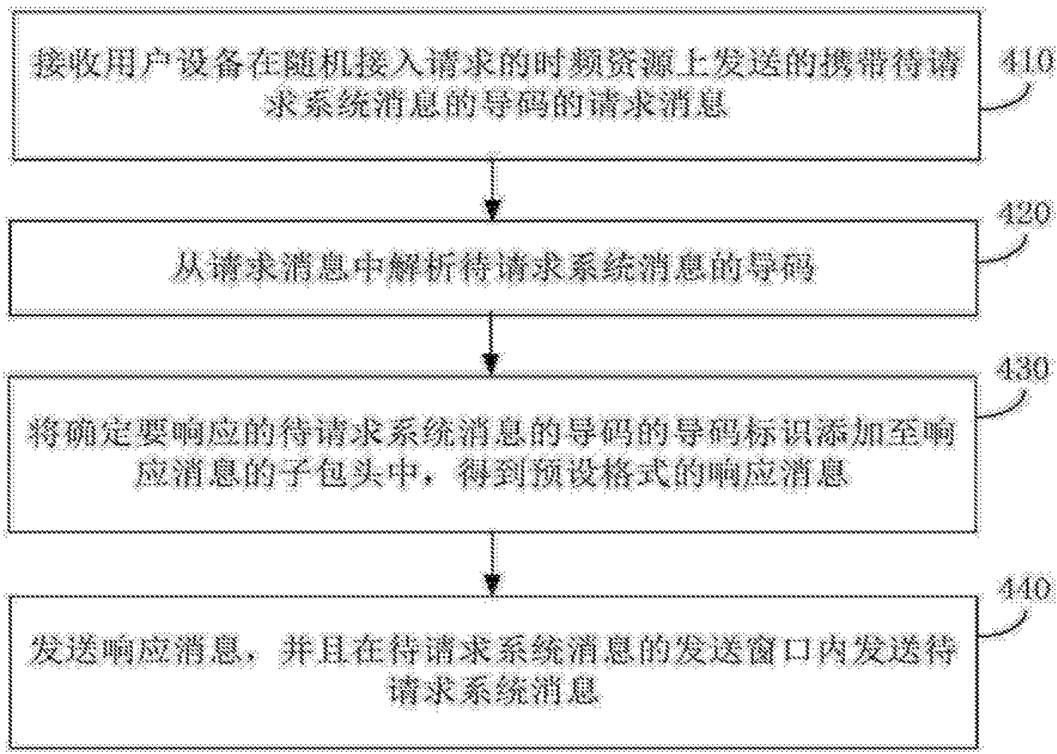

接收用户设备在随机接入请求的时频资源上发送的携带待请求系统消息的导码的请求消息
410
从请求消息中解析待请求系统消息的导码
420
将确定要响应的待请求系统消息的导码的导码标识添加至响应消息的子包头中，得到预设格式的响应消息
430
发送响应消息，并且在待请求系统消息的发送窗口内发送待请求系统消息
440

图4

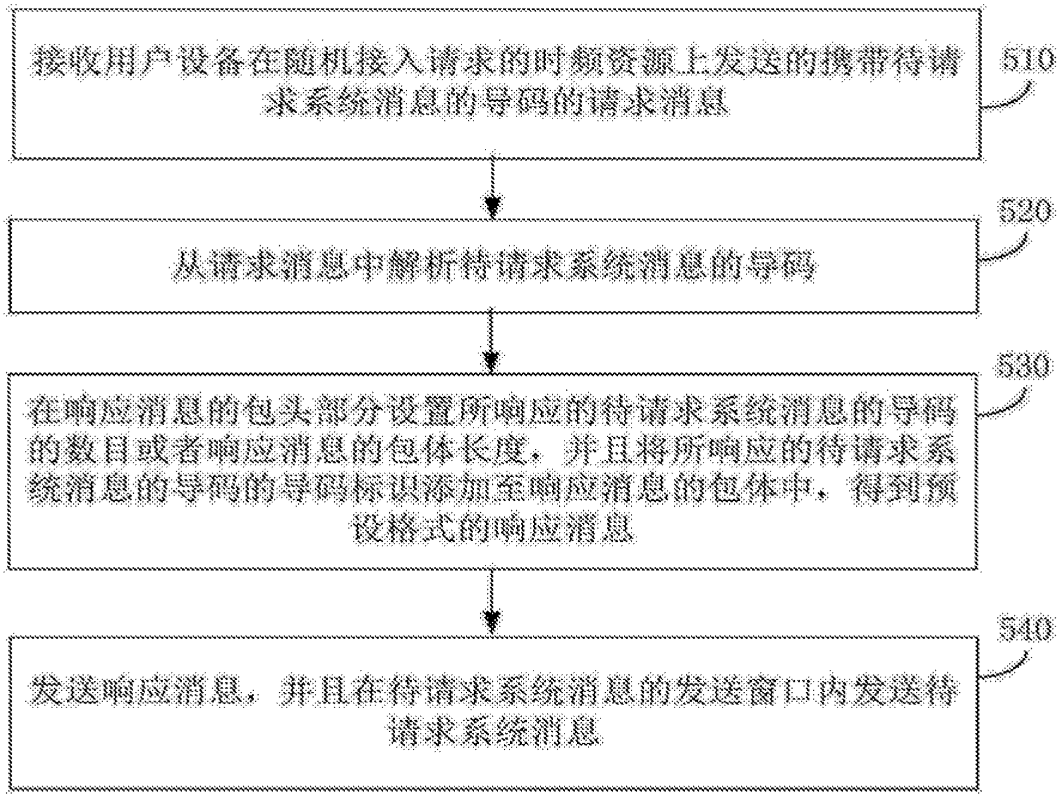

接收用户设备在随机接入请求的时频资源上发送的携带待请求系统消息的导码的请求消息
510
从请求消息中解析待请求系统消息的导码
520
在响应消息的包头部分设置所响应的待请求系统消息的导码的数目或者响应消息的包体长度，并且将所响应的待请求系统消息的导码的导码标识添加至响应消息的包体中，得到预设格式的响应消息
530
发送响应消息，并且在待请求系统消息的发送窗口内发送待请求系统消息
540

图5

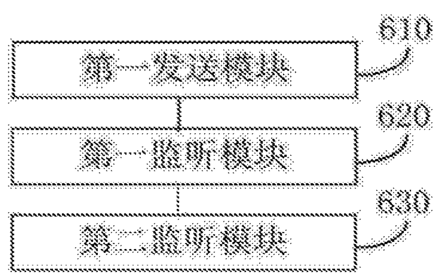

第一发送模块
610
第一监听模块
620
第二监听模块
630

图6

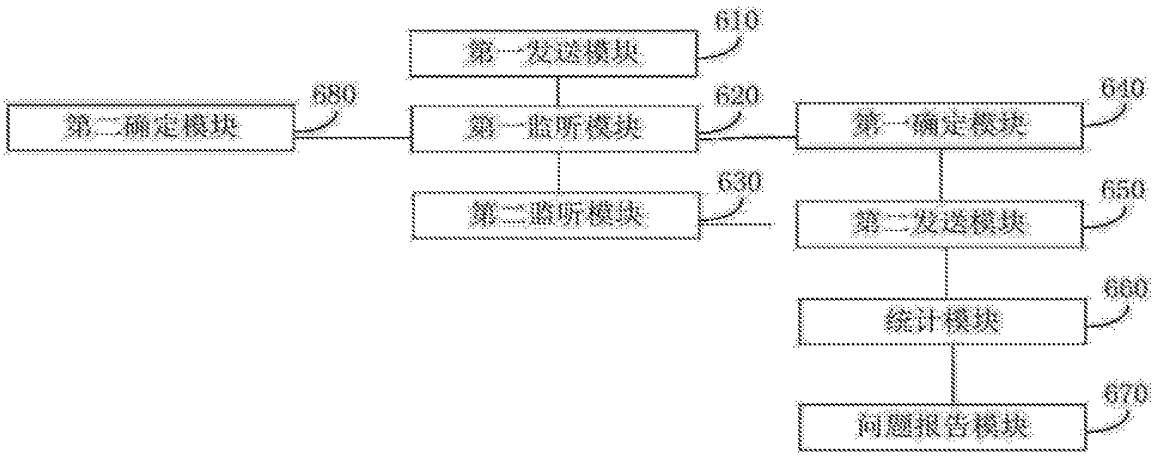

第一发送模块
610
第二确定模块
680
第一监听模块
620
第一确定模块
640
第二监听模块
630
第二发送模块
650
统计模块
660
问题报告模块
670

图7

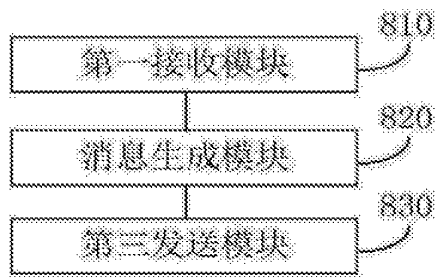

第一接收模块
810
消息生成模块
820
第三发送模块
830

图8

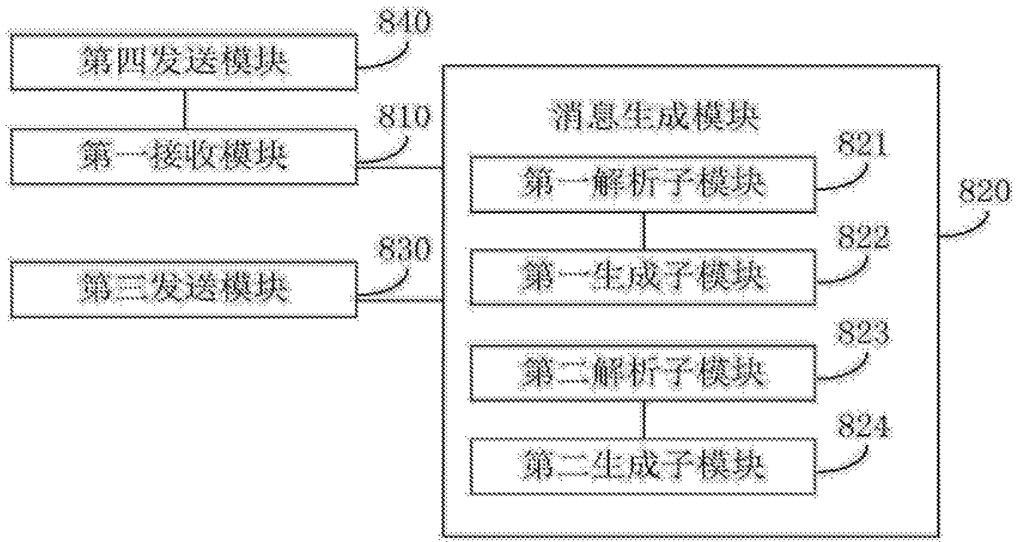

840
第四发送模块
810
第一接收模块
830
第三发送模块
消息生成模块
821
第一解析子模块
822
第一生成子模块
823
第二解析子模块
824
第二生成子模块
820

图9

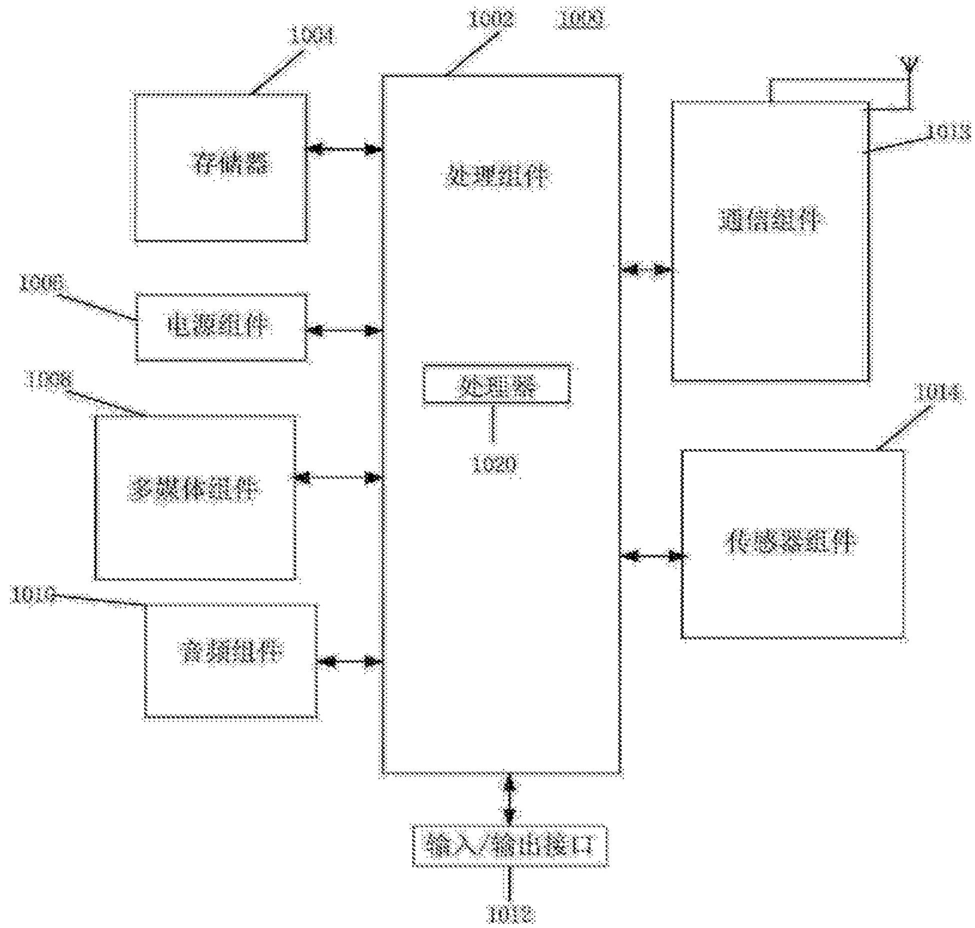

1004
1002
1000
存储器
处理组件
1013
通信组件
1006
电源组件
处理器
1008
1020
1014
多媒体组件
传感器组件
1010
音频组件
输入/输出接口
1012

图10

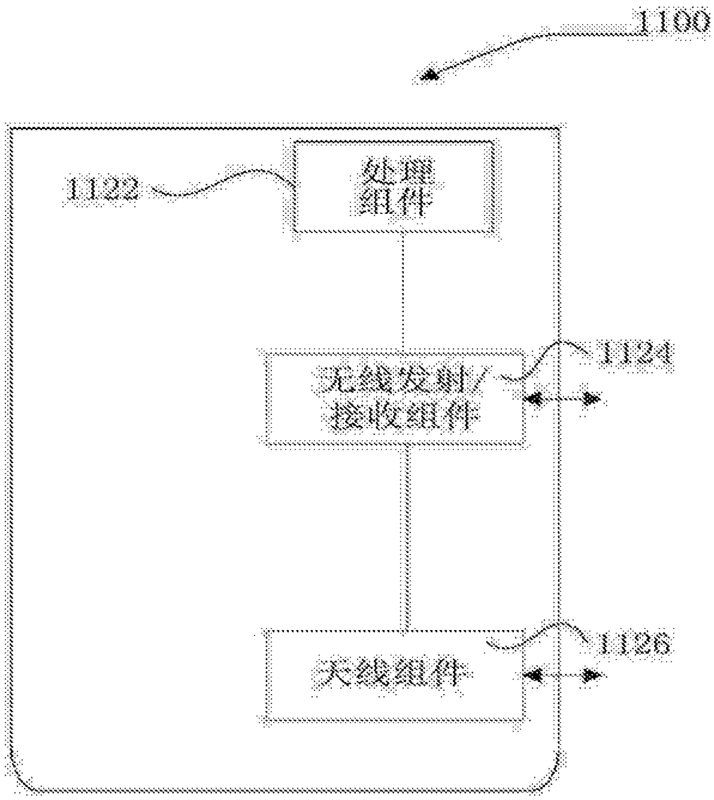


图11

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/372,389

APPLICATION AS FILED - PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	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	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 460 =	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	1720

APPLICATION AS AMENDED - PART II

AMENDMENT A

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	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

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	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	

* 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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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/372,389	04/01/2019	2642	1720	US76468	20	2

CONFIRMATION NO. 2472

FILING RECEIPT

OC000000107443337

54000
ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

Date Mailed: 04/18/2019

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**

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Applicant(s)

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Power of Attorney: The patent practitioners associated with Customer Number 54000

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/651,312 04/02/2018

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: 04/16/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/372,389**

Projected Publication Date: 10/03/2019

Non-Publication Request: No

Early Publication Request: No
Title

ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

Preliminary Class

455

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.

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Application Number	
Filing Date	
First Named Inventor	HUNG-CHEN CHEN
Title	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
Art Unit	
Examiner Name	
Attorney Docket Number	US76468

SIGNATURE of Applicant or Patent Practitioner

Signature	/Calvin H Chai/	Date (Optional)	2019-04-01
Name	Calvin H Chai	Registration Number	68009
Title (if Applicant is a juristic entity)	Patent Practitioner		
Applicant Name (if Applicant is a juristic entity)	FG Innovation Company Limited		

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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	Chie-Ming Chou	Date (Optional)	2018-11-29
Name	CHIE-MING CHOU		
Title	CEO		

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ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application claims the benefit of and priority to a provisional U.S. Patent Application Serial No. 62/651,312, filed on April 2, 2018, entitled "On-Demand System Information Request Procedure and Error Handling," with Attorney Docket No. US73481 (hereinafter referred to as "US73481 application"). The disclosure of the US73481 application is hereby incorporated fully by reference into the present application.

FIELD

[0002] The present disclosure generally relates to wireless communication, and more particularly, to the on-demand system information (SI) request procedure for the next generation wireless communication networks.

BACKGROUND

[0003] The concept of on-demand System Information (SI) request has been introduced in the next generation wireless network (e.g., a 5^{th} generation (5G) new radio (NR) network). When a UE finds that a required SI message(s) is not broadcasted, based on information in the System Information Block Type 1 (SIB1) (e.g., a one-bit indicator that shows whether the corresponding SI message is currently broadcasted or not) and the mapping of the SIBs to SI messages, the UE may perform an on-demand SI request procedure to ask the network (also referred to as NW) to broadcast the required SIB(s) and/or SI message(s). However, the next generation wireless network lacks an efficient mechanism for error handling associated with the on-demand SI request procedure.

SUMMARY

[0004] The present disclosure is directed to on-demand system information request procedure and the corresponding error handling procedure for the next generation wireless communication networks.

[0005] According to an aspect of the present disclosure, a method of wireless communications performed by a user equipment (UE) is provided. The method includes performing an on-demand system information (SI) request procedure in a first cell; and performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful. The error handling procedure includes storing SI request failure information.

[0006] According to another aspect of the present disclosure, a UE is provided. The UE includes one or more non-transitory computer-readable media having computer-executable instructions embodied thereon and at least one processor coupled to the one or more non-transitory computer-readable media. The at least one processor is configured to execute the computer-executable instructions to perform an on-demand system information (SI) request procedure in a first cell, and perform an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful. The error handling procedure includes storing SI request failure information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Aspects of the exemplary disclosure are best understood from the following detailed description when read with the accompanying figures. Various features are not drawn to scale, dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

[0008] Fig. 1 is a sequence diagram illustrating the transmission of SI request failure information, according to an exemplary implementation of the present application.

[0009] Fig. 2 is a sequence diagram illustrating an example of an on-demand SI request being transmitted to an MN in the DC mode, according to an exemplary implementation of the present application.

[0010] Fig. 3 is a sequence diagram illustrating an example of an on-demand SI request being transmitted to an SN in the DC mode, according to an exemplary implementation of the present application.

[0011] Fig. 4 is a sequence diagram illustrating an example of a UE determining the failure of an SI request in the DC mode, according to an exemplary implementation of the present application.

[0012] Fig. 5 is a sequence diagram illustrating an example of a UE receiving SI request rejection information in the DC mode, according to an exemplary implementation of the present application.

[0013] Fig. 6 is a flowchart for a method of wireless communications performed by a UE, according to an example implementation of the present application.

[0014] Fig. 7 illustrates a block diagram of a node for wireless communication, in accordance with various aspects of the present application.

DETAILED DESCRIPTION

[0015] The following description contains specific information pertaining to exemplary implementations in the present disclosure. The drawings in the present disclosure and their accompanying detailed description are directed to merely exemplary implementations. However, the present disclosure is not limited to merely these exemplary implementations. Other variations and implementations of the present disclosure will occur to those skilled in the art. Unless noted otherwise, like or corresponding elements among the figures may be indicated by like or corresponding reference numerals. Moreover, the drawings and illustrations in the present disclosure are generally not to scale, and are not intended to correspond to actual relative dimensions.

[0016] For the purpose of consistency and ease of understanding, like features are identified (although, in some examples, not shown) by numerals in the exemplary figures. However, the features in different implementations may be differed in other respects, and thus shall not be narrowly confined to what is shown in the figures.

[0017] The description uses the phrases "in one implementation," or "in some implementations," which may each refer to one or more of the same or different implementations. The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The term "comprising," when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the equivalent. The expression "at least one of A, B and C" or "at least one of the following: A, B and C" means "only A, or only B, or only C, or any combination of A, B and C."

[0018] Additionally, for the purposes of explanation and non-limitation, specific details, such as functional entities, techniques, protocols, standard, and the like are set forth for providing an understanding of the described technology. In other examples, detailed description of well-known methods, technologies, system, architectures, and the like are omitted so as not to obscure the description with unnecessary details.

[0019] Persons skilled in the art will immediately recognize that any network function(s) or algorithm(s) described in the present disclosure may be implemented by hardware, software or a combination of software and hardware. Described functions may correspond to modules may be software, hardware, firmware, or any combination thereof. The software implementation may comprise computer executable instructions stored on computer readable medium such as memory or other type of storage devices. For example, one or more microprocessors or general purpose computers with communication processing capability may be programmed with corresponding executable instructions and carry out the described network function(s) or algorithm(s). The microprocessors or general purpose computers may be formed of applications specific integrated circuitry (ASIC), programmable logic arrays, and/or using one or more digital signal processor (DSPs). Although some of the exemplary implementations described in this specification are oriented to software installed and executing on computer hardware, nevertheless, alternative exemplary implementations implemented as firmware or as hardware or combination of hardware and software are well within the scope of the present disclosure.

[0020] The computer readable medium includes but is not limited to random access memory (RAM), read only memory (ROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), flash memory, compact disc read-only memory (CD-ROM), magnetic cassettes, magnetic tape, magnetic disk storage, or any other equivalent medium capable of storing computer-readable instructions.

[0021] A radio communication network architecture (e.g., a long term evolution (LTE) system, a LTE-Advanced (LTE-A) system, a LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network) typically includes at least one base station, at least one user equipment (UE), and one or more optional network elements that provide connection towards a network. The UE communicates with the network (e.g., a core network (CN), an evolved packet core (EPC) network, an Evolved Universal Terrestrial Radio Access network (E-UTRAN), a 5G Core (5GC), or an internet), through a radio access network (RAN) established by one or more base stations.

[0022] It should be noted that, in the present application, a UE may include, but is not limited to, a mobile station, a mobile terminal or device, a user communication radio terminal. For example, a UE may be a portable radio equipment, which includes, but is not limited to, a mobile phone, a tablet, a wearable device, a sensor, or a personal digital assistant (PDA) with wireless communication capability. The UE is configured to receive and transmit signals over an air interface to one or more cells in a radio access network.

[0023] A base station may include, but is not limited to, a node B (NB) as in the UMTS, an evolved node B (eNB) as in the LTE-A, a radio network controller (RNC) as in the UMTS, a base station controller (BSC) as in the GSM/GERAN, a ng-eNB as in an E-UTRA base station in connection with the 5GC, a next generation node B (gNB) as in the 5G-RAN, and any other apparatus capable of controlling radio communication and managing radio resources within a cell. The base station may connect to serve the one or more UEs through a radio interface to the network.

[0024] A base station may be configured to provide communication services according to at least one of the following radio access technologies (RATs): Worldwide Interoperability for Microwave Access (WiMAX), Global System for Mobile communications (GSM, often referred to as 2G), GSM EDGE radio access Network (GERAN), General Packet Radio Service (GRPS), Universal Mobile Telecommunication System (UMTS, often referred to as 3G) based on basic wideband-code division multiple access (W-CDMA), high-speed packet access (HSPA), LTE, LTE-A, eLTE (evolved LTE), New Radio (NR, often referred to as 5G), and/or LTE-A Pro. However, the scope of the present application should not be limited to the above mentioned protocols.

[0025] The base station is operable to provide radio coverage to a specific geographical area using a plurality of cells forming the radio access network. The base station supports the operations of the cells. Each cell is operable to provide services to at least one UE within its radio coverage. More specifically, each cell (often referred to as a serving cell) provides services to serve one or more UEs within its radio coverage, (e.g., each cell schedules the downlink and optionally uplink resources to at least one UE within its radio coverage for downlink and optionally uplink packet transmissions). The base station can communicate with one or more UEs in the radio communication system through the plurality of cells. A cell may allocate sidelink (SL) resources for supporting proximity service (ProSe) or Vehicle to Everything (V2X) service. Each cell may have overlapped coverage areas with other cells.

[0026] As discussed above, the frame structure for NR is to support flexible configurations for accommodating various next generation (e.g., 5G) communication requirements, such as enhanced mobile broadband (eMBB), massive machine type communication (mMTC), ultra reliable communication and low latency communication (URLLC), while fulfilling high reliability, high data rate and low latency requirements. The orthogonal frequency-division multiplexing (OFDM) technology as agreed in 3GPP may serve as a baseline for NR waveform. The scalable OFDM numerology, such as the adaptive sub-carrier spacing, the channel bandwidth, and the Cyclic Prefix (CP) may also be used. Additionally, two coding schemes are considered for NR: (1) low-density parity-check (LDPC) code and (2) Polar Code. The coding scheme adaption may be configured based on the channel conditions and/or the service applications.

[0027] Moreover, it is also considered that in a transmission time interval TX of a single NR frame, a downlink (DL) transmission data, a guard period, and an uplink (UL) transmission data should at least be included, where the respective portions of the DL transmission data, the guard period, the UL transmission data should also be configurable, for example, based on the network dynamics of NR. In addition, sidelink resource may also be provided in a NR frame to support ProSe services or V2X services.

[0028] The 3rd Generation Partnership Project (3GPP) has introduced a new radio resource control (RRC) state (i.e., the RRC_INACTIVE state) for the next generation (e.g., 5th generation (5G)) wireless communication networks. The RRC_INACTIVE state (also referred to as inactive state in the following description) aims to achieve power saving with acceptable access latency, and is suitable especially for small data transmission, such as in machine type communications (MTC) scenarios. When a UE is in an inactive state, the 5G radio access network (5G-RAN) (e.g., the next generation radio access network (NG-RAN), other 3GPP/non-3GPP access network connected to a 5G core network) and the UE store the "UE context" (which may include Access Stratum (AS) context and Non-Access Stratum (NAS) context of the UE) separately. In addition, when the UE is in the inactive state, the UE may not have an RRC connection with the 5G-RAN, although the 5G-RAN may keep a connection with the next generation core network (e.g., 5G Core Network (5GC)).

[0029] The on-demand SI request procedure may be implemented differently for the UEs that are in different Radio Resource Control (RRC) states. For example, in one implementation, for a UE that is in a connected state, the NW may deliver on-demand SI messages or SIB(s) via dedicated signaling to the UE after receiving an SI request from the UE. In some implementations, for a UE that is in an idle state or an inactive state, the NW may deliver on-demand SI messages or SIB(s) via broadcasting. In some implementations, the NW may control the message type for the on-demand SI request procedure. For example, the message type for the on-demand SI request procedure may include a Message 1 (MSG1) based approach and a Message 3 (MSG3) based approach.

[0030] In some of the present embodiments, if a Random Access (RA) preamble and/or a Physical Random Access Channel (PRACH) resource specific to each SIB or set of SIBs (which the UE needs to acquire) is included in the minimum SI (e.g., in the Master Information Block and the SIB1), the SI request may be indicated using an MSG 1-based approach.

[0031] In an MSG1-based SI request, in some implementations, the minimum granularity for a requested SI may be one SI message (for a set of SIBs, as in an LTE scenario). In some of such implementations, one RA preamble may be used to request for multiple SI messages. In some implementations, a Random Access Preamble Index (RAPID) may be included in a Message 2 (MSG2). Other fields, such as Timing Advance (TA), UL grant and Temporary Cell Radio Network Temporary Identifier (C-RNTI), may not be included in the MSG2 in some implementations.

[0032] In some of the present embodiments, an RA procedure for SI request may be considered successful when the UE receives an MSG2 that includes a RAPID corresponding to the transmitted preamble. The MSG2 reception may use an RA-RNTI that corresponds to the MSG1 transmitted by the UE.

[0033] In some of the present embodiments, the UE may retransmit the RA preamble according to an NR RA power ramping when the SI request is considered to be unsuccessful. The MSG1 for SI request re-transmission may be continued until reaching maximum preamble transmissions in some of the present embodiments. Thereafter, an RA problem may be indicated to the upper layer (e.g., RRC layer). In some of the present embodiments, a Back off mechanism may be applicable to the MSG1-based SI requests. In some of such embodiments, however, no special back off sub-header/procedure may be required.

[0034] In some of the present embodiments, if the RA preamble and/or the PRACH resource (or PRACH occasions) specific to each SIB or set of SIBs (which the UE needs to acquire) is not included in the minimum SI, the SI request may be included in an MSG3. The UE may determine whether the MSG3-based approach is successful or not based on a reception of the MSG4. The preamble(s) and/or the PRACH occasions for the SI request using the MSG3-based approach may not be reserved in some aspects of the present embodiments. RRC signaling may be used for the SI request in an MSG3-based approach. In some embodiments, the UE's ID may not be included in the MSG3.

[0035] In some of the present embodiments, a temporary C-RNTI received in the MSG2 may be used for an MSG4 reception. The UE may check the contention resolution Medium Access Control (MAC) Control Element (CE) against the transmitted request.

[0036] Specifically, based on the MSG1-based SI request procedure, a UE which transmits a preamble on a dedicated PRACH resource (or PRACH occasions) for the SI request may need to wait for a corresponding Random Access Response (RAR) within a configured RAR window. If no RAR that contains a RAPID corresponding to the transmitted preamble is received, the UE may retransmit the RA preamble until the corresponding RAR is received. The MSG1 for SI request re-transmission, in some of the present embodiments, may be continued until a maximum preamble transmission is reached. In some of such embodiments, an RA problem may be indicated to the upper layers. However, during the whole MSG1-based SI request procedure, the requested SIB(s) or SI message(s) may be broadcasted based on the NW decision or other UE's SI request(s). There may be a power consumption issue if the UE does not stop the ongoing MSG1-based SI request procedure when the required SIB(s) has been broadcasted.

[0037] As described above, based on the MSG1-based SI request procedure, a UE which transmits a preamble on a dedicated PRACH resource for the SI request may need to wait for the corresponding RAR within a configured RAR window. If no RAR that contains a RAPID corresponding to the transmitted preamble is received, the UE may retransmit the RA preamble until reaching a maximum preamble transmission, and then an RA problem may be indicated to upper layers. If the corresponding RAR is received, the UE may send an MSG3 to indicate the required SIB(s) and/or SI message(s). After sending the MSG3, the UE may need to wait for a period e.g., defined by a contention resolution timer) for receiving the MSG4 for contention resolution. If the contention resolution timer expires and no MSG4 is received, the UE may retransmit a preamble again. In some of the present embodiments, the MSG1 for the SI request re-transmission may be continued until a maximum preamble transmission is reached. In some aspects of the present embodiments, an RA problem may be indicated to the upper layers. Similarly, since contention resolution is also adopted for the MSG3-based SI request procedure, an RA problem may be indicated to the upper layers if the maximum preamble transmission is reached.

[0038] CASE 1: A UE's behaviour when an on-demand SI request is unsuccessful for the

UE in an idle state or an inactive state:

[0039] When an MSG1-based SI request or an MSG3-based SI request procedure in a cell is failed, the UE may consider the cell as barred, or may consider that the required SIB(s) and/or SI message(s) are not available. In one implementation, the UE may consider the on-demand SI request procedure as unsuccessful when the number of times the UE transmits a random access preamble reaches a threshold (e.g., maximum allowable preamble transmissions), and/or the UE receives SI request rejection information (e.g., in a RAR) in some of the present embodiments.

[0040] If the UE considers that a cell is barred due to an SI request failure, the UE may consider the cell as barred for a configurable time period or a fixed time period (e.g., for 300s). The UE may perform a cell reselection procedure to find another cell to camp on. The barring time period may be broadcasted to the UE in system information, carried in an MSG2 or MSG4, or may be predefined as a fixed value in some of the present embodiments.

[0041] If the UE considers that the required SIB(s) and/or SI message(s) are not available, the UE may not perform the SI request for the unavailable SIB(s) and/or SI message(s) again on the cell. In some of the present embodiments, when the UE considers that the required SIB(s) and/or SI message(s) are not available (e.g., when an RA procedure problem is reported, or when SI request rejection information is received), the UE may activate a prohibit timer. In some of such embodiments, the UE may avoid initiating another on-demand SI request procedure until the prohibit timer expires. In one implementation, the UE is forbidden to perform another on-demand SI request procedure until the prohibit timer expires. For example, the prohibit timer may start when an upper layer (e.g., the RRC layer) receives the SI request rejection information, or receives the RA problem due to an SI request failure from a lower layer (e.g., the MAC layer). After the prohibit timer expires, the UE may initiate another SI request procedure. The prohibit timer may be preconfigured or may be a fixed value in some of the present embodiments. The value of the prohibit timer may be broadcasted in system information, carried in an MSG2 or MSG4, or may be predefined as a fixed value in some embodiments.

[0042] In one implementation, if the prohibit timer is not present in the signaling from the NW, it is up to UE's implementation on when to start the SI request procedure again.

[0043] In one implementation, the UE may determine whether to perform a cell reselection procedure due to a failure of the MSG1-based SI request or the MSG3-bsed SI request. The UE may make such a determination based on whether the required SIB(s) and/or SI message(s) are essential for the UE (e.g. essential for the UE's targeting services) or based on some other predefined rules. For example, the UE may determine to perform a cell reselection procedure as a result of an unsuccessful SI request if the required SIB(s) and/or SI message(s) are essential.

[0044] The UE may perform a cell reselection procedure due to a failure of the MSG1-based SI request or the MSG3-based SI request. Specifically, when the UE performs a cell reselection procedure, the UE may consider the cell, for which the UE fails to request the required SIB(s) and/or SI messages(s), as barred or having a lower priority (e.g., by setting the priority of the frequency on which the barred cell is to a default value). In one implementation, the requested SIB(s) and/or SI messages(s) may be defined/considered as the essential SI for different UE categories or UE types. If the requested SIB(s) and/or SI messages(s) are not defined/considered as the essential SI for the category or type of the UE, the UE may decide whether to re-request the requested SIB(s) or SI messages(s) on the camped cell. In one implementation, if the requested SIB(s) or SI messages(s) are not defined/considered as the essential SI for the category or type of the UE, a prohibit timer may start when the upper layer (e.g., the RRC layer) receives the RA problem due to an SI request failure from the lower layer (e.g., the MAC layer). After the prohibit timer expires, the UE may perform the SI request procedure again. The prohibit timer may be preconfigured or be a fixed value. The value of the prohibit timer may be broadcasted in the system information, carried in an MSG2 or MSG4, or may be predefined as a fixed value.

[0045] CASE 2: A UE's behaviour when the on-demand SI request is unsuccessful for the UE in a connected state:

[0046] A UE may also request the required SIB(s) or SI message(s) while the UE is in a connected state. Normally, the UE may receive the required SIB(s) or SI message(s) via dedicated signaling. If the UE does not receive the required SIB(s) or SI message(s) via dedicated signaling, (e.g., no response from the NW side to deliver the required SIB(s) or SI message(s), or receiving SI request rejection information), the UE may consider that there is an NW error and perform reestablishment to another qualified cell if there is another qualified cell with a valid UE context. If there is no such a qualified cell or if the reestablishment is rejected/failed, the UE may switch to an idle state and perform a cell reselection procedure by considering the cell as barred. In another implementation, the UE may directly switch to the idle state and then perform a cell reselection procedure by considering the cell as barred.

[0047] In one implementation, the NW may respond an SI request rejection message/information to the UE. After receiving the SI request rejection message/information, the UE may consider that the required SIB(s) or SI message(s) are not available and may not perform the SI request for those SIB(s) or SI message(s) again on the cell. In another implementation, a prohibit timer may be initiated when the UE receives the SI request rejection message/information. After the prohibit timer expires, the UE may perform an SI request procedure again. The prohibit timer may be preconfigured or may be a fixed value.

[0048] In one implementation, when the SI request procedure is unsuccessful, the UE may perform, at least, a reestablishment procedure, switch to an idle state for a cell reselection procedure, mark that the requested SIB(s) or SI message(s) are not available, etc.

[0049] In one implementation, the requested SIB(s) or SI messages(s) may be defined/considered as the essential SI for different UE categories or UE types. The UE may switch to the idle state and perform a cell reselection procedure when the SI request for essential SI is failed. The UE may consider the cell in which the SI request is failed as barred, or having a lower priority when performing a cell reselection procedure (e.g., by setting the priority of the frequency on which the barred cell is to a default value). The UE, in some of the present embodiments, may only mark that the requested SIB(s) or SI message(s) are not available when the SI request for non-essential SI is failed.

[0050] In the connected state, the NW may perform a handover (HO) procedure (e.g., from a source gNB to a target gNB) when receiving the SI request for required SIB(s) or SI message(s) that are not provided by the NW. The target gNB may provide the required SIB(s) or SI message(s) in the HO command (e.g., based on the SI request information provided in the HO Request message from the source gNB).

[0051] In the Dual Connectivity (DC) mode, the UE may inform the cause of a Secondary Node (SN) SI request failure, or the information related to the SI request failure to a Master Node (MN) when the on-demand SI request for the SIB(s) of the SN is rejected or failed. After the MN receives the cause of an SI request failure or the information related to the SI request failure, in some of the present embodiments, the MN may try to resolve the SN SI request rejection/failure problem. For example, in one aspect of the present embodiments, the MN may release the SN or change the SN to a new SN for the UE.

[0052] CASE 3: Store and report the information related to the SI request failure:

[0053] An MSG1-based SI request or an MSG3-bsed SI request procedure may be failed when a lower layer (e.g., the MAC layer) informs an upper layer (e.g., the RRC layer) of an RA problem. Since the RRC layer knows the RA procedure is triggered for the SI request, the UE may store the SI request failure information. The SI request failure information may include one or more parameters used in the on-demand SI request procedure. The SI request failure information may include at least one of the following: the on-demand SIB(s) requested by the UE, the on-demand SI message(s) requested by the UE, the cell ID (of the cell in which the UE has performed the SI procedure but has failed), SSB Index(s) (Synchronization Signal Block Index(s)) to perform the SI request procedure, the message type of the failed SI request procedure (e.g., MSG1-based or MSG3-based), the timestamp (e.g., when to perform the SI request procedure), etc. The SSB Index may indicate which SSB with RA resource (or RA occasions) is used for a preamble transmission. For example, for an MSG1-based approach, the dedicated RA resource (or RA occasions) for transmitting a preamble may be associated with an SSB. For an MSG3-based approach, the common RA resource (or RA occasions) for transmitting a preamble may be associated with an SSB. The UE may report such failure information to the NW when switching to a connected state later. The UE may mandatorily report the information of the SI request failure, according to the configuration, or upon an NW request. The content of the SI request failure information may be predefined, may be based on the required information indicated in the received SI request failure information message, or may be based on the configuration.

[0054] Fig. 1 is a sequence diagram illustrating the transmission of SI request failure information, according to an exemplary implementation of the present application. As shown in diagram 100, in action 110, serving node 104 (e.g., a gNB) may send a request to UE 102 to provide the information related to SI request failure. For example, serving node 104 may send an SI Request Failure Information Request message to UE 102 if UE 102 informs serving node 104 that such information is stored. In one implementation, UE 102 may set one bit in an RRC message (e.g., in the RRC Connection Setup Complete message or in the RRC Connection Resume message) to true (or '1') to inform serving node 104 that UE 102 supports storage of the SI request failure information and it has the SI request failure information stored. Serving node 104 may determine to request the SI request failure information after receiving such information from UE 102. In action 112, UE 102 may send a message including the SI request failure information to serving node 104.

[0055] By utilizing the SI request failure information, serving node 104 may know how to adjust the SI request mechanism between the MSG1-based approach and the MSG3-based approach. For example, if UE 102 reports failure of an MSG3-based SI request procedure in a cell or a certain area, serving node 104 may consider adopting the MSG1-based SI request for the UEs in idle/inactive state to avoid an RA collision by using the dedicated RA resource(s) for SI request. Alternatively, serving node 104 may continue to adopt the MSG3-based SI request procedure when UE 102 reports the failure of the MSG3-based SI request procedure.

[0056] In one implementation, UE 102 may store the information related to the SI request failure when UE 102 considers the cell as barred and performs a cell reselection procedure. UE 102 may not store the information related to the SI request failure when UE 102 considers that the required SIB(s) or SI message(s) are not available.

[0057] When the SI request procedure for a UE that is in a connected state is failed (e.g., UE 102 does not receive the required SIB(s) or SI message(s) via dedicated signaling, or UE 102 receives the SI request rejection information), UE 102 may store the information of the SI request failure. In one implementation, when the SI request procedure is unsuccessful, UE 102 may perform re-establishment to another qualified cell, or UE 102 may switch to an idle state and then perform a cell reselection procedure by considering the cell as barred. The information of the SI request failure may include at least one of the following: the required SIB(s), the required SI message(s), the cell ID (of the cell in which the UE preforms SI procedure but failed), and the timestamp of the SI request procedure. UE 102 may report such failure information to the NW when switching to a connected state later. UE 102 may mandatorily report the information of the SI request failure, according to the configuration, or upon receiving an NW request. The content of the SI request failure information may be predefined, may be based on the required information indicated in the received SI request failure information message, or may be based on the configuration.

[0058] Similarly, UE 102 may store the SI request failure information when UE 102 is in a connected state if the SI request is unsuccessful (where SI request procedure may be an MSG1-based SI approach or an MSG3-based SI approach). The SI request failure information may include at least one of the following: the on-demand SIB(s) requested by UE 102, the on-demand SI message(s) requested by UE 102, the cell ID (of the cell which UE 102 preforms SI procedure but failed), SSB Index(s) (Synchronization Signal Block Index(s)) to perform the on-demand SI request procedure, the message type of the unsuccessful SI request procedure (e.g., MSG1-based or MSG3-based), and the timestamp (e.g., when to perform the SI request procedure). The UE may mandatorily report the SI request failure information, according to the configuration, or by an NW request (e.g., requested by serving node 104). The content in the SI request failure information may be predefined, may be based on the required information indicated in the received SI Request Failure Information message, or may be based on the configuration.

[0059] It may be beneficial for the NW to know the information related to SI request failure. For example, the NW may determine which cell, SIB(s)/SI message(s), or the related dedicated preamble may have problems. As a result, the NW is likely to overcome the problem afterwards, or the NW may consider adopting another mechanism for serving the SI request.

[0060] In the DC mode, a UE may inform the cause of a Secondary Node (SN) SI request failure, or the information related to the SI request failure, to a Master Node (MN) when the on-demand SI request for the SIB(s) of the SN is rejected or failed. After MN receives the cause of the SI request failure or the information related to the SI request failure, the MN may try to resolve the SN's SI request rejection/failure problem. For example, the MN may release the SN or change the SN to a new SN for the UE.

[0061] CASE 4: Harmonization of the SI Request messages in idle, inactive, and connected states:

[0062] For an MSG3-bsed SI request procedure, the MSG3 may include an SI request message (which may be an RRC message) containing no UE ID. In an idle state, there may be no security key and/or security algorithm configured to the UE yet. Therefore, the SI request message transmitted in an idle state may be transmitted on Signaling Radio Bearer 0 (SRB0). Neither integrity protection, nor ciphering, apply to the SRB0 in some embodiments. In one implementation, the SI request message (which is an RRC message) may be the same for idle, inactive, and connected states, resulting in an RRC message harmonization. The SI request message may be transmitted on the SRB0 without integrity protection and ciphering, even if the UE is in a connected state, or in an inactive state, where integrity protection and ciphering may have been already applied.

[0063] In one implementation, the SI request message (which is an RRC message) that includes no UE ID may be the same for idle, inactive, and connected states. The UE may transmit the SI request message on the SRB0 when the UE is in an idle or an inactive state. The UE may transmit the SI request message on Signaling Radio Bearer 1 (SRB1) when the UE is in a connected state. Both integrity protection and ciphering may apply to the SRB1.

[0064] In one implementation, the SI Request message (which is an RRC message) may be the same for idle, inactive, and connected states. The UE may transmit the SI request message on the SRB0 when the UE is in an idle state. The UE may transmit the SI request message on the SRB1 when the UE is in an inactive or a connected state. Both integrity protection and ciphering may apply to the SRB1. In an inactive State, the UE may still have the UE context and the NW's configuration for integrity protection and ciphering.

[0065] In one implementation, whether the SI request message is transmitted on the SRB0 or the SRB1 for a UE in an inactive state may be determined based on the UE's implementation, the NW's preconfiguration, and/or whether the UE context for integrity protection and ciphering is stored/valid or not.

[0066] It may be beneficial to keep the commonality of the SI Request message with respect to the UEs in different states, which may lead to simplification of the overall system design in some of the present embodiments.

[0067] CASE 5: The structure of an SI Request Message:

[0068] In one implementation, the SI request message in the MSG3 (e.g., in an MSG3-based SI request procedure) may be the same for idle, inactive, and connected states. Different minimum granularity of the requested SI (e.g., SIB-based or SI message-based) may be considered in connection with the SI request message. For example, it may be beneficial for the SI request message to use SI message-based granularity (e.g., the UE indicates which SI message(s) is requested) in the MSG3-based SI request procedure, since there is a one-bit indicator in the NR SIB1 to show whether the corresponding SI message is currently broadcasted or not, and the number of SI messages may be much less than the number of SIBs. However, the SI message-based granularity may not provide sufficient information to the NW in regards to which SIB(s) needs to be broadcasted and/or whether the mapping of the SIB(s) and the SI message(s), and the associated periodicity may need to be re-arranged based on the UE's requirements. The UE in connected state may receive the required SI via dedicated signaling. Therefore, in one implementation, the SIB-based granularity may be used, e.g., by the UE indicating which SIB(s) is requested.

[0069] Different implementations regarding the different SIB-based granularities will be discussed next:

[0070] CASE 5-1:

[0071] In the SI Request message, there may be a choice structure in which the UE may choose to use the SI message-based granularity or the SIB-based granularity. The UE may consider the signaling overhead to select which granularity to use. In one implementation, the UE may use a first bitmap to indicate which SI message(s) is requested and a second bitmap to indicate which SIB(s) is requested. In one implementation, there may be a common bitmap for the UE to indicate which SI message(s) is requested or which SIB ID(s) is requested.

[0072] CASE 5-2:

[0073] In the SI Request message, there may be a choice structure in which the UE may choose to use the SI message-based granularity or the SIB-based granularity. The UE may select one of the two types of granularity based on the NW configuration. The NW configuration may be delivered to the UE via dedicated signaling or via broadcasting. In one implementation, the UE may use a first bitmap to indicate which SI message(s) is requested and a second bitmap to indicate which SIB(s) is requested. In one implementation, there may be a common bitmap for the UE to indicate which SI message(s) is requested or which SIB ID(s) is requested.

[0074] CASE 5-3:

[0075] In the SI Request message, in some of the present embodiments, the UE may request one or more SI messages together with one or more SIBs. For example, both SI message-based granularity and SIB-based granularity may be potentially used in the SI Request message. Specifically, a UE may send an SI Request message that only uses the SI message-based granularity, only uses the SIB-based granularity, or uses both SI message-based granularity and SIB-based granularity. The UE may use a first bitmap to indicate which SI message(s) is requested and a second bitmap to indicate which SIB(s) is requested. In one implementation, there may be a common bitmap for the UE to indicate which SI message(s) is requested or which SIB ID(s) is requested.

[0076] CASE 5-4:

[0077] In some of the present embodiments, the UE may use a two-level bitmap for the SI request messages. In some of such embodiments, the first level bitmap may be used for the SI-based granularity, which may be mandatorily appended in the SI request message. The second level bitmap may be used for the SIB-based granularity, which may be optionally appended in the SI request message if the corresponding SI bit is set to "1" in the first level bitmap. As an example, in which there are 5 SI messages, and the SI message#3 includes SIB#7, SIB#8, SIB#9 andSIB#10, when the UE wants to request SIB#9, the first level bitmap of the UE's SI request message may be "0100" (which indicates SI message#3), and the UE may further optionally append the second level bitmap "0100" (which indicates the third SIB in the SI message#3). Consequently, a gNB may provide SIB#9 specifically in response to such an SI request message. In one implementation, if the second bitmap does not appear, the gNB may provide the complete SI message#3.

[0078] CASE 6: On-demand SI Request Procedure in an NR-NR DC scenario:

[0079] A UE in an NR-NR Dual Connectivity (DC) mode may request one or more required SIBs or one or more SI messages for certain purpose(s) or certain service(s). Several implementations are described below regarding how the UE may request and receive the required SIB(s) from a secondary node (SN) or the serving cells in a secondary cell group (SCG).

[0080] CASE 6-1:

[0081] When a UE is in an NR-NR DC mode and one or more SIBs or one or more SI messages are required, the UE may be only allowed to send the SI request message to the master node (MN) in some of the present embodiments.

[0082] Fig. 2 is a sequence diagram illustrating an example of an on-demand SI request being transmitted to an MN in the DC mode, according to an exemplary implementation of the present application. As shown in diagram 200, in action 210, UE 102 may transmit an SI request message to MN 106 when UE 102 requires on-demand system information of a cell belonging to MN 106 or a cell belonging to SN 108. In action 212, MN 106 may inform SN 108 to provide the required SIB(s) or SI message(s) to UE 102 based on the SI request message. For example, MN 106 may use a signaling message between two base stations (e.g., X2-AP message or Xn-AP message) with fields indicating the requested SIB(s) or SI message(s). When SN 108 receives the SI request from MN 106, SN 108 may transmit the required SIB(s) or SI message(s) to UE 102 by initiating serving cell release and addition action in the same RRC reconfiguration message to update the SIB(s) or SI message(s) for certain, or all, serving cell(s). As shown in diagram 200, this RRC reconfiguration may be transmitted via MN 106 or transmitted via Signaling Radio Bearer 3 (SRB3), if configured.

[0083] When the UE requires on-demand system information of a cell belonging to MN 106, if the requested SI message or SIB is not broadcasted, in action 214, MN 106 may transmit the required SI to UE 102. When the UE requires on-demand system information of a cell belonging to SN 108, if the requested SI message or SIB is not provided before, in action 216, SN 108 may transmit RRC Reconfiguration with the required SI to UE 102 (e.g., via the SRB3). In one implementation, SN 108 may transmit RRC Reconfiguration with required SI (e.g., action 216) only when SN 108 receives the SI Request Notification from MN 106 (e.g., action 212).

[0084] In one implementation, SN 108 may directly transmit the modified SIB(s) or SI messages(s) to UE 102 without taking cell release and addition action, when MN 106 sends the SI Request Notification to SN 108. SN 108 may transmit the modified SIB(s) or SI messages(s) directly to UE 102 only when receiving the SI Request Notification from MN 106.

[0085] In one implementation, UE 102 is only allowed to send the SI request message to MN 106. The UE may indicate in the SI request message that the SI Request is for the SIB(s) or the SI message(s) on MN 106 or SN 108. If the SI Request message is marked for MN 106, MN 106 may be responsible for this SI Request message. On the other hand, if the SI Request message is marked for SN 108, MN 106 may forward this message to SN 108 and SN 108 may be responsible for this SI Request message. It should be noted that UE 102 may follow the minimum SI's indication (e.g., SI transmission period) of MN 106 or SN 108 to receive the SI while the SI request message is marked to MN 106 or SN 108, respectively. In another implementation, UE 102 may not mark the SI request toward MN 106 or SN 108, and MN 106 may provide all (MN 106 and SN 108) relative SI to UE 102 in a unicast approach.

[0086] If some or all of the serving cells in the SCG do not provide the requested SIB(s) or SI message(s), SN 108 may inform MN 106 that the SCG, or some serving cells in the SCG, does not provide the requested SIB(s) or SI message(s). MN 106 may decide whether to perform the SCG change action or release SN 108 for UE 102.

[0087] CASE 6-2:

[0088] When a UE in the NR-NR DC mode and one or more SIBs or SI messages are required, the UE may send the SI request message to the MN and/or the SN when required.

[0089] Fig. 3 is a sequence diagram illustrating an example of the on-demand SI request being transmitted to an SN in the DC mode, according to an exemplary implementation of the present application. As shown in diagram 300, in action 310, UE 102 may transmit the SI request message to SN 108 (e.g., via SRB3, if configured). In action 312, SN 108 may transmit RRC Reconfiguration with the required SI to UE 102 via SRB3. If SRB3 is not configured, UE 102 may transmit the SI request message to MN 106 and let MN 106 forward the SI request message to SN 108.

[0090] When some or all of the serving cells in the SCG cannot provide the required SIB(s) or SI message(s), SN 108 may inform MN 106 that the SCG, or some serving cells in the SCG, does not provide the requested SIB(s) or SI message(s). MN 106 may decide whether to perform the SCG change action or release SN 108 for UE 102.

[0091] Fig. 4 is a sequence diagram illustrating an example of the UE determining the failure of an SI request in the DC mode, according to an exemplary implementation of the present application. As shown in diagram 400, in action 410, UE 102 sends an SI request message to SN 108. In action 412, UE 102 determines the failure of the SI request, e.g., when the number of times UE 102 transmits the random access preamble reaches a threshold. After determining the on-demand SI request procedure is unsuccessful, UE 102 may store the SI request failure information related to SN 108. In action 414, UE 102 may transmit the SN SI request failure information to MN 106.

[0092] Fig. 5 is a sequence diagram illustrating an example of the UE receiving SI request rejection information in the DC mode, according to an exemplary implementation of the present application. As shown in diagram 500, in action 510, UE 102 sends an SI request message to SN 108. In action 512, UE 102 receives the SI request rejection information from SN 108. After determining the on-demand SI request procedure is unsuccessful, UE 102 may store the SI request failure information related to SN 108. In action 514, UE 102 may send the SN SI request failure information to MN 106.

[0093] If UE 102 determines that the SI request procedure on SN 108 has failed (e.g., action 412 in diagram 400 or action 512 in diagram 500), UE 102 may inform MN 106 of the cause of SN SI request failure or the information related to SN SI request failure (e.g., by sending an SN SI Request Failure Information when the on-demand SI request for the SIB(s) of SN 108 is rejected or failed, e.g., in action 414 of diagram 400, or action 514 of diagram 500). The information of the SI request failure may include at least one of the following: the required SIB(s), the required SI message(s), the cell ID (of the cell which the UE preforms SI procedure but failed), SSB Index(s) (Synchronization Signal Block Index(s)) to perform SI request, the failed SI request procedure type (e.g., MSG1-based or MSG3-based), or the timestamp (e.g., when to perform the SI request procedure). After MN 106 receives the cause of the SI request failure or the information related to the SI request failure, MN 106 may resolve the SN SI request rejection/failure problem. For example, MN 106 may release SN 108 or change SN 108 to a new SN for UE 102.

[0094] CASE 7: An RA Problem caused by the MSG1-based/MSG3-bsed SI request procedure:

[0095] A UE in connected state may be allowed to apply an MSG1-based SI request procedure and/or an MSG3-based SI request procedure. In one implementation, if the RA problem is caused by the MSG1-based or the MSG3-bsed SI request procedures, the UE's operation in connected state is not affected if the requested SI message(s) or SIB(s) is not essential for the UE to perform the targeting services.

[0096] In one implementation, the UE may still be fine even if the requested SIB(s) or SI message(s) is not received from the serving node (e.g., in a single connectivity mode) or the MN (e.g., in dual connectivity mode) (e.g., the requested SIB or SI message may not be essential). In this scenario, the UE may not consider the RA problem as a normal radio link failure, and the UE may not perform a re-establishment procedure, or enter into an idle state.

[0097] In one implementation, the UE may still be fine even if the requested SIB(s) or SI message(s) is not received from the SN (e.g., in a dual connectivity mode). In this scenario, the UE may not consider the RA problem as a normal radio link failure, and the UE may report the SI failure information to the MN. For example, when the RA problem is reported and the upper layer (e.g., the RRC layer) knows that the problem is caused by an SI request, the UE may initiate a transmission of the SI failure information report to the MN. In this implementation, the UE may not suspend all of the SCG data radio bearers (DRBs) or SCG transmission for the split DRBs or the duplication DRBs. Also, the UE may not reset the MAC entity associated with the SCG (or SN).

[0098] In one implementation, the UE may still be fine even if the requested SIB(s) or SI message(s) is not received from the SN (e.g., in a dual connectivity mode). In this scenario, the UE may not consider the RA problem as a normal radio link failure, and the UE may not report the SI failure information to the MN. For example, when the RA problem is reported and the upper layer (e.g., RRC layer) knows that the problem is caused by an SI request, the UE may not initiate a transmission of the SI failure Information report to the MN. In this implementation, the UE may not suspend all of the SCG DRBs or SCG transmission for the split DRBs or the duplication DRBs. Also, the UE may not reset the MAC entity associated with the SCG (or SN). When the upper layer (e.g., the RRC layer) receives the RA problem caused by the SI request from the lower layer (e.g., the MAC layer), it may also inform the NAS layer (or the application layer) so that the NAS layer (or the application layer) does not trigger the SI request procedure for one or more required SIBs on the same cell, or not trigger the SI request procedure for a while (which may follow the NW configuration or a predefined period). How to handle the SI request failure condition may depend on the UE's implementation, if the NAS layer (or the application layer) is informed about the SI request failure.

[0099] In one implementation, whether the SN initiates the transmission of the SI failure information report to the MN may depend on the NW configuration.

[00100] Fig. 6 is a flowchart for a method of wireless communications performed by a UE, according to an example implementation of the present application. In Fig. 6, the process/method 600 includes actions 602, 604, 606, and 610.

[00101] In action 602, the UE may perform an on-demand system information request procedure in a cell. The UE may be in idle, inactive, or connected state. In addition, the UE may be in a single connectivity mode or a dual connectivity mode.

[00102] In action 604, the UE may determine whether the on-demand SI request procedure is successful. In one implementation, the on-demand SI request procedure is considered unsuccessful when the number of times the UE transmits a random access preamble reaches a threshold, and/or the UE receives the SI request rejection information. If the process 600 determines, in action 604, that the SI request procedure is unsuccessful, the UE may proceed to action 606. On the other hand, if the request procedure is successful, the process 600 may end.

[00103] In action 606, the UE may perform an error handling procedure corresponding to the on-demand SI request procedure. There may be several implementations regarding the error handling procedure in different implementations. In one implementation, the error handling procedure may include action 610, in which the UE may store the SI request failure information. For example, the SI request failure information may include one or more parameters used in the on-demand SI request procedure. In one implementation, the error handling procedure may further include at least one of following: a prohibit timer activation, a cell re-selection procedure, and a re-establishment procedure.

[00104] Fig. 7 illustrates a block diagram of a node for wireless communication, in accordance with various aspects of the present application. As shown in Fig. 7, node 700 may include transceiver 720, processor 726, memory 728, one or more presentation components 734, and at least one antenna 736. Node 700 may also include a Radio Frequency (RF) spectrum band module, a base station communications module, a network communications module, and a system communications management module, input/output (I/O) ports, I/O components, and power supply (not explicitly shown in Fig. 7). Each of these components may be in communication with each other, directly or indirectly, over one or more buses 740.

[00105] Transceiver 720 having transmitter 722 and receiver 724 may be configured to transmit and/or receive time and/or frequency resource partitioning information. In some implementations, transceiver 720 may be configured to transmit in different types of subframes and slots including, but not limited to, usable, non-usable and flexibly usable subframes and slot formats. Transceiver 720 may be configured to receive data and control channels.

[00106] Node 700 may include a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by node 700 and include both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data.

[00107] Computer storage media includes RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices. Computer storage media does not comprise a propagated data signal. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term “modulated data signal” means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

[00108] Memory 728 may include computer-storage media in the form of volatile and/or non-volatile memory. Memory 728 may be removable, non-removable, or a combination thereof.

Exemplary memory includes solid-state memory, hard drives, optical-disc drives, and etc. As illustrated in Fig. 7, memory 728 may store computer-readable, computer-executable instructions 732 (e.g., software codes) that are configured to, when executed, cause processor 726 to perform various functions described herein, for example, with reference to Figures 1 through 6. Alternatively, instructions 732 may not be directly executable by processor 726 but be configured to cause node 700 (e.g., when compiled and executed) to perform various functions described herein.

[00109] Processor 726 may include an intelligent hardware device, e.g., a central processing unit (CPU), a microcontroller, an ASIC, and etc. Processor 726 may include memory. Processor 726 may process data 730 and instructions 732 received from memory 728, and information through transceiver 720, the base band communications module, and/or the network communications module. Processor 726 may also process information to be sent to transceiver 720 for transmission through antenna 736, to the network communications module for transmission to a core network.

[00110] One or more presentation components 734 presents data indications to a person or other device. Exemplary one or more presentation components 734 include a display device, speaker, printing component, vibrating component, and etc.

[00111] From the above description, it is manifest that various techniques can be used for implementing the concepts described in the present application without departing from the scope of those concepts. Moreover, while the concepts have been described with specific reference to certain implementations, a person of ordinary skill in the art may recognize that changes can be made in form and detail without departing from the scope of those concepts. As such, the described implementations are to be considered in all respects as illustrative and not restrictive. It should also be understood that the present application is not limited to the particular implementations described above, but many rearrangements, modifications, and substitutions are possible without departing from the scope of the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. A method of wireless communications performed by a user equipment (UE), the method comprising:

performing an on-demand system information (SI) request procedure in a first cell; and

performing an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful, wherein the error handling procedure comprises:

storing SI request failure information.

2. The method of claim 1, wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met:

a number of times the UE transmits a random access preamble reaches a threshold; and

the UE receives SI request rejection information.

3. The method of claim 1, wherein the SI request failure information comprises at least one of the following:

an on-demand system information block (SIB) requested by the UE;

an on-demand SI message requested by the UE;

a cell identifier (ID) of the first cell;

a synchronization signal block (SSB) index for performing the on-demand SI request procedure;

a message type of the on-demand SI request procedure; and

a timestamp for performing the on-demand SI request procedure.

4. The method of claim 1, wherein the error handling procedure further comprises:

activating a prohibit timer; and

avoiding initiating another on-demand SI request procedure until the prohibit timer expires.

5. The method of claim 1, wherein when the UE is in an idle state or an inactive state, the error handling procedure further comprises:

considering the first cell as barred; and

performing a cell re-selection procedure.

6. The method of claim 1, wherein when the UE is in a connected state, the error handling procedure further comprises at least one of the following:

performing a re-establishment procedure to another qualified cell; and

switching to an idle state and performing a cell re-selection procedure.

7. The method of claim 1, wherein the on-demand SI request procedure comprises:

transmitting an SI request message on signaling radio bearer 0 (SRB0) if the UE is in a connected state or an inactive state.

8. The method of claim 1, wherein when the UE is in a dual connectivity mode, the on-demand SI request procedure comprises:

transmitting an SI request message to a master node when the UE requires on-demand system information of a second cell belonging to a secondary node.

9. The method of claim 1, wherein the error handling procedure further comprises: transmitting the SI request failure information;

wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode.

10. The method of claim 1, further comprising:

considering whether or not requested system information in the on-demand SI request procedure is essential for the UE; and

if the requested system information is considered essential for the UE, the error handling procedure further comprises at least one of the following:

performing a cell re-selection procedure if the UE is in an idle state or an inactive state; and

switching to the idle state and performing the cell re-selection procedure if the UE is in a connected state.

11. A user equipment (UE), comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

perform an on-demand system information (SI) request procedure in a first cell; and

perform an error handling procedure if the on-demand SI request procedure in the first cell is unsuccessful, wherein the error handling procedure comprises:

storing SI request failure information.

12. The UE of claim 11, wherein the on-demand SI request procedure is unsuccessful when one of the following conditions is met:

a number of times the UE transmits a random access preamble reaches a threshold; and

the UE receives SI request rejection information.

13. The UE of claim 11, wherein the SI request failure information comprises at least one of the following:

an on-demand system information block (SIB) requested by the UE;

an on-demand SI message requested by the UE;

a cell identifier (ID) of the first cell;

a synchronization signal block (SSB) index for performing the on-demand SI request procedure;

a message type of the on-demand SI request procedure; and

a timestamp for performing the on-demand SI request procedure.

14. The UE of claim 11, wherein the error handling procedure further comprises:

activating a prohibit timer; and

avoiding initiating another on-demand SI request procedure until the prohibit timer expires.

15. The UE of claim 11, wherein when the UE is in an idle state or an inactive state,

the error handling procedure further comprises:

considering the first cell as barred; and

performing a cell re-selection procedure.

16. The UE of claim 11, wherein when the UE is in a connected state, the error handling procedure further comprises at least one of the following:

performing a re-establishment procedure to another qualified cell; and

switching to an idle state and performing a cell re-selection procedure.

17. The UE of claim 11, wherein the on-demand SI request procedure comprises:

transmitting an SI request message on signaling radio bearer 0 (SRB0) if the UE is in a connected state or an inactive state.

18. The UE of claim 11, wherein when the UE is in a dual connectivity mode, the on-demand SI request procedure comprises:

transmitting an SI request message to a master node when the UE requires on-demand system information of a second cell belonging to a secondary node.

19. The UE of claim 11, wherein the error handling procedure further comprises:

transmitting the SI request failure information;

wherein the SI request failure information is transmitted to a master node when the UE is in a dual connectivity mode.

20. The UE of claim 11, further comprising:

considering whether or not requested system information in the the on-demand SI request procedure is essential for the UE; and

if the requested system information is considered essential for the UE, the error handling procedure further comprises at least one of the following:

performing a cell re-selection procedure if the UE is in an idle state or an inactive state; and

switching to the idle state and performing the cell re-selection procedure if the UE is in a connected state.

ABSTRACT

A method of wireless communications performed by a user equipment (UE) is provided. The method includes performing an on-demand system information (SI) request procedure in a cell; and performing an error handling procedure if the on-demand SI request procedure in the cell is unsuccessful. The error handling procedure includes storing SI request failure information.

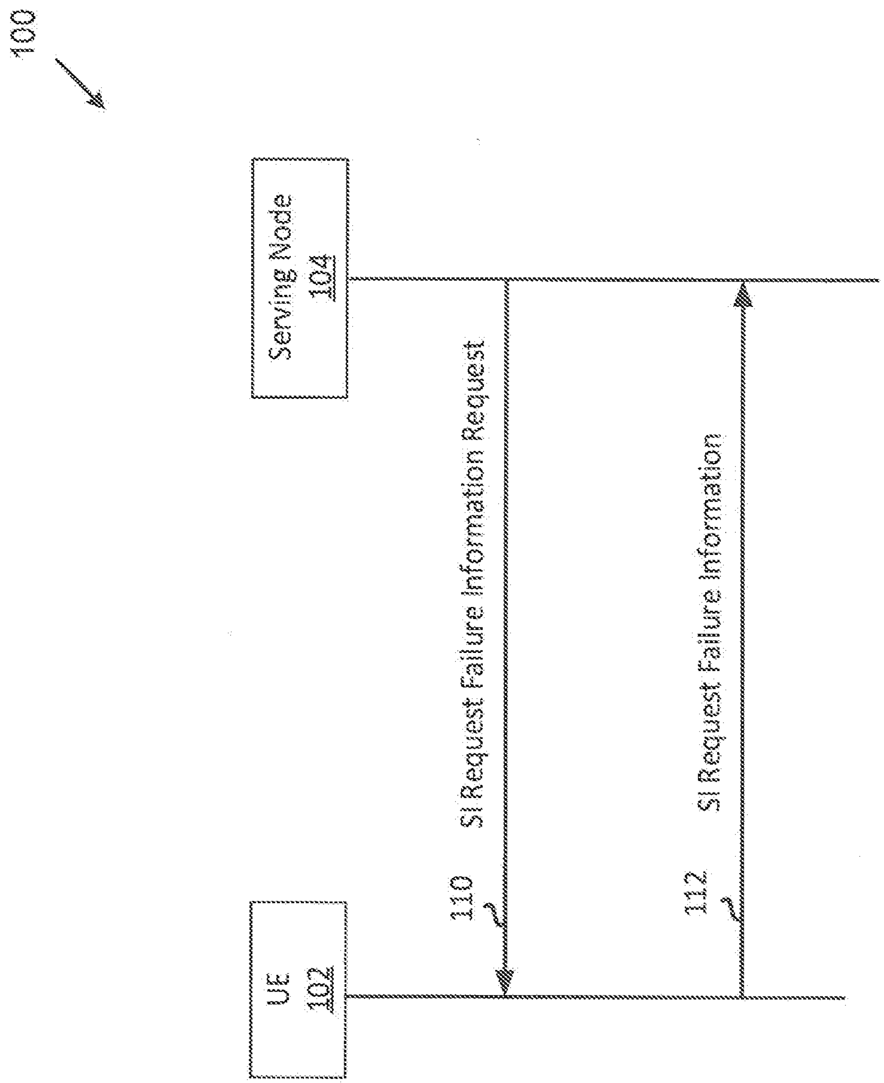

100
Serving Node
104
UE
102
SI Request Failure Information Request
110
SI Request Failure Information
112

FIG. 1

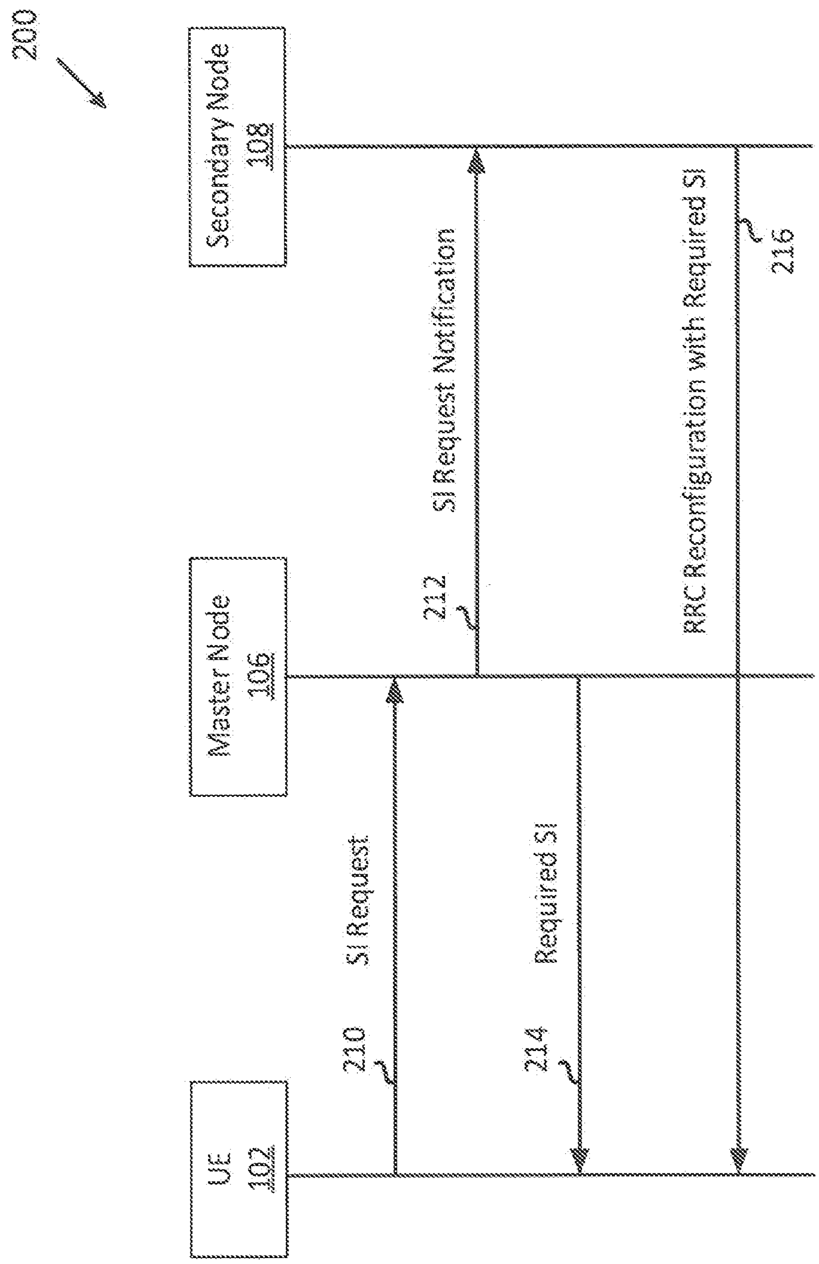

200
UE
102
Master Node
106
Secondary Node
108
210
SI Request
212
SI Request Notification
214
Required SI
216
RRC Reconfiguration with Required SI

FIG. 2

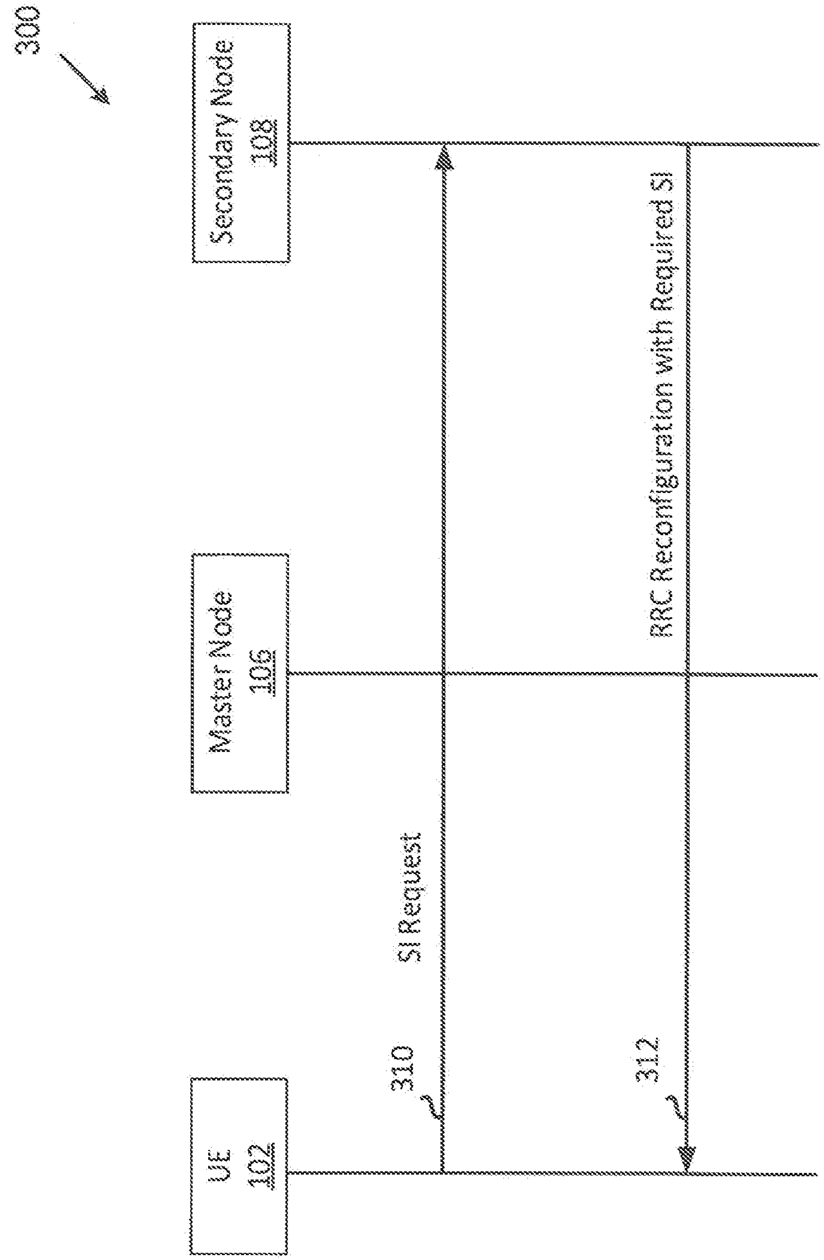

300
UE
102
Master Node
106
Secondary Node
108
310
SI Request
312
RRC Reconfiguration with Required SI

FIG. 3

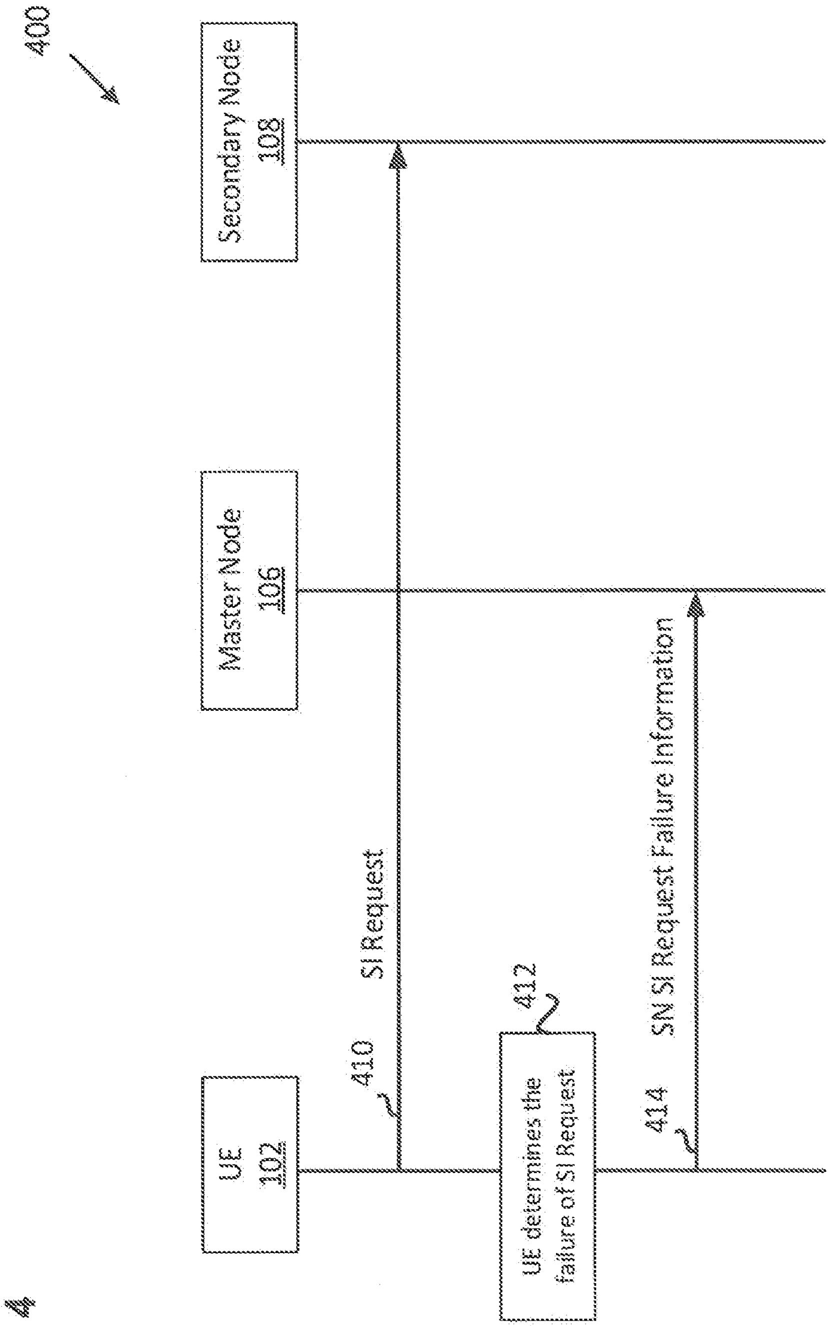

400
Secondary Node
108
Master Node
106
UE
102
410
SI Request
412
UE determines the failure of SI Request
414
SN SI Request Failure Information

FIG. 4

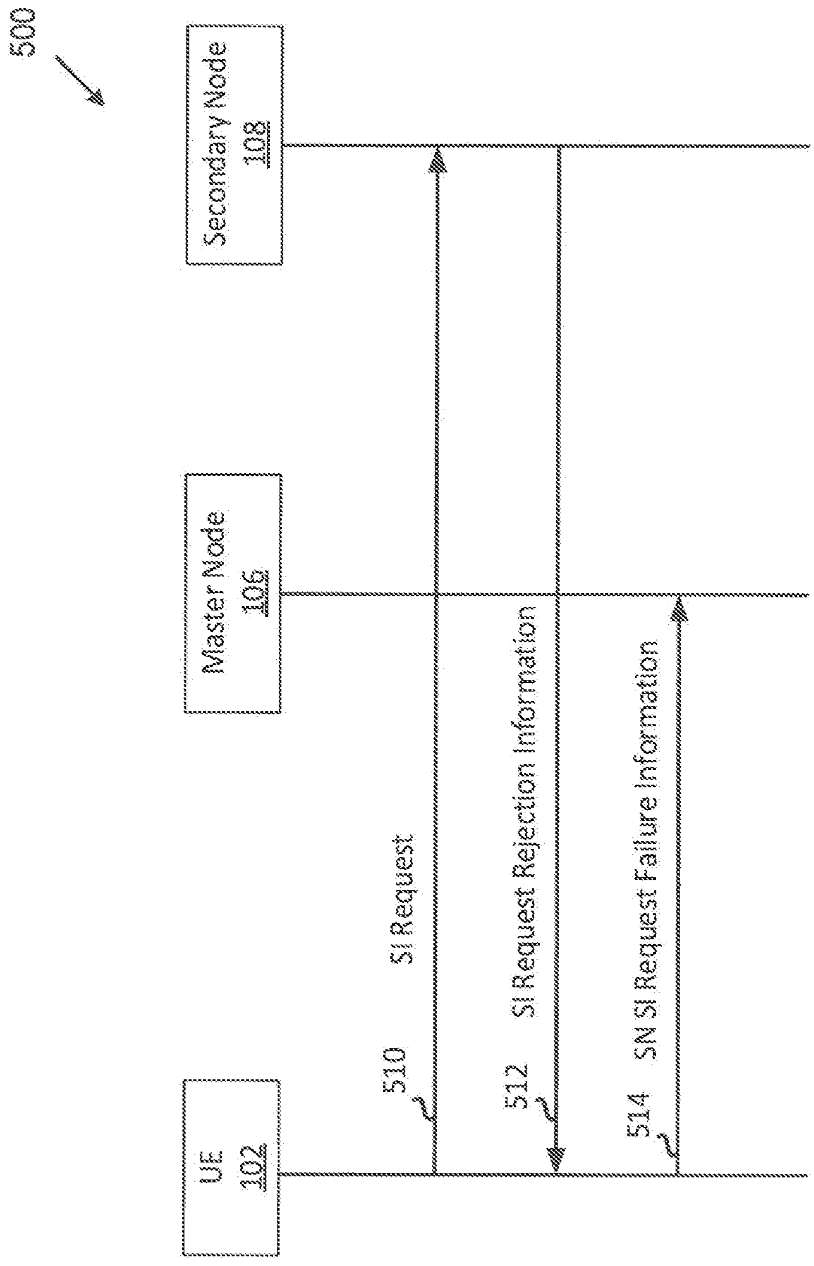
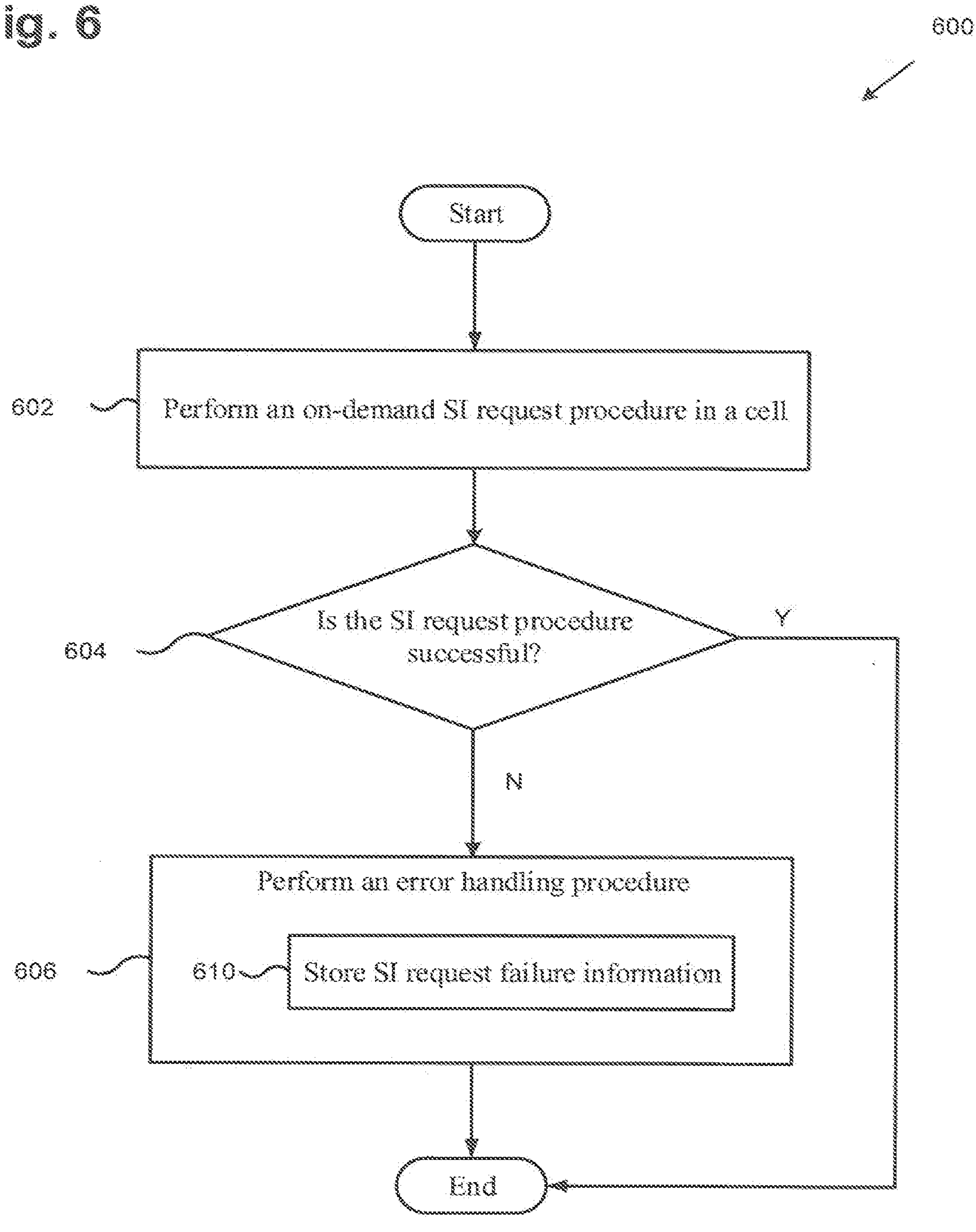

500
UE
102
Master Node
106
Secondary Node
108
510
SI Request
512
SI Request Rejection Information
514
SN SI Request Failure Information

FIG. 5

Fig. 6


600
Start
602
Perform an on-demand SI request procedure in a cell
604
Is the SI request procedure successful?
Y
N
606
Perform an error handling procedure
610
Store SI request failure information
End

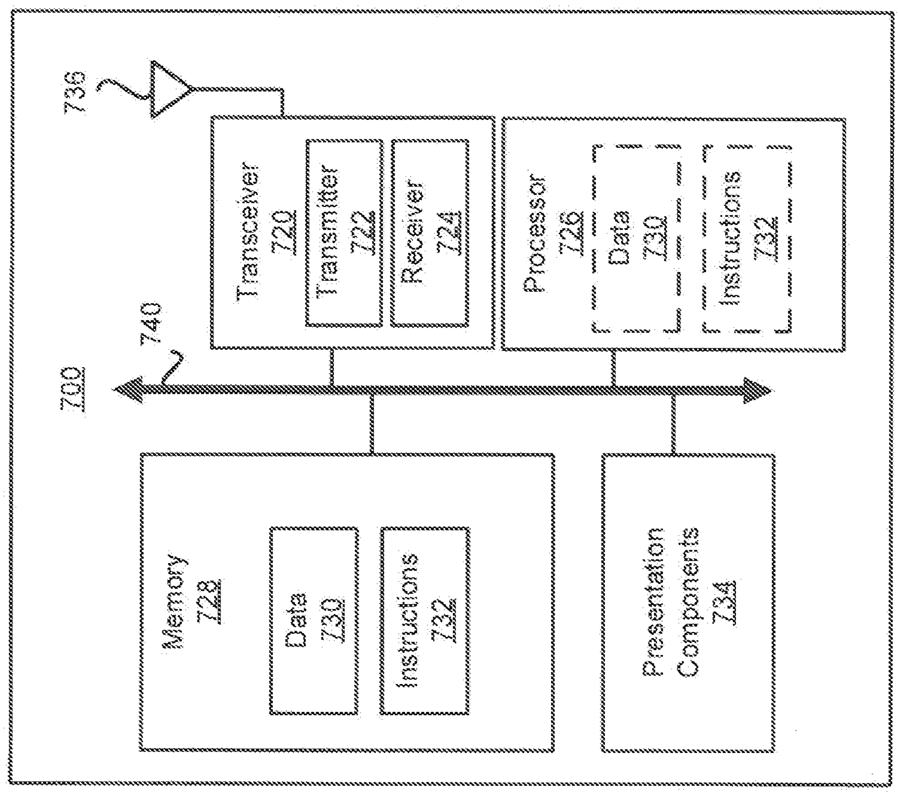

700
740
736
Transceiver 720
Transmitter 722
Receiver 724
Processor 726
Data 730
Instructions 732
Memory 728
Data 730
Instructions 732
Presentation Components 734

FIG. 7

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

Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

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: HUNG-CHEN CHEN Date (Optional) : ____________

Signature: Hung-Chen Chen

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

PTO/AIA/01 (06-12)
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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	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

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.

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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: CHIE-MING CHOU Date (Optional) : ______________

Signature: Chie Ming Chou

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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

Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

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: YUNG-LAN TSENG Date (Optional) : ______________________

Signature: Yung-Lan Tseng

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

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 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	HUNG-CHEN		CHEN	

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

City	Hsinchu	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	4F., No.87, Ln. 28, Sec. 1, Tiedao Rd., East Dist.		
Address 2			
City	Hsinchu	State/Province	
Postal Code	300	Country i	TW

Inventor 2 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHIE-MING		CHOU	

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

City	Hsinchu	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	5F-1, NO. 5, HSIN-AN RD.		
Address 2	HSINCHU SCIENCE-BASED INDUSTRIAL PARK, TAIWAN		
City	Hsinchu	State/Province	
Postal Code	300	Country i	TW

Inventor 3 — Remove

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

Prefix	Given Name	Middle Name	Family Name	Suffix
	YUNG-LAN		TSENG	

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

City	Hsinchu	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	5F-1, NO. 5, HSIN-AN RD.,		
Address 2	HSINCHU SCIENCE-BASED INDUSTRIAL PARK		
City	Hsinchu	**State/Province**	
Postal Code	300	**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	54000	
Email Address	eoa-proce@scienbizip.com	Add Email Remove Email
Email Address	eoa-cbd@scienbizip.com	Add Email Remove Email
Email Address	eoa-proce@sbp-us.com	Remove Email

Application Information:

Title of the Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING		
Attorney Docket Number	US76468	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	**Suggested Figure for Publication (if any)**	6

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	

Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING

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	64000		

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 benefit claim 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" field 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	62/651312	2018-04-02

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

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

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)[i] 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).

Remove

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.

Add

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

☐ 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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

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 Remove

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	FG Innovation Company Limited

Mailing Address Information For Applicant:

Address 1	Flat 2623, 26/F Tuen Mun Central Square		
Address 2	22 Hoi Wing Road, Tuen Mun, New Territories		
City	Tuen Mun	**State/Province**	
Country	HK	Postal Code	
Phone Number		Fax Number	
Email Address			

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

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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

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.

Remove

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. Add

Signature:

Remove

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 <u>INITIAL</u> filing of the application <u>and</u> either box A or B is <u>not</u> 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 **<u>must</u>** 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, **<u>all</u>** 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 **<u>all</u>** joint inventor-applicants.

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

Signature	/Calvin H Chai/			Date (YYYY-MM-DD)	2019-04-01
First Name	Calvin	Last Name	Chai	Registration Number	68009

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	US76468
	Application Number	
Title of Invention	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING	

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 the Freedom of Information Act requires disclosure of these records.

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 CooperationTreaty.

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 inspections 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.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Filer:	Calvin H Chai/CHUNHUA HU
Attorney Docket Number:	US76468

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	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1720**

Electronic Acknowledgement Receipt

EFS ID:	35596430
Application Number:	16372389
International Application Number:	
Confirmation Number:	2472
Title of Invention:	ON-DEMAND SYSTEM INFORMATION REQUEST PROCEDURE AND ERROR HANDLING
First Named Inventor/Applicant Name:	HUNG-CHEN CHEN
Customer Number:	54000
Filer:	Calvin H Chai/CHUNHUA HU
Filer Authorized By:	Calvin H Chai
Attorney Docket Number:	US76468
Receipt Date:	01-APR-2019
Filing Date:	
Time Stamp:	23:34:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1720
RAM confirmation Number	040219INTEFSW00007400505142
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	Power of Attorney	US76468190401POA.pdf	1138475 6db23fef9397e20a6014dd0e199353108a46154f	no	2
Warnings:					
Information:					
2	Specification	US76468190401_Spec.pdf	266081 897da0b831ad166cc347b92df13d1a594198caf0	no	23
Warnings:					
Information:					
3	Claims	US76468190401_Clms.pdf	103161 c55b419fb2b52cef66ba1053738ae4299ec7cd05	no	5
Warnings:					
Information:					
4	Abstract	US76468190401_Abst.pdf	83903 ef31c0572c492fa842d52b45edcaee282c82d2e1	no	1
Warnings:					
Information:					
5	Drawings-only black and white line drawings	US76468190401_draw.pdf	723031 61525ccefe1e108f7d9e9e4ffb0f7547efbd0e21	no	7
Warnings:					
Information:					
6	Oath or Declaration filed	US76468190401DEC.pdf	966773 380b9206d37c6646e18b33e3d287722703a3d6ea	no	3
Warnings:					
Information:					

7	Application Data Sheet	US76468__ADS.pdf	1792868 c35ed7cad3fdf4049b2cbfc020036e6cba8a79bc	no	9
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	34547 7d97cfa7232777e3941811ec71d8de448f319f0a	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	5108839		

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<u>New Applications Under 35 U.S.C. 111</u>
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.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
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.