EXHIBIT D

EXHIBIT A-15

Summary of Invalidity Analysis of U.S. Patent No. 11,627,631 ("'631 Patent") in view of 3GPP TS 36.300 V13.4.0 (2016-06)

3GPP TS 36.300 V13.4.0 (2016-06) ("TS 36.300 V13.4.0") was published on July 7, 2016. Therefore, TS 36.300 V13.4.0 qualifies as prior art to the '631 Patent under at least 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '631 Patent are invalid as expressly and/or inherently anticipated by TS 36.300 V13.4.0.

To the extent that TS 36.300 V13.4.0 is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '631 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of TS 36.300 V13.4.0 in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine TS 36.300 V13.4.0 and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
1[pre]	A method for transmitting and receiving data, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses a method for transmitting and receiving data. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

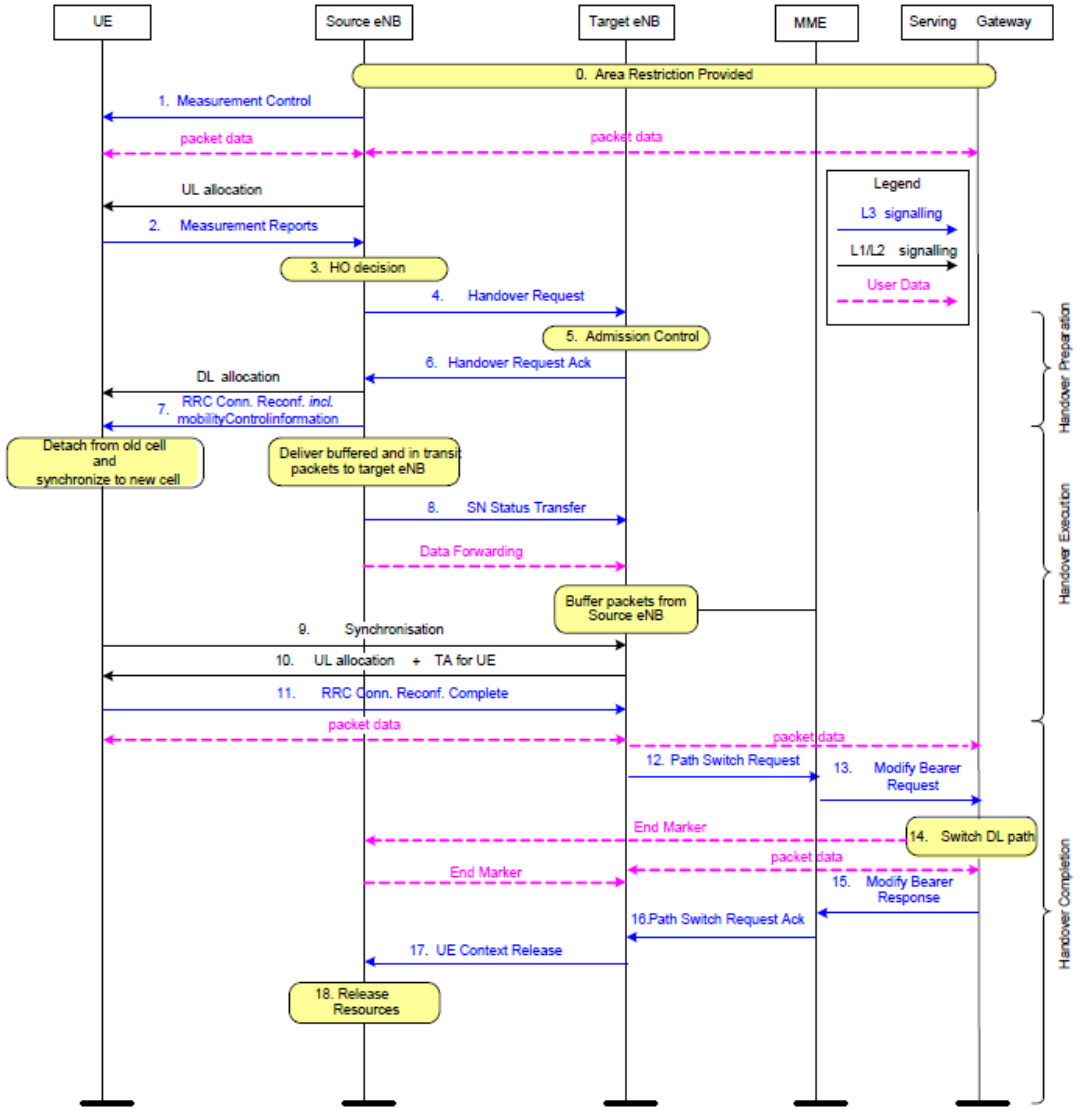


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	deciding, by a source base station (BS), whether to perform a handover;	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses deciding, by a source base station (BS), whether to perform a handover. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context):

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		- When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91. 10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

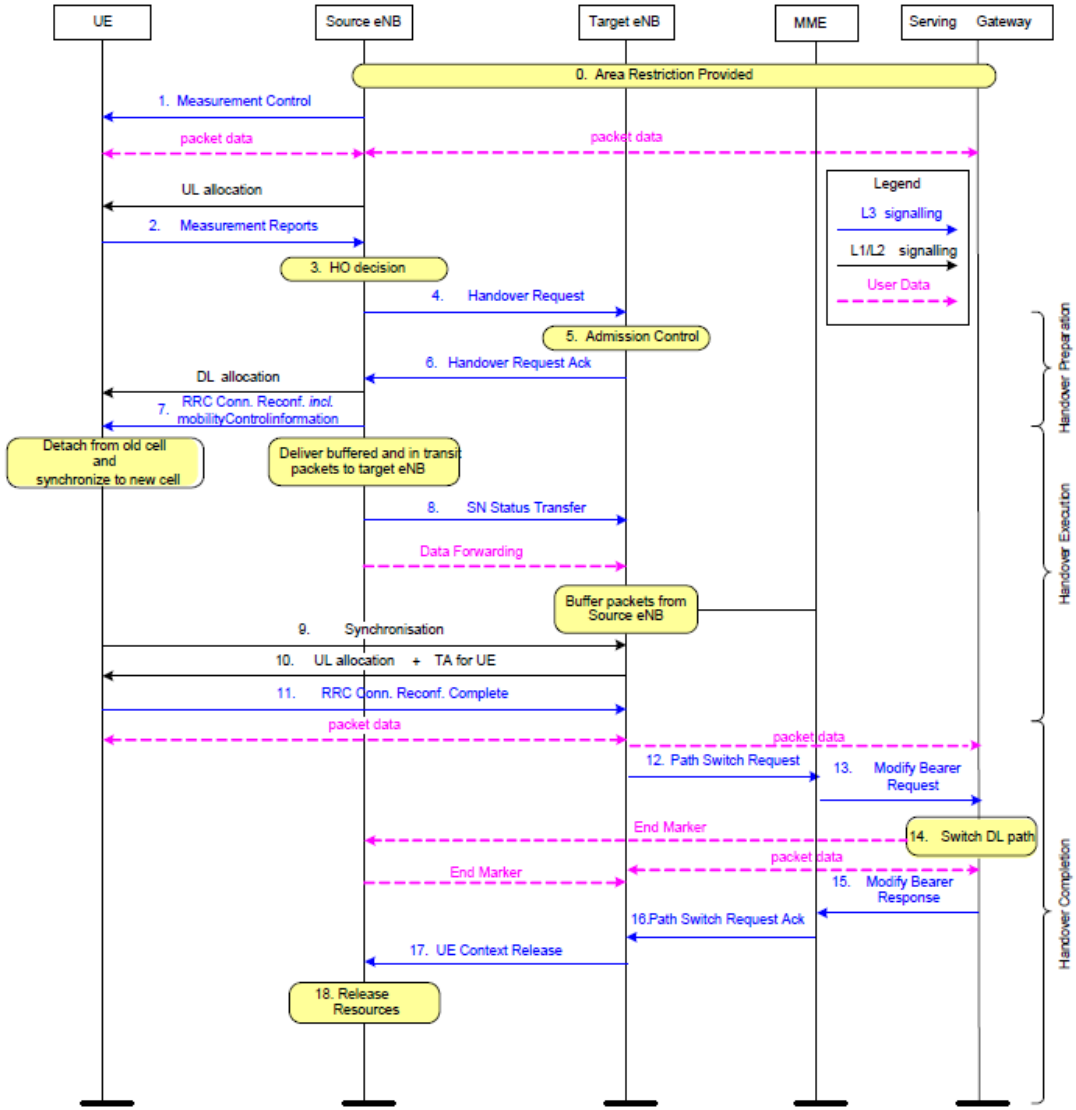


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	transmitting, from the source BS to a target BS, a handover request message when it is decided to perform the handover,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses transmitting, from the source BS to a target BS, a handover request message when it is decided to perform the handover. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91. 10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

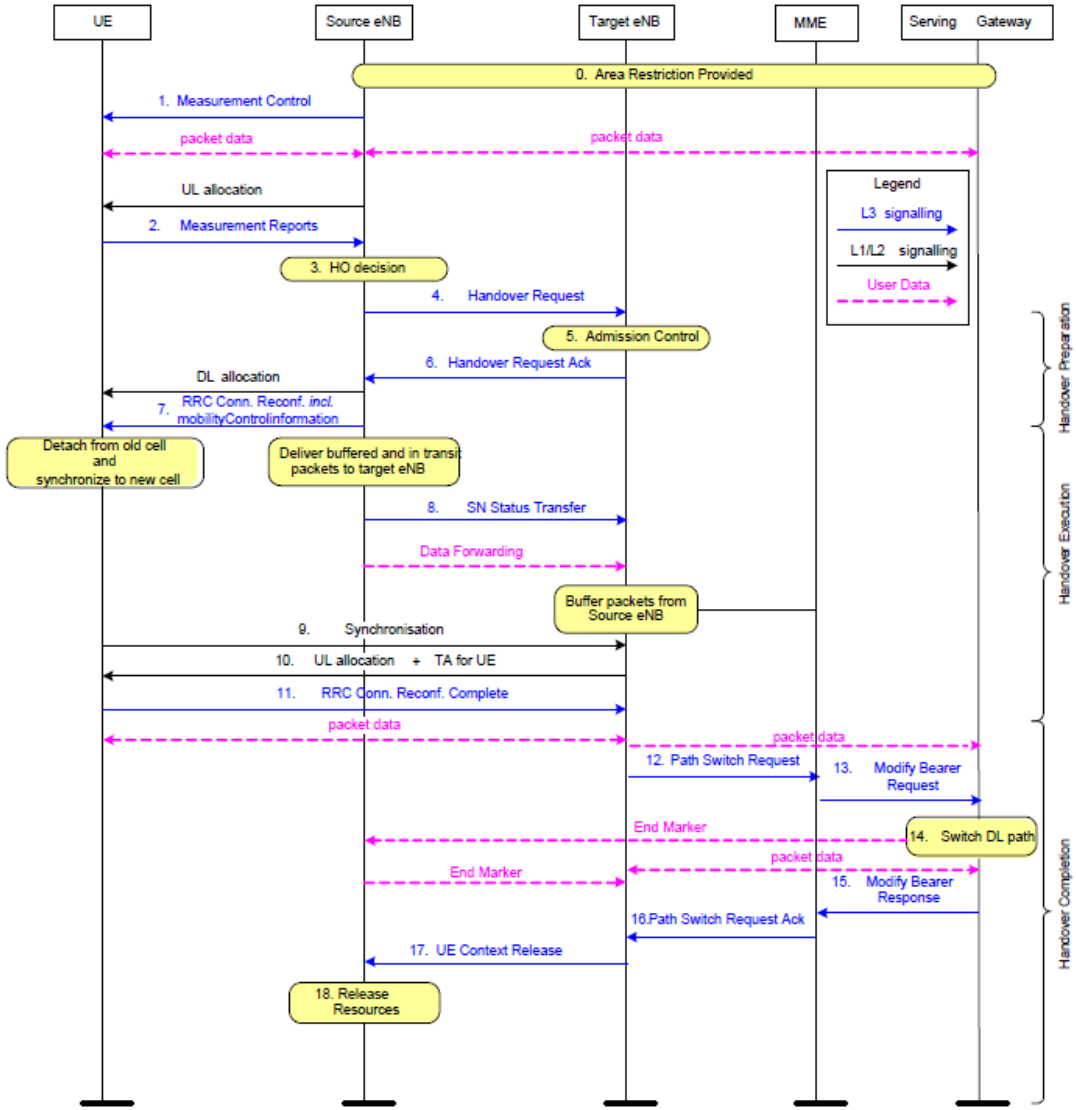


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

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Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

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Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	wherein the handover request message includes network slice information; and	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the handover request message includes network slice information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91. 10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

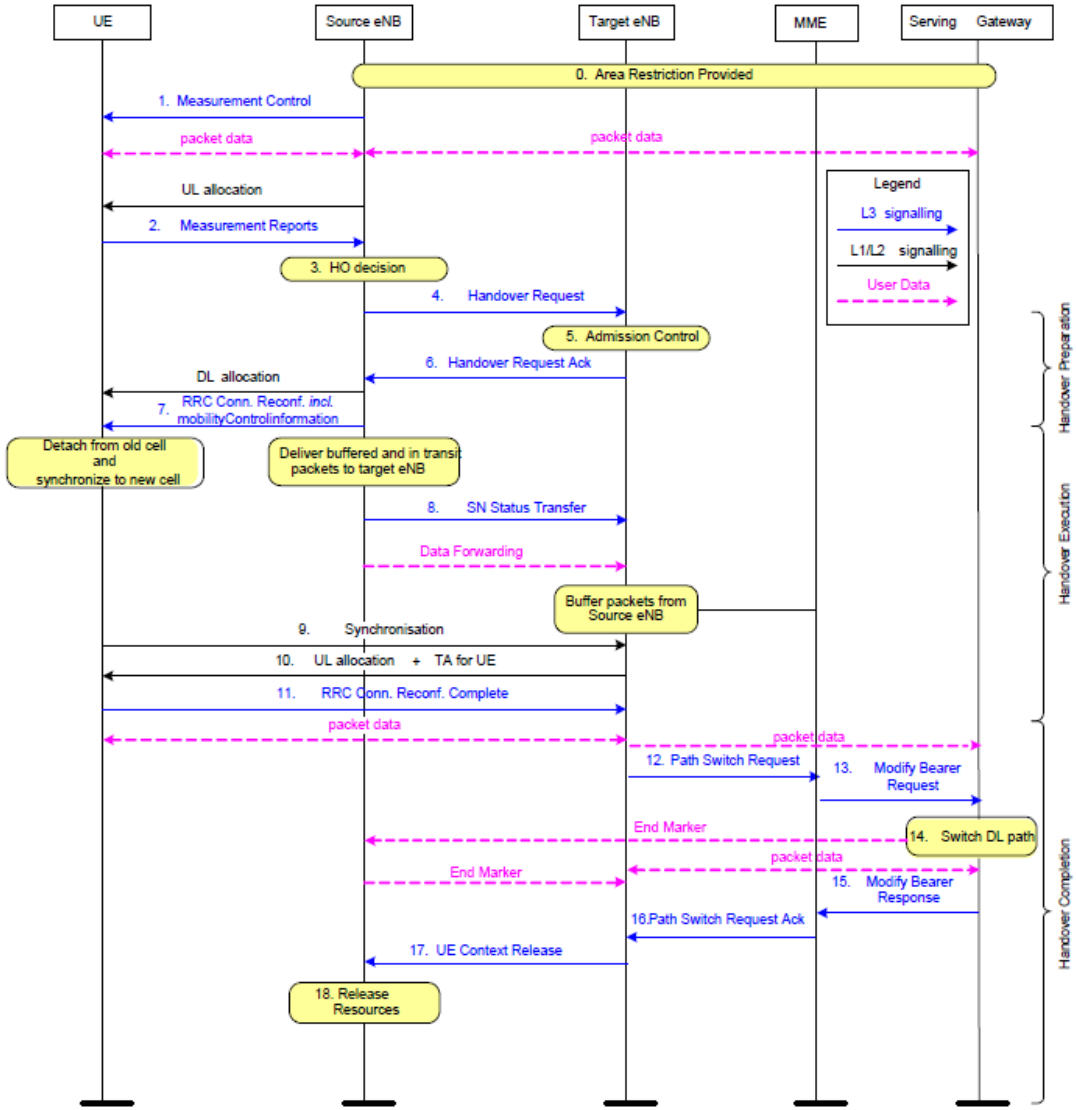


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

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Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	receiving, by the source BS from the target BS, a handover request confirmation message in response to the handover request message,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses receiving, by the source BS from the target BS, a handover request confirmation message in response to the handover request message. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91. 10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

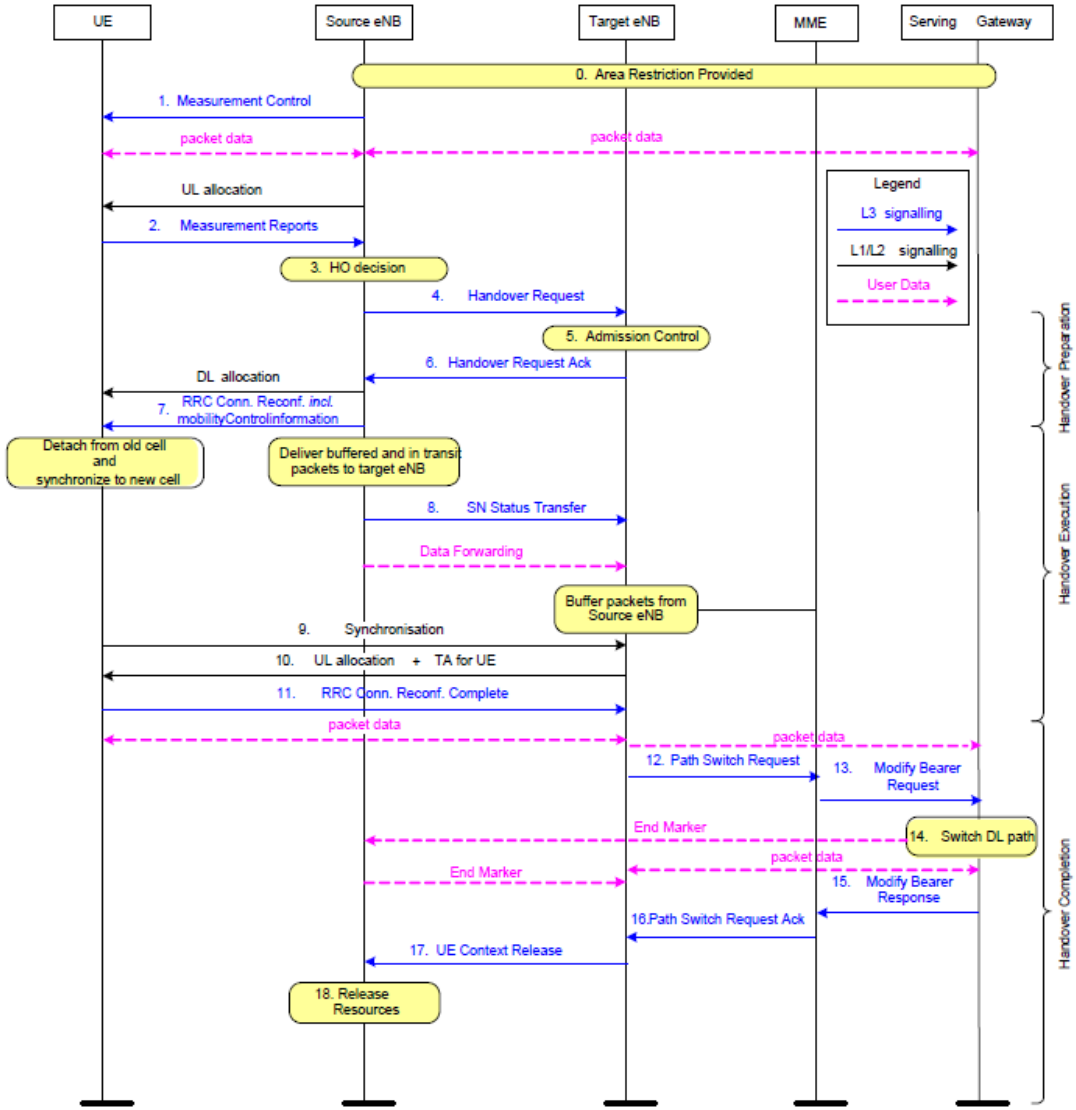


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein, if one or more protocol data unit (PDU) sessions are associated with one or more network slices that are not supported by the	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein, if one or more protocol data unit (PDU) sessions are associated with one or more network slices that are not supported by the target BS, the handover request confirmation message includes information for indicating a rejection of the one or

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Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
	target BS, the handover request confirmation message includes information for indicating a rejection of the one or more PDU sessions by the target BS.	more PDU sessions by the target BS. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

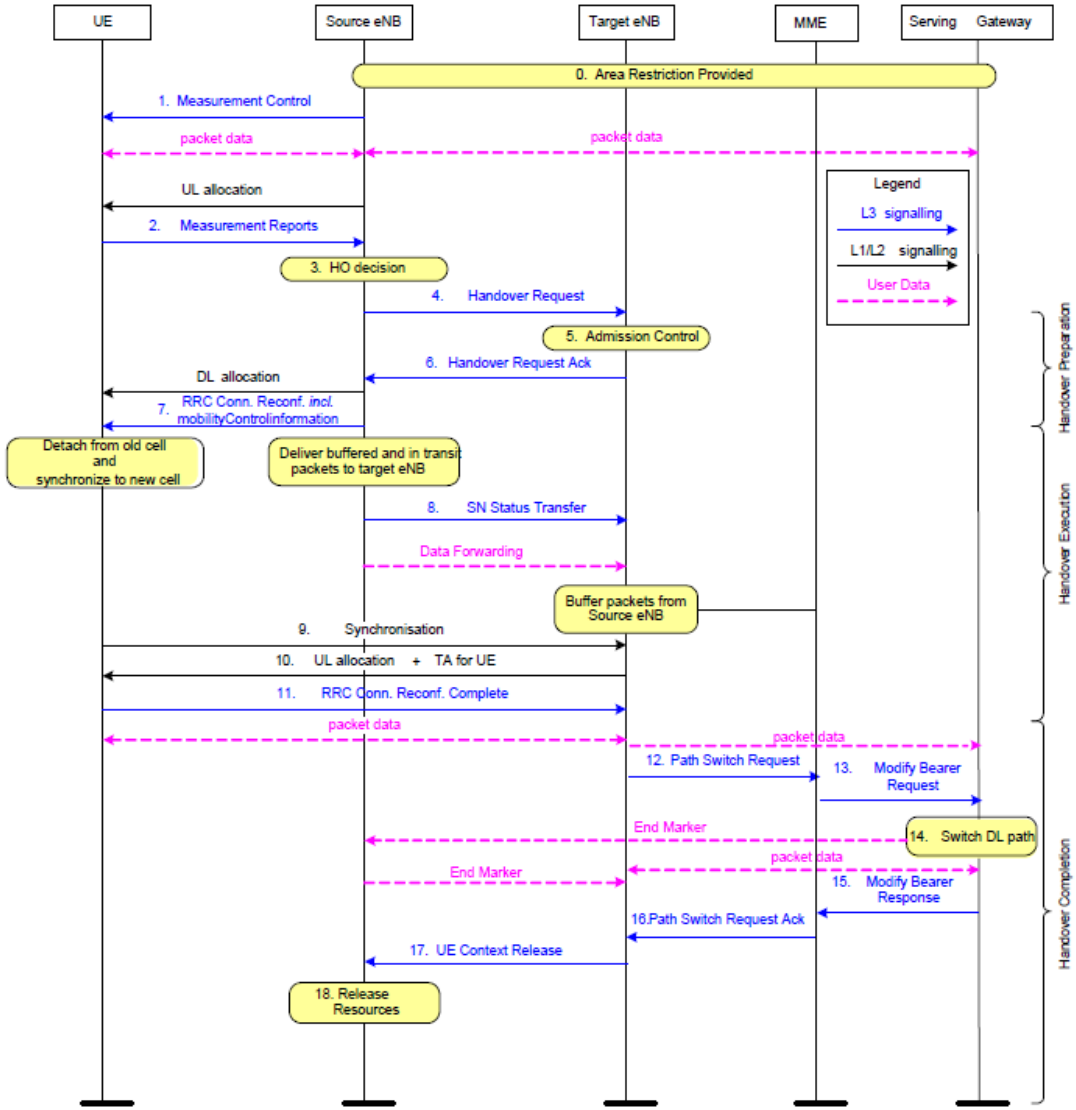


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 2

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
2	The method according to claim 1, further comprising: receiving, by the source BS from a user equipment (UE), a non-access stratum (NAS) message including network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses receiving, by the source BS from a user equipment (UE), a non-access stratum (NAS) message including network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

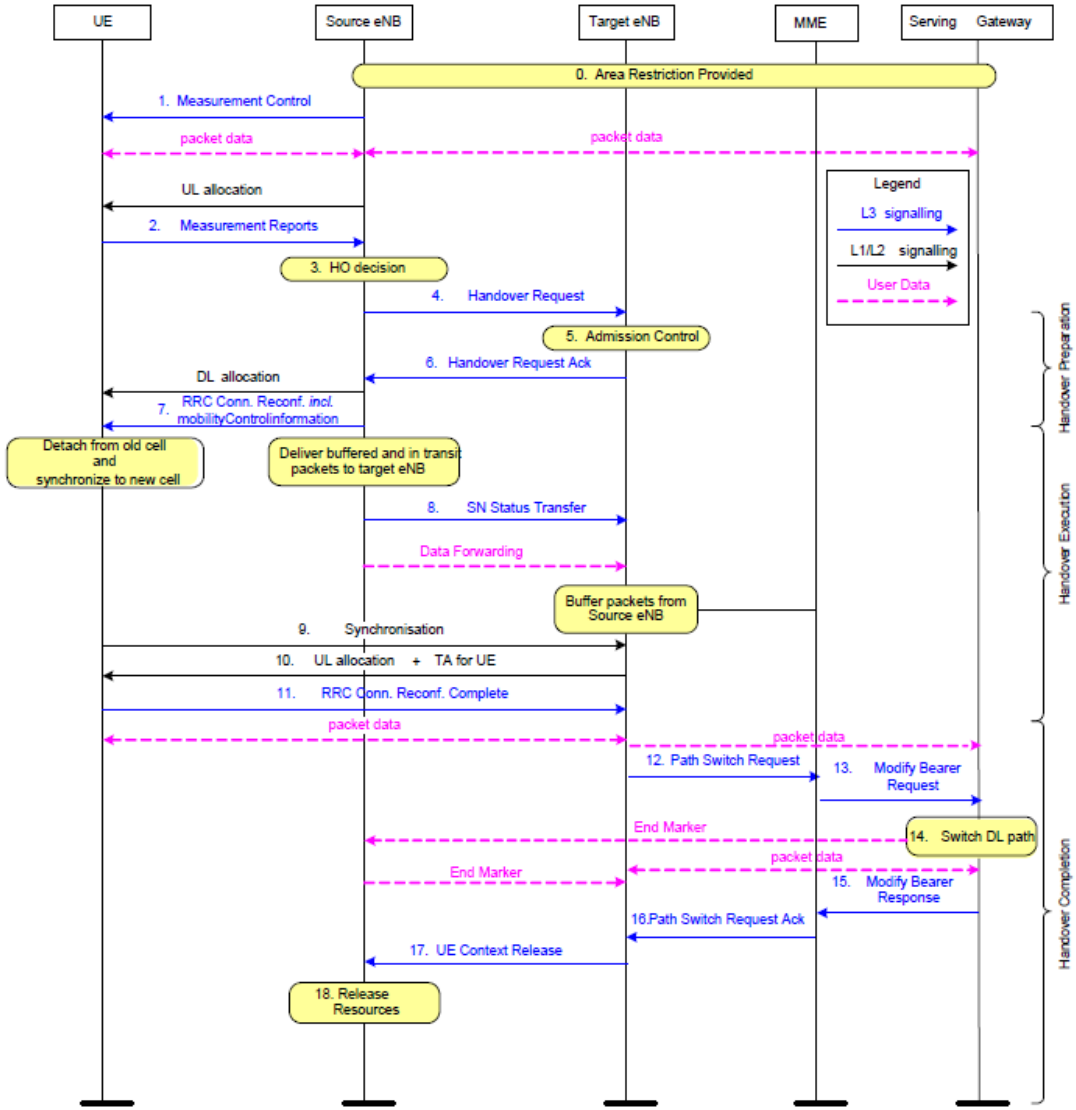


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
3	The method according to claim 2, further comprising: receiving, by the source BS from a core network entity, the network slice information, wherein the network slice information is configured by the network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses receiving, by the source BS from a core network entity, the network slice information, wherein the network slice information is configured by the network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

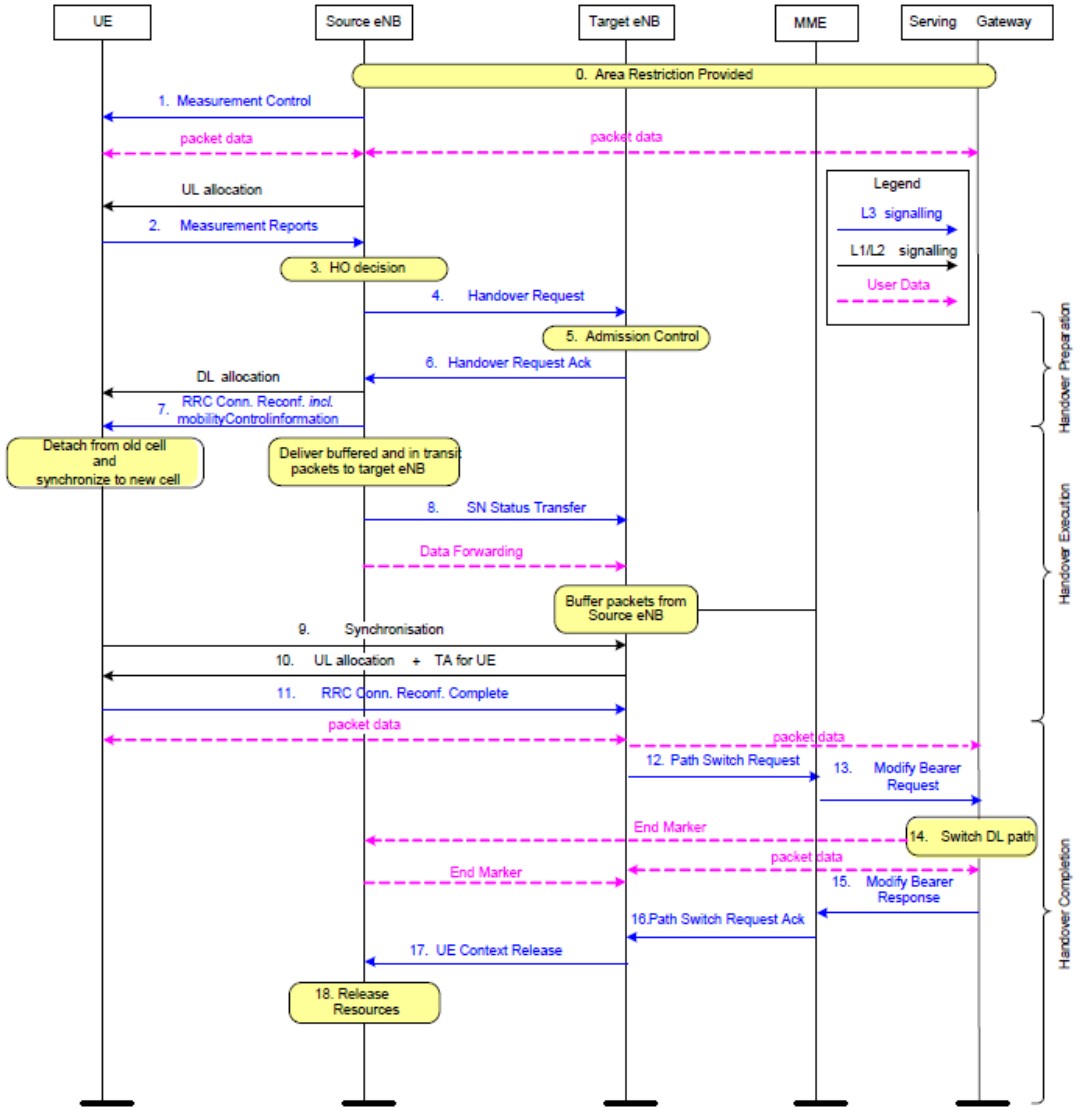


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

4. Claim 4

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
4	The method according to claim 2, wherein the NAS message including the network slice request information is included in a radio resource control (RRC) connection setup completion message.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the NAS message including the network slice request information is included in a radio resource control (RRC) connection setup completion message. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

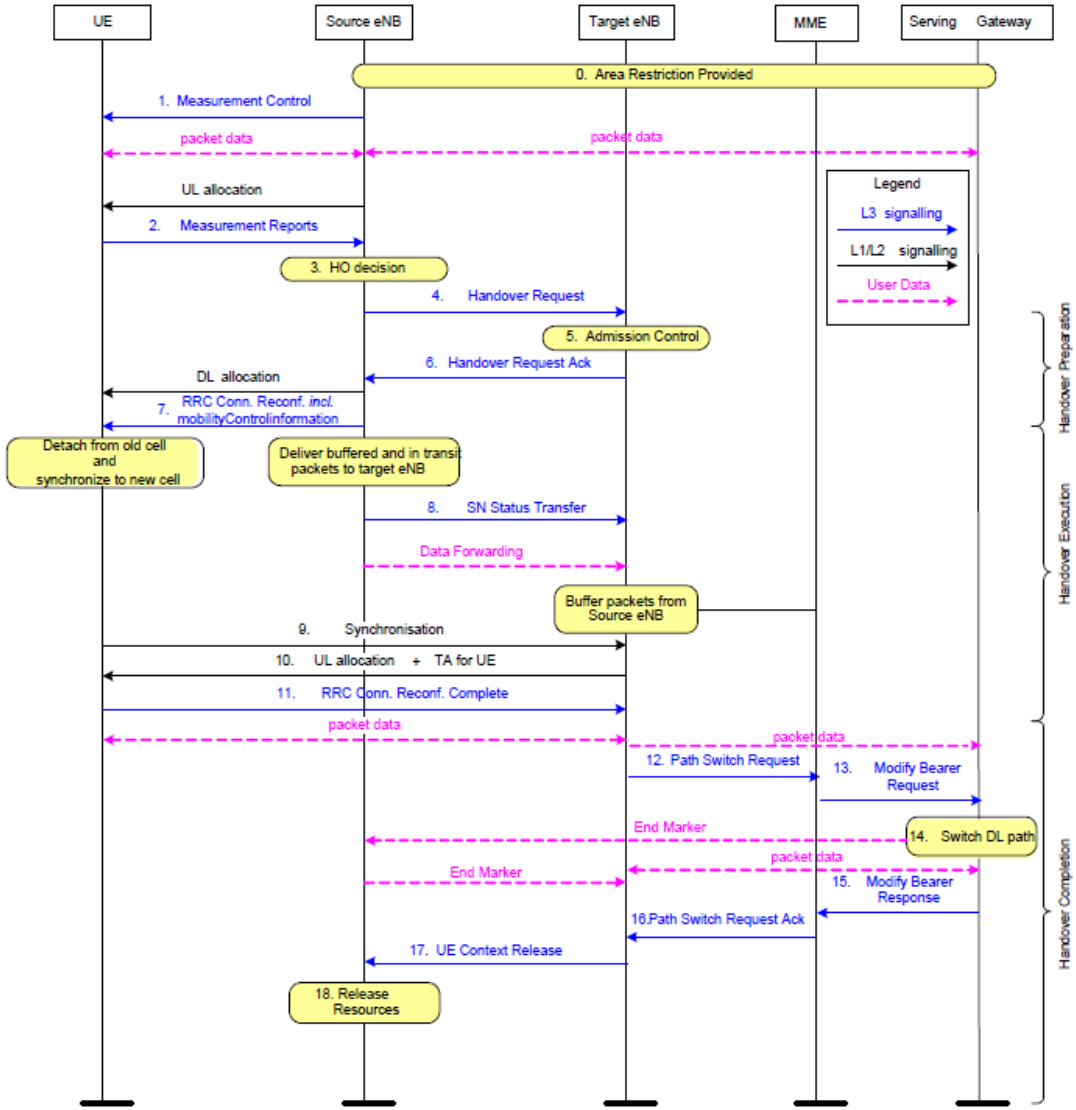


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 5

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
5	The method according to claim 3, wherein the network slice information is configured by the core network entity based on the network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses receiving, by the source BS from a core network entity, the network slice information, wherein the network slice information is configured by the core network entity based on the network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

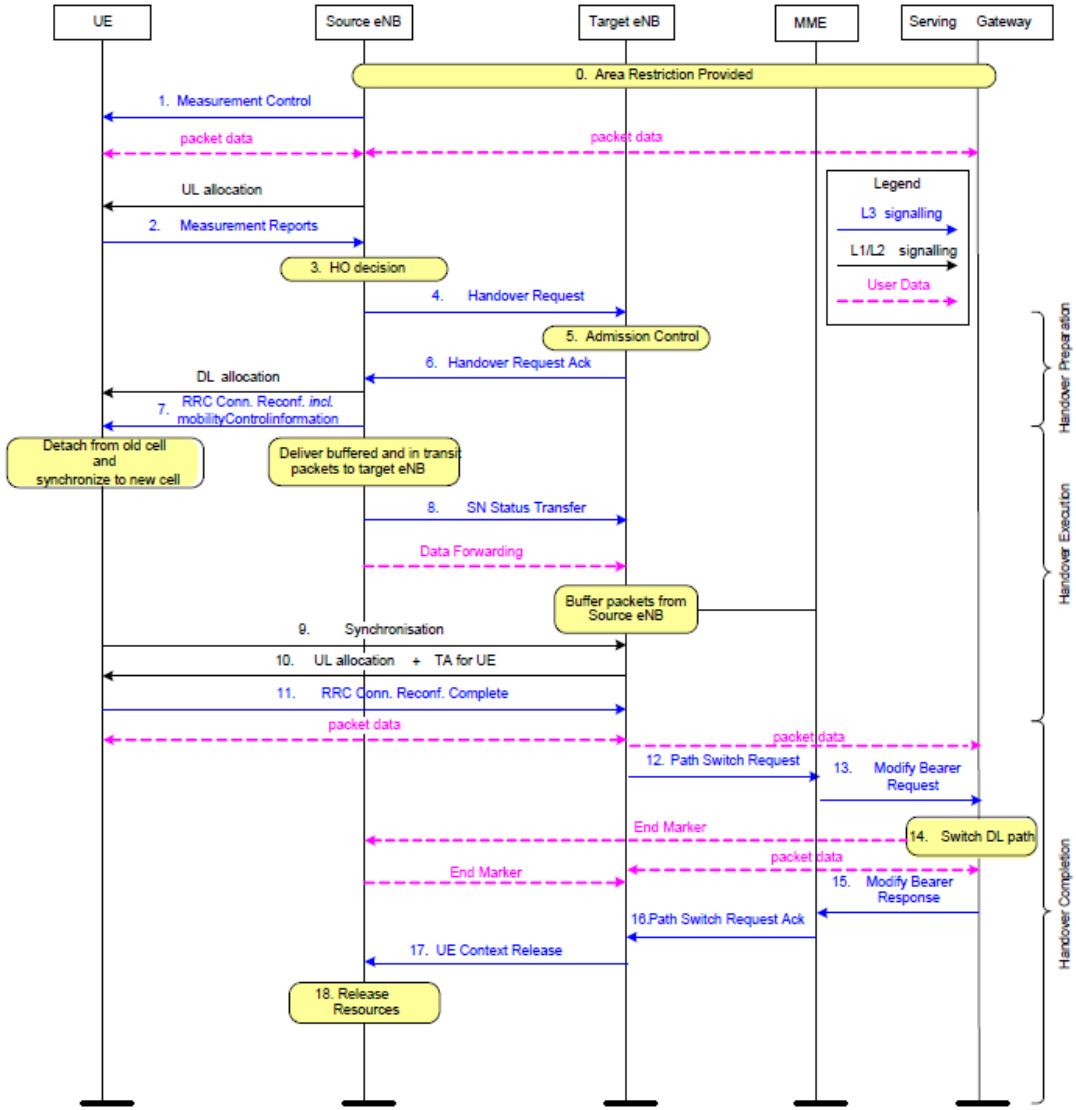


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 6

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
6	The method according to claim 5, wherein the transmission of the handover request message is performed through a direct interface associated with the target base station.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the transmission of the handover request message is performed through a direct interface associated with the target base station. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: 10.1.2.1 Handover The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN: - Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB; - To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context): - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells. - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB. - Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure; - UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available: - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully); - If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell; - No ROHC context is transferred at handover; - ROHC context can be kept at handover within the same eNB. TS 36.300 V13.4.0 at 90-91.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		10.1.2.1.1 C-plane handling The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes: TS 36.300 V13.4.0 at 91.

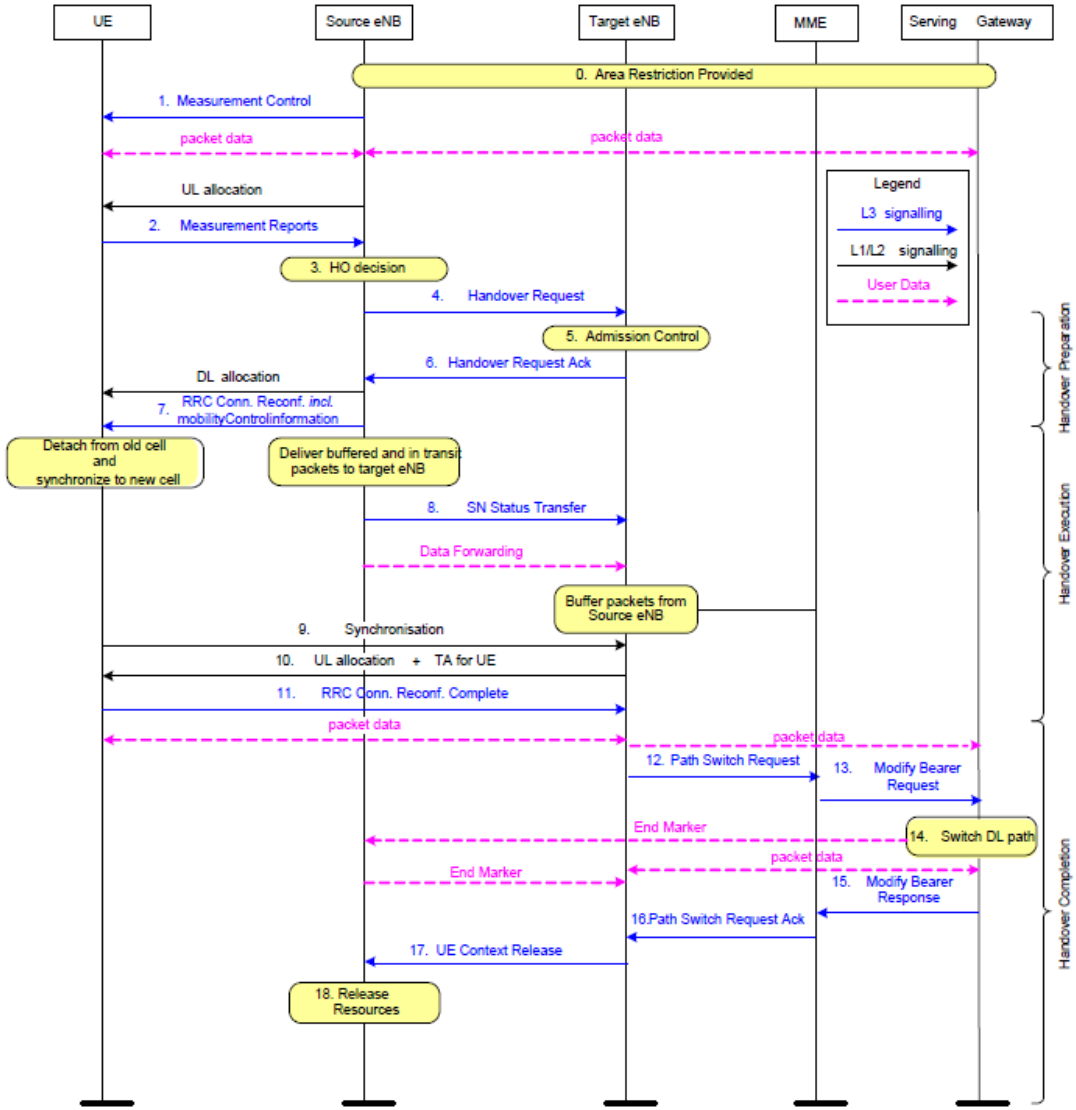


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. Below is a more detailed description of the intra-MME/Serving Gateway HO procedure: 0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update. 1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility. 2 A MEASUREMENT REPORT is triggered and sent to the eNB. 3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE. 4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs. 5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration"). 6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary. NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated. TS 36.300 V13.4.0 at 92-93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3. 7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB. 8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation. 9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell. 10 The target eNB responds with UL allocation and timing advance. 11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE. 12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell. 13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway. TS 36.300 V13.4.0 at 93.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB. 15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME. 16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message. 17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME. 18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue. When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context. TS 36.300 V13.4.0 at 94. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

7. Claim 7

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
7[pre]	A controller for transmitting and receiving data, the controller comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses a controller for transmitting and receiving data. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[a]	a processor performs:	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses a processor. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

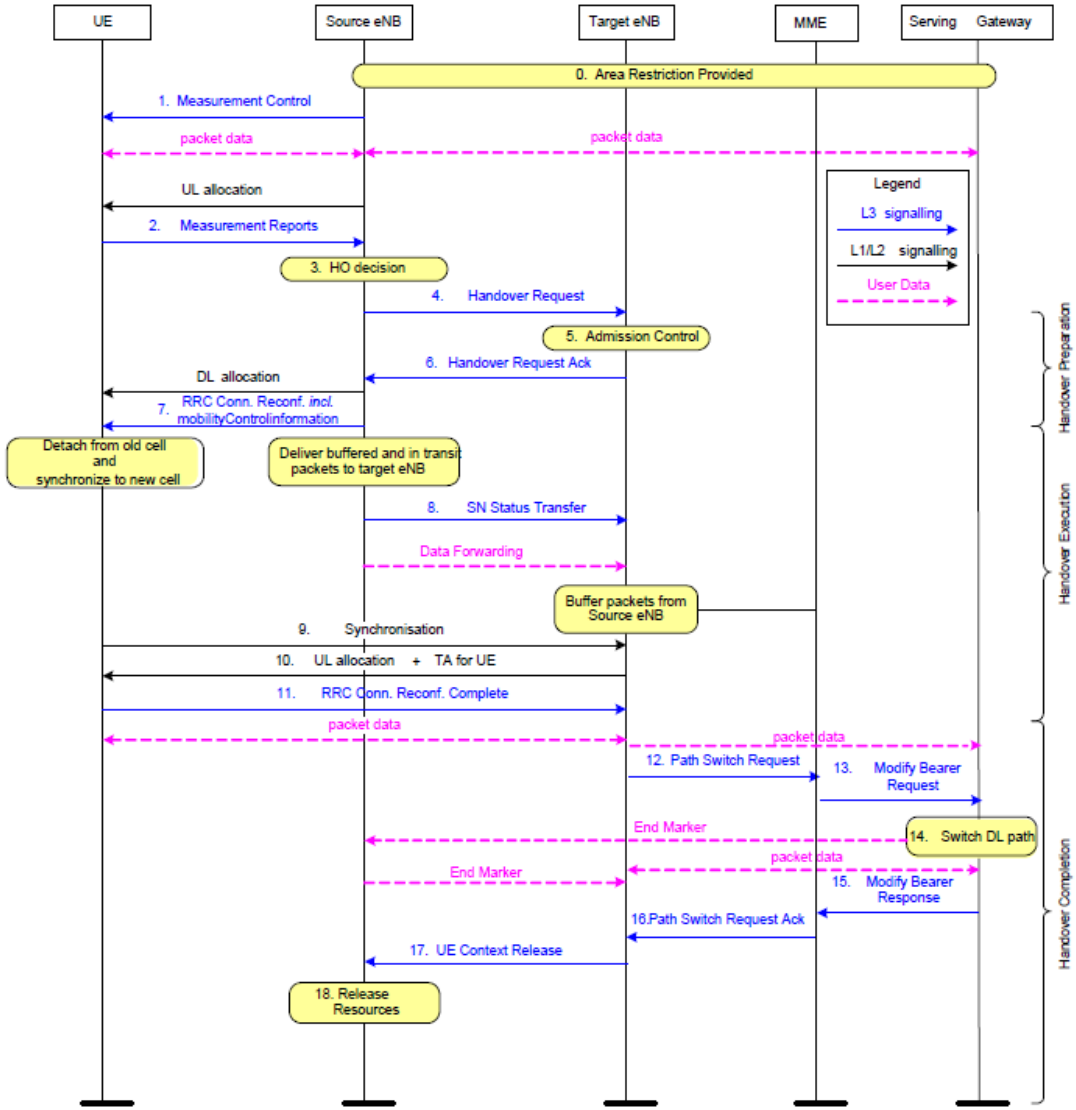


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		TS 36.300 V13.4.0 at Fig. 10.1.2.1.1-1. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[b]	to decide whether to perform a handover,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses to decide whether to perform a handover. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[a]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
7[c]	to transmit a handover request message when it is decided to perform the handover,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses to transmit a handover request message when it is decided to perform the handover. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[b]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[d]	wherein the handover request message includes network slice information; and	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the handover request message includes network slice information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[e]	to receive a handover request confirmation message in response to the handover request message,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses to receive a handover request confirmation message in response to the handover request message. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[d]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[f]	wherein, if one or more protocol data unit (PDU) sessions are associated with one or more network slices that are not supported by a target BS, the handover request confirmation message	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein, if one or more protocol data unit (PDU) sessions are associated with one or more network slices that are not supported by a target BS, the handover request confirmation message includes information for indicating a rejection of the one or more PDU sessions by the target BS. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
	includes information for indicating a rejection of the one or more PDU sessions by the target BS.	*See* limitation 1[e]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 8

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
8	The controller according to claim 7, wherein the processor further performs to receive a non-access stratum (NAS) message including network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 wherein the processor further performs to receive a non-access stratum (NAS) message including network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 9

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
9	The controller according to claim 8, wherein the processor further performs to receive the network slice information from a core network, wherein the network slice information is configured by the network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the processor further performs to receive the network slice information from a core network, wherein the network slice information is configured by the network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

10. Claim 10

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
10	The controller according to claim 8, wherein the NAS message including the network slice request information is included in a radio resource control (RRC) connection setup completion message.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the NAS message including the network slice request information is included in a radio resource control (RRC) connection setup completion message. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

11. Claim 11

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
11	The controller according to claim 9, wherein the network slice information is configured	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the network slice information is configured by the core network entity based

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
	by the core network entity based on the network slice request information.	on the network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 5. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

12. Claim 12

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
12	The controller according to claim 11, wherein the transmission of the handover request message is performed through a direct interface associated with the target base station.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the transmission of the handover request message is performed through a direct interface associated with the target base station. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 6. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

13. Claim 13

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
13[pre]	An apparatus for transmitting and receiving data, the apparatus comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses an apparatus for transmitting and receiving data. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		address the same known problems, according to known methods which would yield predictable results.
13[a]	a controller configured to decide whether to perform a handover,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses a controller configured to decide whether to perform a handover. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[a]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
13[b]	a transmitter configured to transmit a handover request message when it is decided to perform the handover,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses a transmitter configured to transmit a handover request message when it is decided to perform the handover. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[b]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
13[c]	wherein the handover request message includes network slice information; and	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the handover request message includes network slice information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
13[d]	a receiver configured to receive a handover request confirmation message in response to the handover request message,	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses a receiver configured to receive a handover request confirmation message in response to the handover request message. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		See limitation 1[d]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
13[e]	wherein, if one or more protocol data unit (PDU) sessions are associated with one or more network slices that are not supported by a target BS, the handover request confirmation message includes information for indicating a rejection of the one or more PDU sessions by the target BS.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein, if one or more protocol data unit (PDU) sessions are associated with one or more network slices that are not supported by the target BS, the handover request confirmation message includes information for indicating a rejection of the one or more PDU sessions by the target BS. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* limitation 1[e]. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		address the same known problems, according to known methods which would yield predictable results.

14. Claim 14

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
14	The apparatus according to claim 13, wherein the processor further performs to receive a non-access stratum (NAS) message including network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the processor further performs to receive a non-access stratum (NAS) message including network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

15. Claim 15

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
15	The apparatus according to claim 14, wherein the processor further performs to receive the network slice information from a core network, wherein the network slice information is configured by the network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the processor further performs to receive the network slice information from a core network, wherein the network slice information is configured by the network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

16. Claim 16

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
16	The apparatus according to claim 14, wherein the NAS message including the network slice request information is	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the NAS message including the network slice request information is included in a radio resource control (RRC) connection setup completion message. For

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
	included in a radio resource control (RRC) connection setup completion message.	example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

17. Claim 17

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
17	The apparatus according to claim 15, wherein the network slice information is configured by the core network entity based on the network slice request information.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the network slice information is configured by the core network entity based on the network slice request information. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 5. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

18. Claim 18

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
18	The apparatus according to claim 17, wherein the transmission of the handover request message is performed through a direct interface associated with the target base station.	At least under Pegasus's apparent infringement theory, TS 36.300 V13.4.0 discloses wherein the transmission of the handover request message is performed through a direct interface associated with the target base station. For example, TS 36.300 V13.4.0 discloses this limitation based on the following exemplary citations: *See* claim 6. To the extent it is found that TS 36.300 V13.4.0 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that TS 36.300 V13.4.0 does not anticipate this claim, TS 36.300 V13.4.0 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine TS 36.300 V13.4.0 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to

Invalidity of U.S. Patent 11,627,631 in view of TS 36.300 V13.4.0		
Claim Language		**Exemplary Citations to TS 36.300 V13.4.0**
		address the same known problems, according to known methods which would yield predictable results.

EXHIBIT D-9

Summary of Invalidity Analysis of U.S. Patent No. 11,405,942 ("'942 Patent") in view of U.S. Patent Application No. US 2021/0152312 to Xiong et al. ("Xiong")

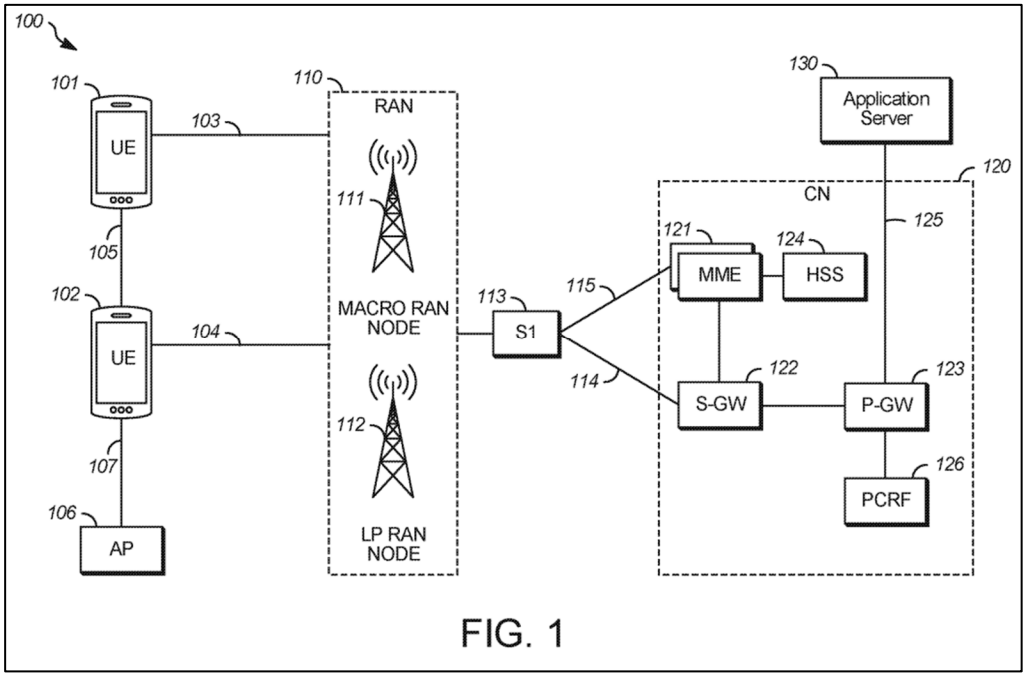
U.S. Patent Application No. US 2021/0152312 to Xiong et al. ("Xiong"), published on May 20, 2021, and claims priority U.S. Provisional Patent Application No. 62/543,647 filed, Aug. 10, 2017, and U.S. Provisional Patent Application No. 62/556,990 filed, Sep. 11, 2017. Therefore, Xiong qualifies as prior art to the '942 Patent under at least 35 U.S.C. §§ 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '942 Patent are invalid as expressly and/or inherently anticipated by Xiong.

To the extent that Xiong is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '942 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Xiong in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Xiong and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

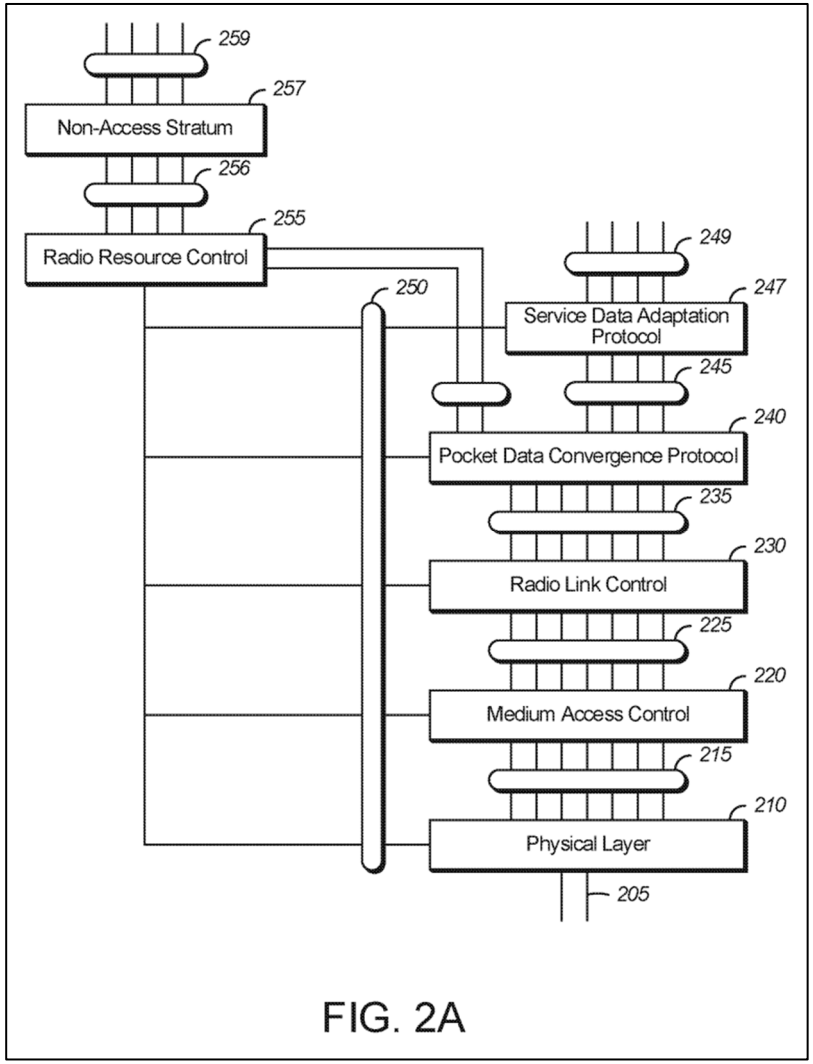
1. Claim 1

Invalidity of U.S. Patent 11,405,942 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
1[pre]	A method of receiving a downlink (DL) signal by a first user equipment (UE), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Xiong discloses a method of receiving a downlink (DL) signal by a first user equipment (UE), the method comprising. For example, Xiong discloses this limitation based on the following exemplary citations: "Embodiments of dynamic multiplexing are described, including the transmission of preemption indication (PI) to indicate preemption of time-frequency resources. In some embodiments, a next Generation NodeB (gNB) is configured to transmit PIs in signaling to preempt an enhanced Mobile Broadband (eMBB) communications transmission with an ultra-reliable and low latency communications (URLCC) transmission. In some embodiments, a user equipment (UE) is configured to monitor a region of time-frequency resources, within a bandwidth part (BWP), for a PI. The PI indicates to the UE a portion of time-frequency resources that omit transmissions intended for the UE. In some embodiments, the gNB transmits the PI to the UE within preemption indication downlink control information (PI-DCI) in a physical downlink control channel (PDCCH) in a control resource set (CORESET). In some embodiments, the BWP is defined according to a frequency domain location, a bandwidth, and a subcarrier spacing for a given numerology." Xiong at Abstract. "Embodiments pertain to wireless networks and wireless communications. Some embodiments relate to New Radio (NR) 5G networks. Some embodiments relate to methods, computer readable media, and apparatuses for preempting time-frequency resources. Some embodiments relate to ultra-reliable and low latency communications (URLCC) preempting enhanced Mobile Broadband (eMBB) communications." Xiong at [0002].

Invalidity of U.S. Patent 11,405,942 in view of Xiong		
	Claim Language	**Exemplary Citations to Xiong**
		 FIG. 1 Xiong at Fig. 1. "FIG. 1 illustrates an architecture of a system 100 of a network in accordance with some embodiments. In some embodiments, the system 100 may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some embodiments, network devices, such as the access nodes described below, can be configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below." Xiong at [0022]; see also, id. at [0023-25].

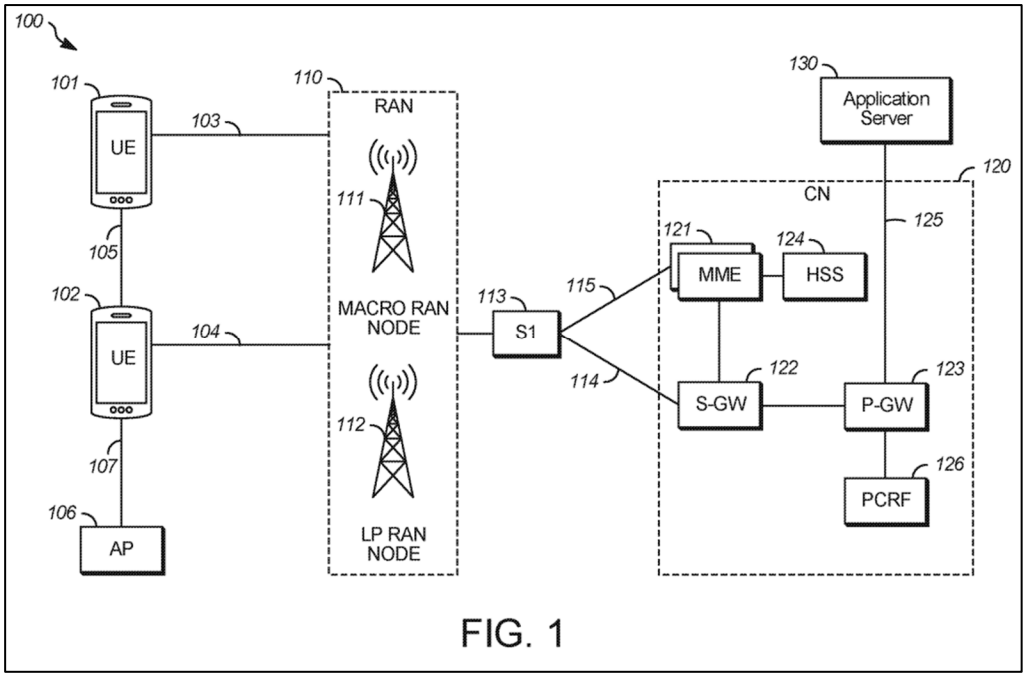
Invalidity of U.S. Patent 11,405,942 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
		"In accordance with some embodiments, the UEs 101 and 102 can be configured to communicate using Orthogonal Frequency-Division Multiplexing (OFDM) communication signals with each other or with any of the RAN nodes 111 and 112 over a multicarrier communication channel in accordance various communication techniques, such as, but not limited to, an Orthogonal Frequency-Division Multiple Access (OFDMA) communication technique (e.g., for downlink communications) or a Single Carrier Frequency Division Multiple Access (SC-TDMA) communication technique (e.g., for uplink and ProSe or sidelink communications), although the scope of the embodiments is not limited in this respect. The OFDM signals can comprise a plurality of orthogonal subcarriers." Xiong at [0030]. "The physical downlink shared channel (PDSCH) may carry user data and higher-layer signaling to the UEs 101 and 102. The physical downlink control channel (PDCCH) may carry information about the transport format and resource allocations related to the PDSCH channel, among other things. It may also inform the UEs 101 and 102 about the transport format, resource allocation, and H-ARQ (Hybrid Automatic Repeat Request) information related to the uplink shared channel. Typically, downlink scheduling (assigning control and shared channel resource blocks to the UE 102 within a cell) may be performed at any of the RAN nodes 111 and 112 based on channel quality information fed back from any of the UEs 101 and 102. The downlink resource assignment information may be sent on the PDCCH used for (e.g., assigned to) each of the UEs 101 and 102." Xiong at [0032]. "Some embodiments may use concepts for resource allocation for control channel information that are an extension of the above-described concepts. For example, some embodiments may utilize an enhanced physical downlink control channel (EPDCCH) that uses PDSCH resources for control information transmission. The EPDCCH may be transmitted using one or more enhanced the control channel elements (ECCEs). Similar to above, each ECCE may correspond to nine sets of four physical resource elements known as an enhanced resource element groups (EREGs). An ECCE may have other numbers of EREGs in some situations." Xiong at [0034].

Invalidity of U.S. Patent 11,405,942 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
		"FIG. 2A illustrates protocol functions that may be implemented in a wireless communication device in accordance with some embodiments, for example in a UE or BS configured for preemption operations. In some embodiments, protocol layers may include one or more of physical layer (PHY) 210, medium access control layer (MAC) 220, radio link control layer (RLC) 230, packet data convergence protocol layer (PDCP) 240, service data adaptation protocol (SDAP) layer 247, radio resource control layer (RRC) 255, and non-access stratum (NAS) layer 257, in addition to other higher layer functions not illustrated." Xiong at [0040]; *see also, id*. at [0041-45].

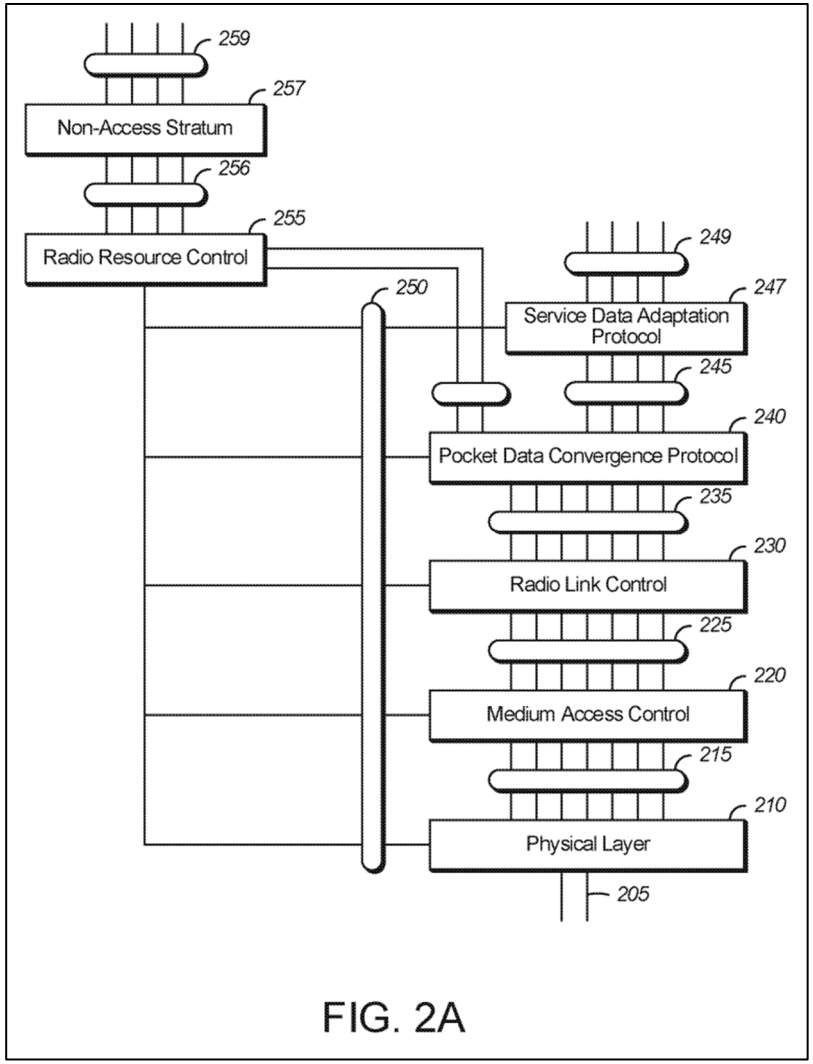
Invalidity of U.S. Patent 11,405,942 in view of Xiong		
	Claim Language	**Exemplary Citations to Xiong**
		 FIG. 2A Xiong at Fig. 2A.

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		"Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI. In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology. "In Example 3, the subject matter of Examples 1-2 includes, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating pre-emption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at [0134-136]. "1. An apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and

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		configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at Claim 1; *see also, id*. at Claims 3, 13, 15, 25. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, by the first UE, a specific radio network temporary identifier (RNTI) for DL preemption indication information through a UE-specific radio resource control (RRC) signaling;	At least under Pegasus's apparent infringement theory, Xiong discloses receiving, by the first UE, a specific radio network temporary identifier (RNTI) for DL preemption indication information through a UE-specific radio resource control (RRC) signaling. For example, Xiong discloses this limitation based on the following exemplary citations: "FIG. 1 illustrates an architecture of a system 100 of a network in accordance with some embodiments. In some embodiments, the system 100 may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some embodiments, network devices, such as the access nodes described below, can be configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below.

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		The system 100 is shown to include a UE 101 and a UE 102, for example a UE configured for preemption operations. The UEs 101 and 102 are illustrated as smartphones (e.g., handheld touchscreen mobile computing devices connectable to one or more cellular networks), but may also comprise any mobile or non-mobile computing device, such as Personal Data Assistants (PDAs), pagers, laptop computers, desktop computers, wireless handsets, or any computing device including a wireless communications interface." Xiong at [0022-23].  FIG. 1 Xiong at Fig. 1. "FIG. 2A illustrates protocol functions that may be implemented in a wireless communication device in accordance with some embodiments, for example in a UE or BS configured for preemption operations. In some embodiments, protocol layers

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		may include one or more of physical layer (PHY) 210, medium access control layer (MAC) 220, radio link control layer (RLC) 230, packet data convergence protocol layer (PDCP) 240, service data adaptation protocol (SDAP) layer 247, radio resource control layer (RRC) 255, and non-access stratum (NAS) layer 257, in addition to other higher layer functions not illustrated." Xiong at [0040]; *see also, id*. at [0041].

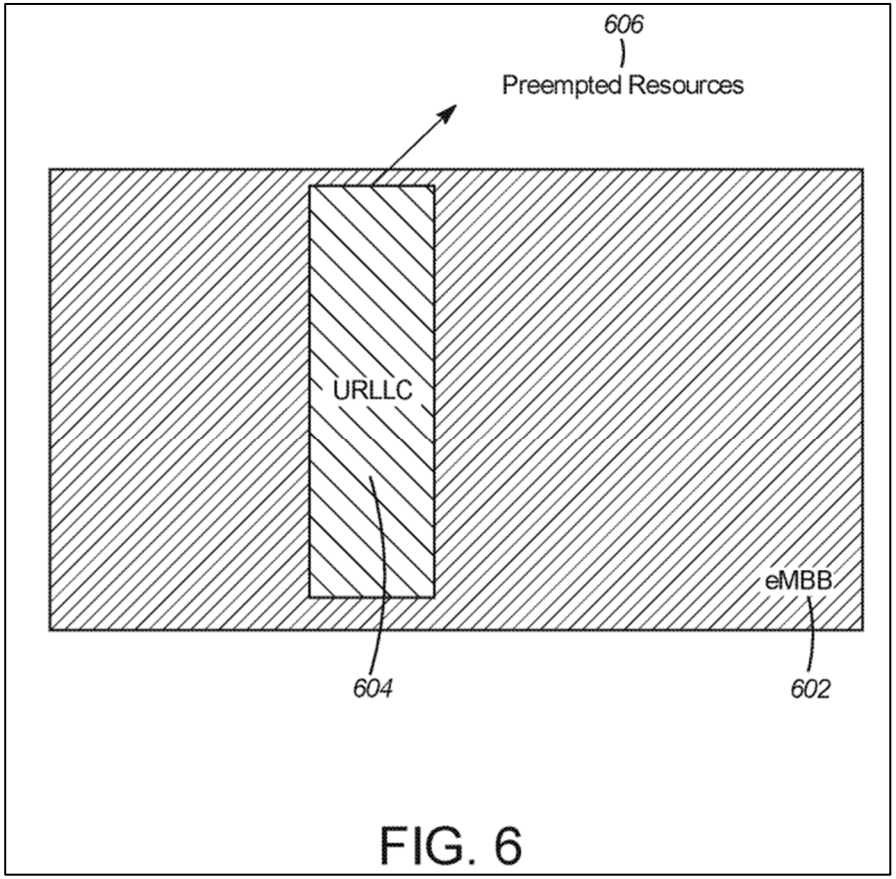
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		 FIG. 2A Xiong at Fig. 2A.

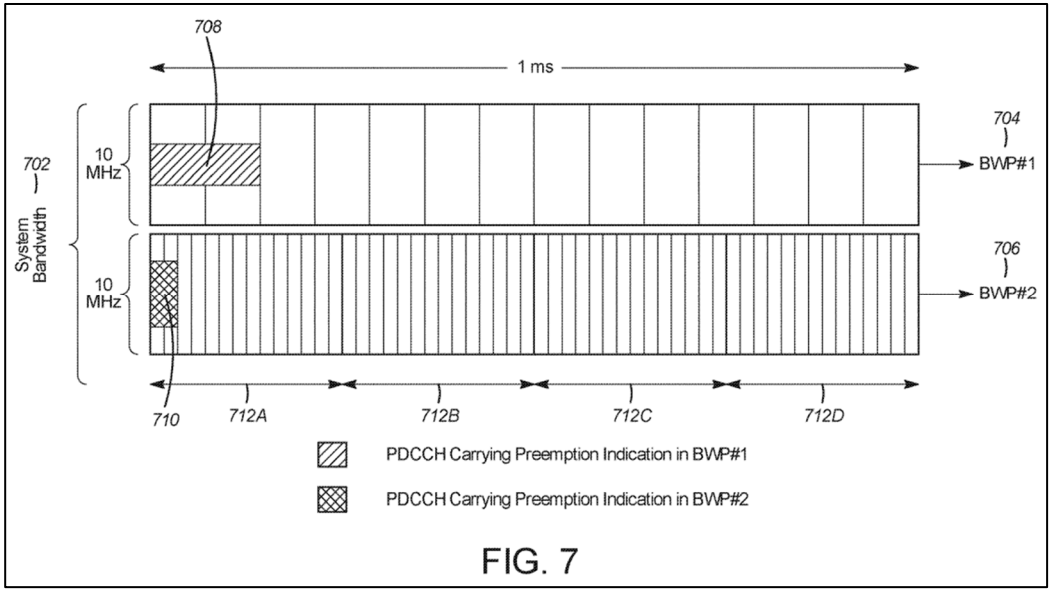
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		"According to some embodiments, an instance of PDCP 240 may process requests from and provide indications to one or more of an instance of RRC 255 and one or more instances of SDAP 247 via one or more packet data convergence protocol service access points (PDCP-SAP) 245. According to some embodiments, requests and indications communicated via PDCP-SAP 245 may comprise one or more radio bearers. According to some embodiments, an instance of SDAP 247 may process requests from and provide indications to one or more higher layer protocol entities via one or more service data adaptation protocol service access points (SDAP-SAP) 249. According to some embodiments, requests and indications communicated via SDAP-SAP 249 may comprise one or more quality of service (QoS) flows. According to some embodiments, RRC entity 255 may configure, via one or more management service access points (M-SAP), embodiments of one or more protocol layers, which may include one or more instances of PHY 210, MAC 220, RLC 230, PDCP 240 and SDAP 247. According to some embodiments, an instance of RRC may process requests from and provide indications to one or more NAS entities via one or more RRC service access points (RRC-SAP)." Xiong at [0042]. "According to some embodiments, 5GNB 280 may be implemented as one or more of a dedicated physical device such as a macro-cell, a femto-cell or other suitable device, or in an alternative aspect, may be implemented as one or more software entities running on server computers as part of a virtual network termed a cloud radio access network (CRAN). According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260 (e.g., UE 101, UE 102, device 300), gNB 280 and AMF 294, may be described as implementing all or part of a protocol stack in which the layers are considered to be ordered from lowest to highest in the order PHY, MAC, RLC, PDCP, RRC and NAS. According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260, gNB 280 and AMF 294, may communicate with a respective peer protocol entity that may be implemented on another device, using the services of respective lower layer protocol entities to perform such communication." Xiong at [0044].

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		"According to some embodiments, UE PHY 272 and peer entity gNB PHY 290 may communicate using signals transmitted and received via a wireless medium. According to some embodiments, UE MAC 270 and peer entity gNB MAC 288 may communicate using the services provided respectively by UE PHY 272 and gNB PHY 290. According to some embodiments, UE RLC 268 and peer entity gNB RLC 286 may communicate using the services provided respectively by UE MAC 270 and gNB MAC 288. According to some embodiments, UE PDCP 266 and peer entity gNB PDCP 284 may communicate using the services provided respectively by UE RLC 268 and SGNB RLC 286. According to some embodiments, UE RRC 264 and gNB RRC 282 may communicate using the services provided respectively by UE PDCP 266 and gNB PDCP 284. According to some embodiments, UE NAS 262 and AMF NAS 292 may communicate using the services provided respectively by UE RRC 264 and gNB RRC 282." Xiong at [0045]. "As will be described below in further detail, in some embodiments, an access node (e.g., gNB) can configure a device (e.g., UE) to monitor a region of time-frequency resources (e.g., reference downlink resources) for a PI. The gNB can configure the UE to monitor the region of time-frequency resources semi-statically, for example, by transmitting radio resource control (RRC) signaling that includes information to configure the UE with the region of time-frequency resources for monitoring. Embodiments are not limited to RRC signaling, however, as other embodiments include configuring the UE for monitoring the time-frequency region for a PI using various techniques. In some embodiments, the RRC signaling can include information (e.g., an information element (IE)) to configure the UE to monitor for a PI within a region of a system bandwidth, for example, within a bandwidth part (BWP). The RRC signaling can also include information to configure the UE to monitor for a PI within multiple BWPs and according to different BWP configurations, including different numerologies (e.g., numerologies defined in the 3GPP standard). In some embodiments, the gNB can encode a DCI format that is

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		specific to (e.g., and includes information for) preemption indication (e.g., PI-DCI)." Xiong at 77. "As previously described, in certain embodiments, a UE can be configured to monitor for a PI within a BWP. A BWP part can be defined as a subset of a bandwidth of contiguous common resource blocks, according to a given numerology (μ), on a given carrier. A BWP can also be defined by a starting position (e.g., starting resource block) and a number of resource blocks. In some embodiments, a maximum NR channel bandwidth may be 400 MHz and a gNB may configure one or multiple BWP configurations (e.g., for respective component carriers) within a wide system bandwidth for a given UE. For example, the gNB can semi-statically configure (e.g., transmit configuration information in RRC signaling to the UE) the BWP configurations. In some embodiments, the gNB can configure BWPs by encoding and transmitting to a UE information (e.g., IEs, higher-layer parameters) specific to a given numerology. Such information may also be transmitted in RRC signaling, and can include a reference numerology (e.g., for a BWP, for preempted resources), a frequency domain location for a given numerology, a bandwidth for a given numerology, and/or a subcarrier spacing of a BWP for a given numerology. According to some embodiments, the gNB can include such information in RRC signaling. The RRC signaling may also include information." Xiong at [0079]. "According to certain embodiments, the gNB can encode RRC signaling to include a radio network temporary identifier (RNTI) that is specific to preemption indication (e.g., PI-RNTI). The gNB can encode DCI (e.g., PI-DCI, DCI Format 2_1) with a cyclic redundancy check (CRC), that is scrambled (e.g., masked) by the RNTI (e.g, PI-RNTI), and the UE identifying the PI-RNTI can decode the PI-DCI to determine a PI and a location of preempted time-frequency resources. In some embodiments, a PI may be used for additional purposes, for example, to dynamically signal resources in UL. A gNB can achieve differentiation in UL by transmitting another RNTI for scrambling the DCI and reinterpreting the DCI format fields, assuming UL preemption, while keeping the same DCI size." Xiong at [0081].

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		"In some embodiments, the gNB can transmit DCI (e.g., PI-DCI) in a specific format (e.g., including the PI) via a PDCCH in a control-resource set (CORESET). A CORESET consists of a number of resource blocks in the frequency domain, which can be defined by a higher-layer parameter (e.g., in an IE), and a number of symbols (e.g., OFDM symbols) in the time domain, which can also be defined by a higher-layer parameter (e.g., in an IE). In some embodiments, an access node (e.g., gNB) can transmit the CORESET and associated defining parameters and/or IEs within RRC signaling to a UE to configure the UE for monitoring for PI-DCI (e.g., DCI format 2_1) and a PI within the CORESET." Xiong at [0082].

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		 FIG. 6 Xiong at Fig. 6; *see also, id*. at Figs. 7-11.

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		 FIG. 7 Xiong at Fig. 7. "FIG. 7 illustrates an example of multiple BWPs within a system bandwidth, in accordance with some embodiments. For example, the multiple BWPs of FIG. 7 can have different numerologies within a system bandwidth. In some embodiments, a system bandwidth 702 (e.g., wide system bandwidth) includes multiple BWPs, for example, BWP 704, BWP 706, and additional BWPs in some cases. In some embodiments, different BWPs (e.g., BWP 704, BWP 706) have different numerologies, including different subcarrier spacings and slot durations. A BWP configuration, according to its numerology, may have subcarrier spacing that is a scaled multiple (e.g., by a power of 2n, where n is an integer) of a 15 kHz subcarrier spacing." Xiong at [0084]; *see also, id*. at [0085-100]. "In some embodiments, for example, in the case of wideband operation, a network device (e.g., gNB) can determine preempted time-frequency resources (e.g., for

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		indication by PI in PI-DCI) in accordance with a numerology (e.g., reference numerology). A numerology for determination of preempted time-frequency resources may be any of a numerology used for the transmission of a synchronization block (SS block), a numerology predefined in a specification (e.g., 3GPP specification), a numerology configured for the CORESET used for transmission of PI-DCI (e.g., DCI format 2_1) in PDCCH, a numerology that is configured in a cell-specific manner for PI (e.g., via NR minimum system information (MSI), NR remaining minimum system information (RMSI), NR system information block (SIB)), or UE-specifically via UE-specific RRC signaling), and/or a numerology which is indicated within the PI. Further, frequency domain resources can be allocated based on a common physical resource block (PRB) indexing which can be employed for the wide system bandwidth operation." Xiong at [0085]. "In some embodiments, a network node (e.g., gNB) can transmit a PI in DCI (e.g., PI-DCI, DCI format 2_1) within the CORESET to a group of UEs or in a cell-specific manner. The CORESET may be a shared and/or common CORESET and can be the same as a CORESET for PDCCH monitoring for scheduling, for example, for scheduling of remaining system information (RMSI) or paging or random access response (RAR). In certain embodiments, when the CORESET is different from a CORESET for PDCCH monitoring of common control messages, the CORESET configuration, including a time-frequency resource transmission scheme (e.g., interleaved or non-interleaved), resource element group (REG)-to-control channel element (CCE) mapping, monitoring periodicity, and numerology, can be configured by higher-layers via NR MSI, NR RMSI, NR SIB and/or UE-specific RRC signaling." Xiong at [0087]. "In time domain, according to a monitoring configuration in some embodiments, a LIE may not monitor certain slots for the PDCCH carrying PI. In such cases, the gNB may not transmit the PI in an affected slot or an immediately adjacent slot to the affected slot. In some embodiments, an additional field (e.g., included in the PI) can be used to indicate a number of slots prior to the slot carrying the PI that a preemption

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		occurs. For example, a number of slots between a portion of PRBs and OFDM symbols that omit transmissions intended for a UE and a slot that includes the PI. On the other hand, a UE receiving a PI significantly after an actual preemption event can cause reprocessing of a received PDSCH to be difficult or resource-intensive for a UE. In some embodiments, an upper bound, N_s^{max} can be specified that indicates how much later in time (e.g., a number of slots) that the PI may be transmitted after the actual preemption event. In one embodiment, a maximum number of slots that may be indicated as part of the PI is the same as the upper bound, N_s^{max}. Alternatively, N_s^{max} may be defined as part of a UE capability, and if a UE detects a PI indicating preemption more than N_s^{max} slots before the PI where N_s^{max} is reported by the UE, it is not required to reprocess the PDSCH taking into consideration the PI." Xiong at [0088]. "In some embodiments, the gNB can indicate multiple preemptions of time-frequency resources by encoding a parameter (e.g., granularity parameter, bitmap parameter, indication granularity). The granularity parameter can be transmitted explicitly in signaling (e.g., RRC signaling), transmitted in DCI (e.g., PI-DCI, DCI format 2_1), or can be derived by a UE implicitly. In some embodiments, the granularity parameter can specify a frequency granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of elements (e.g., PRBs) within a monitoring region of time-frequency resources, according to a given numerology. The granularity parameter can also specify a time granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of symbols within a monitoring region of time-frequency resources, also according to the given numerology. In certain embodiments, a gNB, in determining the granularity of the preempted resources, can consider a payload size of a group common DCI (e.g., PI-DCI, DCI format 2_1) carrying the PI." Xiong at [0090]; *see also, id*. at [0091]. "As a more flexible approach, an access node (e.g., gNB) can encode an additional bit field (e.g., a small 1-2 bit field in the PI-DCI). The bit field, for example, can serve as the granularity parameter and/or indication granularity, to switch time-frequency

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		granularity (e.g., preemption granularity) dynamically. For example, if y=g·y0 and x=x0/g, then the additional bit could switch between different values of g. In certain embodiments, different values of g may be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, different values of g may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1).” Xiong at [0108]. “In certain embodiments, a granularity parameter (e.g., indication granularity) can indicate a granularity of preempted time-frequency resources through a mapping of a bitmap. For example, the granularity parameter can include a bit value indicating how many bits of a field in the preemption indication (e.g., PI, PI-DCI, DCI format 2_1) map to groups of symbols in preempted time-frequency resources (e.g., a portion of PRBs and OFDM symbols that are preempted, eMBB transmissions). In some embodiments, a granularity parameter including a value of 0 indicates that 14 bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 14 groups of consecutive symbols in preempted time-frequency resources. In other embodiments, a granularity parameter including a value of 1 indicates that 7 pairs of bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 7 groups of consecutive symbols in preempted time-frequency resources. Embodiments are not so limited however, as the granularity parameter can indicate other granularities of preempted time-frequency resources.” Xiong at [0109]. “FIG. 9A illustrates an example of preempted time-frequency resources, in accordance with certain embodiments. For example, time-frequency resources can be preempted in multiple portions **902**A, **902**B, and **902**C, and a transmitted bitmap can indicate the multiple portions of preempted time-frequency resources (e.g., bitmap transmitted in PI and/or PI-DCI/DCI format 2_1). FIG. 9B illustrates an example of a bitmap **904** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **904** can indicate a configurable time-frequency granularity, for example, a 4×7 time-frequency granularity. A 4×7 granularity can indicate 4 partitions in the

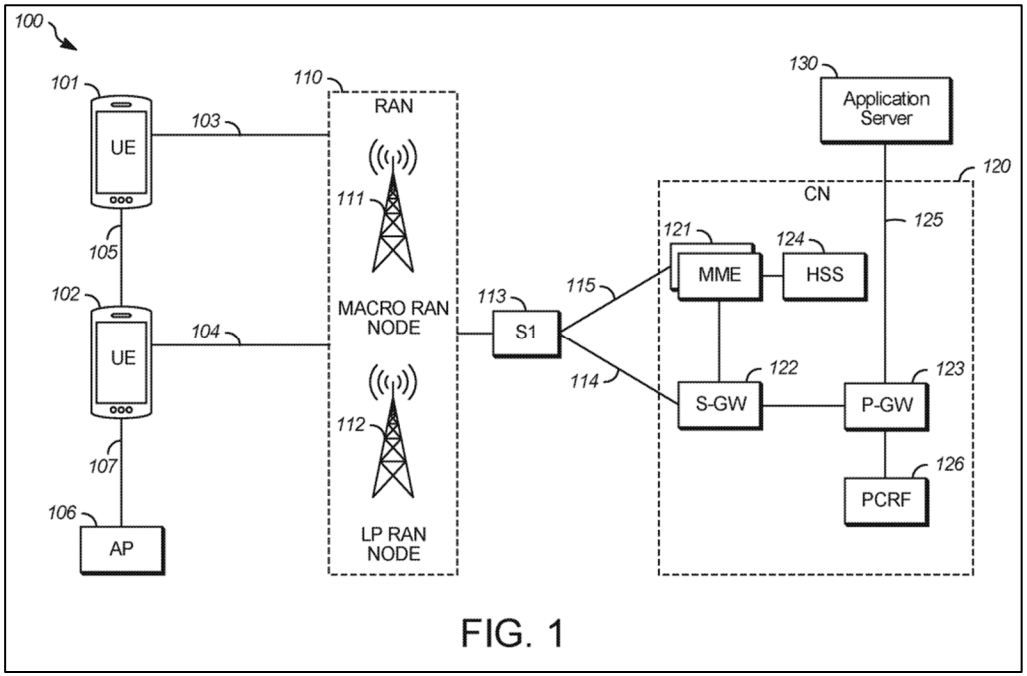
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		frequency domain and 7 partitions in the time domain. FIG. 9C illustrates an alternative example of a bitmap **906** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **906** can indicate a configurable time-frequency granularity, for example, a 2×14 time-frequency granularity. A 2×14 granularity can indicate 2 partitions in the frequency domain and 14 partitions in the time domain. In FIG. 9B and FIG. 9C, the bitmaps **904** and **906** can indicate and/or configure time-frequency granularities for preemption of resources (e.g., preemption of eMBB transmissions by URLLC). In other embodiments, bitmaps that include different values can indicate and/or configure different time-frequency granularities. In certain embodiments, with respect to FIG. 9B and FIG. 9C, a bit value of 0 in one of bitmaps **904** or **906**, or a different bitmap, can indicate no preemption of time-frequency resources. In such embodiments, indication of no preemption of time-frequency resources indicates a not mal transmission (e.g., transmission of eMBB, transmission of signaling in PDSCH). In alternative embodiments, a bit value of 1 in one of bitmaps **904** or **906**, or a different bitmap, can indicate a preemption of time-frequency resources. In such embodiments, indication of a preemption of time-frequency resources indicates that a transmission is not intended for a certain UE and/or corruption of signaling by the gNB. In some embodiments, a granularity value (e.g., bitmap and/or matrix indicating a granularity) can change dynamically, for example, the gNB may change bit values in a bitmap and indicate bit values through DCI (e.g., PI-DCI). In certain embodiments, bitmaps (e.g., **904** and **906**) to indicate and/or configure time-frequency granularities for preemption of resources can be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, the bitmaps may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1). Bitmaps can be configured to indicate and/or configure one of time granularity or frequency granularity, and based on receiving this infoiination through signaling (e.g., from a gNB), a device (e.g., UE) can derive a time granularity from an indicated frequency granularity (e.g., indicated in a bitmap), or vice versa." Xiong at [0110-114].

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		"In some embodiments, a gNB may configure a set of puncturing time-frequency patterns, for example, via transmission of semi-static signaling (e.g., RRC signaling) and/or DCI signaling (e.g., via configuration index). In one embodiment, a gNB can limit a number of signaled preemptions and use combinatorial indexing to optimize higher-layer signaling. If a number of preemptions is limited there are fewer combinations to signal. For example, referring to FIG. 9A and FIG. 10A, the number of preemptions may be limited to half of the resources or the 28 overall puncturing resources. Such optimizations may only introduce 1-2 bit savings unless a reduced number of preemptions can be signaled (e.g., 7 arbitrary preemptions in 28 resources require approximately 21 bit signaling). In some embodiments, optimized signaling can be defined, while accounting for a maximum payload for indications (e.g., maximum DCI payload). In such embodiments, signaling can include one or more parameters including a number of bits available for indication of preemptions, D, reference time resource symbols, Rt, reference frequency resources (e.g., PRBs), Rf, time and frequency granularities 'x' and 'y,' respectively, a number of time resources within a region Nt=floor(Rt/x), and a number of frequency resources within a region Nf=floor(Rf/y), where D=NfNt=floor(Rt/x)·floor(Rf/y). In some embodiments, knowing the overall size of an indication D, and one of a granularity of time or frequency, a UE can derive another granularity of one of time or frequency. In other embodiments, knowing D and Rt and Rf, (e.g., from a DL resource configuration), the UE can derive a number of partitions in time and/or frequency. In such embodiments, either 'x' or 'y' can be signaled and the UE can derive the value of 'x' or 'y' that is not signaled from the signaled value, the overall available number of signaling bits, and the reference resource region size." Xiong at [0121-122]. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC

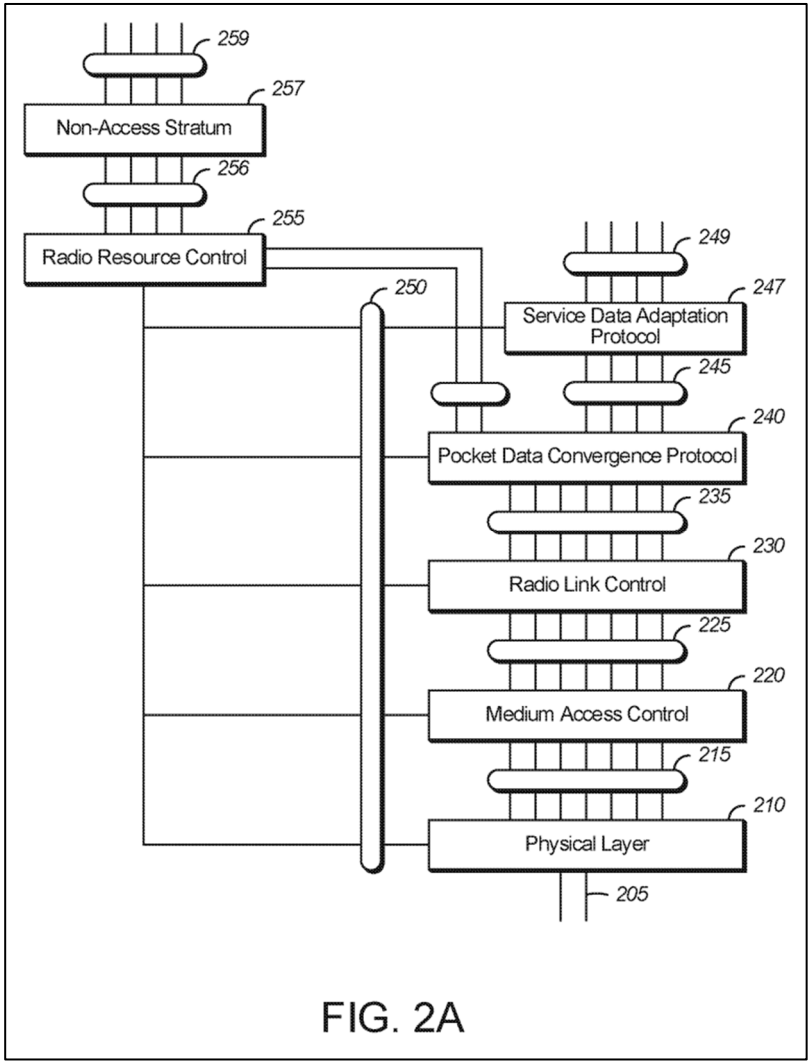
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		signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI. In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology. "In Example 3, the subject matter of Examples 1-2 includes, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating pre-emption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at [0134-136]. "Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI." Xiong at [0146].

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		"In Example 15, the subject matter of Examples 13-14 includes, wherein the processing circuitry is configured to: decode, from the RRC signaling, a preemption indication radio network temporary identifier (PI-RNTI) indicating preemption in a downlink (DL); and identify a cyclic redundancy check (CRC) scrambled by the PI-RNTI and decode the PI-DCI based on the PI-RNTI." Xiong at [0148]. "1. An apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at Claim 1; *see also, id*. at Claims 6, 13, 17. "3. The apparatus of claim 1, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating preemption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at Claim 3; *see also, id*. at Claim 15. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other

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		prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	after receiving the specific RNTI, monitoring, by the first UE, a DL control channel for receiving the DL preemption indication information based on the received specific RNTI; and	At least under Pegasus's apparent infringement theory, Xiong discloses after receiving the specific RNTI, monitoring, by the first UE, a DL control channel for receiving the DL preemption indication information based on the received specific RNTI; and. For example, Xiong discloses this limitation based on the following exemplary citations: "Embodiments of dynamic multiplexing are described, including the transmission of preemption indication (PI) to indicate preemption of time-frequency resources. In some embodiments, a next Generation NodeB (gNB) is configured to transmit PIs in signaling to preempt an enhanced Mobile Broadband (eMBB) communications transmission with an ultra-reliable and low latency communications (URLCC) transmission. In some embodiments, a user equipment (UE) is configured to monitor a region of time-frequency resources, within a bandwidth part (BWP), for a PI. The PI indicates to the UE a portion of time-frequency resources that omit transmissions intended for the UE. In some embodiments, the gNB transmits the PI to the UE within preemption indication downlink control information (PI-DCI) in a physical downlink control channel (PDCCH) in a control resource set (CORESET). In some embodiments, the BWP is defined according to a frequency domain location, a bandwidth, and a subcarrier spacing for a given numerology." Xiong at Abstract. "FIG. 1 illustrates an architecture of a system 100 of a network in accordance with some embodiments. In some embodiments, the system 100 may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some embodiments, network devices, such as the access nodes described below, can be

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		configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below. The system 100 is shown to include a UE 101 and a UE 102, for example a UE configured for preemption operations. The UEs 101 and 102 are illustrated as smartphones (e.g., handheld touchscreen mobile computing devices connectable to one or more cellular networks), but may also comprise any mobile or non-mobile computing device, such as Personal Data Assistants (PDAs), pagers, laptop computers, desktop computers, wireless handsets, or any computing device including a wireless communications interface." Xiong at [0022-23].  FIG. 1 Xiong at Fig. 1.

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		"FIG. 2A illustrates protocol functions that may be implemented in a wireless communication device in accordance with some embodiments, for example in a UE or BS configured for preemption operations. In some embodiments, protocol layers may include one or more of physical layer (PHY) 210, medium access control layer (MAC) 220, radio link control layer (RLC) 230, packet data convergence protocol layer (PDCP) 240, service data adaptation protocol (SDAP) layer 247, radio resource control layer (RRC) 255, and non-access stratum (NAS) layer 257, in addition to other higher layer functions not illustrated." Xiong at [0040]; *see also, id*. at [0041].

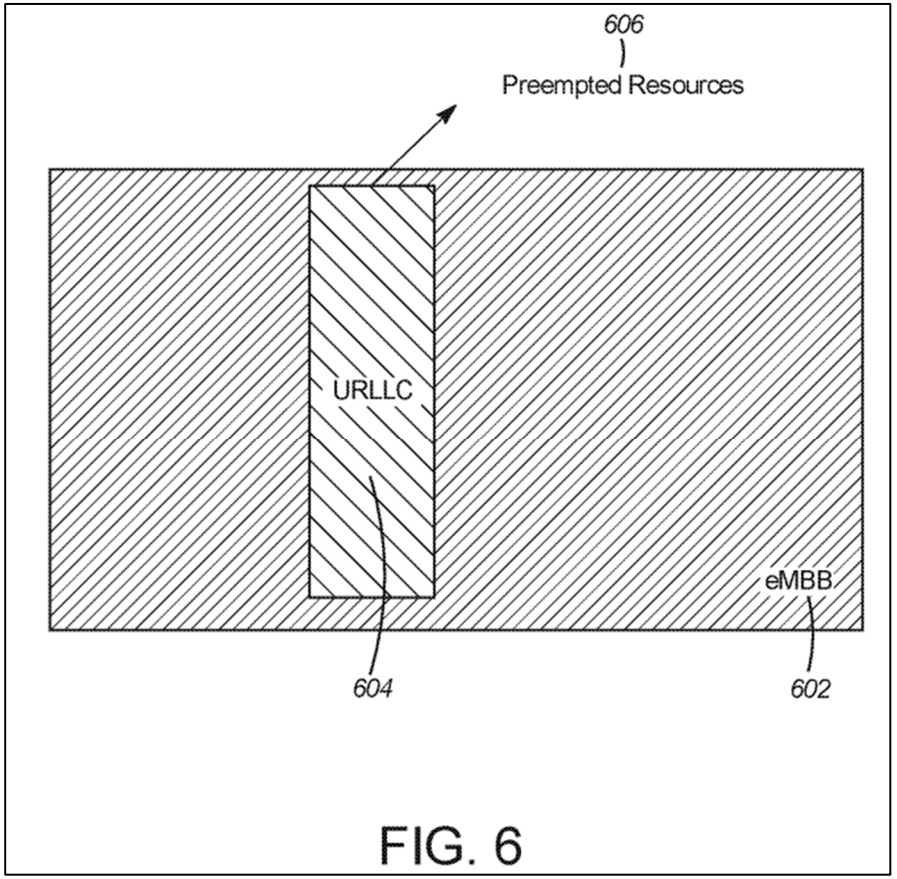
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	 FIG. 2A Xiong at Fig. 2A.

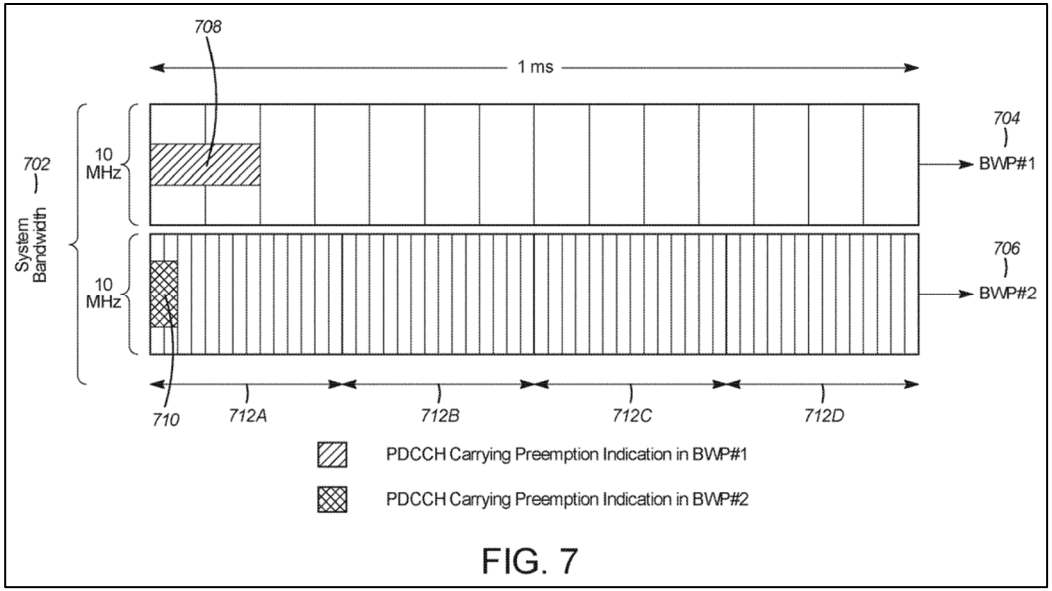
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		"According to some embodiments, an instance of PDCP 240 may process requests from and provide indications to one or more of an instance of RRC 255 and one or more instances of SDAP 247 via one or more packet data convergence protocol service access points (PDCP-SAP) 245. According to some embodiments, requests and indications communicated via PDCP-SAP 245 may comprise one or more radio bearers. According to some embodiments, an instance of SDAP 247 may process requests from and provide indications to one or more higher layer protocol entities via one or more service data adaptation protocol service access points (SDAP-SAP) 249. According to some embodiments, requests and indications communicated via SDAP-SAP 249 may comprise one or more quality of service (QoS) flows. According to some embodiments, RRC entity 255 may configure, via one or more management service access points (M-SAP), embodiments of one or more protocol layers, which may include one or more instances of PHY 210, MAC 220, RLC 230, PDCP 240 and SDAP 247. According to some embodiments, an instance of RRC may process requests from and provide indications to one or more NAS entities via one or more RRC service access points (RRC-SAP)." Xiong at [0042]. "According to some embodiments, 5GNB 280 may be implemented as one or more of a dedicated physical device such as a macro-cell, a femto-cell or other suitable device, or in an alternative aspect, may be implemented as one or more software entities running on server computers as part of a virtual network termed a cloud radio access network (CRAN). According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260 (e.g., UE 101, UE 102, device 300), gNB 280 and AMF 294, may be described as implementing all or part of a protocol stack in which the layers are considered to be ordered from lowest to highest in the order PHY, MAC, RLC, PDCP, RRC and NAS. According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260, gNB 280 and AMF 294, may communicate with a respective peer protocol entity that may be implemented on another device, using the services of respective lower layer protocol entities to perform such communication." Xiong at [0044].

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		"According to some embodiments, UE PHY 272 and peer entity gNB PHY 290 may communicate using signals transmitted and received via a wireless medium. According to some embodiments, UE MAC 270 and peer entity gNB MAC 288 may communicate using the services provided respectively by UE PHY 272 and gNB PHY 290. According to some embodiments, UE RLC 268 and peer entity gNB RLC 286 may communicate using the services provided respectively by UE MAC 270 and gNB MAC 288. According to some embodiments, UE PDCP 266 and peer entity gNB PDCP 284 may communicate using the services provided respectively by UE RLC 268 and SGNB RLC 286. According to some embodiments, UE RRC 264 and gNB RRC 282 may communicate using the services provided respectively by UE PDCP 266 and gNB PDCP 284. According to some embodiments, UE NAS 262 and AMF NAS 292 may communicate using the services provided respectively by UE RRC 264 and gNB RRC 282." Xiong at [0045]. "As will be described below in further detail, in some embodiments, an access node (e.g., gNB) can configure a device (e.g., UE) to monitor a region of time-frequency resources (e.g., reference downlink resources) for a PI. The gNB can configure the UE to monitor the region of time-frequency resources semi-statically, for example, by transmitting radio resource control (RRC) signaling that includes information to configure the UE with the region of time-frequency resources for monitoring. Embodiments are not limited to RRC signaling, however, as other embodiments include configuring the UE for monitoring the time-frequency region for a PI using various techniques. In some embodiments, the RRC signaling can include information (e.g., an information element (IE)) to configure the UE to monitor for a PI within a region of a system bandwidth, for example, within a bandwidth part (BWP). The RRC signaling can also include information to configure the UE to monitor for a PI within multiple BWPs and according to different BWP configurations, including different numerologies (e.g., numerologies defined in the 3GPP standard). In some embodiments, the gNB can encode a DCI format that is

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		specific to (e.g., and includes information for) preemption indication (e.g., PI-DCI)." Xiong at [0077]. "In certain embodiments, the DCI format may be used for notifying a group of UEs of a portion of physical resource blocks (PRBs) and symbols, such as Orthogonal Frequency Division Multiplexing (OFDM) symbols. A UE or multiple UEs may assume that, within the portion of the PRBs and OFDM symbols (e.g., a portion of PRBs and symbols of a PDSCH transmission), no transmission is intended for the respective UE receiving the DCI format. In certain embodiments, this means that some time-frequency resources (e.g., URLLC transmissions) are preempted (e.g., eMBB transmissions are preempted). To preempt eMBB transmissions, for example, a gNB can puncture resource elements that are scheduled for the eMBB transmissions, although embodiments are not so limited. In embodiments of a preempted transmission, a UE considers the preempted transmission (e.g., from the gNB) to be corrupted and can then perform soft combining of the corrupted (e.g., preempted) initial transmission and a retransmission (e.g., retransmission of an eMBB transmission). Receiving the PI from the gNB in such embodiments can assist with the soft combining." Xiong at [0078]. "As previously described, in certain embodiments, a UE can be configured to monitor for a PI within a BWP. A BWP part can be defined as a subset of a bandwidth of contiguous common resource blocks, according to a given numerology (μ), on a given carrier. A BWP can also be defined by a starting position (e.g., starting resource block) and a number of resource blocks. In some embodiments, a maximum NR channel bandwidth may be 400 MHz and a gNB may configure one or multiple BWP configurations (e.g., for respective component carriers) within a wide system bandwidth for a given UE. For example, the gNB can semi-statically configure (e.g., transmit configuration information in RRC signaling to the UE) the BWP configurations. In some embodiments, the gNB can configure BWPs by encoding and transmitting to a UE information (e.g., IEs, higher-layer parameters) specific to a given numerology. Such information may also be transmitted in RRC signaling, and

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		can include a reference numerology (e.g., for a BWP, for preempted resources), a frequency domain location for a given numerology, a bandwidth for a given numerology, and/or a subcarrier spacing of a BWP for a given numerology. According to some embodiments, the gNB can include such information in RRC signaling. The RRC signaling may also include information." Xiong at [0079]. "According to certain embodiments, the gNB can encode RRC signaling to include a radio network temporary identifier (RNTI) that is specific to preemption indication (e.g., PI-RNTI). The gNB can encode DCI (e.g., PI-DCI, DCI Format 2_1) with a cyclic redundancy check (CRC), that is scrambled (e.g., masked) by the RNTI (e.g, PI-RNTI), and the UE identifying the PI-RNTI can decode the PI-DCI to determine a PI and a location of preempted time-frequency resources. In some embodiments, a PI may be used for additional purposes, for example, to dynamically signal resources in UL. A gNB can achieve differentiation in UL by transmitting another RNTI for scrambling the DCI and reinterpreting the DCI format fields, assuming UL preemption, while keeping the same DCI size." Xiong at [0081]. "In some embodiments, the gNB can transmit DCI (e.g., PI-DCI) in a specific format (e.g., including the PI) via a PDCCH in a control-resource set (CORESET). A CORESET consists of a number of resource blocks in the frequency domain, which can be defined by a higher-layer parameter (e.g., in an IE), and a number of symbols (e.g., OFDM symbols) in the time domain, which can also be defined by a higher-layer parameter (e.g., in an IE). In some embodiments, an access node (e.g., gNB) can transmit the CORESET and associated defining parameters and/or IEs within RRC signaling to a UE to configure the UE for monitoring for PI-DCI (e.g., DCI format 2_1) and a PI within the CORESET." Xiong at [0082].

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	 FIG. 6 Xiong at Fig. 6; *see also, id*. at Figs. 7-11.

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		 FIG. 7 Xiong at Fig. 7. "FIG. 7 illustrates an example of multiple BWPs within a system bandwidth, in accordance with some embodiments. For example, the multiple BWPs of FIG. 7 can have different numerologies within a system bandwidth. In some embodiments, a system bandwidth 702 (e.g., wide system bandwidth) includes multiple BWPs, for example, BWP 704, BWP 706, and additional BWPs in some cases. In some embodiments, different BWPs (e.g., BWP 704, BWP 706) have different numerologies, including different subcarrier spacings and slot durations. A BWP configuration, according to its numerology, may have subcarrier spacing that is a scaled multiple (e.g., by a power of 2n, where n is an integer) of a 15 kHz subcarrier spacing." Xiong at [0084]; *see also, id*. at [0085-100]. "In some embodiments, for example, in the case of wideband operation, a network device (e.g., gNB) can determine preempted time-frequency resources (e.g., for

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		indication by PI in PI-DCI) in accordance with a numerology (e.g., reference numerology). A numerology for determination of preempted time-frequency resources may be any of a numerology used for the transmission of a synchronization block (SS block), a numerology predefined in a specification (e.g., 3GPP specification), a numerology configured for the CORESET used for transmission of PI-DCI (e.g., DCI format 2_1) in PDCCH, a numerology that is configured in a cell-specific manner for PI (e.g., via NR minimum system information (MSI), NR remaining minimum system information (RMSI), NR system information block (SIB)), or UE-specifically via UE-specific RRC signaling), and/or a numerology which is indicated within the PI. Further, frequency domain resources can be allocated based on a common physical resource block (PRB) indexing which can be employed for the wide system bandwidth operation." Xiong at [0085]. "In some embodiments, a network node (e.g., gNB) can transmit a PI in DCI (e.g., PI-DCI, DCI format 2_1) within the CORESET to a group of UEs or in a cell-specific manner. The CORESET may be a shared and/or common CORESET and can be the same as a CORESET for PDCCH monitoring for scheduling, for example, for scheduling of remaining system information (RMSI) or paging or random access response (RAR). In certain embodiments, when the CORESET is different from a CORESET for PDCCH monitoring of common control messages, the CORESET configuration, including a time-frequency resource transmission scheme (e.g., interleaved or non-interleaved), resource element group (REG)-to-control channel element (CCE) mapping, monitoring periodicity, and numerology, can be configured by higher-layers via NR MSI, NR RMSI, NR SIB and/or UE-specific RRC signaling." Xiong at [0087]. "In time domain, according to a monitoring configuration in some embodiments, a LIE may not monitor certain slots for the PDCCH carrying PI. In such cases, the gNB may not transmit the PI in an affected slot or an immediately adjacent slot to the affected slot. In some embodiments, an additional field (e.g., included in the PI) can be used to indicate a number of slots prior to the slot carrying the PI that a preemption

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		occurs. For example, a number of slots between a portion of PRBs and OFDM symbols that omit transmissions intended for a UE and a slot that includes the PI. On the other hand, a UE receiving a PI significantly after an actual preemption event can cause reprocessing of a received PDSCH to be difficult or resource-intensive for a UE. In some embodiments, an upper bound, N_s^{max} can be specified that indicates how much later in time (e.g., a number of slots) that the PI may be transmitted after the actual preemption event. In one embodiment, a maximum number of slots that may be indicated as part of the PI is the same as the upper bound, N_s^{max}. Alternatively, N_s^{max} may be defined as part of a UE capability, and if a UE detects a PI indicating preemption more than N_s^{max} slots before the PI where N_s^{max} is reported by the UE, it is not required to reprocess the PDSCH taking into consideration the PI." Xiong at [0088]. "In some embodiments, the gNB can indicate multiple preemptions of time-frequency resources by encoding a parameter (e.g., granularity parameter, bitmap parameter, indication granularity). The granularity parameter can be transmitted explicitly in signaling (e.g., RRC signaling), transmitted in DCI (e.g., PI-DCI, DCI format 2_1), or can be derived by a UE implicitly. In some embodiments, the granularity parameter can specify a frequency granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of elements (e.g., PRBs) within a monitoring region of time-frequency resources, according to a given numerology. The granularity parameter can also specify a time granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of symbols within a monitoring region of time-frequency resources, also according to the given numerology. In certain embodiments, a gNB, in determining the granularity of the preempted resources, can consider a payload size of a group common DCI (e.g., PI-DCI, DCI format 2_1) carrying the PI." Xiong at [0090]. "In some embodiments, configuration of frequency regions smaller than a UE bandwidth can lead to scheduling restrictions and overdesigned signaling. To address this, the gNB can encode signaling so that the frequency region is implicitly indicated

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		as a bandwidth of a BWP or a component carrier (CC) where a UE operates. For example, the BWP in which the CORESET is transmitted can be considered by the UE to be the bandwidth in which the UE monitors for the PI. In some embodiments, the gNB can transmit an indication to the UE in signaling to notify the UE of the bandwidth for monitoring being equal to the BWP. In other embodiments, additional start-RB and end-RB may be configured via RRC for the concerned BWP in order to further restrict the monitoring region (e.g., in case the puncturing/preemption is expected to affect only a portion of the BWP). With respect to time domain resources, configurability may be directly linked with a PI-DCI monitoring configuration. For example, a monitoring periodicity (e.g., 'p') can be reused as a monitoring region for monitoring for the PI. In some cases, a UE may not benefit from receiving a PI that indicates a slot earlier than 'n−c' because of processing latency. If 'c' is smaller than a configured monitoring periodicity, the reference resource can be adjusted accordingly based on processing capabilities of all UEs in the group. To resolve the issue of UE processing time in relation to PI monitoring periodicity and in relation to the region of time-domain resources for PI, several techniques may be used." Xiong at [0091-92]. "In some embodiments, if a time gap between reception of a PI and HARQ ACK/NACK feedback is less than a time t_reproc, the UE is not expected to consider a PI for determining the ACK/NACK corresponding to the PDSCH indicated as being affected by preemption (e.g., indicated in PI-DCI as preempted). In some embodiments, t_reproc is equal to a minimum UE processing time (e.g., N1 symbols), for example, processing time for the PDSCH. In other embodiments, t_reproc may be less than N1, but is at least greater than f*N1, where 'f' is a predefined fraction. Processing time, t_reproc, can also be indicated by a UE as part of UE capability, and may also be configured by the network per UE based on UE capability for minimum UE processing time (e.g., if UE capability is defined for minimum UE processing time). In some embodiments, the UE is not expected to consider a PI corresponding to a TB for which it already received a retransmission during a time-gap between an

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		affected PDSCH and the next PI monitoring instance (e.g., monitoring for PI-DCI)." Xiong at [0095]. "In certain embodiments, when a UE is configured to monitor for both an eMBB and URLLC transmission, the UE may receive a DL control channel (e.g., PDCCH) and/or DL shared channel (e.g., PDSCH) for a URLLC within time-frequency resources (e.g., resources indicated by the PI). In such embodiments, the CORESET for PDCCH monitoring or the scheduled data will have higher priority than the preempted time-frequency resources (e.g., indicated by the PI) if the CORESET or scheduled data overlaps with the preempted time-frequency resources. In some embodiments, if a PI indicates the PDCCH and/or PDSCH for URLLC as being preempted, the UE will not assume that these resources are corrupted for a receive processing adjustment. UE behavior, for such embodiments, may be configurable by higher-layer signaling. For this purpose, a bit indication (e.g., one bit) may be conveyed (e.g., transmitted by the gNB) as part of signaling for configuration of UE monitoring of a BWP and the CORESET (e.g., including PI-DCI) within the PDCCH (e.g., associated with a certain PDCCH search space to be used for scheduling of particular services). For example, the bit indication may be set to '1' to indicate to the LIE that when scheduled via DCI (e.g., PI-DCI) in the CORESET, or PDCCH search space, the resources corresponding to the scheduled PDSCH cannot be preempted and thus should be excluded from calculation of corrupted resource elements (e.g., preempted resource elements) indicated by PI. In certain embodiments, the resources corresponding to transmission of PDCCH in the indicated CORESETs and resources corresponding to PDSCH scheduled using DCI in such CORESETs are reserved from being preempted, which can lead to restrictions to scheduling flexibility." Xiong at [0097-98]. "To indicate preempted resources, an access node (e.g., gNB) can encode the PI-DCI (e.g., PI), for transmission within the region of time-frequency resources for monitoring, to include various information for indicating preempted time-resources.

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		In one embodiment, the PI-DCI (e.g., PI) can include a joint time-frequency bitmap. For example, the joint time-frequency bitmap may comprise a two-dimensional (2D) bitmap and/or matrix to indicate (e.g., encode) multiple preemptions within time-frequency resources (e.g., within an eMBB transmission). As a nonlimiting example, a NR slot can have 14 symbols, which may be divided into 7 symbol parts (e.g., 2 symbols per part), or 14 symbol parts (e.g., 1 symbol per part). In some embodiments, a bitmap can signal which portions of the NR slot (e.g., subframe) are preempted in the time-frequency resources. In some embodiments, the y-axis of a time-frequency grid, representing frequency (e.g., bandwidth), can be configured to comprise ¼ of a BWP, and the x-axis of the time-frequency grid, representing time (e.g., symbols and slots of a subframe), can be configured to comprise 2 symbols with a 1 slot monitoring periodicity. In such embodiments, a bitmap may consume 4·7=28 bits. However, in certain applications that cover almost an entire bandwidth, such an approach may not be efficient, for example, for purposes of a distributed DL resource allocation for URLLC, where the distributed resource allocation can enable frequency diversity." Xiong at [0106-107]. "As a more flexible approach, an access node (e.g., gNB) can encode an additional bit field (e.g., a small 1-2 bit field in the PI-DCI). The bit field, for example, can serve as the granularity parameter and/or indication granularity, to switch time-frequency granularity (e.g., preemption granularity) dynamically. For example, if y=g·y0 and x=x0/g, then the additional bit could switch between different values of g. In certain embodiments, different values of g may be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, different values of g may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1)." Xiong at [0108]. "In certain embodiments, a granularity parameter (e.g., indication granularity) can indicate a granularity of preempted time-frequency resources through a mapping of a bitmap. For example, the granularity parameter can include a bit value indicating how many bits of a field in the preemption indication (e.g., PI, PI-DCI, DCI format 2_1)

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		map to groups of symbols in preempted time-frequency resources (e.g., a portion of PRBs and OFDM symbols that are preempted, eMBB transmissions). In some embodiments, a granularity parameter including a value of 0 indicates that 14 bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 14 groups of consecutive symbols in preempted time-frequency resources. In other embodiments, a granularity parameter including a value of 1 indicates that 7 pairs of bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 7 groups of consecutive symbols in preempted time-frequency resources. Embodiments are not so limited however, as the granularity parameter can indicate other granularities of preempted time-frequency resources." Xiong at [0109]. "FIG. 9A illustrates an example of preempted time-frequency resources, in accordance with certain embodiments. For example, time-frequency resources can be preempted in multiple portions **902**A, **902**B, and **902**C, and a transmitted bitmap can indicate the multiple portions of preempted time-frequency resources (e.g., bitmap transmitted in PI and/or PI-DCI/DCI format 2_1). FIG. 9B illustrates an example of a bitmap **904** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **904** can indicate a configurable time-frequency granularity, for example, a 4×7 time-frequency granularity. A 4×7 granularity can indicate 4 partitions in the frequency domain and 7 partitions in the time domain. FIG. 9C illustrates an alternative example of a bitmap **906** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **906** can indicate a configurable time-frequency granularity, for example, a 2×14 time-frequency granularity. A 2×14 granularity can indicate 2 partitions in the frequency domain and 14 partitions in the time domain. In FIG. 9B and FIG. 9C, the bitmaps **904** and **906** can indicate and/or configure time-frequency granularities for preemption of resources (e.g., preemption of eMBB transmissions by URLLC). In other embodiments, bitmaps that include different values can indicate and/or configure different time-frequency granularities.

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		In certain embodiments, with respect to FIG. 9B and FIG. 9C, a bit value of 0 in one of bitmaps **904** or **906**, or a different bitmap, can indicate no preemption of time-frequency resources. In such embodiments, indication of no preemption of time-frequency resources indicates a not mal transmission (e.g., transmission of eMBB, transmission of signaling in PDSCH). In alternative embodiments, a bit value of 1 in one of bitmaps **904** or **906**, or a different bitmap, can indicate a preemption of time-frequency resources. In such embodiments, indication of a preemption of time-frequency resources indicates that a transmission is not intended for a certain UE and/or corruption of signaling by the gNB. In some embodiments, a granularity value (e.g., bitmap and/or matrix indicating a granularity) can change dynamically, for example, the gNB may change bit values in a bitmap and indicate bit values through DCI (e.g., PI-DCI). In certain embodiments, bitmaps (e.g., **904** and **906**) to indicate and/or configure time-frequency granularities for preemption of resources can be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, the bitmaps may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1). Bitmaps can be configured to indicate and/or configure one of time granularity or frequency granularity, and based on receiving this infoiination through signaling (e.g., from a gNB), a device (e.g., UE) can derive a time granularity from an indicated frequency granularity (e.g., indicated in a bitmap), or vice versa." Xiong at [0110-114]. "In some embodiments, a gNB may configure a set of puncturing time-frequency patterns, for example, via transmission of semi-static signaling (e.g., RRC signaling) and/or DCI signaling (e.g., via configuration index). In one embodiment, a gNB can limit a number of signaled preemptions and use combinatorial indexing to optimize higher-layer signaling. If a number of preemptions is limited there are fewer combinations to signal. For example, referring to FIG. 9A and FIG. 10A, the number of preemptions may be limited to half of the resources or the 28 overall puncturing resources. Such optimizations may only introduce 1-2 bit savings unless a reduced

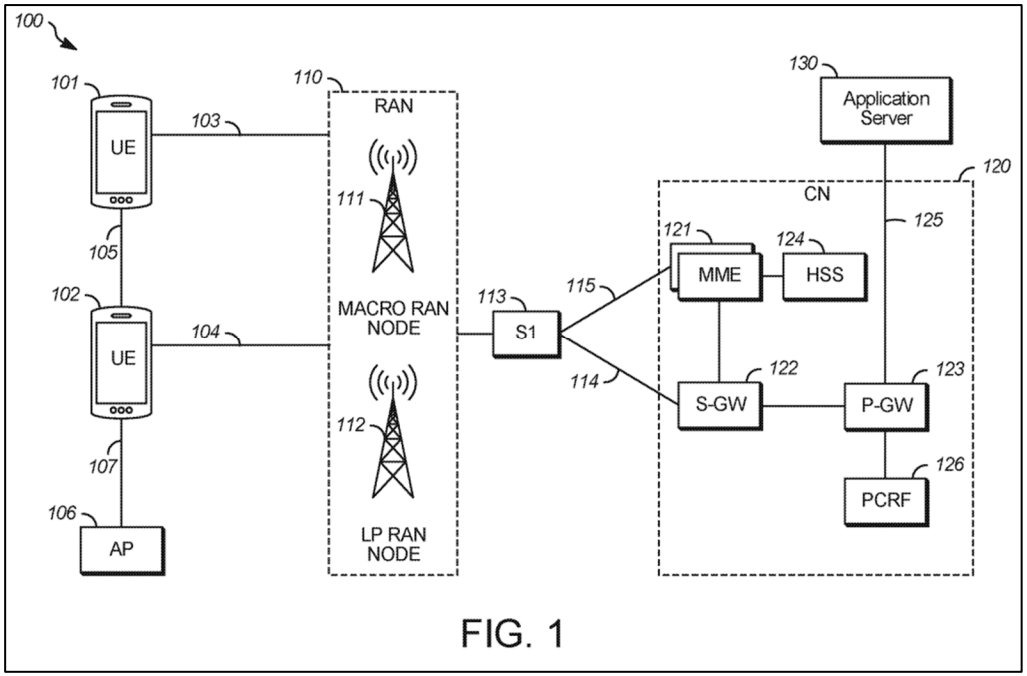
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		number of preemptions can be signaled (e.g., 7 arbitrary preemptions in 28 resources require approximately 21 bit signaling). In some embodiments, optimized signaling can be defined, while accounting for a maximum payload for indications (e.g., maximum DCI payload). In such embodiments, signaling can include one or more parameters including a number of bits available for indication of preemptions, D, reference time resource symbols, Rt, reference frequency resources (e.g., PRBs), Rf, time and frequency granularities 'x' and 'y,' respectively, a number of time resources within a region Nt=floor(Rt/x), and a number of frequency resources within a region Nf=floor(Rf/y), where D=NfNt=floor(Rt/x)·floor(Rf/y). In some embodiments, knowing the overall size of an indication D, and one of a granularity of time or frequency, a UE can derive another granularity of one of time or frequency. In other embodiments, knowing D and Rt and Rf, (e.g., from a DL resource configuration), the UE can derive a number of partitions in time and/or frequency. In such embodiments, either 'x' or 'y' can be signaled and the UE can derive the value of 'x' or 'y' that is not signaled from the signaled value, the overall available number of signaling bits, and the reference resource region size." Xiong at [0121-122]. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI.

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		In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology. "In Example 3, the subject matter of Examples 1-2 includes, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating pre-emption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at [0134-136]. "Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI." Xiong at [0146]. "In Example 15, the subject matter of Examples 13-14 includes, wherein the processing circuitry is configured to: decode, from the RRC signaling, a preemption indication radio network temporary identifier (PI-RNTI) indicating preemption in a downlink (DL); and identify a cyclic redundancy check (CRC) scrambled by the PI-RNTI and decode the PI-DCI based on the PI-RNTI." Xiong at [0148]. "Example 24 is a computer-readable hardware storage device that stores instructions for execution by one or more processors of a user equipment (UE), the instructions to configure the one or more processors to: decode radio resource control (RRC)

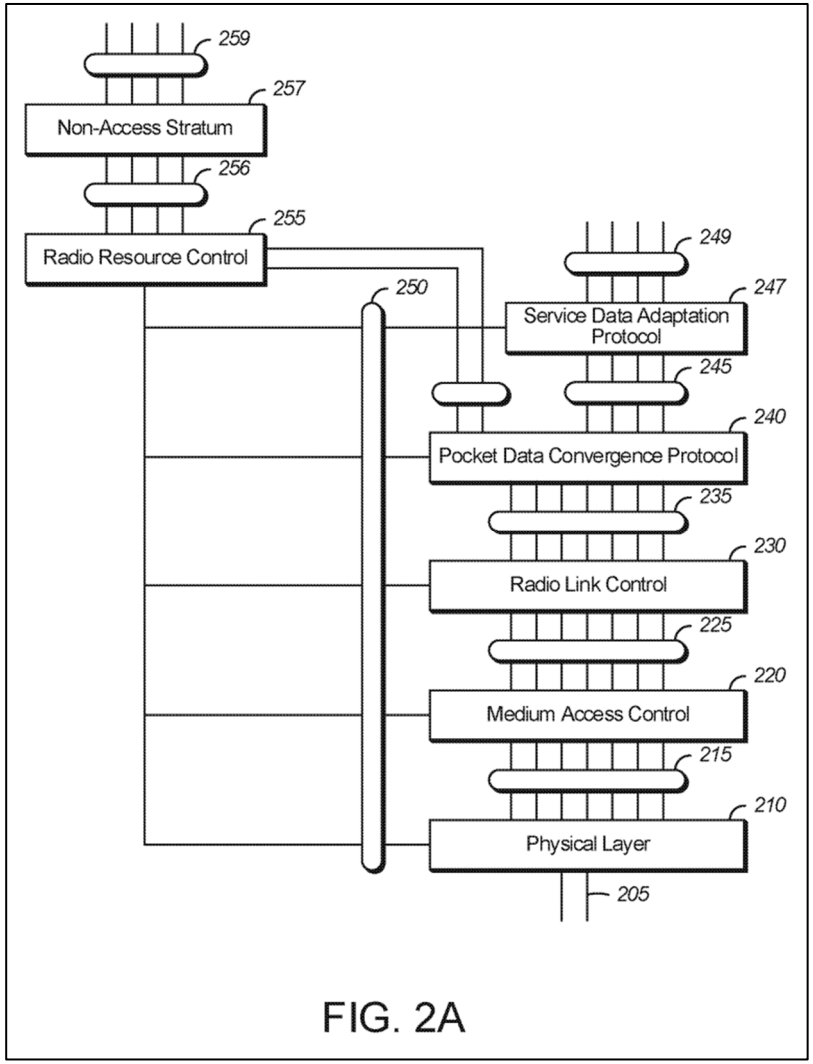
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		signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) infoiination element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE. Example 25 is a computer-readable hardware storage device that stores instructions for execution by one or more processors of a New Radio (NR) NodeB (gNB), the instructions to configure the one or more processors to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the UE." Xiong at [0157-158]. "1. An apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI);

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		encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at Claim 1; *see also, id*. at Claims 6, 13, 17. "3. The apparatus of claim 1, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating preemption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at Claim 3; *see also, id*. at Claim 15. "25. A computer-readable hardware storage device that stores instructions for execution by one or more processors of a New Radio (NR) NodeB (gNB), the instructions to configure the one or more processors to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the UE." Xiong at Claim 25. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not

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		anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	receiving, by the first UE, the DL preemption indication information through a multicast signal,	At least under Pegasus's apparent infringement theory, Xiong discloses receiving, by the first UE, the DL preemption indication information through a multicast signal. For example, Xiong discloses this limitation based on the following exemplary citations: "Embodiments of dynamic multiplexing are described, including the transmission of preemption indication (PI) to indicate preemption of time-frequency resources. In some embodiments, a next Generation NodeB (gNB) is configured to transmit PIs in signaling to preempt an enhanced Mobile Broadband (eMBB) communications transmission with an ultra-reliable and low latency communications (URLCC) transmission. In some embodiments, a user equipment (UE) is configured to monitor a region of time-frequency resources, within a bandwidth part (BWP), for a PI. The PI indicates to the UE a portion of time-frequency resources that omit transmissions intended for the UE. In some embodiments, the gNB transmits the PI to the UE within preemption indication downlink control information (PI-DCI) in a physical downlink control channel (PDCCH) in a control resource set (CORESET). In some embodiments, the BWP is defined according to a frequency domain location, a bandwidth, and a subcarrier spacing for a given numerology." Xiong at Abstract. "FIG. 1 illustrates an architecture of a system 100 of a network in accordance with some embodiments. In some embodiments, the system 100 may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some

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		embodiments, network devices, such as the access nodes described below, can be configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below. The system 100 is shown to include a UE 101 and a UE 102, for example a UE configured for preemption operations. The UEs 101 and 102 are illustrated as smartphones (e.g., handheld touchscreen mobile computing devices connectable to one or more cellular networks), but may also comprise any mobile or non-mobile computing device, such as Personal Data Assistants (PDAs), pagers, laptop computers, desktop computers, wireless handsets, or any computing device including a wireless communications interface." Xiong at [0022-23].  FIG. 1

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		Xiong at Fig. 1. "In this embodiment, the UEs 101 and 102 may further directly exchange communication data via a ProSe interface 105. The ProSe interface 105 may alternatively be referred to as a sidelink interface comprising one or more logical channels, including but not limited to a Physical Sidelink Control Channel (PSBCH), a Physical Sidelink Shared Channel (PSBCH), a Physical Sidelink Discovery Channel (PSBCH), and a Physical Sidelink Broadcast Channel (PSBCH)." Xiong at [0026]. "The physical downlink shared channel (PDSCH) may carry user data and higher-layer signaling to the UEs 101 and 102. The physical downlink control channel (PDCCH) may carry information about the transport format and resource allocations related to the PDSCH channel, among other things. It may also inform the UEs 101 and 102 about the transport format, resource allocation, and H-ARQ (Hybrid Automatic Repeat Request) information related to the uplink shared channel. Typically, downlink scheduling (assigning control and shared channel resource blocks to the UE 102 within a cell) may be performed at any of the RAN nodes 111 and 112 based on channel quality information fed back from any of the UEs 101 and 102. The downlink resource assignment information may be sent on the PDCCH used for (e.g., assigned to) each of the UEs 101 and 102." Xiong at [0032]. "FIG. 2A illustrates protocol functions that may be implemented in a wireless communication device in accordance with some embodiments, for example in a UE or BS configured for preemption operations. In some embodiments, protocol layers may include one or more of physical layer (PHY) 210, medium access control layer (MAC) 220, radio link control layer (RLC) 230, packet data convergence protocol layer (PDCP) 240, service data adaptation protocol (SDAP) layer 247, radio resource control layer (RRC) 255, and non-access stratum (NAS) layer 257, in addition to other higher layer functions not illustrated." Xiong at [0040]; *see also, id*. at [0041].

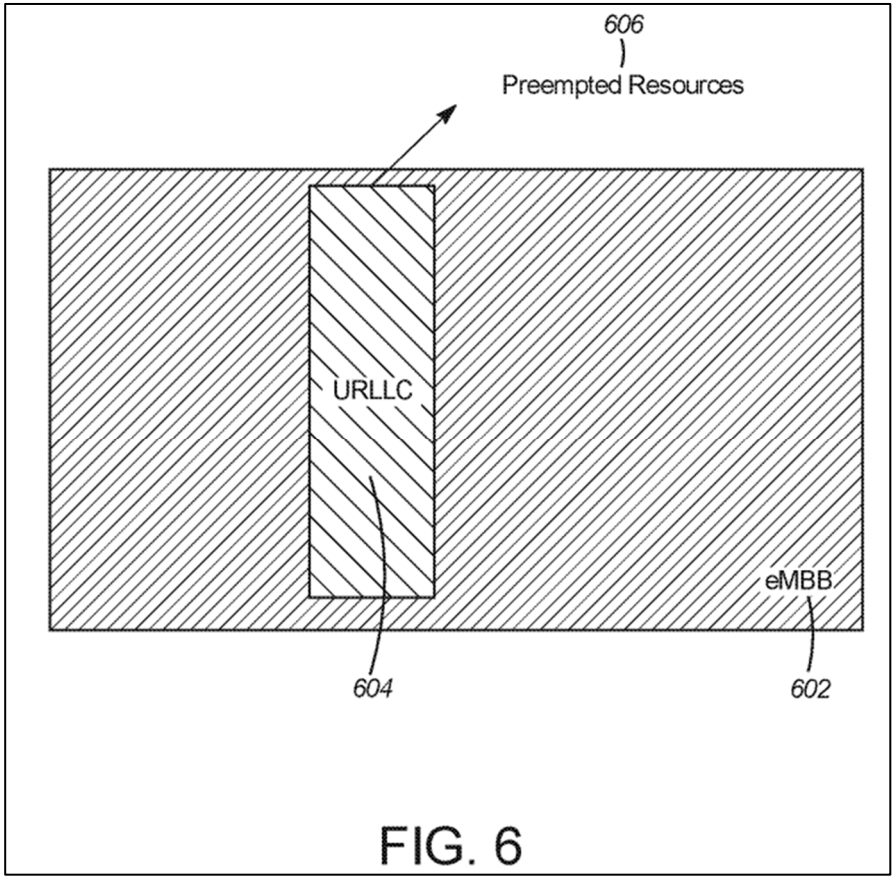
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		 FIG. 2A Xiong at Fig. 2A.

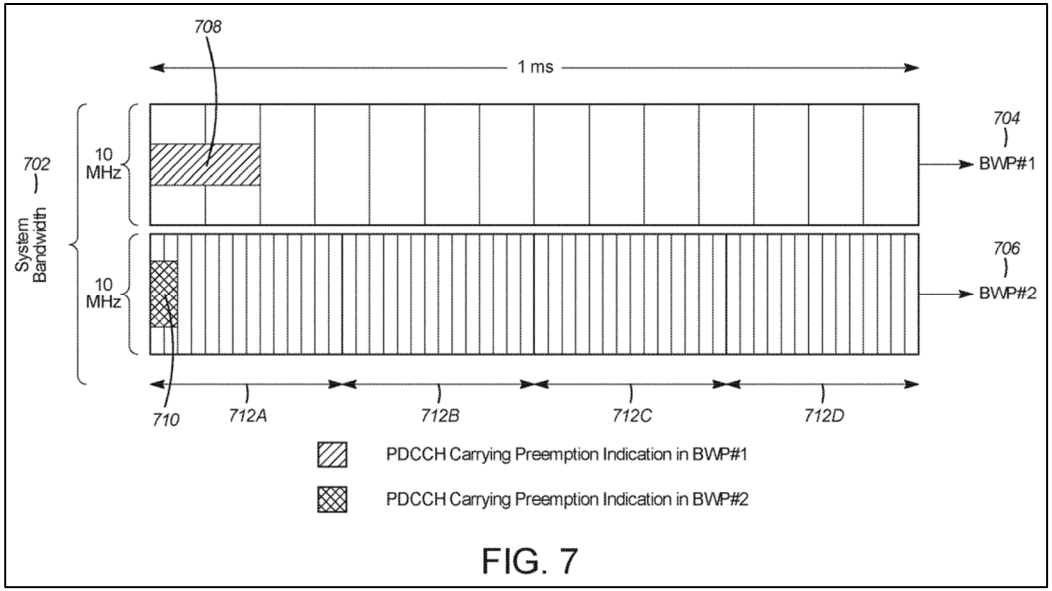
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		"According to some embodiments, an instance of PDCP 240 may process requests from and provide indications to one or more of an instance of RRC 255 and one or more instances of SDAP 247 via one or more packet data convergence protocol service access points (PDCP-SAP) 245. According to some embodiments, requests and indications communicated via PDCP-SAP 245 may comprise one or more radio bearers. According to some embodiments, an instance of SDAP 247 may process requests from and provide indications to one or more higher layer protocol entities via one or more service data adaptation protocol service access points (SDAP-SAP) 249. According to some embodiments, requests and indications communicated via SDAP-SAP 249 may comprise one or more quality of service (QoS) flows. According to some embodiments, RRC entity 255 may configure, via one or more management service access points (M-SAP), embodiments of one or more protocol layers, which may include one or more instances of PHY 210, MAC 220, RLC 230, PDCP 240 and SDAP 247. According to some embodiments, an instance of RRC may process requests from and provide indications to one or more NAS entities via one or more RRC service access points (RRC-SAP)." Xiong at [0042]. "According to some embodiments, 5GNB 280 may be implemented as one or more of a dedicated physical device such as a macro-cell, a femto-cell or other suitable device, or in an alternative aspect, may be implemented as one or more software entities running on server computers as part of a virtual network termed a cloud radio access network (CRAN). According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260 (e.g., UE 101, UE 102, device 300), gNB 280 and AMF 294, may be described as implementing all or part of a protocol stack in which the layers are considered to be ordered from lowest to highest in the order PHY, MAC, RLC, PDCP, RRC and NAS. According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260, gNB 280 and AMF 294, may communicate with a respective peer protocol entity that may be implemented on another device, using the services of respective lower layer protocol entities to perform such communication." Xiong at [0044].

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		"According to some embodiments, UE PHY 272 and peer entity gNB PHY 290 may communicate using signals transmitted and received via a wireless medium. According to some embodiments, UE MAC 270 and peer entity gNB MAC 288 may communicate using the services provided respectively by UE PHY 272 and gNB PHY 290. According to some embodiments, UE RLC 268 and peer entity gNB RLC 286 may communicate using the services provided respectively by UE MAC 270 and gNB MAC 288. According to some embodiments, UE PDCP 266 and peer entity gNB PDCP 284 may communicate using the services provided respectively by UE RLC 268 and SGNB RLC 286. According to some embodiments, UE RRC 264 and gNB RRC 282 may communicate using the services provided respectively by UE PDCP 266 and gNB PDCP 284. According to some embodiments, UE NAS 262 and AMF NAS 292 may communicate using the services provided respectively by UE RRC 264 and gNB RRC 282." Xiong at [0045]. "As will be described below in further detail, in some embodiments, an access node (e.g., gNB) can configure a device (e.g., UE) to monitor a region of time-frequency resources (e.g., reference downlink resources) for a PI. The gNB can configure the UE to monitor the region of time-frequency resources semi-statically, for example, by transmitting radio resource control (RRC) signaling that includes information to configure the UE with the region of time-frequency resources for monitoring. Embodiments are not limited to RRC signaling, however, as other embodiments include configuring the UE for monitoring the time-frequency region for a PI using various techniques. In some embodiments, the RRC signaling can include information (e.g., an information element (IE)) to configure the UE to monitor for a PI within a region of a system bandwidth, for example, within a bandwidth part (BWP). The RRC signaling can also include information to configure the UE to monitor for a PI within multiple BWPs and according to different BWP configurations, including different numerologies (e.g., numerologies defined in the 3GPP standard). In some embodiments, the gNB can encode a DCI format that is

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		specific to (e.g., and includes information for) preemption indication (e.g., PI-DCI)." Xiong at [0077]. "In certain embodiments, the DCI format may be used for notifying a group of UEs of a portion of physical resource blocks (PRBs) and symbols, such as Orthogonal Frequency Division Multiplexing (OFDM) symbols. A UE or multiple UEs may assume that, within the portion of the PRBs and OFDM symbols (e.g., a portion of PRBs and symbols of a PDSCH transmission), no transmission is intended for the respective UE receiving the DCI format. In certain embodiments, this means that some time-frequency resources (e.g., URLLC transmissions) are preempted (e.g., eMBB transmissions are preempted). To preempt eMBB transmissions, for example, a gNB can puncture resource elements that are scheduled for the eMBB transmissions, although embodiments are not so limited. In embodiments of a preempted transmission, a UE considers the preempted transmission (e.g., from the gNB) to be corrupted and can then perform soft combining of the corrupted (e.g., preempted) initial transmission and a retransmission (e.g., retransmission of an eMBB transmission). Receiving the PI from the gNB in such embodiments can assist with the soft combining." Xiong at [0078]. "As previously described, in certain embodiments, a UE can be configured to monitor for a PI within a BWP. A BWP part can be defined as a subset of a bandwidth of contiguous common resource blocks, according to a given numerology (μ), on a given carrier. A BWP can also be defined by a starting position (e.g., starting resource block) and a number of resource blocks. In some embodiments, a maximum NR channel bandwidth may be 400 MHz and a gNB may configure one or multiple BWP configurations (e.g., for respective component carriers) within a wide system bandwidth for a given UE. For example, the gNB can semi-statically configure (e.g., transmit configuration information in RRC signaling to the UE) the BWP configurations. In some embodiments, the gNB can configure BWPs by encoding and transmitting to a UE information (e.g., IEs, higher-layer parameters) specific to a given numerology. Such information may also be transmitted in RRC signaling, and

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		can include a reference numerology (e.g., for a BWP, for preempted resources), a frequency domain location for a given numerology, a bandwidth for a given numerology, and/or a subcarrier spacing of a BWP for a given numerology. According to some embodiments, the gNB can include such information in RRC signaling. The RRC signaling may also include information." Xiong at [0079]. "According to certain embodiments, the gNB can encode RRC signaling to include a radio network temporary identifier (RNTI) that is specific to preemption indication (e.g., PI-RNTI). The gNB can encode DCI (e.g., PI-DCI, DCI Format 2_1) with a cyclic redundancy check (CRC), that is scrambled (e.g., masked) by the RNTI (e.g, PI-RNTI), and the UE identifying the PI-RNTI can decode the PI-DCI to determine a PI and a location of preempted time-frequency resources. In some embodiments, a PI may be used for additional purposes, for example, to dynamically signal resources in UL. A gNB can achieve differentiation in UL by transmitting another RNTI for scrambling the DCI and reinterpreting the DCI format fields, assuming UL preemption, while keeping the same DCI size." Xiong at [0081]. "In some embodiments, the gNB can transmit DCI (e.g., PI-DCI) in a specific format (e.g., including the PI) via a PDCCH in a control-resource set (CORESET). A CORESET consists of a number of resource blocks in the frequency domain, which can be defined by a higher-layer parameter (e.g., in an IE), and a number of symbols (e.g., OFDM symbols) in the time domain, which can also be defined by a higher-layer parameter (e.g., in an IE). In some embodiments, an access node (e.g., gNB) can transmit the CORESET and associated defining parameters and/or IEs within RRC signaling to a UE to configure the UE for monitoring for PI-DCI (e.g., DCI format 2_1) and a PI within the CORESET." Xiong at [0082].

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	 FIG. 6 Xiong at Fig. 6; *see also, id*. at Figs. 7-11.

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		 FIG. 7 Xiong at Fig. 7. "FIG. 7 illustrates an example of multiple BWPs within a system bandwidth, in accordance with some embodiments. For example, the multiple BWPs of FIG. 7 can have different numerologies within a system bandwidth. In some embodiments, a system bandwidth 702 (e.g., wide system bandwidth) includes multiple BWPs, for example, BWP 704, BWP 706, and additional BWPs in some cases. In some embodiments, different BWPs (e.g., BWP 704, BWP 706) have different numerologies, including different subcarrier spacings and slot durations. A BWP configuration, according to its numerology, may have subcarrier spacing that is a scaled multiple (e.g., by a power of 2n, where n is an integer) of a 15 kHz subcarrier spacing." Xiong at [0084]; *see also, id*. at [0085-100]. "In some embodiments, for example, in the case of wideband operation, a network device (e.g., gNB) can determine preempted time-frequency resources (e.g., for

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		indication by PI in PI-DCI) in accordance with a numerology (e.g., reference numerology). A numerology for determination of preempted time-frequency resources may be any of a numerology used for the transmission of a synchronization block (SS block), a numerology predefined in a specification (e.g., 3GPP specification), a numerology configured for the CORESET used for transmission of PI-DCI (e.g., DCI format 2_1) in PDCCH, a numerology that is configured in a cell-specific manner for PI (e.g., via NR minimum system information (MSI), NR remaining minimum system information (RMSI), NR system information block (SIB)), or UE-specifically via UE-specific RRC signaling), and/or a numerology which is indicated within the PI. Further, frequency domain resources can be allocated based on a common physical resource block (PRB) indexing which can be employed for the wide system bandwidth operation." Xiong at [0085]. "In some embodiments, a network node (e.g., gNB) can transmit a PI in DCI (e.g., PI-DCI, DCI format 2_1) within the CORESET to a group of UEs or in a cell-specific manner. The CORESET may be a shared and/or common CORESET and can be the same as a CORESET for PDCCH monitoring for scheduling, for example, for scheduling of remaining system information (RMSI) or paging or random access response (RAR). In certain embodiments, when the CORESET is different from a CORESET for PDCCH monitoring of common control messages, the CORESET configuration, including a time-frequency resource transmission scheme (e.g., interleaved or non-interleaved), resource element group (REG)-to-control channel element (CCE) mapping, monitoring periodicity, and numerology, can be configured by higher-layers via NR MSI, NR RMSI, NR SIB and/or UE-specific RRC signaling." Xiong at [0087]. "In time domain, according to a monitoring configuration in some embodiments, a LIE may not monitor certain slots for the PDCCH carrying PI. In such cases, the gNB may not transmit the PI in an affected slot or an immediately adjacent slot to the affected slot. In some embodiments, an additional field (e.g., included in the PI) can be used to indicate a number of slots prior to the slot carrying the PI that a preemption

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		occurs. For example, a number of slots between a portion of PRBs and OFDM symbols that omit transmissions intended for a UE and a slot that includes the PI. On the other hand, a UE receiving a PI significantly after an actual preemption event can cause reprocessing of a received PDSCH to be difficult or resource-intensive for a UE. In some embodiments, an upper bound, N_s^{max} can be specified that indicates how much later in time (e.g., a number of slots) that the PI may be transmitted after the actual preemption event. In one embodiment, a maximum number of slots that may be indicated as part of the PI is the same as the upper bound, N_s^{max}. Alternatively, N_s^{max} may be defined as part of a UE capability, and if a UE detects a PI indicating preemption more than N_s^{max} slots before the PI where N_s^{max} is reported by the UE, it is not required to reprocess the PDSCH taking into consideration the PI." Xiong at [0088]. "In some embodiments, the gNB can indicate multiple preemptions of time-frequency resources by encoding a parameter (e.g., granularity parameter, bitmap parameter, indication granularity). The granularity parameter can be transmitted explicitly in signaling (e.g., RRC signaling), transmitted in DCI (e.g., PI-DCI, DCI format 2_1), or can be derived by a UE implicitly. In some embodiments, the granularity parameter can specify a frequency granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of elements (e.g., PRBs) within a monitoring region of time-frequency resources, according to a given numerology. The granularity parameter can also specify a time granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of symbols within a monitoring region of time-frequency resources, also according to the given numerology. In certain embodiments, a gNB, in determining the granularity of the preempted resources, can consider a payload size of a group common DCI (e.g., PI-DCI, DCI format 2_1) carrying the PI." Xiong at [0090]. "In some embodiments, configuration of frequency regions smaller than a UE bandwidth can lead to scheduling restrictions and overdesigned signaling. To address this, the gNB can encode signaling so that the frequency region is implicitly indicated

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		as a bandwidth of a BWP or a component carrier (CC) where a UE operates. For example, the BWP in which the CORESET is transmitted can be considered by the UE to be the bandwidth in which the UE monitors for the PI. In some embodiments, the gNB can transmit an indication to the UE in signaling to notify the UE of the bandwidth for monitoring being equal to the BWP. In other embodiments, additional start-RB and end-RB may be configured via RRC for the concerned BWP in order to further restrict the monitoring region (e.g., in case the puncturing/preemption is expected to affect only a portion of the BWP). With respect to time domain resources, configurability may be directly linked with a PI-DCI monitoring configuration. For example, a monitoring periodicity (e.g., 'p') can be reused as a monitoring region for monitoring for the PI. In some cases, a UE may not benefit from receiving a PI that indicates a slot earlier than 'n−c' because of processing latency. If 'c' is smaller than a configured monitoring periodicity, the reference resource can be adjusted accordingly based on processing capabilities of all UEs in the group. To resolve the issue of UE processing time in relation to PI monitoring periodicity and in relation to the region of time-domain resources for PI, several techniques may be used." Xiong at [0091-92]. "In some embodiments, if a time gap between reception of a PI and HARQ ACK/NACK feedback is less than a time t_reproc, the UE is not expected to consider a PI for determining the ACK/NACK corresponding to the PDSCH indicated as being affected by preemption (e.g., indicated in PI-DCI as preempted). In some embodiments, t_reproc is equal to a minimum UE processing time (e.g., N1 symbols), for example, processing time for the PDSCH. In other embodiments, t_reproc may be less than N1, but is at least greater than f*N1, where 'f' is a predefined fraction. Processing time, t_reproc, can also be indicated by a UE as part of UE capability, and may also be configured by the network per UE based on UE capability for minimum UE processing time (e.g., if UE capability is defined for minimum UE processing time). In some embodiments, the UE is not expected to consider a PI corresponding to a TB for which it already received a retransmission during a time-gap between an

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		affected PDSCH and the next PI monitoring instance (e.g., monitoring for PI-DCI)." Xiong at [0095]. "In certain embodiments, when a UE is configured to monitor for both an eMBB and URLLC transmission, the UE may receive a DL control channel (e.g., PDCCH) and/or DL shared channel (e.g., PDSCH) for a URLLC within time-frequency resources (e.g., resources indicated by the PI). In such embodiments, the CORESET for PDCCH monitoring or the scheduled data will have higher priority than the preempted time-frequency resources (e.g., indicated by the PI) if the CORESET or scheduled data overlaps with the preempted time-frequency resources. In some embodiments, if a PI indicates the PDCCH and/or PDSCH for URLLC as being preempted, the UE will not assume that these resources are corrupted for a receive processing adjustment. UE behavior, for such embodiments, may be configurable by higher-layer signaling. For this purpose, a bit indication (e.g., one bit) may be conveyed (e.g., transmitted by the gNB) as part of signaling for configuration of UE monitoring of a BWP and the CORESET (e.g., including PI-DCI) within the PDCCH (e.g., associated with a certain PDCCH search space to be used for scheduling of particular services). For example, the bit indication may be set to '1' to indicate to the LIE that when scheduled via DCI (e.g., PI-DCI) in the CORESET, or PDCCH search space, the resources corresponding to the scheduled PDSCH cannot be preempted and thus should be excluded from calculation of corrupted resource elements (e.g., preempted resource elements) indicated by PI. In certain embodiments, the resources corresponding to transmission of PDCCH in the indicated CORESETs and resources corresponding to PDSCH scheduled using DCI in such CORESETs are reserved from being preempted, which can lead to restrictions to scheduling flexibility." Xiong at [0097-98]. "To indicate preempted resources, an access node (e.g., gNB) can encode the PI-DCI (e.g., PI), for transmission within the region of time-frequency resources for monitoring, to include various information for indicating preempted time-resources.

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		In one embodiment, the PI-DCI (e.g., PI) can include a joint time-frequency bitmap. For example, the joint time-frequency bitmap may comprise a two-dimensional (2D) bitmap and/or matrix to indicate (e.g., encode) multiple preemptions within time-frequency resources (e.g., within an eMBB transmission). As a nonlimiting example, a NR slot can have 14 symbols, which may be divided into 7 symbol parts (e.g., 2 symbols per part), or 14 symbol parts (e.g., 1 symbol per part). In some embodiments, a bitmap can signal which portions of the NR slot (e.g., subframe) are preempted in the time-frequency resources. In some embodiments, the y-axis of a time-frequency grid, representing frequency (e.g., bandwidth), can be configured to comprise ¼ of a BWP, and the x-axis of the time-frequency grid, representing time (e.g., symbols and slots of a subframe), can be configured to comprise 2 symbols with a 1 slot monitoring periodicity. In such embodiments, a bitmap may consume 4·7=28 bits. However, in certain applications that cover almost an entire bandwidth, such an approach may not be efficient, for example, for purposes of a distributed DL resource allocation for URLLC, where the distributed resource allocation can enable frequency diversity." Xiong at [0106-107]. "As a more flexible approach, an access node (e.g., gNB) can encode an additional bit field (e.g., a small 1-2 bit field in the PI-DCI). The bit field, for example, can serve as the granularity parameter and/or indication granularity, to switch time-frequency granularity (e.g., preemption granularity) dynamically. For example, if y=g·y0 and x=x0/g, then the additional bit could switch between different values of g. In certain embodiments, different values of g may be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, different values of g may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1)." Xiong at [0108]. "In certain embodiments, a granularity parameter (e.g., indication granularity) can indicate a granularity of preempted time-frequency resources through a mapping of a bitmap. For example, the granularity parameter can include a bit value indicating how many bits of a field in the preemption indication (e.g., PI, PI-DCI, DCI format 2_1)

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		map to groups of symbols in preempted time-frequency resources (e.g., a portion of PRBs and OFDM symbols that are preempted, eMBB transmissions). In some embodiments, a granularity parameter including a value of 0 indicates that 14 bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 14 groups of consecutive symbols in preempted time-frequency resources. In other embodiments, a granularity parameter including a value of 1 indicates that 7 pairs of bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 7 groups of consecutive symbols in preempted time-frequency resources. Embodiments are not so limited however, as the granularity parameter can indicate other granularities of preempted time-frequency resources." Xiong at [0109]. "FIG. 9A illustrates an example of preempted time-frequency resources, in accordance with certain embodiments. For example, time-frequency resources can be preempted in multiple portions **902**A, **902**B, and **902**C, and a transmitted bitmap can indicate the multiple portions of preempted time-frequency resources (e.g., bitmap transmitted in PI and/or PI-DCI/DCI format 2_1). FIG. 9B illustrates an example of a bitmap **904** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **904** can indicate a configurable time-frequency granularity, for example, a 4×7 time-frequency granularity. A 4×7 granularity can indicate 4 partitions in the frequency domain and 7 partitions in the time domain. FIG. 9C illustrates an alternative example of a bitmap **906** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **906** can indicate a configurable time-frequency granularity, for example, a 2×14 time-frequency granularity. A 2×14 granularity can indicate 2 partitions in the frequency domain and 14 partitions in the time domain. In FIG. 9B and FIG. 9C, the bitmaps **904** and **906** can indicate and/or configure time-frequency granularities for preemption of resources (e.g., preemption of eMBB transmissions by URLLC). In other embodiments, bitmaps that include different values can indicate and/or configure different time-frequency granularities.

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		In certain embodiments, with respect to FIG. 9B and FIG. 9C, a bit value of 0 in one of bitmaps **904** or **906**, or a different bitmap, can indicate no preemption of time-frequency resources. In such embodiments, indication of no preemption of time-frequency resources indicates a not mal transmission (e.g., transmission of eMBB, transmission of signaling in PDSCH). In alternative embodiments, a bit value of 1 in one of bitmaps **904** or **906**, or a different bitmap, can indicate a preemption of time-frequency resources. In such embodiments, indication of a preemption of time-frequency resources indicates that a transmission is not intended for a certain UE and/or corruption of signaling by the gNB. In some embodiments, a granularity value (e.g., bitmap and/or matrix indicating a granularity) can change dynamically, for example, the gNB may change bit values in a bitmap and indicate bit values through DCI (e.g., PI-DCI). In certain embodiments, bitmaps (e.g., **904** and **906**) to indicate and/or configure time-frequency granularities for preemption of resources can be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, the bitmaps may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1). Bitmaps can be configured to indicate and/or configure one of time granularity or frequency granularity, and based on receiving this infoiination through signaling (e.g., from a gNB), a device (e.g., UE) can derive a time granularity from an indicated frequency granularity (e.g., indicated in a bitmap), or vice versa." Xiong at [0110-114]. "In some embodiments, a gNB may configure a set of puncturing time-frequency patterns, for example, via transmission of semi-static signaling (e.g., RRC signaling) and/or DCI signaling (e.g., via configuration index). In one embodiment, a gNB can limit a number of signaled preemptions and use combinatorial indexing to optimize higher-layer signaling. If a number of preemptions is limited there are fewer combinations to signal. For example, referring to FIG. 9A and FIG. 10A, the number of preemptions may be limited to half of the resources or the 28 overall puncturing resources. Such optimizations may only introduce 1-2 bit savings unless a reduced

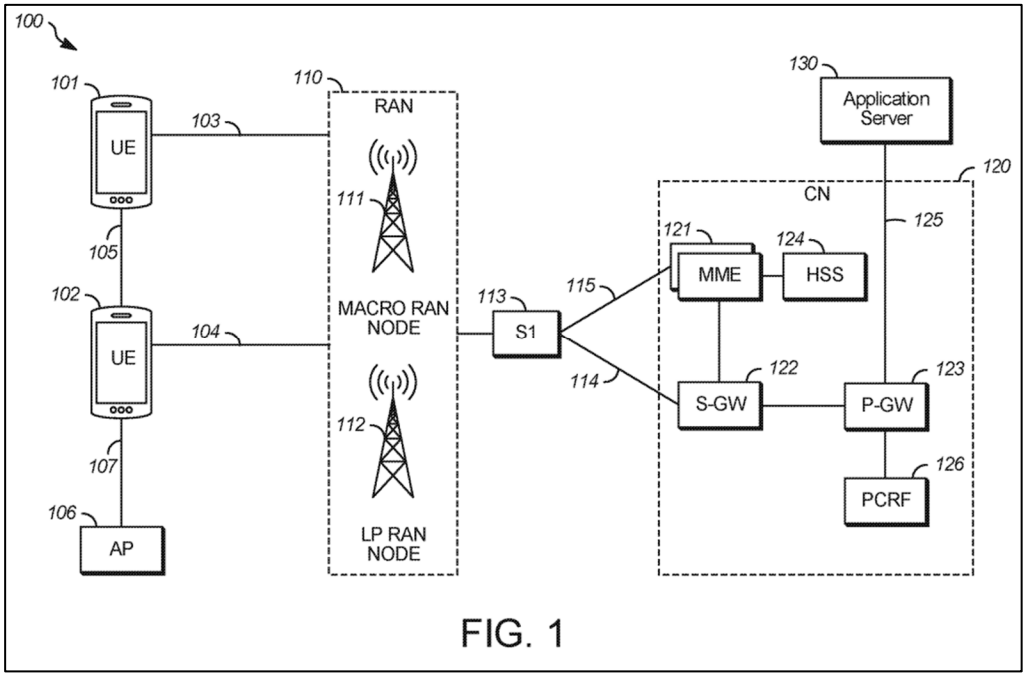
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		number of preemptions can be signaled (e.g., 7 arbitrary preemptions in 28 resources require approximately 21 bit signaling). In some embodiments, optimized signaling can be defined, while accounting for a maximum payload for indications (e.g., maximum DCI payload). In such embodiments, signaling can include one or more parameters including a number of bits available for indication of preemptions, D, reference time resource symbols, Rt, reference frequency resources (e.g., PRBs), Rf, time and frequency granularities 'x' and 'y,' respectively, a number of time resources within a region Nt=floor(Rt/x), and a number of frequency resources within a region Nf=floor(Rf/y), where D=NfNt=floor(Rt/x)·floor(Rf/y). In some embodiments, knowing the overall size of an indication D, and one of a granularity of time or frequency, a UE can derive another granularity of one of time or frequency. In other embodiments, knowing D and Rt and Rf, (e.g., from a DL resource configuration), the UE can derive a number of partitions in time and/or frequency. In such embodiments, either 'x' or 'y' can be signaled and the UE can derive the value of 'x' or 'y' that is not signaled from the signaled value, the overall available number of signaling bits, and the reference resource region size." Xiong at [0121-122]. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI.

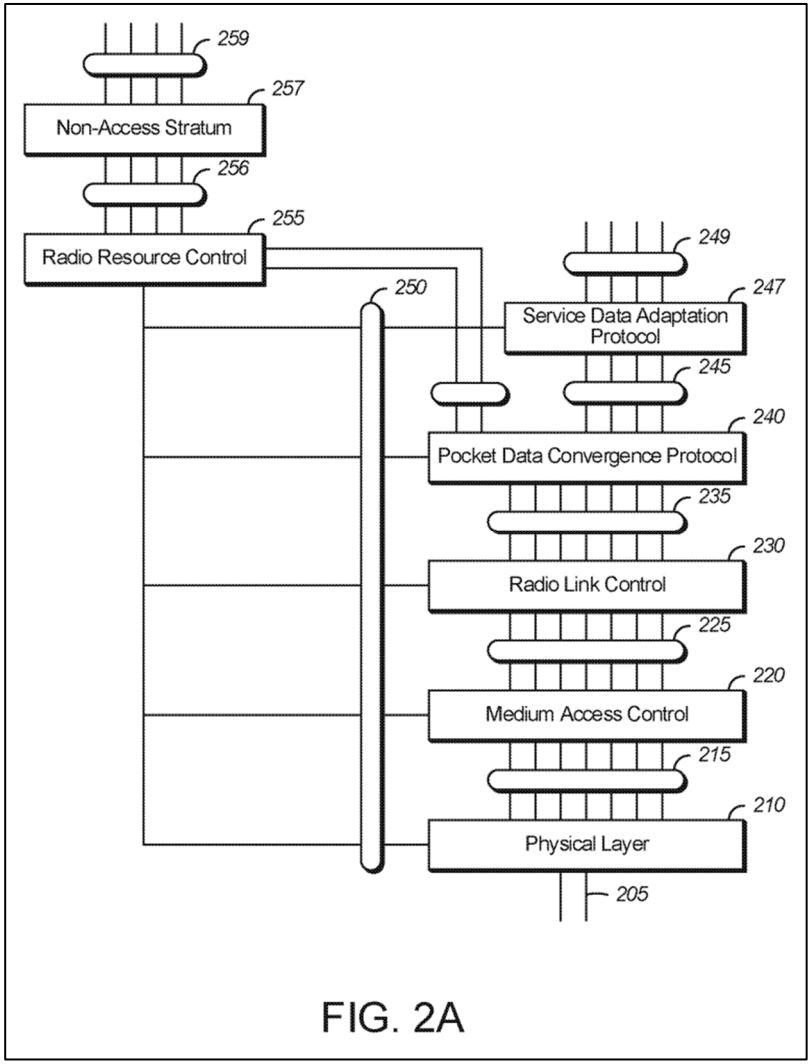
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		In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology. "In Example 3, the subject matter of Examples 1-2 includes, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating pre-emption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at [0134-136]. "Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI." Xiong at [0146]. "In Example 15, the subject matter of Examples 13-14 includes, wherein the processing circuitry is configured to: decode, from the RRC signaling, a preemption indication radio network temporary identifier (PI-RNTI) indicating preemption in a downlink (DL); and identify a cyclic redundancy check (CRC) scrambled by the PI-RNTI and decode the PI-DCI based on the PI-RNTI." Xiong at [0148]. "Example 24 is a computer-readable hardware storage device that stores instructions for execution by one or more processors of a user equipment (UE), the instructions to configure the one or more processors to: decode radio resource control (RRC)

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		signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) infoiination element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE. Example 25 is a computer-readable hardware storage device that stores instructions for execution by one or more processors of a New Radio (NR) NodeB (gNB), the instructions to configure the one or more processors to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the UE." Xiong at [0157-158]. "1. An apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI);

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		encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at Claim 1; *see also, id*. at Claims 6, 13, 17. "3. The apparatus of claim 1, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating preemption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at Claim 3; *see also, id*. at Claim 15. "25. A computer-readable hardware storage device that stores instructions for execution by one or more processors of a New Radio (NR) NodeB (gNB), the instructions to configure the one or more processors to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the UE." Xiong at Claim 25. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not

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		anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	wherein the specific RNTI received through the UE specific RRC signaling is a newly defined RNTI other than at least a cell-RNTI (C-RNTI),	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the specific RNTI received through the UE specific RRC signaling is a newly defined RNTI other than at least a cell-RNTI (C-RNTI). For example, Xiong discloses this limitation based on the following exemplary citations: "FIG. 1 illustrates an architecture of a system 100 of a network in accordance with some embodiments. In some embodiments, the system 100 may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some embodiments, network devices, such as the access nodes described below, can be configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below. The system 100 is shown to include a UE 101 and a UE 102, for example a UE configured for preemption operations. The UEs 101 and 102 are illustrated as smartphones (e.g., handheld touchscreen mobile computing devices connectable to one or more cellular networks), but may also comprise any mobile or non-mobile computing device, such as Personal Data Assistants (PDAs), pagers, laptop computers, desktop computers, wireless handsets, or any computing device including a wireless communications interface." Xiong at [0022-23].

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		 FIG. 1 Xiong at Fig. 1. "FIG. 2A illustrates protocol functions that may be implemented in a wireless communication device in accordance with some embodiments, for example in a UE or BS configured for preemption operations. In some embodiments, protocol layers may include one or more of physical layer (PHY) 210, medium access control layer (MAC) 220, radio link control layer (RLC) 230, packet data convergence protocol layer (PDCP) 240, service data adaptation protocol (SDAP) layer 247, radio resource control layer (RRC) 255, and non-access stratum (NAS) layer 257, in addition to other higher layer functions not illustrated." Xiong at [0040]; *see also, id*. at [0041].

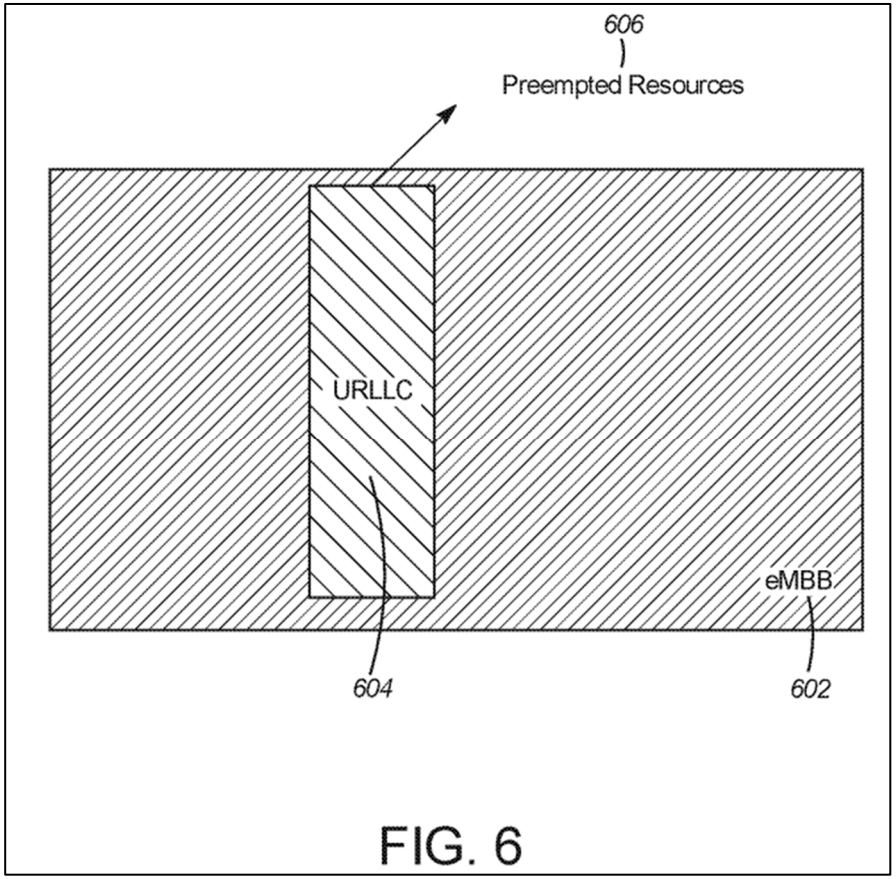
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	 FIG. 2A Xiong at Fig. 2A.

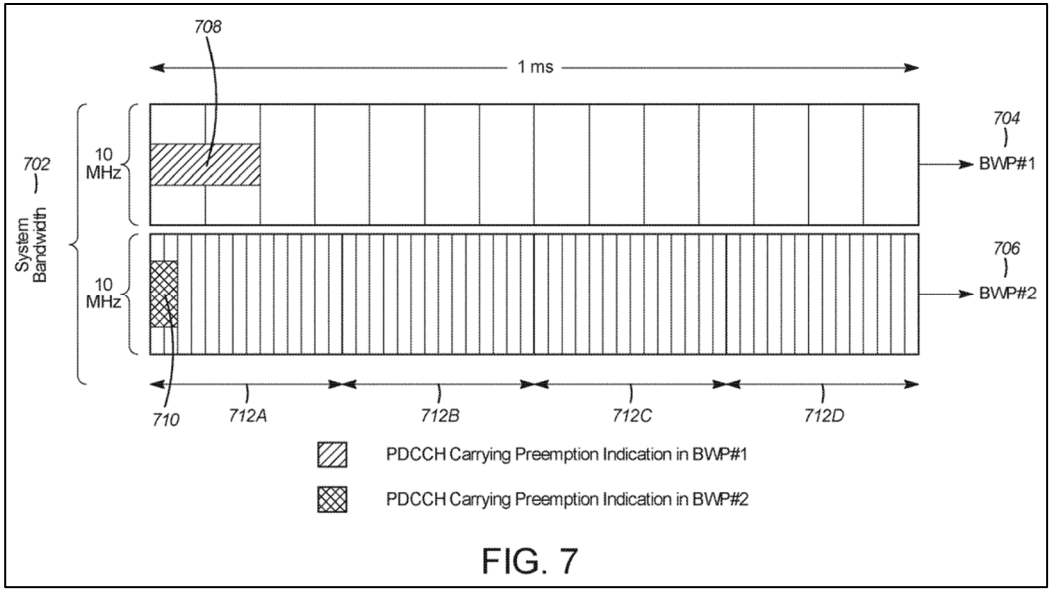
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		"According to some embodiments, an instance of PDCP 240 may process requests from and provide indications to one or more of an instance of RRC 255 and one or more instances of SDAP 247 via one or more packet data convergence protocol service access points (PDCP-SAP) 245. According to some embodiments, requests and indications communicated via PDCP-SAP 245 may comprise one or more radio bearers. According to some embodiments, an instance of SDAP 247 may process requests from and provide indications to one or more higher layer protocol entities via one or more service data adaptation protocol service access points (SDAP-SAP) 249. According to some embodiments, requests and indications communicated via SDAP-SAP 249 may comprise one or more quality of service (QoS) flows. According to some embodiments, RRC entity 255 may configure, via one or more management service access points (M-SAP), embodiments of one or more protocol layers, which may include one or more instances of PHY 210, MAC 220, RLC 230, PDCP 240 and SDAP 247. According to some embodiments, an instance of RRC may process requests from and provide indications to one or more NAS entities via one or more RRC service access points (RRC-SAP)." Xiong at [0042]. "According to some embodiments, 5GNB 280 may be implemented as one or more of a dedicated physical device such as a macro-cell, a femto-cell or other suitable device, or in an alternative aspect, may be implemented as one or more software entities running on server computers as part of a virtual network termed a cloud radio access network (CRAN). According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260 (e.g., UE 101, UE 102, device 300), gNB 280 and AMF 294, may be described as implementing all or part of a protocol stack in which the layers are considered to be ordered from lowest to highest in the order PHY, MAC, RLC, PDCP, RRC and NAS. According to some embodiments, one or more protocol entities that may be implemented in one or more of UE 260, gNB 280 and AMF 294, may communicate with a respective peer protocol entity that may be implemented on another device, using the services of respective lower layer protocol entities to perform such communication." Xiong at [0044].

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		"According to some embodiments, UE PHY 272 and peer entity gNB PHY 290 may communicate using signals transmitted and received via a wireless medium. According to some embodiments, UE MAC 270 and peer entity gNB MAC 288 may communicate using the services provided respectively by UE PHY 272 and gNB PHY 290. According to some embodiments, UE RLC 268 and peer entity gNB RLC 286 may communicate using the services provided respectively by UE MAC 270 and gNB MAC 288. According to some embodiments, UE PDCP 266 and peer entity gNB PDCP 284 may communicate using the services provided respectively by UE RLC 268 and SGNB RLC 286. According to some embodiments, UE RRC 264 and gNB RRC 282 may communicate using the services provided respectively by UE PDCP 266 and gNB PDCP 284. According to some embodiments, UE NAS 262 and AMF NAS 292 may communicate using the services provided respectively by UE RRC 264 and gNB RRC 282." Xiong at [0045]. "As will be described below in further detail, in some embodiments, an access node (e.g., gNB) can configure a device (e.g., UE) to monitor a region of time-frequency resources (e.g., reference downlink resources) for a PI. The gNB can configure the UE to monitor the region of time-frequency resources semi-statically, for example, by transmitting radio resource control (RRC) signaling that includes information to configure the UE with the region of time-frequency resources for monitoring. Embodiments are not limited to RRC signaling, however, as other embodiments include configuring the UE for monitoring the time-frequency region for a PI using various techniques. In some embodiments, the RRC signaling can include information (e.g., an information element (IE)) to configure the UE to monitor for a PI within a region of a system bandwidth, for example, within a bandwidth part (BWP). The RRC signaling can also include information to configure the UE to monitor for a PI within multiple BWPs and according to different BWP configurations, including different numerologies (e.g., numerologies defined in the 3GPP standard). In some embodiments, the gNB can encode a DCI format that is

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		specific to (e.g., and includes information for) preemption indication (e.g., PI-DCI).” Xiong at 77. “As previously described, in certain embodiments, a UE can be configured to monitor for a PI within a BWP. A BWP part can be defined as a subset of a bandwidth of contiguous common resource blocks, according to a given numerology (μ), on a given carrier. A BWP can also be defined by a starting position (e.g., starting resource block) and a number of resource blocks. In some embodiments, a maximum NR channel bandwidth may be 400 MHz and a gNB may configure one or multiple BWP configurations (e.g., for respective component carriers) within a wide system bandwidth for a given UE. For example, the gNB can semi-statically configure (e.g., transmit configuration information in RRC signaling to the UE) the BWP configurations. In some embodiments, the gNB can configure BWPs by encoding and transmitting to a UE information (e.g., IEs, higher-layer parameters) specific to a given numerology. Such information may also be transmitted in RRC signaling, and can include a reference numerology (e.g., for a BWP, for preempted resources), a frequency domain location for a given numerology, a bandwidth for a given numerology, and/or a subcarrier spacing of a BWP for a given numerology. According to some embodiments, the gNB can include such information in RRC signaling. The RRC signaling may also include information.” Xiong at [0079]. “According to certain embodiments, the gNB can encode RRC signaling to include a radio network temporary identifier (RNTI) that is specific to preemption indication (e.g., PI-RNTI). The gNB can encode DCI (e.g., PI-DCI, DCI Format 2_1) with a cyclic redundancy check (CRC), that is scrambled (e.g., masked) by the RNTI (e.g, PI-RNTI), and the UE identifying the PI-RNTI can decode the PI-DCI to determine a PI and a location of preempted time-frequency resources. In some embodiments, a PI may be used for additional purposes, for example, to dynamically signal resources in UL. A gNB can achieve differentiation in UL by transmitting another RNTI for scrambling the DCI and reinterpreting the DCI format fields, assuming UL preemption, while keeping the same DCI size.” Xiong at [0081].

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		"In some embodiments, the gNB can transmit DCI (e.g., PI-DCI) in a specific format (e.g., including the PI) via a PDCCH in a control-resource set (CORESET). A CORESET consists of a number of resource blocks in the frequency domain, which can be defined by a higher-layer parameter (e.g., in an IE), and a number of symbols (e.g., OFDM symbols) in the time domain, which can also be defined by a higher-layer parameter (e.g., in an IE). In some embodiments, an access node (e.g., gNB) can transmit the CORESET and associated defining parameters and/or IEs within RRC signaling to a UE to configure the UE for monitoring for PI-DCI (e.g., DCI format 2_1) and a PI within the CORESET." Xiong at [0082].

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	 FIG. 6 Xiong at Fig. 6; *see also, id*. at Figs. 7-11.

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		 FIG. 7 Xiong at Fig. 7. "FIG. 7 illustrates an example of multiple BWPs within a system bandwidth, in accordance with some embodiments. For example, the multiple BWPs of FIG. 7 can have different numerologies within a system bandwidth. In some embodiments, a system bandwidth 702 (e.g., wide system bandwidth) includes multiple BWPs, for example, BWP 704, BWP 706, and additional BWPs in some cases. In some embodiments, different BWPs (e.g., BWP 704, BWP 706) have different numerologies, including different subcarrier spacings and slot durations. A BWP configuration, according to its numerology, may have subcarrier spacing that is a scaled multiple (e.g., by a power of 2n, where n is an integer) of a 15 kHz subcarrier spacing." Xiong at [0084]; *see also, id*. at [0085-100]. "In some embodiments, for example, in the case of wideband operation, a network device (e.g., gNB) can determine preempted time-frequency resources (e.g., for

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		indication by PI in PI-DCI) in accordance with a numerology (e.g., reference numerology). A numerology for determination of preempted time-frequency resources may be any of a numerology used for the transmission of a synchronization block (SS block), a numerology predefined in a specification (e.g., 3GPP specification), a numerology configured for the CORESET used for transmission of PI-DCI (e.g., DCI format 2_1) in PDCCH, a numerology that is configured in a cell-specific manner for PI (e.g., via NR minimum system information (MSI), NR remaining minimum system information (RMSI), NR system information block (SIB)), or UE-specifically via UE-specific RRC signaling), and/or a numerology which is indicated within the PI. Further, frequency domain resources can be allocated based on a common physical resource block (PRB) indexing which can be employed for the wide system bandwidth operation." Xiong at [0085]. "In some embodiments, a network node (e.g., gNB) can transmit a PI in DCI (e.g., PI-DCI, DCI format 2_1) within the CORESET to a group of UEs or in a cell-specific manner. The CORESET may be a shared and/or common CORESET and can be the same as a CORESET for PDCCH monitoring for scheduling, for example, for scheduling of remaining system information (RMSI) or paging or random access response (RAR). In certain embodiments, when the CORESET is different from a CORESET for PDCCH monitoring of common control messages, the CORESET configuration, including a time-frequency resource transmission scheme (e.g., interleaved or non-interleaved), resource element group (REG)-to-control channel element (CCE) mapping, monitoring periodicity, and numerology, can be configured by higher-layers via NR MSI, NR RMSI, NR SIB and/or UE-specific RRC signaling." Xiong at [0087]. "In time domain, according to a monitoring configuration in some embodiments, a LIE may not monitor certain slots for the PDCCH carrying PI. In such cases, the gNB may not transmit the PI in an affected slot or an immediately adjacent slot to the affected slot. In some embodiments, an additional field (e.g., included in the PI) can be used to indicate a number of slots prior to the slot carrying the PI that a preemption

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		occurs. For example, a number of slots between a portion of PRBs and OFDM symbols that omit transmissions intended for a UE and a slot that includes the PI. On the other hand, a UE receiving a PI significantly after an actual preemption event can cause reprocessing of a received PDSCH to be difficult or resource-intensive for a UE. In some embodiments, an upper bound, N_s^{max} can be specified that indicates how much later in time (e.g., a number of slots) that the PI may be transmitted after the actual preemption event. In one embodiment, a maximum number of slots that may be indicated as part of the PI is the same as the upper bound, N_s^{max}. Alternatively, N_s^{max} may be defined as part of a UE capability, and if a UE detects a PI indicating preemption more than N_s^{max} slots before the PI where N_s^{max} is reported by the UE, it is not required to reprocess the PDSCH taking into consideration the PI." Xiong at [0088]. "In some embodiments, the gNB can indicate multiple preemptions of time-frequency resources by encoding a parameter (e.g., granularity parameter, bitmap parameter, indication granularity). The granularity parameter can be transmitted explicitly in signaling (e.g., RRC signaling), transmitted in DCI (e.g., PI-DCI, DCI format 2_1), or can be derived by a UE implicitly. In some embodiments, the granularity parameter can specify a frequency granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of elements (e.g., PRBs) within a monitoring region of time-frequency resources, according to a given numerology. The granularity parameter can also specify a time granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of symbols within a monitoring region of time-frequency resources, also according to the given numerology. In certain embodiments, a gNB, in determining the granularity of the preempted resources, can consider a payload size of a group common DCI (e.g., PI-DCI, DCI format 2_1) carrying the PI." Xiong at [0090]; *see also, id*. at [0091]. "As a more flexible approach, an access node (e.g., gNB) can encode an additional bit field (e.g., a small 1-2 bit field in the PI-DCI). The bit field, for example, can serve as the granularity parameter and/or indication granularity, to switch time-frequency

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		granularity (e.g., preemption granularity) dynamically. For example, if y=g·y0 and x=x0/g, then the additional bit could switch between different values of g. In certain embodiments, different values of g may be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, different values of g may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1).” Xiong at [0108]. “In certain embodiments, a granularity parameter (e.g., indication granularity) can indicate a granularity of preempted time-frequency resources through a mapping of a bitmap. For example, the granularity parameter can include a bit value indicating how many bits of a field in the preemption indication (e.g., PI, PI-DCI, DCI format 2_1) map to groups of symbols in preempted time-frequency resources (e.g., a portion of PRBs and OFDM symbols that are preempted, eMBB transmissions). In some embodiments, a granularity parameter including a value of 0 indicates that 14 bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 14 groups of consecutive symbols in preempted time-frequency resources. In other embodiments, a granularity parameter including a value of 1 indicates that 7 pairs of bits of a field in the PI-DCI (e.g., DCI format 2_1) have a one-to-one mapping with 7 groups of consecutive symbols in preempted time-frequency resources. Embodiments are not so limited however, as the granularity parameter can indicate other granularities of preempted time-frequency resources.” Xiong at [0109]. “FIG. 9A illustrates an example of preempted time-frequency resources, in accordance with certain embodiments. For example, time-frequency resources can be preempted in multiple portions **902**A, **902**B, and **902**C, and a transmitted bitmap can indicate the multiple portions of preempted time-frequency resources (e.g., bitmap transmitted in PI and/or PI-DCI/DCI format 2_1). FIG. 9B illustrates an example of a bitmap **904** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **904** can indicate a configurable time-frequency granularity, for example, a 4×7 time-frequency granularity. A 4×7 granularity can indicate 4 partitions in the

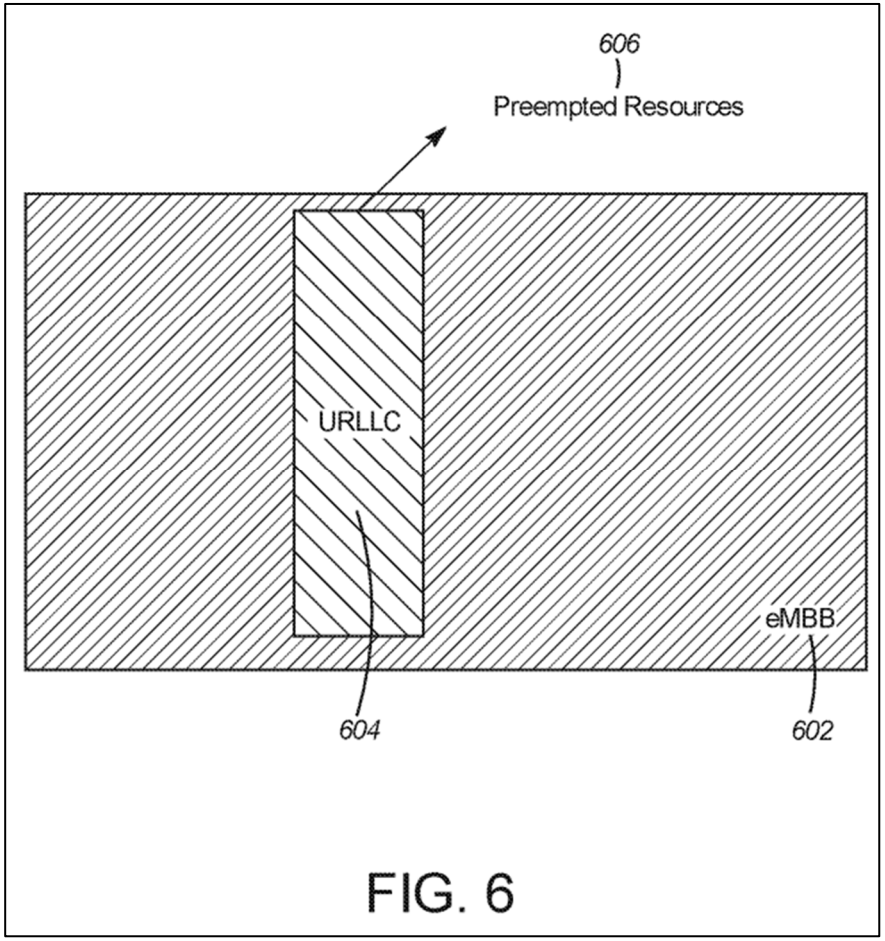
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		frequency domain and 7 partitions in the time domain. FIG. 9C illustrates an alternative example of a bitmap **906** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **906** can indicate a configurable time-frequency granularity, for example, a 2×14 time-frequency granularity. A 2×14 granularity can indicate 2 partitions in the frequency domain and 14 partitions in the time domain. In FIG. 9B and FIG. 9C, the bitmaps **904** and **906** can indicate and/or configure time-frequency granularities for preemption of resources (e.g., preemption of eMBB transmissions by URLLC). In other embodiments, bitmaps that include different values can indicate and/or configure different time-frequency granularities. In certain embodiments, with respect to FIG. 9B and FIG. 9C, a bit value of 0 in one of bitmaps **904** or **906**, or a different bitmap, can indicate no preemption of time-frequency resources. In such embodiments, indication of no preemption of time-frequency resources indicates a not mal transmission (e.g., transmission of eMBB, transmission of signaling in PDSCH). In alternative embodiments, a bit value of 1 in one of bitmaps **904** or **906**, or a different bitmap, can indicate a preemption of time-frequency resources. In such embodiments, indication of a preemption of time-frequency resources indicates that a transmission is not intended for a certain UE and/or corruption of signaling by the gNB. In some embodiments, a granularity value (e.g., bitmap and/or matrix indicating a granularity) can change dynamically, for example, the gNB may change bit values in a bitmap and indicate bit values through DCI (e.g., PI-DCI). In certain embodiments, bitmaps (e.g., **904** and **906**) to indicate and/or configure time-frequency granularities for preemption of resources can be semi-statically configured (e.g., configured by higher-layers, configured via RRC signaling) and in other embodiments, the bitmaps may be dynamically configured via DCI (e.g., PI-DCI, DCI format 2_1). Bitmaps can be configured to indicate and/or configure one of time granularity or frequency granularity, and based on receiving this infoiination through signaling (e.g., from a gNB), a device (e.g., UE) can derive a time granularity from an indicated frequency granularity (e.g., indicated in a bitmap), or vice versa." Xiong at [0110-114].

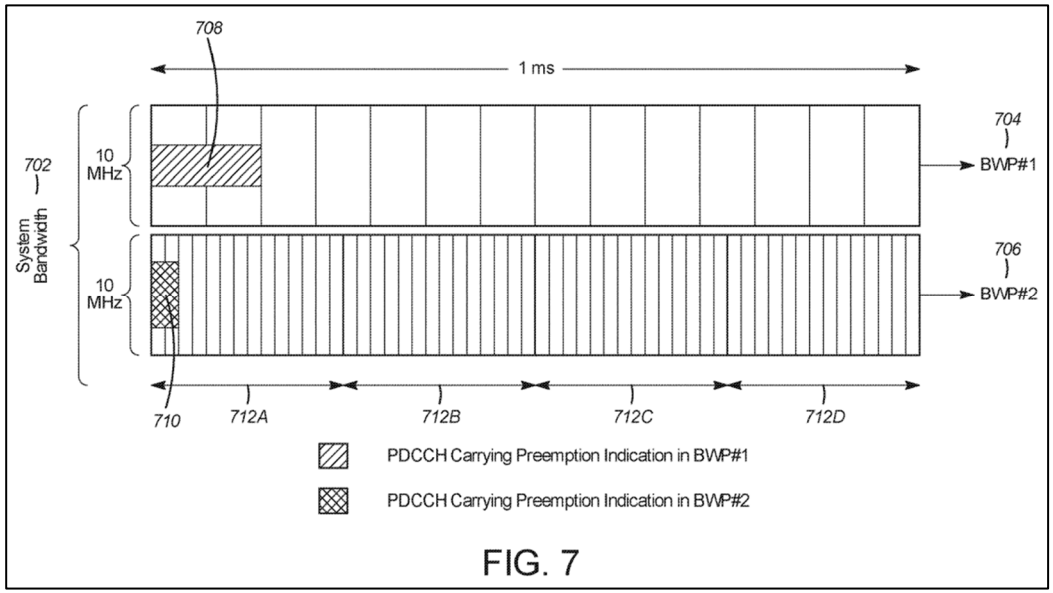
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		"In some embodiments, a gNB may configure a set of puncturing time-frequency patterns, for example, via transmission of semi-static signaling (e.g., RRC signaling) and/or DCI signaling (e.g., via configuration index). In one embodiment, a gNB can limit a number of signaled preemptions and use combinatorial indexing to optimize higher-layer signaling. If a number of preemptions is limited there are fewer combinations to signal. For example, referring to FIG. 9A and FIG. 10A, the number of preemptions may be limited to half of the resources or the 28 overall puncturing resources. Such optimizations may only introduce 1-2 bit savings unless a reduced number of preemptions can be signaled (e.g., 7 arbitrary preemptions in 28 resources require approximately 21 bit signaling). In some embodiments, optimized signaling can be defined, while accounting for a maximum payload for indications (e.g., maximum DCI payload). In such embodiments, signaling can include one or more parameters including a number of bits available for indication of preemptions, D, reference time resource symbols, Rt, reference frequency resources (e.g., PRBs), Rf, time and frequency granularities 'x' and 'y,' respectively, a number of time resources within a region Nt=floor(Rt/x), and a number of frequency resources within a region Nf=floor(Rf/y), where D=NfNt=floor(Rt/x)·floor(Rf/y). In some embodiments, knowing the overall size of an indication D, and one of a granularity of time or frequency, a UE can derive another granularity of one of time or frequency. In other embodiments, knowing D and Rt and Rf, (e.g., from a DL resource configuration), the UE can derive a number of partitions in time and/or frequency. In such embodiments, either 'x' or 'y' can be signaled and the UE can derive the value of 'x' or 'y' that is not signaled from the signaled value, the overall available number of signaling bits, and the reference resource region size." Xiong at [0121-122]. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC

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		signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI. In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology. "In Example 3, the subject matter of Examples 1-2 includes, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating pre-emption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at [0134-136]. "Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI." Xiong at [0146].

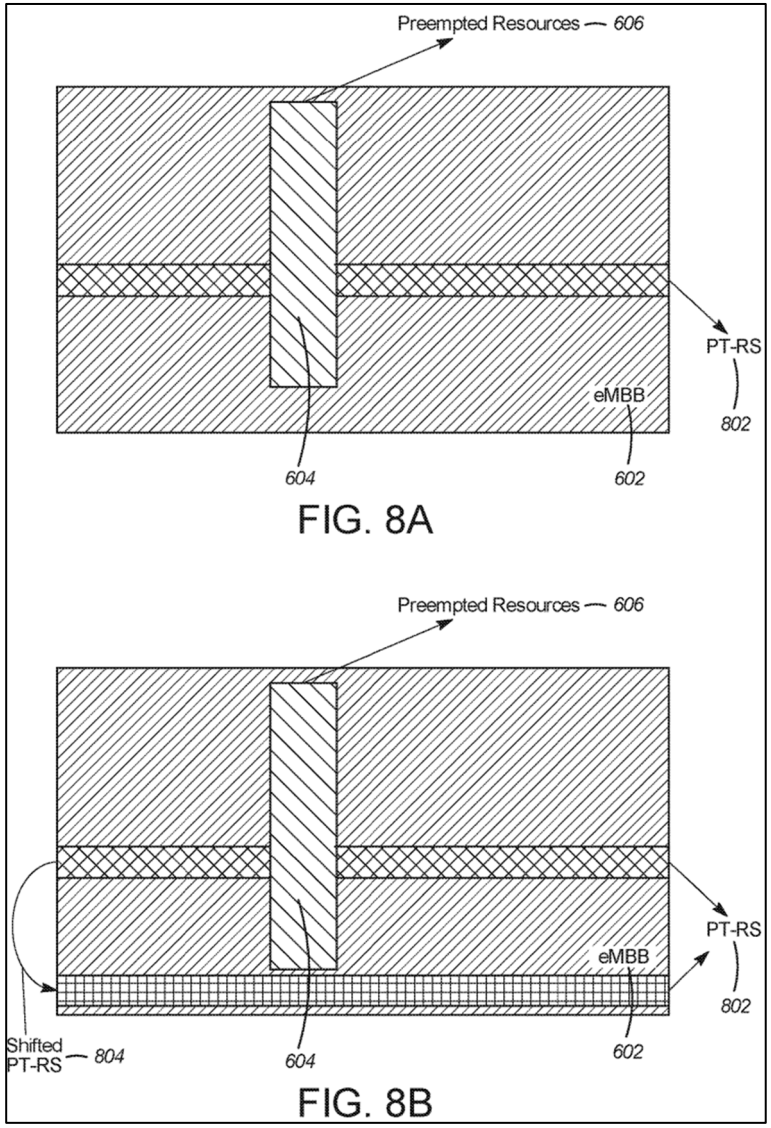
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		"In Example 15, the subject matter of Examples 13-14 includes, wherein the processing circuitry is configured to: decode, from the RRC signaling, a preemption indication radio network temporary identifier (PI-RNTI) indicating preemption in a downlink (DL); and identify a cyclic redundancy check (CRC) scrambled by the PI-RNTI and decode the PI-DCI based on the PI-RNTI." Xiong at [0148]. "1. An apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at Claim 1; *see also, id*. at Claims 6, 13, 17. "3. The apparatus of claim 1, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating preemption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at Claim 3; *see also, id*. at Claim 15. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other

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		prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein the DL preemption indication information indicates preempted resource information in a prior slot, which precedes a slot in which the DL preemption indication information is received,	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the DL preemption indication information indicates preempted resource information in a prior slot, which precedes a slot in which the DL preemption indication information is received. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[c], *supra*.

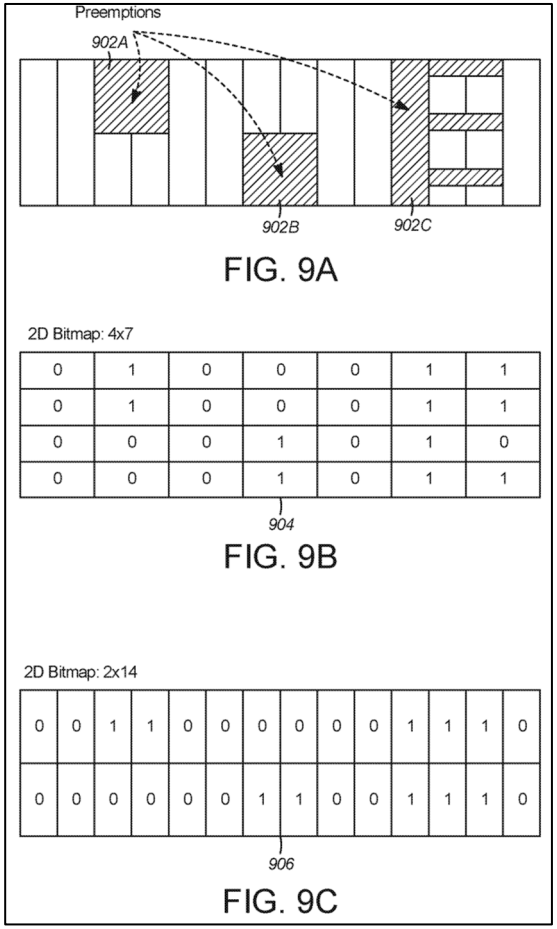
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	 FIG. 6 Xiong at Fig. 6. "FIG. 6 illustrates an example of dynamic multiplexing of an eMBB transmission and an URLLC transmission, in accordance with certain embodiments. In some embodiments, an access node, such as a gNB can preempt resources 606, within an eMBB transmission 602, for the transmission of a control channel and/or a data

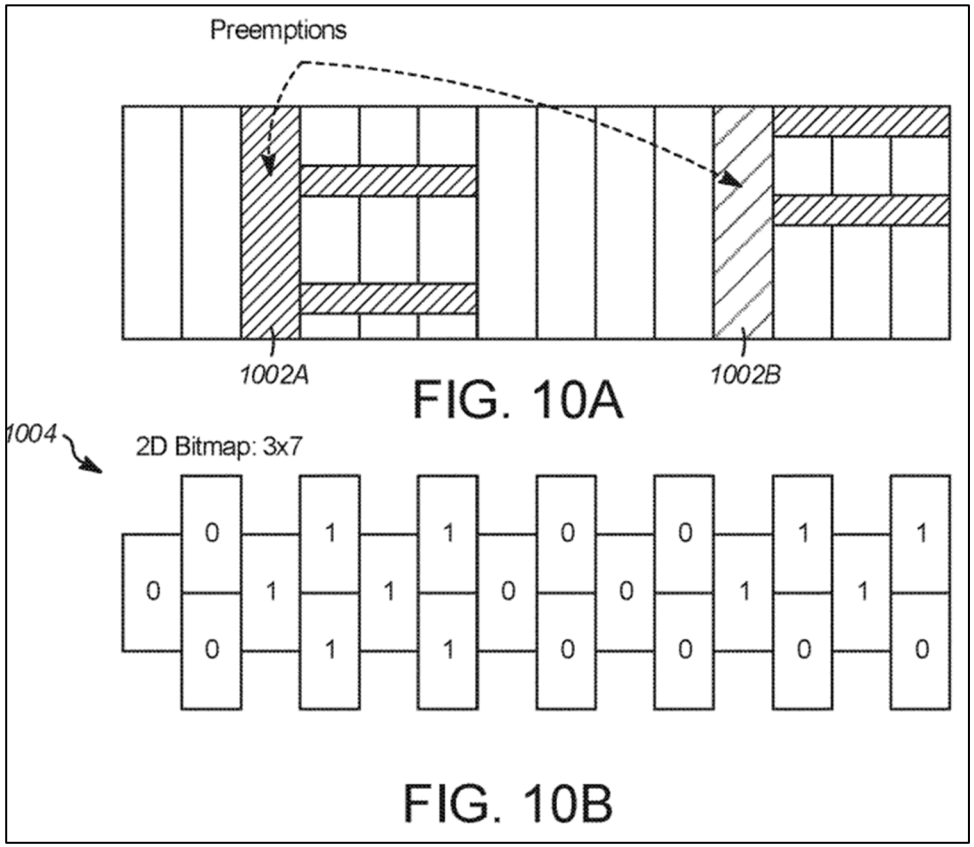
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		channel, for example, for an URLLC application (e.g., URLLC 604).” Xiong at [0076]; *see also, id*. at [0077-83].  FIG. 7 Xiong at Fig. 7. “FIG. 7 illustrates an example of multiple BWPs within a system bandwidth, in accordance with some embodiments. For example, the multiple BWPs of FIG. 7 can have different numerologies within a system bandwidth. In some embodiments, a system bandwidth 702 (e.g., wide system bandwidth) includes multiple BWPs, for example, BWP 704, BWP 706, and additional BWPs in some cases. In some embodiments, different BWPs (e.g., BWP 704, BWP 706) have different numerologies, including different subcarrier spacings and slot durations. A BWP configuration, according to its numerology, may have subcarrier spacing that is a scaled multiple (e.g., by a power of 2n, where n is an integer) of a 15 kHz subcarrier spacing.” Xiong at [0084]; *see also, id*. at [0085-100].

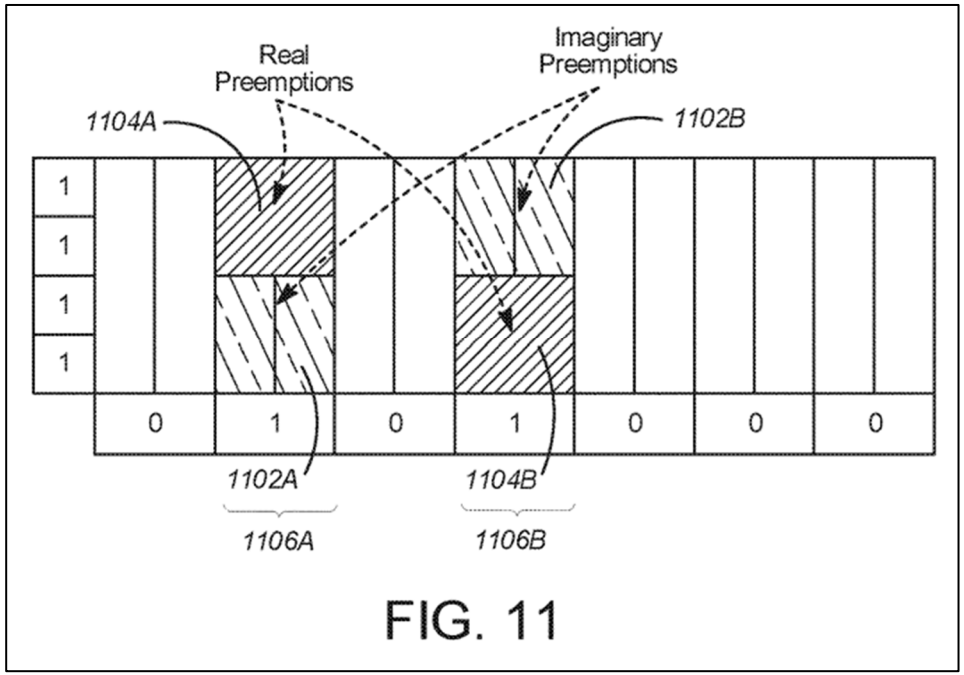
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		"In time domain, according to a monitoring configuration in some embodiments, a LIE may not monitor certain slots for the PDCCH carrying PI. In such cases, the gNB may not transmit the PI in an affected slot or an immediately adjacent slot to the affected slot. In some embodiments, an additional field (e.g., included in the PI) can be used to indicate a number of slots prior to the slot carrying the PI that a preemption occurs. For example, a number of slots between a portion of PRBs and OFDM symbols that omit transmissions intended for a UE and a slot that includes the PI. On the other hand, a UE receiving a PI significantly after an actual preemption event can cause reprocessing of a received PDSCH to be difficult or resource-intensive for a UE. In some embodiments, an upper bound, N_s^{max} can be specified that indicates how much later in time (e.g., a number of slots) that the PI may be transmitted after the actual preemption event. In one embodiment, a maximum number of slots that may be indicated as part of the PI is the same as the upper bound, N_s^{max}. Alternatively, N_s^{max} may be defined as part of a UE capability, and if a UE detects a PI indicating preemption more than N_s^{max} slots before the PI where N_s^{max} is reported by the UE, it is not required to reprocess the PDSCH taking into consideration the PI." Xiong at [0088].

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		 Xiong at Fig. 8.

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		"FIG. 8A illustrates an example of preempted resource overlapping with a phase tracking-reference signal (PT-RS), in accordance with certain embodiments. In embodiments when preempted time-frequency resources (e.g., preempted resources 606) partially or fully overlap with a PT-RS 802, for example, if a PT-RS 802 is transmitted in the same subcarrier across different symbols within a slot, the UE may need to flush a soft-bit buffer for the code blocks corresponding to physical resources following the preempted time-frequency resources (e.g., physical resources in time). In some embodiments, the time-frequency resources of FIG. 8A may include an eMBB transmission 602. In certain embodiments, soft-bits may not be reliable, as PT-RS 802 is corrupted after the preempted physical resources and the subsequent phase offset tracking performance cannot be guaranteed." Xiong at [0101]; *see also, id*. at [0102-109].

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	 Xiong at Fig. 9. "FIG. 9A illustrates an example of preempted time-frequency resources, in accordance with certain embodiments. For example, time-frequency resources can be preempted in multiple portions 902A, 902B, and 902C, and a transmitted bitmap can indicate the multiple portions of preempted time-frequency resources (e.g., bitmap

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	transmitted in PI and/or PI-DCI/DCI format 2_1).” Xiong at [0110]; *see also, id*. at [0111-114].  Xiong at Fig. 10. “In other embodiments, a gNB can use a non-uniform bitmap density per time resource to better reflect mini-slot structures. For example, each ‘m’ occasion in a time bitmap can correspond to a single bit puncturing information without frequency

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		resolution. Such an embodiment may be useful when the PDCCH for URLLC scheduling (e.g., and DMRS) is to span a whole bandwidth, (e.g., because of a high aggregation level) while the PDSCH is to be transmitted in distributed manner. FIG. 10A illustrates an example of preempted time-frequency resources, as indicated by a non-uniform bitmap, in accordance with certain embodiments. For example, time-frequency resources might be preempted in multiple portions 1002A and 1002B, and a transmitted non-uniform bitmap can indicate the multiple portions of preempted time-frequency resources (e.g., non-uniform bitmap transmitted in P1 and/or PI-DCl/DCI format 2_1).” Xiong at [0115]; *see also, id*. at [0116].  FIG. 11 Xiong at Fig. 11.

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		"In some embodiments, an access node (e.g., gNB) can transmit signaling including time information (e.g., time indications) separately from frequency indications (e.g., separate time and frequency bitmaps). FIG. 11 illustrates an example of preemption indication signaling with separate time domain and frequency domain indications, in accordance with certain embodiments. For example, this approach can be advantageous when time information is considered to be more important than frequency information (e.g., in wideband URLLC puncturing and frequency-first RE mapping). Separate time and frequency bitmaps may result in a reduction in signaling size." Xiong at [0117]; *see also, id*. at [0118-122]. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[f]	wherein the specific RNTI is received with information related to time and frequency, and	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the specific RNTI is received with information related to time and frequency, and. For example, Xiong discloses this limitation based on the following exemplary citations: *See* claims 1[a], 1[d], and 1[e], *supra*. "Embodiments of dynamic multiplexing are described, including the transmission of preemption indication (PI) to indicate preemption of time-frequency resources. In some embodiments, a next Generation NodeB (gNB) is configured to transmit PIs in signaling to preempt an enhanced Mobile Broadband (eMBB) communications transmission with an ultra-reliable and low latency communications (URLCC)

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		transmission. In some embodiments, a user equipment (UE) is configured to monitor a region of time-frequency resources, within a bandwidth part (BWP), for a PI. The PI indicates to the UE a portion of time-frequency resources that omit transmissions intended for the UE. In some embodiments, the gNB transmits the PI to the UE within preemption indication downlink control information (PI-DCI) in a physical downlink control channel (PDCCH) in a control resource set (CORESET). In some embodiments, the BWP is defined according to a frequency domain location, a bandwidth, and a subcarrier spacing for a given numerology." Xiong at Abstract. "FIG. 1 illustrates an architecture of a system **100** of a network in accordance with some embodiments. In some embodiments, the system **100** may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some embodiments, network devices, such as the access nodes described below, can be configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below." Xiong at [0022]. "In some embodiments, a downlink resource grid can be used for downlink transmissions from any of the RAN nodes 111 and 112 to the UEs 101 and 102, while uplink transmissions can utilize similar techniques. The grid can be a time-frequency grid, called a resource grid or time-frequency resource grid, which is the physical resource in the downlink in each slot. Such a time-frequency plane representation is a common practice for OFDM systems, which makes it intuitive for radio resource allocation. Each column and each row of the resource grid corresponds to one OFDM symbol and one OFDM subcarrier, respectively. The duration of the resource grid in the time domain corresponds to one slot in a radio frame. The smallest time-frequency unit in a resource grid. is denoted as a resource element. Each resource grid comprises a number of resource blocks, which describe the mapping of certain physical channels to resource elements. Each resource block comprises a collection of

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		resource elements; in the frequency domain, this may represent the smallest quantity of resources that currently can be allocated. There are several different physical downlink channels that are conveyed using such resource blocks." Xiong at [0031]. "In some embodiments, the gNB can transmit DCI (e.g., PI-DCI) in a specific format (e.g., including the PI) via a PDCCH in a control-resource set (CORESET). A CORESET consists of a number of resource blocks in the frequency domain, which can be defined by a higher-layer parameter (e.g., in an IE), and a number of symbols (e.g., OFDM symbols) in the time domain, which can also be defined by a higher-layer parameter (e.g., in an IE). In some embodiments, an access node (e.g., gNB) can transmit the CORESET and associated defining parameters and/or IEs within RRC signaling to a UE to configure the UE for monitoring for PI-DCI (e.g., DCI format 2_1) and a PI within the CORESET." Xiong at [0082]. "In time domain, according to a monitoring configuration in some embodiments, a LIE may not monitor certain slots for the PDCCH carrying PI. In such cases, the gNB may not transmit the PI in an affected slot or an immediately adjacent slot to the affected slot. In some embodiments, an additional field (e.g., included in the PI) can be used to indicate a number of slots prior to the slot carrying the PI that a preemption occurs. For example, a number of slots between a portion of PRBs and OFDM symbols that omit transmissions intended for a UE and a slot that includes the PI. On the other hand, a UE receiving a PI significantly after an actual preemption event can cause reprocessing of a received PDSCH to be difficult or resource-intensive for a UE. In some embodiments, an upper bound, N_s^{max} can be specified that indicates how much later in time (e.g., a number of slots) that the PI may be transmitted after the actual preemption event. In one embodiment, a maximum number of slots that may be indicated as part of the PI is the same as the upper bound, N_s^{max}. Alternatively, N_s^{max} may be defined as part of a UE capability, and if a UE detects a PI indicating preemption more than N_s^{max} slots before the PI where N_s^{max} is reported by the UE, it is not required to reprocess the PDSCH taking into consideration the PI." Xiong at [0088].

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		"In some embodiments, configuration of frequency regions smaller than a UE bandwidth can lead to scheduling restrictions and overdesigned signaling. To address this, the gNB can encode signaling so that the frequency region is implicitly indicated as a bandwidth of a BWP or a component carrier (CC) where a UE operates. For example, the BWP in which the CORESET is transmitted can be considered by the UE to be the bandwidth in which the UE monitors for the PI. In some embodiments, the gNB can transmit an indication to the UE in signaling to notify the UE of the bandwidth for monitoring being equal to the BWP. In other embodiments, additional start-RB and end-RB may be configured via RRC for the concerned BWP in order to further restrict the monitoring region (e.g., in case the puncturing/preemption is expected to affect only a portion of the BWP). With respect to time domain resources, configurability may be directly linked with a PI-DCI monitoring configuration. For example, a monitoring periodicity (e.g., 'p') can be reused as a monitoring region for monitoring for the PI." Xiong at [0091]. "In some embodiments, a transmitted SS block may have a higher priority than other physical channels and/or signaling. For example, in some embodiments, a gNB is configured to refrain from preempting time-frequency resources that would overlap with transmitted SS blocks. Alternatively, preempted time-frequency resources (e.g., time-frequency resources indicated by PI) can overlap with time-frequency resources of transmitted SS blocks. However, in such cases, the data and control channels transmitting within the preempted physical resource should be rate-matched around and/or puncture resources of the transmitted SS blocks." Xiong at [0096] *see also, id.* at [0097-110]. "FIG. 9B illustrates an example of a bitmap **904** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **904** can indicate a configurable time-frequency granularity, for example, a 4×7 time-frequency granularity. A 4×7 granularity can indicate 4 partitions in the frequency domain and 7 partitions in the time domain. FIG. 9C illustrates an

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		alternative example of a bitmap **906** for preemption of time-frequency resources, in accordance with certain embodiments. In some embodiments, the bitmap **906** can indicate a configurable time-frequency granularity, for example, a 2×14 time-frequency granularity. A 2×14 granularity can indicate 2 partitions in the frequency domain and 14 partitions in the time domain." Xiong at [0111]. "FIG. 10B illustrates an example of non-uniform bitmap **1004**, in accordance with certain embodiments. In some embodiments, bitmap **1004** can indicate and/or configure a non-uniform bitmap density per time resource, for example, to configure time-frequency granularities for preemption of resources **1002**A and **1002**B. In certain embodiments, the bitmap **1004** can be a 3×7 bitmap to indicate non-uniform 3 partitions in the frequency domain and 7 partitions in the time domain." Xiong at [0116]. "In some embodiments, an access node (e.g., gNB) can transmit signaling including time information (e.g., time indications) separately from frequency indications (e.g., separate time and frequency bitmaps). FIG. 11 illustrates an example of preemption indication signaling with separate time domain and frequency domain indications, in accordance with certain embodiments. For example, this approach can be advantageous when time information is considered to be more important than frequency information (e.g., in wideband URLLC puncturing and frequency-first RE mapping). Separate time and frequency bitmaps may result in a reduction in signaling size." Xiong at [0117]. "In some embodiments, a gNB can avoid imaginary preemptions by signaling several frequency domain patterns as a vector of bitmaps, the frequency domain patterns corresponding to different preemptions. In some embodiments, a number of time domain preemptions are limited to less than a time domain preemption bitmap length to conserve signaling overhead. In certain embodiments, a UE can interpret a received frequency indication based on a number of is in a time bitmap. For example, the resolution of each frequency indication bitmap can be configured based on a

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		number of time domain preemptions num_freq_bit=floor (D_f/sum(time_bitmap)), where D_f is a number of bits for a frequency domain indication, time_bitmap is a time domain bitmap, and num_freq_bit is a bitmap size of each frequency domain indication." Xiong at [0120]. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at [0134]. "Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI." Xiong at [0146].

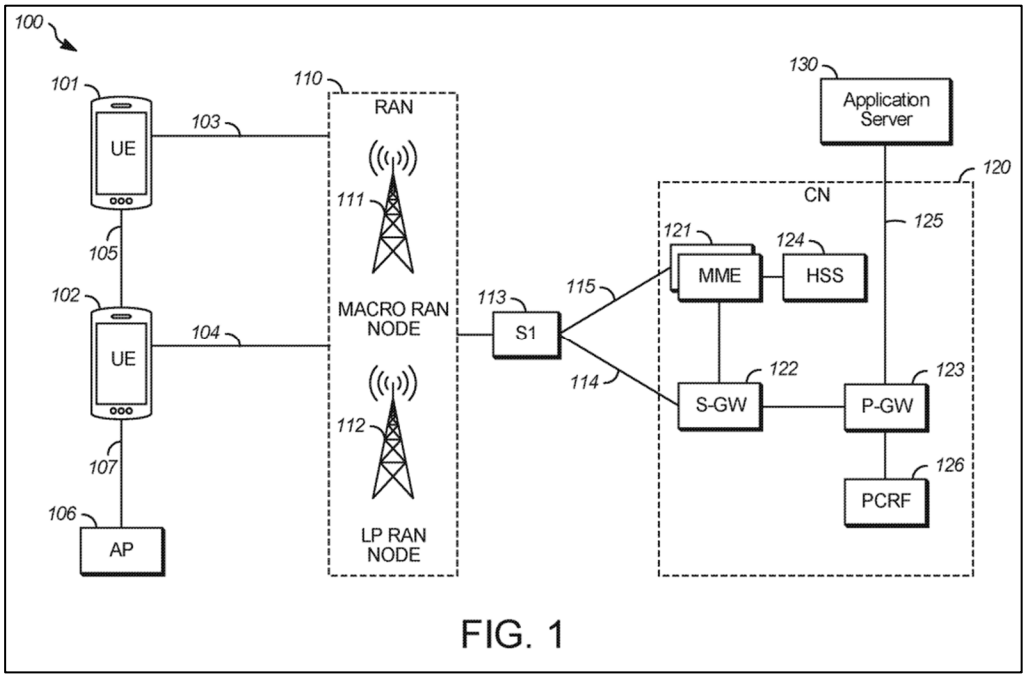
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		"In Example 16, the subject matter of Examples 13-15 includes, wherein the region of time-frequency resources is defined by a starting position and a number of resource blocks within the BWP." Xiong at [0150]. "1. An apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at Claim 1; *see also, id*. at Claims 2, 13, 14. "4. The apparatus of claim 1, wherein the region of time-frequency resources is defined by a starting position and a number of resource blocks within the BWP." Xiong at Claim 4; *see also, id*. at Claims 6, 9, 16, 17, 25. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[g]	wherein the information related to time and frequency is received for the reception of the DL preemption indication information through the UE-specific RRC signaling.	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the information related to time and frequency is received for the reception of the DL preemption indication information through the UE-specific RRC signaling. For example, Xiong discloses this limitation based on the following exemplary citations: *See* claims 1[a] and 1[f], supra. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI." Xiong at [0134]. "In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology." Xiong at [0135]. "In Example 3, the subject matter of Examples 1-2 includes, wherein the RRC signaling includes a preemption indication radio network temporary identifier (PI-RNTI) used for indicating pre-emption in a downlink (DL), and wherein the processing circuitry is configured to encode the PI-DCI with a cyclic redundancy check (CRC) scrambled by the PI-RNTI." Xiong at [0136].

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		"Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI." Xiong at [0146]. "In Example 16, the subject matter of Examples 13-15 includes, wherein the region of time-frequency resources is defined by a starting position and a number of resource blocks within the BWP." Xiong at [0150]. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

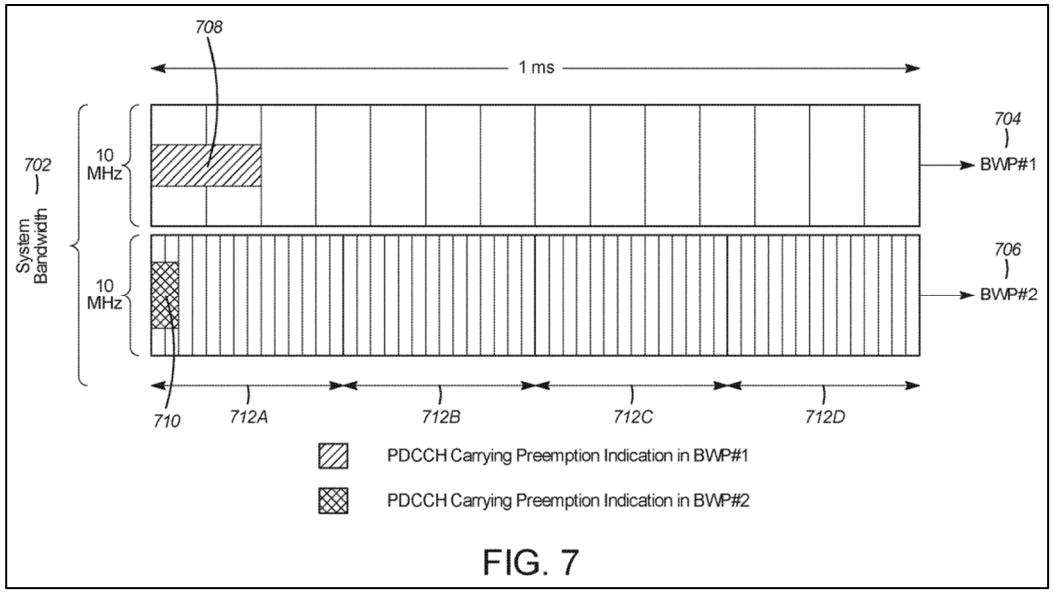
2. Claim 2

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2[a]	The method according to claim 1, wherein at least one of a subcarrier spacing and a time-domain scheduling unit of first radio resources allocated for the first UE are different from second radio resources allocated for a second UE.	At least under Pegasus's apparent infringement theory, Xiong discloses the method according to claim 1, wherein at least one of a subcarrier spacing and a time-domain scheduling unit of first radio resources allocated for the first UE are different from second radio resources allocated for a second UE. For example, Xiong discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. "Embodiments of dynamic multiplexing are described, including the transmission of preemption indication (PI) to indicate preemption of time-frequency resources. In some embodiments, a next Generation NodeB (gNB) is configured to transmit PIs in signaling to preempt an enhanced Mobile Broadband (eMBB) communications transmission with an ultra-reliable and low latency communications (URLCC) transmission. In some embodiments, a user equipment (UE) is configured to monitor a region of time-frequency resources, within a bandwidth part (BWP), for a PI. The PI indicates to the UE a portion of time-frequency resources that omit transmissions intended for the UE. In some embodiments, the gNB transmits the PI to the UE within preemption indication downlink control information (PI-DCI) in a physical downlink control channel (PDCCH) in a control resource set (CORESET). In some embodiments, the BWP is defined according to a frequency domain location, a bandwidth, and a subcarrier spacing for a given numerology." Xiong at Abstract. "FIG. 1 illustrates an architecture of a system 100 of a network in accordance with some embodiments. In some embodiments, the system 100 may be configured for dynamic multiplexing operations, for example, involving preemption of time-frequency resources by certain types of communication signals. In some embodiments, network devices, such as the access nodes described below, can be configured to preempt ongoing eMBB transmissions with URLLC transmissions in time-frequency resources. The access nodes can indicate preemption of time-

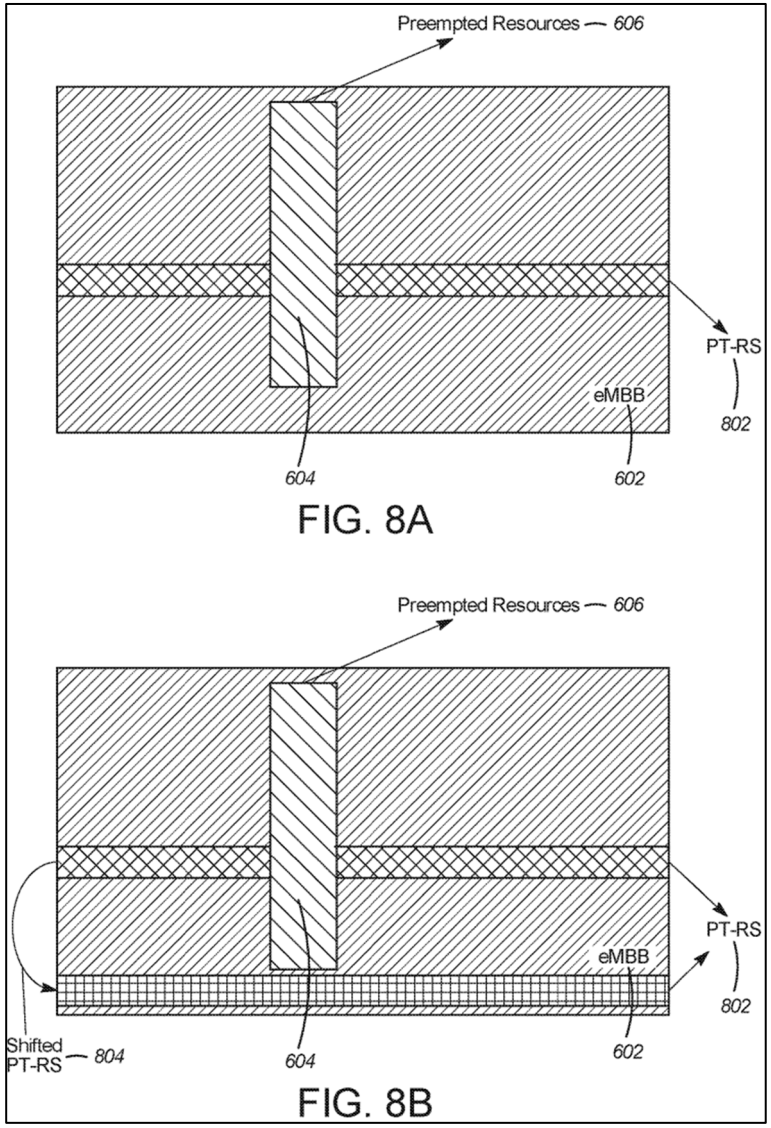
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	frequency resources to other network devices, such as user equipment (UE), using preemption indications, as described further below. The system 100 is shown to include a UE 101 and a UE 102, for example a UE configured for preemption operations. The UEs 101 and 102 are illustrated as smartphones (e.g., handheld touchscreen mobile computing devices connectable to one or more cellular networks), but may also comprise any mobile or non-mobile computing device, such as Personal Data Assistants (PDAs), pagers, laptop computers, desktop computers, wireless handsets, or any computing device including a wireless communications interface." Xiong at [0022-23]; see also, id. at [0024-29].  FIG. 1 Xiong at Fig. 1.

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		"In accordance with some embodiments, the UEs 101 and 102 can be configured to communicate using Orthogonal Frequency-Division Multiplexing (OFDM) communication signals with each other or with any of the RAN nodes 111 and 112 over a multicarrier communication channel in accordance various communication techniques, such as, but not limited to, an Orthogonal Frequency-Division Multiple Access (OFDMA) communication technique (e.g., for downlink communications) or a Single Carrier Frequency Division Multiple Access (SC-TDMA) communication technique (e.g., for uplink and ProSe or sidelink communications), although the scope of the embodiments is not limited in this respect. The OFDM signals can comprise a plurality of orthogonal subcarriers." Xiong at [0030]. "In some embodiments, a downlink resource grid can be used for downlink transmissions from any of the RAN nodes 111 and 112 to the UEs 101 and 102, while uplink transmissions can utilize similar techniques. The grid can be a time-frequency grid, called a resource grid or time-frequency resource grid, which is the physical resource in the downlink in each slot. Such a time-frequency plane representation is a common practice for OFDM systems, which makes it intuitive for radio resource allocation. Each column and each row of the resource grid corresponds to one OFDM symbol and one OFDM subcarrier, respectively. The duration of the resource grid in the time domain corresponds to one slot in a radio frame. The smallest time-frequency unit in a resource grid. is denoted as a resource element. Each resource grid comprises a number of resource blocks, which describe the mapping of certain physical channels to resource elements. Each resource block comprises a collection of resource elements; in the frequency domain, this may represent the smallest quantity of resources that currently can be allocated. There are several different physical downlink channels that are conveyed using such resource blocks." Xiong at [0031]. "The physical downlink shared channel (PDSCH) may carry user data and higher-layer signaling to the UEs 101 and 102. The physical downlink control channel (PDCCH) may carry information about the transport format and resource allocations related to the PDSCH channel, among other things. It may also inform the UEs 101

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		and 102 about the transport format, resource allocation, and H-ARQ (Hybrid Automatic Repeat Request) information related to the uplink shared channel. Typically, downlink scheduling (assigning control and shared channel resource blocks to the UE 102 within a cell) may be performed at any of the RAN nodes 111 and 112 based on channel quality information fed back from any of the UEs 101 and 102. The downlink resource assignment information may be sent on the PDCCH used for (e.g., assigned to) each of the UEs 101 and 102." Xiong at [0032]. "As previously described, in certain embodiments, a UE can be configured to monitor for a PI within a BWP. A BWP part can be defined as a subset of a bandwidth of contiguous common resource blocks, according to a given numerology (μ), on a given carrier. A BWP can also be defined by a starting position (e.g., starting resource block) and a number of resource blocks. In some embodiments, a maximum NR channel bandwidth may be 400 MHz and a gNB may configure one or multiple BWP configurations (e.g., for respective component carriers) within a wide system bandwidth for a given UE. For example, the gNB can semi-statically configure (e.g., transmit configuration information in RRC signaling to the UE) the BWP configurations. In some embodiments, the gNB can configure BWPs by encoding and transmitting to a UE information (e.g., IEs, higher-layer parameters) specific to a given numerology. Such information may also be transmitted in RRC signaling, and can include a reference numerology (e.g., for a BWP, for preempted resources), a frequency domain location for a given numerology, a bandwidth for a given numerology, and/or a subcarrier spacing of a BWP for a given numerology. According to some embodiments, the gNB can include such information in RRC signaling. The RRC signaling may also include information In some embodiments, a UE can be configured with up to four BWPs in a downlink (DL) and a single DL BWP may be active at a given time. In some embodiments, a UE can be configured with up to four BWPs in an uplink (UL) and a single UL BWP may be active at a given time. In some embodiments, for a given numerology and carrier, a resource grid of a number of subcarriers and a number of symbols (e.g., OFDM symbols) is defined, starting at a common resource block, which can be

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		indicated by higher-layer signaling. A given numerology (e.g., for a given BWP) can have one of various subcarrier spacings and slot length configurations." Xiong at [0079-80]. "FIG. 7 illustrates an example of multiple BWPs within a system bandwidth, in accordance with some embodiments. For example, the multiple BWPs of FIG. 7 can have different numerologies within a system bandwidth. In some embodiments, a system bandwidth 702 (e.g., wide system bandwidth) includes multiple BWPs, for example, BWP 704, BWP 706, and additional BWPs in some cases. In some embodiments, different BWPs (e.g., BWP 704, BWP 706) have different numerologies, including different subcarrier spacings and slot durations. A BWP configuration, according to its numerology, may have subcarrier spacing that is a scaled multiple (e.g., by a power of 2n, where n is an integer) of a 15 kHz subcarrier spacing." Xiong at [0084].  FIG. 7

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		Xiong at Fig. 7. "In some embodiments, for example in FIG. 7, the BWP 704 is configured with a 15 kHz subcarrier spacing and a slot duration of 1 ms, while BWP 706 is configured with a 60 kHz subcarrier spacing and a slot duration of roughly 0.25 ins (e.g., 712A-712D), wherein for BWP 704 and BWP 706, the number of OFDM symbols within a slot is 14. In other embodiments, the system bandwidth 702 may include additional BWPs of different numerologies. For NR systems, symbol level alignment across different subcarrier spacings with a same cyclic prefix (CP) overhead may be assumed within a subframe duration in a NR carrier." Xiong at [0086]. "FIG. 8A illustrates an example of preempted resource overlapping with a phase tracking-reference signal (PT-RS), in accordance with certain embodiments. In embodiments when preempted time-frequency resources (e.g., preempted resources 606) partially or fully overlap with a PT-RS 802, for example, if a PT-RS 802 is transmitted in the same subcarrier across different symbols within a slot, the UE may need to flush a soft-bit buffer for the code blocks corresponding to physical resources following the preempted time-frequency resources (e.g., physical resources in time). In some embodiments, the time-frequency resources of FIG. 8A may include an eMBB transmission 602. In certain embodiments, soft-bits may not be reliable, as PT-RS 802 is corrupted after the preempted physical resources and the subsequent phase offset tracking performance cannot be guaranteed." Xiong at [0101].

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	 Xiong at Fig. 8.

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		"Alternatively, in some embodiments, the PT-RS may be shifted to other time-frequency resources without collision. FIG. 8B illustrates an example of a shifted PT-RS, in accordance with certain embodiments. New subcarfiers for PT-RS 802, for example, the shifted time-frequency resources for PT-RS 804, can be determined by the bandwidth of preempted resources and can be configured by higher-layer signaling and/or DCI (e.g., PI-DCI). Whether the PT-RS should be punctured or shifted can be pre-defined and/or configured by higher-layer signaling and/or DCI. Additionally, whether the PT-RS should be punctured can be determined by any one or more of a subcarrier spacing μ, an allocated bandwidth, a modulation and coding scheme (MCS), and/or a number of symbols for preempted resources. Further, for a slot, the dynamic presence of the PT-RS can be determined by the number of symbols for preempted resources in addition to subcarrier spacing μ, allocated bandwidth, and MCS. In some embodiments, the time-frequency resources of FIG. 8B may include an eMBB transmission 602." Xiong at [0103]. "Example 1 is an apparatus of a New Radio (NR) NodeB (gNB), the apparatus comprising: memory; and one or more processors configured to: encode radio resource control (RRC) signaling to configure a user equipment (UE) for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for transmission of preemption indication downlink control information (PI-DCI); encode, for transmission to a group of UEs including the UE, the PI-DCI to include, the PI and to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE; and configure transceiver circuitry to transmit the PI-DCI in a physical downlink control channel (PDCCH) in a control resource set (CORESET) to the group of UEs, and wherein the memory is configured to store the PI. In Example 2, the subject matter of Example 1 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology." Xiong at [0134-135].

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Claim Language		**Exemplary Citations to Xiong**
		"Example 13 is an apparatus of a user equipment (UE) comprising: memory; and processing circuitry, the processing circuitry configured to: decode radio resource control (RRC) signaling, received from a New Radio (NR) NodeB (gNB), the RRC signaling to configure the UE for monitoring a region of time-frequency resources for a preemption indication (PI), the RRC signaling including a bandwidth part (BWP) information element to configure a BWP of the region of time-frequency resources for monitoring for preemption indication downlink control information (PI-DCI); configure transceiver circuitry to receive signaling in a physical downlink control channel (PDCCH) in a control resource set (CORESET); and decode the PI-DCI from the received signaling, the PI-DCI including the PI to indicate a portion of physical resource blocks (PRBs) that omit transmissions intended for the UE, and wherein the memory is configured to store the PI. In Example 14, the subject matter of Example 13 includes, wherein the BWP information element includes a frequency domain location, a bandwidth, and a subcarrier spacing of the BWP for a given numerology." Xiong at [0146-147]. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
3[a]	The method according to claim 1, wherein the DL preemption indication information is received through a common search space of the DL control channel.	At least under Pegasus's apparent infringement theory, Xiong discloses the method according to claim 1, wherein the DL preemption indication information is received through a common search space of the DL control channel. For example, Xiong discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. "In some embodiments, for example, in the case of wideband operation, a network device (e.g., gNB) can determine preempted time-frequency resources (e.g., for indication by PI in PI-DCI) in accordance with a numerology (e.g., reference numerology). A numerology for determination of preempted time-frequency resources may be any of a numerology used for the transmission of a synchronization block (SS block), a numerology predefined in a specification (e.g., 3GPP specification), a numerology configured for the CORESET used for transmission of PI-DCI (e.g., DCI format 2_1) in PDCCH, a numerology that is configured in a cell-specific manner for PI (e.g., via NR minimum system information (MSI), NR remaining minimum system information (RMSI), NR system information block (SIB)), or UE-specifically via UE-specific RRC signaling), and/or a numerology which is indicated within the PI. Further, frequency domain resources can be allocated based on a common physical resource block (PRB) indexing which can be employed for the wide system bandwidth operation." Xiong at [0085]. "In some embodiments, a network node (e.g., gNB) can transmit a PI in DCI (e.g., PI-DCI, DCI format 2_1) within the CORESET to a group of UEs or in a cell-specific manner. The CORESET may be a shared and/or common CORESET and can be the same as a CORESET for PDCCH monitoring for scheduling, for example, for scheduling of remaining system information (RMSI) or paging or random access response (RAR). In certain embodiments, when the CORESET is different from a CORESET for PDCCH monitoring of common control messages, the CORESET

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Claim Language		**Exemplary Citations to Xiong**
		configuration, including a time-frequency resource transmission scheme (e.g., interleaved or non-interleaved), resource element group (REG)-to-control channel element (CCE) mapping, monitoring periodicity, and numerology, can be configured by higher-layers via NR MSI, NR RMSI, NR SIB and/or UE-specific RRC signaling." Xiong at [0087]. "In some embodiments, the gNB can indicate multiple preemptions of time-frequency resources by encoding a parameter (e.g., granularity parameter, bitmap parameter, indication granularity). The granularity parameter can be transmitted explicitly in signaling (e.g., RRC signaling), transmitted in DCI (e.g., PI-DCI, DCI format 2_1), or can be derived by a UE implicitly. In some embodiments, the granularity parameter can specify a frequency granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of elements (e.g., PRBs) within a monitoring region of time-frequency resources, according to a given numerology. The granularity parameter can also specify a time granularity of preempted resources (e.g., preempted eMBB), which can be configured to be a number of symbols within a monitoring region of time-frequency resources, also according to the given numerology. In certain embodiments, a gNB, in determining the granularity of the preempted resources, can consider a payload size of a group common DCI (e.g., PI-DCI, DCI format 2_1) carrying the PI." Xiong at [0090]. "UE behavior, for such embodiments, may be configurable by higher-layer signaling. For this purpose, a bit indication (e.g., one bit) may be conveyed (e.g., transmitted by the gNB) as part of signaling for configuration of UE monitoring of a BWP and the CORESET (e.g., including PI-DCI) within the PDCCH (e.g., associated with a certain PDCCH search space to be used for scheduling of particular services). For example, the bit indication may be set to '1' to indicate to the LIE that when scheduled via DCI (e.g., PI-DCI) in the CORESET, or PDCCH search space, the resources corresponding to the scheduled PDSCH cannot be preempted and thus should be excluded from calculation of corrupted resource elements (e.g., preempted resource elements) indicated by PI. In certain embodiments, the resources corresponding to

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Claim Language		**Exemplary Citations to Xiong**
		transmission of PDCCH in the indicated CORESETs and resources corresponding to PDSCH scheduled using DCI in such CORESETs are reserved from being preempted, which can lead to restrictions to scheduling flexibility." Xiong at [0098]. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

4. Claim 5

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
5[pre]	A method of transmitting a downlink (DL) signal by a base station (BS), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Xiong discloses a method of transmitting a downlink (DL) signal by a base station (BS), the method comprising. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[pre], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other

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Claim Language		**Exemplary Citations to Xiong**
		prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[a]	configuring, by the BS, a specific radio network temporary identifier (RNTI) for DL preemption indication information;	At least under Pegasus's apparent infringement theory, Xiong discloses configuring, by the BS, a specific radio network temporary identifier (RNTI) for DL preemption indication information. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[b]	transmitting, from the BS, the configured specific RNTI to a first user equipment (UE) through a UE-specific radio resource control (RRC) signaling; and	At least under Pegasus's apparent infringement theory, Xiong discloses transmitting, from the BS, the configured specific RNTI to a first user equipment (UE) through a UE-specific radio resource control (RRC) signaling; and. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*.

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Claim Language		**Exemplary Citations to Xiong**
		To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[c]	transmitting, from the BS, the DL preemption indication information based on the specific RNTI through a multicast signal	At least under Pegasus's apparent infringement theory, Xiong discloses transmitting, from the BS, the DL preemption indication information based on the specific RNTI through a multicast signal. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[c], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[d]	wherein the specific RNTI transmitted through the UE specific RRC signaling is a	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the specific RNTI transmitted through the UE specific RRC signaling is a newly defined

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Claim Language		**Exemplary Citations to Xiong**
	newly defined RNTI other than at least a cell-RNTI (C-RNTI),	RNTI other than at least a cell-RNTI (C-RNTI). For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[d], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[e]	wherein the DL preemption indication information indicates preempted resource information in a prior slot, which precedes a slot in which the DL preemption indication information is transmitted,	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the DL preemption indication information indicates preempted resource information in a prior slot, which precedes a slot in which the DL preemption indication information is transmitted. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[b] and 1[e], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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Claim Language		**Exemplary Citations to Xiong**
		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[f]	wherein the specific RNTI is transmitted with information related to time and frequency, and	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the specific RNTI is transmitted with information related to time and frequency, and. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[f] and 1[g], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[g]	wherein the information related to time and frequency is transmitted for a reception of the DL preemption indication information by the first UE through the UE-specific RRC signaling.	At least under Pegasus's apparent infringement theory, Rudolf discloses wherein the information related to time and frequency is transmitted for a reception of the DL preemption indication information by the first UE through the UE-specific RRC signaling. For example, Rudolf discloses this limitation based on the following exemplary citations: *See* 1[f] and 1[g], *supra*. To the extent it is found that Rudolf does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Rudolf does not anticipate this claim, Rudolf renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other

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Claim Language		**Exemplary Citations to Xiong**
		prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Rudolf with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 6

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
6[a]	The method according to claim 5, wherein at least one of a subcarrier spacing and a time-domain scheduling unit of first radio resources allocated for the first UE are different from second radio resources allocated for a second UE.	At least under Pegasus's apparent infringement theory, Xiong discloses the method according to claim 5, wherein at least one of a subcarrier spacing and a time-domain scheduling unit of first radio resources allocated for the first UE are different from second radio resources allocated for a second UE. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 2[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 7

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
7[a]	The method according to claim 5, wherein the DL preemption indication information is transmitted through a common search space of the DL control channel.	At least under Pegasus's apparent infringement theory, Xiong discloses the method according to claim 5, wherein the DL preemption indication information is transmitted through a common search space of the DL control channel. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 3[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

7. Claim 9

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
9[pre]	A user equipment (UE) for receiving a downlink (DL) signal, the UE comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Xiong discloses A user equipment (UE) for receiving a downlink (DL) signal, the UE comprising. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[pre], *supra*.

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Claim Language		**Exemplary Citations to Xiong**
		To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	a receiver configured to receive a specific radio network temporary identifier (RNTI) for DL preemption indication information through a UE-specific radio resource control (RRC) signaling;	At least under Pegasus's apparent infringement theory, Xiong discloses a receiver configured to receive a specific radio network temporary identifier (RNTI) for DL preemption indication information through a UE-specific radio resource control (RRC) signaling. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	after reception of the specific RNTI, a controller configured	At least under Pegasus's apparent infringement theory, Xiong discloses after reception of the specific RNTI, a controller configured to monitor a DL control

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Claim Language		**Exemplary Citations to Xiong**
	to monitor a DL control channel for receiving the DL preemption indication information based on the received specific RNTI,	channel for receiving the DL preemption indication information based on the received specific RNTI. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[c]	wherein the receiver further configured to receive the DL preemption indication information through a multicast signal,	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the receiver further configured to receive the DL preemption indication information through a multicast signal. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 5[c], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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Claim Language		**Exemplary Citations to Xiong**
		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[d]	wherein the specific RNTI received through the UE specific RRC signaling is a newly defined RNTI other than at least a cell-RNTI (C-RNTI),	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the specific RNTI received through the UE specific RRC signaling is a newly defined RNTI other than at least a cell-RNTI (C-RNTI). For example, Xiong discloses this limitation based on the following exemplary citations: *See* 5[d], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[e]	wherein the DL preemption indication information indicates preempted resource information in a prior slot, which precedes a slot in which the DL preemption indication information is received,	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the DL preemption indication information indicates preempted resource information in a prior slot, which precedes a slot in which the DL preemption indication information is received. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 5[e], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the

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Claim Language		**Exemplary Citations to Xiong**
		knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[f]	wherein the specific RNTI is received with information related to time and frequency, and	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the specific RNTI is received with information related to time and frequency, and. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[b] and 1[f], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[g]	wherein the information related to time and frequency is received for the reception of the DL preemption indication information through the UE-specific RRC signaling.	At least under Pegasus's apparent infringement theory, Xiong discloses wherein the information related to time and frequency is received for the reception of the DL preemption indication information through the UE-specific RRC signaling. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 1[g], *supra*.

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Claim Language		**Exemplary Citations to Xiong**
		To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 10

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
10[a]	The UE according to claim 9, wherein at least one of a subcarrier spacing and a time-domain scheduling unit of first radio resources allocated for the UE are different from second radio resources allocated for another UE.	At least under Pegasus's apparent infringement theory, Xiong discloses the UE according to claim 9, wherein at least one of a subcarrier spacing and a time-domain scheduling unit of first radio resources allocated for the UE are different from second radio resources allocated for another UE. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 2[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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Claim Language		**Exemplary Citations to Xiong**
		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 11

Invalidity of U.S. Patent 8,554,196 in view of Xiong		
Claim Language		**Exemplary Citations to Xiong**
11[a]	The UE according to claim 9, wherein the DL preemption indication information is received through a common search space of the DL control channel.	At least under Pegasus's apparent infringement theory, Xiong discloses the UE according to claim 9, wherein the DL preemption indication information is received through a common search space of the DL control channel. For example, Xiong discloses this limitation based on the following exemplary citations: *See* 3[a], *supra*. To the extent it is found that Xiong does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Xiong does not anticipate this claim, Xiong renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Xiong with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT E-8

Summary of Invalidity Analysis of U.S. Patent No. 10,594,460 ("'460 Patent") in view of U.S. Patent Pub. US2020/0336269Al ("Shen")

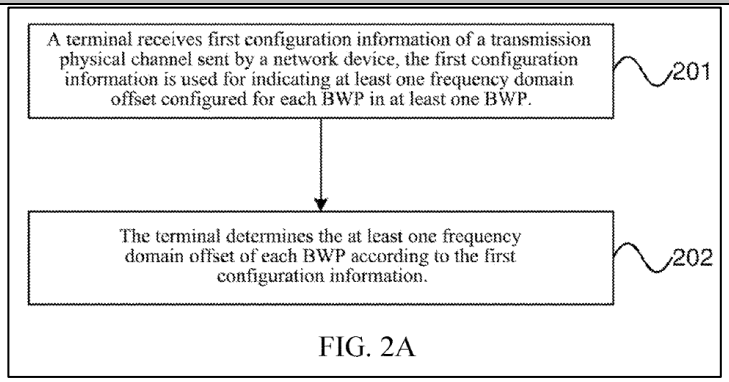
U.S. Patent Pub. US2020/0336269Al ("Shen") published on October 22, 2020 and is a continuation of application No. PCT CN2018/071932 filed on January 9, 2018, which published as WO 2019/136597A1 on July 18, 2019. WO 2019/136597A1 supports at least Claim 1 of Shen. By way of example only, at least the following disclosures of WO 2019/136597A1 are sufficient to support Claim 1 of Shen. *See, e.g.*, Figs. 1B, 1C, 2A, 2B, 4B and the paragraphs associated with these figures. Therefore, Shen qualifies as prior art to the '460 Patent under at least 35 U.S.C. § 102(a). Defendants reserve the right to identify additional support. As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '460 Patent are invalid as expressly and/or inherently anticipated by Shen.

To the extent that Shen is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '460 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Shen in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Amended Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Shen and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

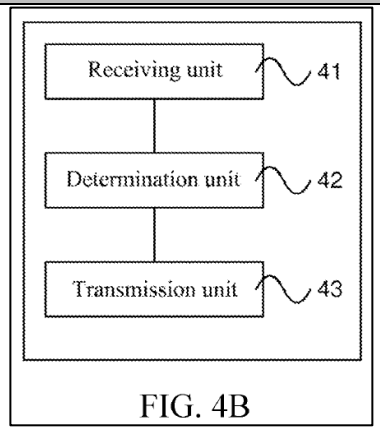
Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
1[pre]	A method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS), the method comprising	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Shen discloses a method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS). For example, Shen discloses this limitation based on the following exemplary citations: **[0002]** The present disclosure relates to wireless access technology, in particular to a method for frequency hopping configuration of Bandwidth Part (BWP), a network device and a terminal. **[0003]** In a New Radio (NR) system such as a 5G application scenario, a physical channel may adopt frequency hopping technology to obtain a frequency selective gain and improve transmission performance of the physical channel. After a concept of Bandwidth Part (BWP) is introduced, since a terminal may be configured with multiple BWPs, a frequency domain offset of a physical channel may be uniformly configured according to the BWP with the minimum bandwidth to realize the frequency hopping of the physical channel in each BWP. **[0028]** The main idea of the present disclosure is to configure different frequency domain offset sets for different BWPs and make full use of the bandwidth of each BWP, so that the frequency hopping offset can be maximized on the basis of not exceeding the bandwidth of the BWP to obtain a greater frequency selective gain, thereby improving the transmission performance of a physical channel.

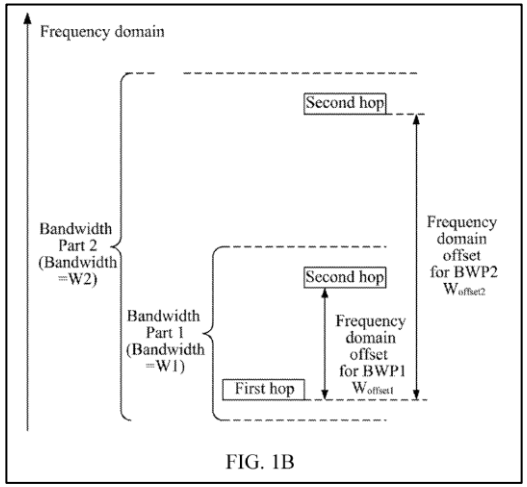
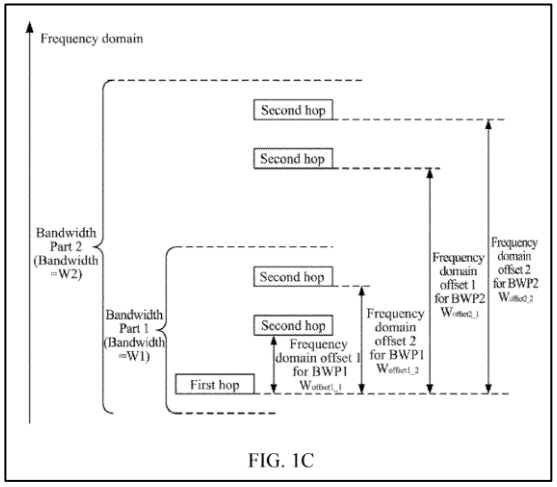
Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
		 FIG. 2A Shen, Fig. 2A. **[0062]** In 201, a terminal receives first configuration information of a transmission physical channel sent by a network device, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. **[0063]** In 202, the terminal determines the at least one frequency domain offset for each BWP according to the first configuration information. **[0064]** The frequency domain offset refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB). **[0065]** Optionally, in a possible implementation mode of this implementation, the physical channel may include, but is not limited to, at least one of a Physical Uplink Shared Channel (PUSCH), a Physical Downlink Shared Channel (PDSCH), a Physical Uplink Control Channel (PUCCH), and a Physical Downlink Control Channel (PDCCH). To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate

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		this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE;	At least under Pegasus's apparent infringement theory, Shen discloses receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE. For example, Shen discloses this limitation based on the following exemplary citations: **[0036]** In the present disclosure, the network device may further send second configuration information to the terminal for indicating to configure the at least one BWP. After receiving the second configuration information, the terminal may determine a position of each BWP in the at least one BWP. **[0052]** FIG. 1B is a diagram of a frequency domain offset configuration provided by the implementation according to FIG. 1A. As shown in FIG. 1B, it is assumed that two BWPs, namely BWP1 and BWP2, are configured for the terminal. The bandwidth of BWP1 is W1, the bandwidth of BWP2 is W2, the frequency domain offset $W_{offset1}$ is configured for BWP1, and the frequency domain offset $W_{offset2}$ is configured for BWP2. **[0055]** FIG. 1C is another frequency domain offset configuration diagram provided by the implementation according to FIG. 1A. As shown in FIG. 1C, it is assumed that two BWPs, namely BWP1 and BWP2, are configured for the terminal, the bandwidth of BWP1 is W1, and the bandwidth of BWP2 is W2. Two frequency domain offsets,

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		namely $W_{offset1\_1}$ and $W_{offset1\_2}$, are configured for BWP1, and two frequency domain offsets, namely $W_{offset2\_1}$ and $W_{offset2\_2}$, are configured for BWP2. **[0069]** In the present disclosure, the terminal may further receive the second configuration information sent by the network device, for indicating to configure the at least one BWP, and further, the position of each BWP in the at least one BWP may be determined. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	receiving, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and	At least under Pegasus's apparent infringement theory, Shen discloses receiving, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set. For example, Shen discloses this limitation based on the following exemplary citations: **[0062]** In 201, a terminal receives first configuration information of a transmission physical channel sent by a network device, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. **[0063]** In 202, the terminal determines the at least one frequency domain offset for each BWP according to the first configuration information.

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Claim Language		**Exemplary Citations to Shen**
		[0064] The frequency domain offset refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB). **[0065]** Optionally, in a possible implementation mode of this implementation, the physical channel may include, but is not limited to, at least one of a Physical Uplink Shared Channel (PUSCH), a Physical Downlink Shared Channel (PDSCH), a Physical Uplink Control Channel (PUCCH), and a Physical Downlink Control Channel (PDCCH). *See also* Shen at [0002-0004], [0031], [0033-34], [0061], [0089], [0102], Fig. 2A. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Shen discloses transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Shen discloses this limitation based on the following exemplary citations:

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		 FIG. 4B Shen, Fig. 4B. **[0111]** Optionally, in a possible implementation mode of this implementation, as shown in FIG. 4B, the terminal provided by this implementation may further include a transmission unit 43, which may be configured to determine a position of the second frequency domain resource for transmitting the physical channel in the activated BWP by using the formula $R2=(R1+W_{offset})\text{mod } W$ according to the bandwidth for the activated BWP, the frequency domain offset used and the position of the first frequency domain resource for transmitting the physical channel in the activated BWP; wherein R2 is the position of the second frequency domain resource in the activated BWP, R1 is the position of the first frequency domain resource in the activated BWP, W_{offset} is the frequency domain offset used, W is the bandwidth for the activated BWP; and transmit the physical channel with the network device on the first frequency domain resource and the second frequency domain resource. *See also* Shen at [0065]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of

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		a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Shen discloses wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Shen discloses this limitation based on the following exemplary citations:  FIG. 1B  FIG. 1C Shen, Figs. 1B, 1C. **[0051]** In order to make the method provided by an implementation of the present disclosure clearer, configuring one frequency domain offset and configuring two

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		different frequency domain offset sets for different BWPs are taken as examples respectively in the following. **[0052]** FIG. 1B is a diagram of a frequency domain offset configuration provided by the implementation according to FIG. 1A. As shown in FIG. 1B, it is assumed that two BWPs, namely BWP1 and BWP2, are configured for the terminal. The bandwidth of BWP1 is W1, the bandwidth of BWP2 is W2, the frequency domain offset $W_{offset1}$ is configured for BWP1, and the frequency domain offset $W_{offset2}$ is configured for BWP2. **[0055]** FIG. 1C is another frequency domain offset configuration diagram provided by the implementation according to FIG. 1A. As shown in FIG. 1C, it is assumed that two BWPs, namely BWP1 and BWP2, are configured for the terminal, the bandwidth of BWP1 is W1, and the bandwidth of BWP2 is W2. Two frequency domain offsets, namely $W_{offset1\_1}$ and $W_{offset1\_2}$, are configured for BWP1, and two frequency domain offsets, namely $W_{offset2\_1}$ and $W_{offset2\_2}$, are configured for BWP2. **[0062]** In 201, a terminal receives first configuration information of a transmission physical channel sent by a network device, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same

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		field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Shen discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Shen discloses this limitation based on the following exemplary citations: **[0076]** Optionally, in a possible implementation mode of this implementation, as shown in FIG. 2B, after 201, 204 may be further performed, the terminal receives second control information sent by the network device, the second control information is for indicating, in the at least one frequency domain offset, a frequency domain offset used. In this way, the terminal may determine a frequency domain offset used for the activated BWP. **[0077]** Specifically, the terminal may specifically receive the second control information sent by the network device through downlink control information or high-level signaling. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 2

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2	The method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	At least under Pegasus's apparent infringement theory, Shen discloses the method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Shen discloses this limitation based on the following exemplary citations: **[0028]** The main idea of the present disclosure is to configure different frequency domain offset sets for different BWPs and make full use of the bandwidth of each BWP, so that the frequency hopping offset can be maximized on the basis of not exceeding the bandwidth of the BWP to obtain a greater frequency selective gain, thereby improving the transmission performance of a physical channel. **[0030]** In 101, a network device sends first configuration information of a transmission physical channel to a terminal, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. **[0031]** The frequency domain offset refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB). **[0060]** In this implementation, the first configuration information of a transmission physical channel is sent to a terminal through a network device, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP respectively, so that different frequency domain offset sets are configured for different BWPs, and the bandwidth of each BWP is fully utilized, thus the frequency hopping offset can be maximized on the basis of not

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		exceeding the bandwidth of the BWP to obtain a greater frequency selective gain, thereby improving the transmission performance of the physical channel. **[0062]** In 201, a terminal receives first configuration information of a transmission physical channel sent by a network device, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. **[0064]** The frequency domain offset refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB). *See also* Shen [0037-0038]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

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Claim Language		**Exemplary Citations to Shen**
3	The method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.	At least under Pegasus's apparent infringement theory, Shen discloses the method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP. For example, Shen discloses this limitation based on the following exemplary citations: **[0030]** In 101, a network device sends first configuration information of a transmission physical channel to a terminal, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. **[0031]** The frequency domain offset refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB). **[0032]** Optionally, in a possible implementation mode of this implementation, the physical channel may include, but is not limited to, at least one of a Physical Uplink Shared Channel (PUSCH), a Physical Downlink Shared Channel (PDSCH), a Physical Uplink Control Channel (PUCCH), and a Physical Downlink Control Channel (PDCCH). **[0062]** In 201, a terminal receives first configuration information of a transmission physical channel sent by a network device, the first configuration information is used for indicating at least one frequency domain offset configured for each BWP in at least one BWP. **[0064]** The frequency domain offset refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB). *See also* Shen at [0003], [0028], [0037-0038].

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Claim Language		**Exemplary Citations to Shen**
		To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

4. Claim 4

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Claim Language		**Exemplary Citations to Shen**
4	The method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Shen discloses the method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 1 and 3 above. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art

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Claim Language		**Exemplary Citations to Shen**
		references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 5

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Claim Language		**Exemplary Citations to Shen**
5[pre]	A method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Shen discloses a method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE). For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[a]	transmitting bandwidth part (BWP) configuration information	At least under Pegasus's apparent infringement theory, Shen discloses transmitting bandwidth part (BWP) configuration information of a BWP set composed of one or

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Claim Language		**Exemplary Citations to Shen**
	of a BWP set composed of one or more BWPs configured for a UE to the UE;	more BWPs configured for a UE to the UE. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[a]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[b]	transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE; and	At least under Pegasus's apparent infringement theory, Shen discloses transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[b]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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5[c]	receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Shen discloses receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[d]	wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Shen discloses wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[d]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art

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Claim Language		**Exemplary Citations to Shen**
		references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[e]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Shen discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[e]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 6

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Claim Language		**Exemplary Citations to Shen**
6	The method of claim 5, wherein the frequency hopping configuration information for a	At least under Pegasus's apparent infringement theory, Shen discloses the method of claim 5, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency

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Claim Language		**Exemplary Citations to Shen**
	UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

7. Claim 7

Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
7	The method of claim 5, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP.	At least under Pegasus's apparent infringement theory, Shen discloses the method of claim 5, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 3.

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Claim Language		**Exemplary Citations to Shen**
		To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 8

Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
8	The method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Shen discloses the method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art

Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
		references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 9

Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
9[pre]	A user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS), the UE comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Shen discloses a user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS). For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	a receiver configured to receive, from a BS, bandwidth part (BWP)	At least under Pegasus's apparent infringement theory, Shen discloses a receiver configured to receive, from a BS, bandwidth part (BWP) configuration information of

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Claim Language		**Exemplary Citations to Shen**
	configuration information of a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and	a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitations 1[a] and 1[b]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Shen discloses a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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Claim Language		**Exemplary Citations to Shen**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[c]	wherein the frequency hopping configuration information for UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Shen discloses wherein the frequency hopping configuration information for UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[d]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[d]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Shen discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Shen discloses this limitation based on the following exemplary citations: *See* limitation 1[e]. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art

Invalidity of U.S. Patent No. 10,594,460 in view of Shen		
Claim Language		**Exemplary Citations to Shen**
		references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

10. Claim 10

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Claim Language		**Exemplary Citations to Shen**
10	The UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	At least under Pegasus's apparent infringement theory, Shen discloses the UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same

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Claim Language		**Exemplary Citations to Shen**
		field of endeavor to address the same known problems, according to known methods which would yield predictable results.

11. Claim 11

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Claim Language		**Exemplary Citations to Shen**
11	The UE of claim 9, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.	At least under Pegasus's apparent infringement theory, Shen discloses the UE of claim 9, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

12. Claim 12

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Claim Language		**Exemplary Citations to Shen**
12	The UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Shen discloses the UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, Shen discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that Shen does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Shen does not anticipate this claim, Shen renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Shen with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT E-9

Summary of Invalidity Analysis of U.S. Patent No. 10,594,460 ("'460 Patent") in view of U.S. Patent Pub. US2020/0389204 ("Matsumura")

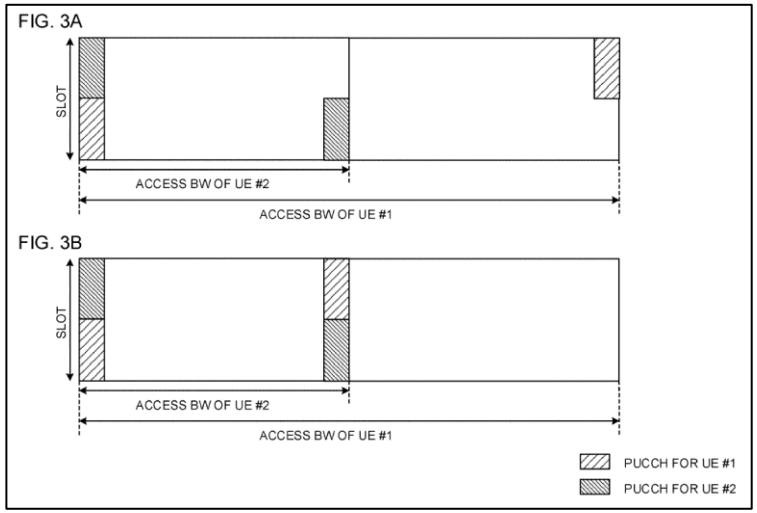
U.S. Patent Pub. US2020/0389204 ("Matsumura") published on December 10, 2020 and claims priority to PCT/JP2017/041378 filed on November 16, 2017, which published as WO 2019/097659A1 on May 23, 2019. WO 2019/097659A1 supports at least Claim 7 of Matsumura. By way of example only, at least the following disclosures of WO 2019/097659A1 are sufficient to support Claim 7 of Matsumura. *See, e.g.*, Figs. 1-8, 18, and the paragraphs associated with these figures. Therefore, Matsumura qualifies as prior art to the '460 Patent under at least 35 U.S.C. § 102(a). Defendants reserve the right to identify additional support. As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '460 Patent are invalid as expressly and/or inherently anticipated by Matsumura.

To the extent that Matsumura is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '460 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Matsumura in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Amended Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Matsumura and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

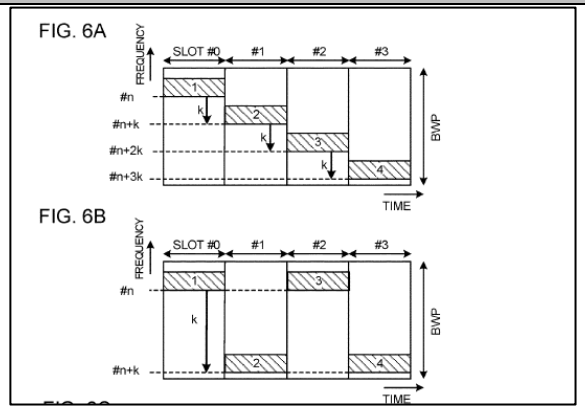
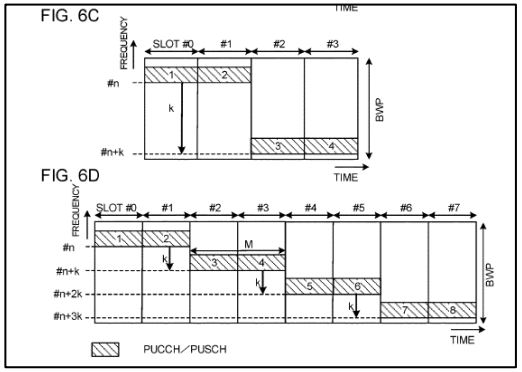
1. Claim 1

Invalidity of U.S. Patent No. 10,594,460 in view of Matsumura		
Claim Language		**Exemplary Citations to Matsumura**
1[pre]	A method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS), the method comprising	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Matsumura discloses a method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS). For example, Matsumura discloses this limitation based on the following exemplary citations: **[0006]** It has been studied for future radio communication systems (e.g., LTE Rel. 14 and 15~, 5G and NR) to introduce an uplink channel and/or an uplink signal (uplink channel/signal) (e.g., at least one of, for example, an uplink control channel (PUCCH), an uplink data channel (PUSCH) and a Sounding Reference Signal (SRS)) over a plurality of slots. Furthermore, it has been studied to apply frequency hopping (inter-slot frequency hopping) for hopping frequency resources on which the uplink channel/signal are mapped between a plurality of these slots. **[0010]** One aspect of a user terminal according to the present invention includes: a transmission section that transmits an uplink data channel over a plurality of slots; and a control section that controls frequency hopping of the uplink data channel between the plurality of slots. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

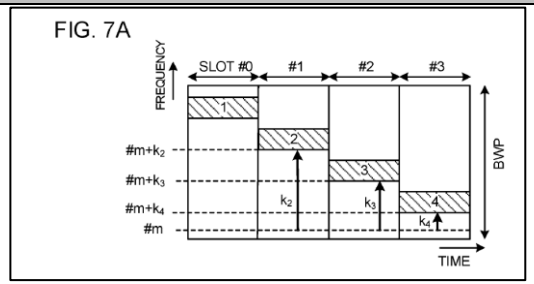
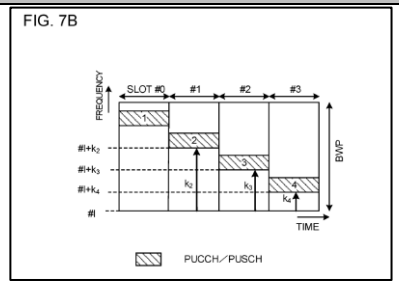
Invalidity of U.S. Patent No. 10,594,460 in view of Matsumura		
Claim Language		**Exemplary Citations to Matsumura**
1[a]	receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE;	At least under Pegasus's apparent infringement theory, Matsumura discloses receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE. For example, Matsumura discloses this limitation based on the following exemplary citations:  Matsumura, Figs. 3A, 3B. **[0048]** FIG. 3 is a diagram illustrating one example of intra-slot frequency hopping of a PUCCH (e.g., long PUCCH). In addition, FIGS. 3A and 3B exemplify the long PUCCH as one example of the PUCCH. However, intra-slot frequency hopping can be enabled likewise for other uplink channels/signals such as a short PUCCH, a PUSCH and an SRS, too. **[0049]** As illustrated in FIGS. 3A and 3B, the above future radio communication system may configure an accessible bandwidth (access Bandwidth (BW)) per user terminal. In this regard, the access BW may be referred to as, for example, a carrier (a

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Claim Language		**Exemplary Citations to Matsumura**
		Component Carrier (CC) or a system band), or a partial frequency band ((partial band) or a Bandwidth Part (BWP)) in the carrier. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	receiving, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and	At least under Pegasus's apparent infringement theory, Matsumura discloses receiving, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set. For example, Matsumura discloses this limitation based on the following exemplary citations: **[0008]** Thus, it is preferred that the future radio communication system in which different access BWs can be configured to a plurality of user terminals appropriately controls an inter-slot frequency hopping pattern (e.g., a position and/or a hopping timing (hopping boundary) of each frequency resource to be hopped) of an uplink channel/signal. **[0059]** When inter-slot frequency hopping is enabled for the PUCCH/PUSCH over a plurality of slots, frequency resources on which the PUCCH/PUSCH are mapped may be hopped per given number of slots. A number of slots (the number of hopping slots) M that the frequency resources of the PUCCH/PUSCH hop may be determined based on the number of slots to which the PUCCH/PUSCH are allocated, or may be indicated by a higher layer signaling and/or DCI.

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Claim Language		**Exemplary Citations to Matsumura**
		[0067] According to the first aspect, when inter-slot frequency hopping is enabled for the PUCCH/PUSCH over a plurality of slots, information (frequency resource information) related to the frequency resources on which the PUCCH/PUSCH are mapped may be notified from a radio base station to the user terminal. **[0068]** In this regard, the frequency resource information may include information indicating an index (e.g., an index of a PRB and/or a Resource Element (RE) (PRB/RE)) of a specific frequency resource (e.g., a (starting) frequency resource of a first hop)), and information related to other frequency resources (e.g., frequency resources of second and subsequent hops). The information related to the other frequency resources may be, for example, information (frequency offset information) indicating a given frequency offset, or may be information indicating indices of the other frequency resources. **[0069]** FIG. 6 is a diagram illustrating one example of a frequency offset in a case where inter-slot frequency hopping is enabled according to the first aspect. FIGS. 6A to 6D exemplify a case where inter-slot frequency hopping is enabled in a BWP configured to the user terminal. A bandwidth for which the inter-slot frequency hopping is enabled is not limited to the BWP, and may be an access BW of the user terminal.

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Claim Language		**Exemplary Citations to Matsumura**
		  Matsumura, Figs. 6A-6D. *See also*, Matsumura [0275-0276]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency	At least under Pegasus's apparent infringement theory, Matsumura discloses transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Matsumura discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Matsumura**
	hopping configuration information,	**[0010]** One aspect of a user terminal according to the present invention includes: a transmission section that transmits an uplink data channel over a plurality of slots; and a control section that controls frequency hopping of the uplink data channel between the plurality of slots. **[0051]** Furthermore, it has been also studied for the above future radio communication system to make it possible to transmit UCI by using the long PUCCH over a plurality of slots. FIG. 4 is a diagram illustrating one example of the long PUCCH over a plurality of slots. In addition, FIG. 4 exemplifies the long PUCCH. However, other uplink channels/signals such as a PUSCH and an SRS are applicable likewise. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Matsumura discloses wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Matsumura discloses this limitation based on the following exemplary citations:

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Claim Language	**Exemplary Citations to Matsumura**
	  Matsumura, Figs. 7A, 7B. **[0079]** In FIG. 7A, frequency offset information indicating a frequency offset ki of an ith (i=2 to 4 in FIG. 7A) from an index #m of a frequency resource that serves as a reference (reference frequency resource) is notified from the radio base station to the user terminal. Information indicating the index #m may be notified (configured) to the user terminal by a higher layer signaling. In FIG. 7A, based on the index #m of the reference frequency resource and the frequency offset k_i (k_i=integer) of the ith hop, the user terminal may determine an index #m+k_i (e.g., a minimum PRB index or RE index) of the frequency resource of the ith hop. **[0080]** In FIG. 7B, the frequency offset information indicating the frequency offset ki of the ith (i=2 to 4 in FIG. 7B) from an index #1 (e.g., a PRB or RE index) of an edge of an access BW (a BWP in this case) of the user terminal is notified from the radio base station to the user terminal. The index #1 may be an index (e.g., the PRB index or the RE index) of an edge of the access BW on a side opposite to the frequency resource of the first hop. **[0085]** According to the first aspect, when inter-slot frequency hopping is enabled for a PUCCH/PUSCH, frequency resource information (e.g., the information indicating the frequency offset k illustrated in FIG. 6A to 6D, 7A or 7B) is notified from the radio

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Claim Language		**Exemplary Citations to Matsumura**
		base station to the user terminal, so that the user terminal can appropriately control an inter-slot frequency hopping pattern based on the frequency resource information. **[0098]** Furthermore, even when intra-slot frequency hopping is enabled for a PUCCH/PUSCH over a plurality of slots, enabling of intra-slot frequency hopping in a certain slot may be controlled based on the number of available symbols (e.g., the number of UL symbols) in the certain slot. When, for example, the number of available symbols in the certain slot is smaller than a given threshold X, enabling of intra-slot frequency hopping for the slot may be turned off. In addition, X may be, for example, 7 or 4. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Matsumura discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Matsumura discloses this limitation based on the following exemplary citations:

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Claim Language	**Exemplary Citations to Matsumura**

FIG. 12A

GIVEN FIELD VALUE IN DCI	PUCCH RESOURCE SET
00	PUCCH RESOURCE SET #0
01	PUCCH RESOURCE SET #1
10	PUCCH RESOURCE SET #2
11	PUCCH RESOURCE SET #3

FIG. 12B

PARAMETER GROUP INCLUDED IN EACH PUCCH RESOURCE SET

START SYMBOL
NUMBER OF SYMBOLS IN SLOT
INDEX FOR IDENTIFYING FREQUENCY RESOURCE OF FIRST HOP
NUMBER OF PRBS
WHETHER FREQUENCY HOPPING IS ENABLED OR IS NOT ENABLED
INFORMATION RELATED TO FREQUENCY RESOURCES OF SECOND AND SUBSEQUENT HOPS
FREQUENCY HOPPING MODE FOR A PLURALITY OF SLOTS

Matsumura, Figs. 12A, 12B.

[0117] The fourth aspect will describe in detail a signaling in a case where inter-slot frequency hopping is enabled for a PUCCH.

[0118] A plurality of sets (PUCCH resource sets or parameter sets) each including one or more parameters related to a resource for a PUCCH (PUCCH resource) is configured (notified from a radio base station) to a user terminal in advance by a higher layer signaling. One of a plurality of these PUCCH resource sets is indicated by using a given field in Downlink Control Information (DCI). The user terminal controls transmission of the PUCCH based on the PUCCH resource set indicated by the given field value in the DCI.

[0119] When inter-slot frequency hopping is enabled for the PUCCH, each PUCCH resource set configured by the higher layer signaling may include frequency resource information described in, for example, the first aspect.

[0120] FIG. 12 is a diagram illustrating one example of PUCCH resource sets according to the fourth aspect. As illustrated in FIG. 12A, each value of a given field of DCI indicates a PUCCH resource set. In, for example, FIG. 12A, the given field values "00", "01", "10" and "11" indicate PUCCH resource sets #0, #1, #2 and #3, respectively.

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Claim Language		**Exemplary Citations to Matsumura**
		[0121] As illustrated in FIG. 12B, each PUCCH resource set may include at least one of following parameters. **[0122]** Information indicating a start symbol of a PUCCH **[0123]** Information indicating the number of symbols of the PUCCH in a slot **[0124]** Information (e.g., a start PRB index) for identifying a frequency resource (e.g., start PRB) of a first hop of the PUCCH **[0125]** Information indicating the number of resource units (e.g., the number of PRBs) that compose the frequency resources of the PUCCH **[0126]** Information indicating whether frequency hopping is enabled or is not enabled (turned on or turned off) **[0127]** Information related to frequency resources of second and subsequent hops in a case where frequency hopping is enabled (the information may be, for example, information indicating the frequency offset illustrated in FIGS. 4A to 4C or information indicating an index of each frequency resource of the second and subsequent hops) **[0128]** Information (information indicating a frequency hopping mode) indicating which one of intra-slot frequency hopping and inter-slot frequency hopping is enabled for the PUSCH over a plurality of slots. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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Claim Language		**Exemplary Citations to Matsumura**
		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 2

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Claim Language		**Exemplary Citations to Matsumura**
2	The method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	At least under Pegasus's apparent infringement theory, Matsumura discloses the method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Matsumura discloses this limitation based on the following exemplary citations: **[0068]** In this regard, the frequency resource information may include information indicating an index (e.g., an index of a PRB and/or a Resource Element (RE) (PRB/RE)) of a specific frequency resource (e.g., a (starting) frequency resource of a first hop)), and information related to other frequency resources (e.g., frequency resources of second and subsequent hops). The information related to the other frequency resources may be, for example, information (frequency offset information) indicating a given frequency offset, or may be information indicating indices of the other frequency resources. *See* also Matsumara [0059], [0069], [0085], [0118-0127] and claim 1 above. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not

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		anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

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Claim Language		**Exemplary Citations to Matsumura**
3	The method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.	At least under Pegasus's apparent infringement theory, Matsumura discloses the method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP. For example, Matsumura discloses this limitation based on the following exemplary citations: **[0062]** In addition, in FIG. 5A, a bandwidth of the frequency resource of each hop may be calculated based on a BWP and the number of slots of the PUCCH/PUSCH. In addition, in FIG. 5B, a bandwidth between the frequency resources of each hop may be calculated based on a BWP (by, for example, multiplying the BWP with a given coefficient). **[0084]** Thus, when the index of the frequency resource of the ith hop is not included in the access BW (e.g., BWP) configured to the user terminal, the ith frequency resource

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Claim Language		**Exemplary Citations to Matsumura**
		may be determined based on a surplus of the index and a resource unit (e.g., the number of PRBs or the number of REs) in the BWP. *See* also Matsumara [0059-0062], [0137], and claim 1 above. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

4. Claim 4

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Claim Language		**Exemplary Citations to Matsumura**
4	The method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether	At least under Pegasus's apparent infringement theory, Matsumura discloses the method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For

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Claim Language		**Exemplary Citations to Matsumura**
	the number of PRBs constituting the transmission BWP is a preset threshold value or less.	example, Matsumura discloses this limitation based on the following exemplary citations: **[0098]** Furthermore, even when intra-slot frequency hopping is enabled for a PUCCH/PUSCH over a plurality of slots, enabling of intra-slot frequency hopping in a certain slot may be controlled based on the number of available symbols (e.g., the number of UL symbols) in the certain slot. When, for example, the number of available symbols in the certain slot is smaller than a given threshold X, enabling of intra-slot frequency hopping for the slot may be turned off. In addition, X may be, for example, 7 or 4. **[0156]** Furthermore, the number of bits Z indicating (b) the information related to the frequency resources of the second and subsequent hops and (c) the allocation information of the frequency resources to the PUSCH may be a fixed value, or may be a value derived based on a bandwidth S of the access BW of the user terminal (e.g., UL BWP) or a total bandwidth S subjected to frequency hopping. When, for example, the bandwidth S of the access BW or the total bandwidth S to be subjected to frequency hopping is a given threshold or less, Z=1 bit may hold, and, when the bandwidth S is larger than the given threshold, Z=2 bits may hold. *See* also Matsumara [0059], [0068-0069], [0085], and claim 1 above. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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Claim Language		**Exemplary Citations to Matsumura**
		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 5

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Claim Language		**Exemplary Citations to Matsumura**
5[pre]	A method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Matsumura discloses a method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE). For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[a]	transmitting bandwidth part (BWP) configuration information of a BWP set composed of one or	At least under Pegasus's apparent infringement theory, Matsumura discloses transmitting bandwidth part (BWP) configuration information of a BWP set composed

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Claim Language		**Exemplary Citations to Matsumura**
	more BWPs configured for a UE to the UE;	of one or more BWPs configured for a UE to the UE. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[a]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[b]	transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE; and	At least under Pegasus's apparent infringement theory, Matsumura discloses transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[b]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements

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Claim Language		**Exemplary Citations to Matsumura**
		within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[c]	receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Matsumura discloses receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[d]	wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Matsumura discloses wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[d]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other

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Claim Language		**Exemplary Citations to Matsumura**
		prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[e]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Matsumura discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[e]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 6

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Claim Language		**Exemplary Citations to Matsumura**
6	The method of claim 5, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	At least under Pegasus's apparent infringement theory, Matsumura discloses the method of claim 5, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

7. Claim 7

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Claim Language		**Exemplary Citations to Matsumura**
7	The method of claim 5, wherein a number of frequency hopping	At least under Pegasus's apparent infringement theory, Matsumura discloses the method of claim 5, wherein a number of frequency hopping offset values included in

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Claim Language		**Exemplary Citations to Matsumura**
	offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP.	the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 8

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Claim Language		**Exemplary Citations to Matsumura**
8	The method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Matsumura discloses the method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* claim 4.

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Claim Language		**Exemplary Citations to Matsumura**
		To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 9

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Claim Language		**Exemplary Citations to Matsumura**
9[pre]	A user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS), the UE comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Matsumura discloses a user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS). For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other

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		prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	a receiver configured to receive, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and	At least under Pegasus's apparent infringement theory, Matsumura discloses a receiver configured to receive, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitations 1[a] and 1[b]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency	At least under Pegasus's apparent infringement theory, Matsumura discloses a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[c].

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	hopping configuration information,	To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[c]	wherein the frequency hopping configuration information for UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Matsumura discloses wherein the frequency hopping configuration information for UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[d]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[d]	wherein a frequency hopping offset value used to transmit the UL data channel among the	At least under Pegasus's apparent infringement theory, Matsumura discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is

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Claim Language		**Exemplary Citations to Matsumura**
	frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	indicated by UL grant downlink control information (DCI). For example, Matsumura discloses this limitation based on the following exemplary citations: *See* limitation 1[e]. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

10. Claim 10

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Claim Language		**Exemplary Citations to Matsumura**
10	The UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the	At least under Pegasus's apparent infringement theory, Matsumura discloses the UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* claim 2.

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Claim Language		**Exemplary Citations to Matsumura**
	UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

11. Claim 11

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Claim Language		**Exemplary Citations to Matsumura**
11	The UE of claim 9, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.	At least under Pegasus's apparent infringement theory, Matsumura discloses the UE of claim 9, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other

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Claim Language		**Exemplary Citations to Matsumura**
		prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

12. Claim 12

Invalidity of U.S. Patent No. 10,594,460 in view of Matsumura		
Claim Language		**Exemplary Citations to Matsumura**
12	The UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Matsumura discloses the UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, Matsumura discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that Matsumura does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Matsumura does not anticipate this claim, Matsumura renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Matsumura with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT E-10

Summary of Invalidity Analysis of U.S. Patent No. 10,594,460 ("'460 Patent") in view of Zhang

WO 2018/203727 A1 ("Zhang") was published on November 8, 2018 and claims priority to PCT KR2018/005223 filed on May 4, 2018. Zhang also claims priority to six earlier filed foreign applications: CN201810339204 (2018-04-16); CN201810291338 (2018-04-03); CN201710911763 (2017-09-29); CN201710488133 (2017-06-23); CN201710365873 (2017-05-19); and, CN201710313543 (2017-05-05). Therefore, Zhang qualifies as prior art to the '460 Patent under 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '460 Patent are invalid as expressly and/or inherently anticipated by Zhang.

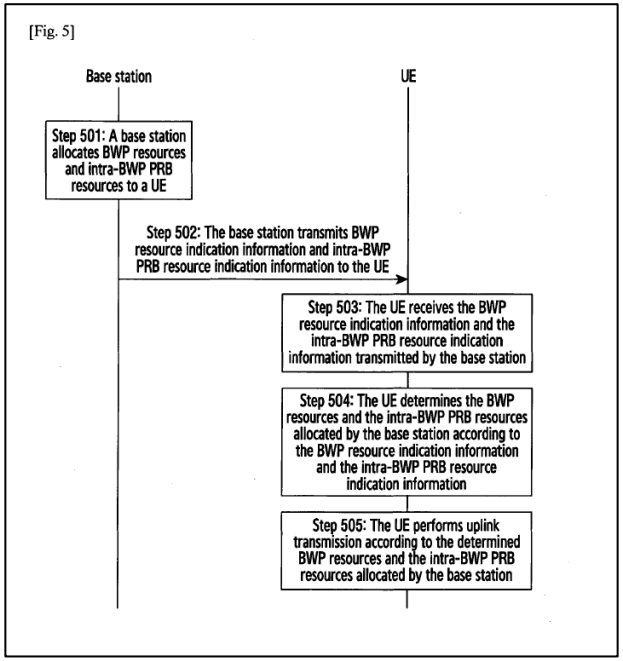
To the extent that Zhang is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '460 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Zhang in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Amended Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Zhang and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
1[pre]	A method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS), the method comprising	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Zhang discloses a method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS). For example, Zhang discloses this limitation based on the following exemplary citations: **(57) Abstract:** The present disclosure relates to a pre-5th-Generation (5G) or 5G communication system to be provided for supporting higher data rates Beyond 4th-Generation (4G) communication system such as Long Term Evolution (LTE). An embodiment of the present disclosure provides a base station, a user equipment (UE), and a method for uplink resource allocation and a method for uplink transmission, which are applied in the field of communication technologies. The method includes that: a base station allocates Bandwidth Part (BWP) resources and intra-BWP Physical Resource Block (PRB) resources to a UE, and then transmits BWP resource indication information and intra-BWP PRB resource indication information to the UE. The BWP resource indication information is used for indicating the BWP resources allocated by the base station to the UE. The intra-BWP PRB resource indication information is used for indicating the intra-BWP PRB resources allocated by the base station, and then the UE receives the BWP resource indication information and the intra-BWP PRB resource indication information transmitted by the base station, and then determines the BWP resources and the intra-BWP PRB resources allocated by the base station according to the BWP resource indication information and the intra-BWP PRB resource indication information so as to perform uplink transmission. **[20]** According to still another aspect, an embodiment of the present disclosure further provides a UE, including: **[21]** a receiving module, configured to receive the BWP resource indication information transmitted by the base station and intra-BWP PRB resource indication information; and

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		[22] a transmitting module, configured to determine BWP resources allocated by the base station and intra-BWP PRB resources according to the BWP resource indication information received by the receiving module and the intra-BWP PRB resource indication information and performs uplink transmission. **[550]** According to the embodiment of the present application, the eMTC UE is scheduled to transmit UL data on an Msg3 PUSCH, the base station provides multiple possible TBSs in the RAR grant for the UE to select, and the UE will select one TBS value which most closely matches with the data size in the MAC buffer to transmit Msg3, so that the number of the padding bits in the MAC PDU is reduced as much as possible. It is assumed that the base station will perform blindly decoding on the Msg3 based on the multiple possible TBS values. The maximal number of times for blindly decoding is the same as the number of the provided multiple possible TBSs. **[572]** In one embodiment, an eNB provides Msg3 with multiple possible TBSs for the UE to select, the UE selects an appropriate TBS value according to the actual data size, and the TBS value used for the actual transmission of Msg3 is transmitted through a PUCCH and is transmitted to the base station before transmitting Msg3, so the eNB can detect the TBS value used for the actual transmission of Msg3 and decode the Msg3 based on the TBS value, thereby avoiding blind decoding on Msg3 based on the hypothesis that there are multiple TBSs. The specific steps of the embodiment are shown in Fig. 26. **[645]** The method for uplink resources allocation provided in the embodiments of the present disclosure can be applied to a situation in which full bandwidth needs to be divided in a future radio communication system, and a resource allocation requirement that meets a diversity of needs is provided, and the complexity and the system overhead are relatively low, so that the user can perform more efficient uplink transmission and to provide users with a better access experience.

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		 Fig. 5. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE;	At least under Pegasus's apparent infringement theory, Zhang discloses receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE. For example, Zhang discloses this limitation based on the following exemplary citations: **[10]** An embodiment of the present disclosure provides, according to one aspect, a method for uplink resource allocation, which is executed by a base station and includes the following steps of: **[11]** allocating BWP resources within the whole bandwidth and intra-BWP PRB resources to a UE; and **[12]** transmitting BWP resource indication information and intra-BWP PRB resource indication information to the UE, wherein, the BWP resource indication information is used for indicating the BWP resources that is allocated by the base station to the UE, and the intra-BWP PRB resource indication information is used for indicating the intra-BWP PRB resources which is allocated by the base station to the UE. **[20]** According to still another aspect, an embodiment of the present disclosure further provides a UE, including: **[21]** a receiving module, configured to receive the BWP resource indication information transmitted by the base station and intra-BWP PRB resource indication information; and **[22]** a transmitting module, configured to determine BWP resources allocated by the base station and intra-BWP PRB resources according to the BWP resource indication information received by the receiving module and the intra-BWP PRB resource indication information and performs uplink transmission. **[56]** The present disclosure provides a base station, a UE, a method for uplink resource allocation, and a method for uplink transmission. Compared with the prior art, in the

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		embodiment of the present disclosure, a base station allocates BWP resources and intra-BWP PRB resources to a UE, the base station then transmits the BWP resource indication information and the intra-BWP PRB resource indication information to the UE. The BWP resource indication information is used for indicating the BWP resources allocated by the base station to the UE. The intra-BWP PRB resource indication information is used for indicating the intra-BWP PRB resources allocated by the base station, and then the UE receives the BWP resource indication information and the intra-BWP PRB resource indication information transmitted by the base station, and then determines the BWP resources and the intra-BWP PRB resources allocated by the base station according to the BWP resource indication information and the intra-BWP PRB resource indication information so as to perform uplink transmission. That is, a new method for uplink resource allocation is designed to be applied to BWP -based bandwidth allocation for future radio communication systems. **[646]** An embodiment of the present disclosure provides a base station. As shown in Fig. 31, which includes an allocating module 2301 and a transmitting module 2302, wherein, **[647]** the allocating module 2301 is configured to allocate BWP resources and intra-BWP PRB resources to the UE. **[648]** the transmitting module 2302 is configured to transmit BWP resource indication information and intra-BWP PRB resource indication information to the UE. **[649]** Wherein, the BWP resource indication information is used for indicating the BWP resources allocated by the base station to the UE, and the intra-BWP PRB resource indication information is used for indicating the intra-BWP PRB resources allocated by the base station to the UE.

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		[650] An embodiment of the present disclosure provides a method for uplink resource allocation and a method for uplink transmission. Compared with the prior art, in the embodiment of the present disclosure, a base station allocates BWP resources and intra-BWP PRB resources to a UE, the base station then transmits the BWP resource indication information and the intra-BWP PRB resource indication information to the UE. The BWP resource indication information is used for indicating the BWP resources allocated by the base station to the UE. The intra-BWP PRB resource indication information is used for indicating the intra-BWP PRB resources allocated by the base station, and then the UE receives the BWP resource indication information and the intra-BWP PRB resource indication information transmitted by the base station, and then determines the BWP resources and the intra-BWP PRB resources allocated by the base station according to the BWP resource indication information and the intra-BWP PRB resource indication information so as to perform uplink transmission, that is, a new method for uplink resource allocation is designed to be applied to BWP-based bandwidth allocation for future radio communication systems. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	receiving, from the BS, frequency hopping configuration information for a UL control	At least under Pegasus's apparent infringement theory, Zhang discloses receiving, from the BS, frequency hopping configuration information for a UL control channel and a

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
	channel and a UL data channel transmitted through one transmission BWP of the BWP set; and	UL data channel transmitted through one transmission BWP of the BWP set. For example, Zhang discloses this limitation based on the following exemplary citations: **[224]** For the future radio communication system, an embodiment of the present disclosure proposes a new method for uplink resource allocation. In this method, the UL Grant is still used for uplink resource allocation, wherein the uplink resource allocation information includes at least two parts of indication information: one part indicates the information of the BWP and the other indicates the information of PRB within the BWP. If the UL Grant further includes indication of frequency hopping, the uplink resource allocation information should also include resource allocation of the corresponding frequency hopping. Specifically, for the foregoing two part of the indication information, the embodiments of the present disclosure provide different specific resource allocation solutions, in which each solution supports two different frequency hopping indications, i.e. no frequency hopping and frequency hopping, and also supports three different PRB allocation ways, i.e. continuous allocation of PRBs, discontinuous allocation of PRBs and partially continuous allocation of PRBs. **[225]** The method for uplink resource allocation provided in the embodiments of the present disclosure can be applied to a situation in which full bandwidth needs to be divided in a future radio communication system, and a resource allocation requirement that meets a diversity of needs is provided, and the complexity and the system overhead are relatively low, so that the user can perform more efficient uplink transmission and provide the user with a better access experience. **[226]** Fig. 5 is an interactive flowchart of a method for uplink resource allocation, in which, **[227]** Step 501: a base station allocates BWP resources and PRB resources within the BWP to a UE; Step 502: the base station transmits BWP resource indication information and intra-BWP PRB resource indication information to the UE, wherein, the BWP resource indication information is used for indicating the BWP resources which is allocated by the base station to the UE, and the intra-BWP PRB resource

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Claim Language		**Exemplary Citations to Zhang**
		indication information is used for indicating the intra-BWP PRB resources allocated by the base station to the UE; Step 503: the UE receives the BWP resource indication information and the intra-BWP PRB resource indication information transmitted by the base station; Step 504: the UE determines the BWP resources and the intra-BWP PRB resources allocated by the base station according to the BWP resource indication information and the intra-BWP PRB resource indication information; Step 505: the UE performs uplink transmission according to the determined BWP resources and the intra-BWP PRB resources allocated by the base station. **[228]** Further, before Step 502, the method further includes: transmitting, by the base station, the Remaining System Information (RMSI) based on the resource information of the downlink BWP. **[229]** Specifically, Step 502 includes: transmitting, by the base station, the BWP resource indication information and the intra-BWP PRB resource indication information through the uplink grant information to the UE; or, transmitting, by the base station, the BWP resource indication information to the UE through the RMSI, and transmitting, through uplink grant information, intra-BWP PRB resource indication information to the UE. **[230]** Wherein, if the uplink grant information does not carry frequency hopping indication information, the BWP resource indication information in the uplink grant information indicates the UE the BWP used for uplink transmission, wherein the intra-BWP PRB resource indication information in the uplink grant information indicates the UE the PRB in the BWP indicated by the BWP indication information used for uplink transmission. **[231]** wherein, if the uplink grant information carries the frequency hopping indication information, the frequency hopping indication information is located in the at least one of the BWP indication information and the intra-BWP PRB resource indication information.

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Zhang discloses transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Zhang discloses this limitation based on the following exemplary citations: **[20]** According to still another aspect, an embodiment of the present disclosure further provides a UE, including: **[21]** a receiving module, configured to receive the BWP resource indication information transmitted by the base station and intra-BWP PRB resource indication information; and **[22]** a transmitting module, configured to determine BWP resources allocated by the base station and intra-BWP PRB resources according to the BWP resource indication information received by the receiving module and the intra-BWP PRB resource indication information and performs uplink transmission. **[298]** Further, if the UE acquires the intra-BWP PRB resource indication information only from the uplink grant information, the method further includes:

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		[299] if the uplink grant information does not contain the frequency hopping indication information, the UE determines the PRB resources used for uplink transmission allocated within the uplink BWP based on the intra-BWP PRB resource indication information acquired in the uplink grant information; and if the uplink grant information contains the frequency hopping indication information, the UE determines, based on the intra-BWP inter-PRB frequency hopping resource allocation information in the intra-BWP PRB resource indication information and the part, which is not the frequency hopping resource allocation information, of the intra-BWP PRB resource indication information, the PRB resources used for uplink transmission allocated within the uplink BWP on the first time unit and the second time unit respectively. **[300]** Specifically, the step of receiving the BWP resource indication information and the intra-BWP PRB resource indication information transmitted by the base station includes: **[301]** receiving the BWP resource indication information, the intra-BWP PRB resource indication information and the time domain resource indication information transmitted by the base station; **[302]** the step of determining the BWP resources and the intra-BWP PRB resources allocated by the base station according to the BWP resource indication information and the intra-BWP PRB resource indication information includes: **[303]** determining the BWP resources, the intra-BWP PRB resources and the time domain resources allocated by the base station according to the BWP resource indication information, the intra-BWP PRB resource indication information and the time domain resource indication information.

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		[550] According to the embodiment of the present application, the eMTC UE is scheduled to transmit UL data on an Msg3 PUSCH, the base station provides multiple possible TBSs in the RAR grant for the UE to select, and the UE will select one TBS value which most closely matches with the data size in the MAC buffer to transmit Msg3, so that the number of the padding bits in the MAC PDU is reduced as much as possible. It is assumed that the base station will perform blindly decoding on the Msg3 based on the multiple possible TBS values. The maximal number of times for blindly decoding is the same as the number of the provided multiple possible TBSs. **[572]** In one embodiment, an eNB provides Msg3 with multiple possible TBSs for the UE to select, the UE selects an appropriate TBS value according to the actual data size, and the TBS value used for the actual transmission of Msg3 is transmitted through a PUCCH and is transmitted to the base station before transmitting Msg3, so the eNB can detect the TBS value used for the actual transmission of Msg3 and decode the Msg3 based on the TBS value, thereby avoiding blind decoding on Msg3 based on the hypothesis that there are multiple TBSs. The specific steps of the embodiment are shown in Fig. 26. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
1[d]	wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Zhang discloses wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Zhang discloses this limitation based on the following exemplary citations: **[172]** The UE can obtain a starting Physical Resource Block (PRB) location (RB_{START}) and the number (L_{CRBs}) of allocated continuous PRBs according to the RIV and a corresponding calculation method. If the frequency hopping flag is 0, only the RIV is included in the resource allocation indication. In this case, a Physical Uplink Shared Channel (PUSCH) continuously maps LCRBS resource blocks starting from the resource block RB_{START} ^{m} accordance with a way of increasing the resource block index. If the frequency hopping flag is 1, the resource allocation indication includes both the frequency hopping resource allocation information and the RIV. In this case, the PUSCH resource allocation in a first slot (or a subframe during an even number of HARQ transmissions) and the PUSCH resource allocation in a second slot (or a subframe during an odd number of HARQ transmissions) can be obtained according to the RIV, the frequency hopping resource allocation information and other possible information (such as the cell-specific frequency hopping pattern, mirror pattern, etc.). **[203]** According to another embodiment of the present disclosure, the controller 240 may determine values of a preamble sequence cyclic shift N^{cs} based on a Zadoff-Chu (ZC) sequence and a degree of frequency offset, select a preset number of preamble sequence cyclic shifts N^{cs} from the values of the preamble sequence cyclic shift N^{cs} to generate a preamble sequence cyclic shift set, and control to transmit the generated preamble sequence cyclic shift set to at least one of a base station (BS) and a user equipment (UE). **[460]** The base station allocates one or more RBG resources within a RBG set to a certain UE. In the above way, the base station first indicates the RBG set resource allocation information, and then generates a corresponding bit set according to whether to allocate a certain RBG within the RBG set, both of the above steps are included in

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		the intra-BWP PRB resource allocation information to be transmitted in the UL Grant. It should be noted that, the intra-BWP PRB resource allocation information may also include a fixed bit of RBG offset indication. **[702]** Specifically, the system determines the number of preamble sequence cyclic shift sets according to all possible degrees of frequency offset in different conditions. Each set corresponds to one degree of frequency offset. The system also allocates a unique preamble sequence cyclic shift set index (CyclicShiftSetIndex) for each set. **[703]** For example, when the maximum allowable degree of frequency offset of the system is 3 times of the sub-carrier spacing of a random access channel, the system can generate four preamble sequence cyclic shift sets, and allocate an index 0, an index 1, an index 2 and an index 3 to the four preamble sequence cyclic shift sets, respectively. The preamble sequence cyclic shift set corresponding to the index 0 supports a situation where there is no or negligible frequency offset; the preamble sequence cyclic shift set corresponding to the index 1 supports a situation where the maximum frequency offset is 1 time of the sub-carrier spacing of the random access channel; the preamble sequence cyclic shift set corresponding to the index 2 supports a situation where the maximum frequency offset is 2 times of the sub-carrier spacing of the random access channel; and, the preamble sequence cyclic shift set corresponding to the index 3 supports a situation where the maximum frequency offset is 3 times of the sub-carrier spacing of the random access channel. **[1235]** In the present disclosure, for a 5G wireless communication system, the present disclosure provides a method for configuring a preamble sequence cyclic shift set. Different preamble sequence cyclic shift sets correspond to different degrees of frequency offset, and the specific values of preamble sequence cyclic shifts in each preamble sequence cyclic shift set are determined according to the related conditions such as different degrees of frequency offset. During the random access process, a user receives a System Information Block (SIB) transmitted by a base station, and reads a cyclic shift configuration index and a cyclic shift set index contained in the SIB. Eventually, the user selects, according to the cyclic shift set index, one set from all

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		preamble sequence cyclic shift sets, and determines, based on the cyclic shift configuration index, a final cyclic shift from the selected cyclic shift set. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Zhang discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Zhang discloses this limitation based on the following exemplary citations: **[326]** When a subsequent base station transmits a Random Access Response (RAR) and when it is necessary to perform uplink scheduling using Downlink Control Information (DCI), the transmitted UL Grant includes the following information: **[327]** - BWP resource indication information **[328]** - intra-BWP PRB resource indication information [329] - other information **[330]** Wherein, when there is no frequency hopping indication in the UL Grant, the BWP resource indication information indicates a certain BWP resource used for UE uplink data transmission, and the intra-BWP PRB resource indication information indicates the PRB resources within the uplink BWP for UE uplink transmission; when there is a frequency hopping indication in the UL Grant, the BWP resource indication

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		information can include both frequency hopping indication information and BWP resource information used for UE uplink data transmission. The intra-BWP PRB resource indication information can include both frequency hopping indication information and activated uplink intra-BWP PRB resource information used for transmission. **[460]** The base station allocates one or more RBG resources within a RBG set to a certain UE. In the above way, the base station first indicates the RBG set resource allocation information, and then generates a corresponding bit set according to whether to allocate a certain RBG within the RBG set, both of the above steps are included in the intra-BWP PRB resource allocation information to be transmitted in the UL Grant. It should be noted that, the intra-BWP PRB resource allocation information may also include a fixed bit of RBG offset indication. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 2

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
2	The method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	At least under Pegasus's apparent infringement theory, Zhang discloses the method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Zhang discloses this limitation based on the following exemplary citations: **[224]** For the future radio communication system, an embodiment of the present disclosure proposes a new method for uplink resource allocation. In this method, the UL Grant is still used for uplink resource allocation, wherein the uplink resource allocation information includes at least two parts of indication information: one part indicates the information of the BWP and the other indicates the information of PRB within the BWP. If the UL Grant further includes indication of frequency hopping, the uplink resource allocation information should also include resource allocation of the corresponding frequency hopping. Specifically, for the foregoing two part of the indication information, the embodiments of the present disclosure provide different specific resource allocation solutions, in which each solution supports two different frequency hopping indications, i.e. no frequency hopping and frequency hopping, and also supports three different PRB allocation ways, i.e. continuous allocation of PRBs, discontinuous allocation of PRBs and partially continuous allocation of PRBs. **[225]** The method for uplink resource allocation provided in the embodiments of the present disclosure can be applied to a situation in which full bandwidth needs to be divided in a future radio communication system, and a resource allocation requirement that meets a diversity of needs is provided, and the complexity and the system overhead are relatively low, so that the user can perform more efficient uplink transmission and provide the user with a better access experience.

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
		To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
3	The method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.	At least under Pegasus's apparent infringement theory, Zhang discloses the method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP. For example, Zhang discloses this limitation based on the following exemplary citations: **[262]** Further, the intra-BWP PRB resource indication information indicates the BWP resources within the BWP which is allocated by the base station to the UE by at least one of the following ways: **[263]** RIV;

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Claim Language		**Exemplary Citations to Zhang**
		[264] number of segments of multiple continuous uplink PRB resources allocated by the base station to the UE, and RIV respectively corresponding to each segment; **[265]** bit-map information, wherein the intra-BWP PRB resource indication information uses a resource block group (RBG) as a unit; **[266]** RBG indication information and bit-map information, wherein, the intra-BWP PRB resource indication information uses the RBG as a unit; **[267]** RBG resource allocation information and bit group information, wherein, the intra-BWP PRB resource indication information uses the PRB as a unit; **[268]** at least one of the number of segments of multiple continuous RBG resources allocated by the base station to the UE, starting location information of each segment of RBG, and length information of each segment of RBG; **[269]** at least one of the number of segments of multiple continuous PRB resources allocated by the base station to the UE, starting location information of each segment of PRB, and length information of each segment of PRB. **[270]** Further, the starting location information of each segment of RBG is used for indicating at least one of the followings: **[271]** the starting location of each segment of RBG resources; **[272]** a difference between the starting location of the 0th segment of RBG resources and the starting locations of each remaining segment of RBG resources; **[273]** a ratio between the starting location of the 0th segment of RBG resources and the starting location of each remaining segment of RBG resources; **[274]** wherein, the length information of each segment of RBG is used for indicating at least one of the following: **[275]** the length of each segment of RBG resources;

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Claim Language		**Exemplary Citations to Zhang**
		[276] a difference between the length of the 0th segment of RBG resources and the length of each remaining segment of RBG resources; **[277]** a ratio between the length of the 0th segment of RBG resource and the length of each remaining segment of RBG resources; **[278]** wherein, the starting location information of each segment of PRB is used for indicating at least one of the followings: **[279]** the starting location of each segment of PRB resources; **[280]** a difference between the starting location of the 0th segment of PRB resources and the starting location of each remaining segment of PRB resources; **[281]** a ratio between the starting location of the 0th segment of PRB resources and the starting location of each remaining segment of PRB resources; **[282]** wherein, the length information of each segment of PRB resources is used for indicating at least one of the followings: **[283]** the length of each segment of PRB resources; **[284]** a difference between the length of the 0th segment of PRB resources and the length of each remaining segment of PRB resources; **[285]** a ratio between the length of the 0th segment of PRB resources and the length of each remaining segment of PRB resources. *See also*, Zhang [0313-0320]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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Claim Language		**Exemplary Citations to Zhang**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

4. Claim 4

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Claim Language		**Exemplary Citations to Zhang**
4	The method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Zhang discloses the method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, Zhang discloses this limitation based on the following exemplary citations: **[453]** Type 3: The bandwidth of the BWP, where the uplink resources are located, allocated by the base station to the UE is L_{UL} PRBs, and indexes of the L_{UL} PRBs are 0, 1, . . . , L_{UL} — 1 in order. According to the size of the bandwidth of the BWP, the system defines a concept of RBG, wherein, each RBG consists of a fixed number of P PRBs (the number of PRBs in the RBG at the edge of the BWP may be less than P), wherein, P is a positive integer. The base station uses Q = [L_{UL}/P] bits of bit-map information to indicate the intra-BWP PRB uplink resource allocation and the base station allocates the uplink transmission resources in units of RBGs. **[458]** Type 4: The bandwidth of the BWP, where the uplink resources are located, allocated by the base station to the UE is L_{UL} PRBs, and indexes of the L_{UL} PRBs are 0, 1, . . . , L_{UL}— 1 in order. According to the size of the bandwidth of the BWP, the system defines a concept of the RBG, wherein, each RBG consists of a fixed number of P_1 PRBs (the number of the PRBs in the RBG at the edge of the BWP may be less than P_1), wherein, P_1 is a positive integer. On the basis of [L_{UL}/P_1] PRBS, the system

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Claim Language		**Exemplary Citations to Zhang**
		further defines P_2 RBG sets, wherein, the number of the RBGs of each RBG set is $[[L_{UL}/P_1]/P_2]$ or $[[L_{UL}/P_1]/P_2] - 1$. P_2 RBG sets are sequentially allocated indexes 0, 1, P_2 - 1. The base station indicates the intra-BWP PRB uplink resource allocation to allocate uplink transmission resources in units of RBG in a way of combining the RBG set indication and the bit-map information. **[473]** Type 6: The bandwidth of the BWP, where the uplink resources are located, allocated by the base station to the UE is L_{UL} PRBs, and indexes of the L_{UL} PRBs are 0, 1, .. . , L_{UL}— 1 in order. According to the size of the bandwidth of the BWP, the system defines a concept of RBG, wherein, each RBG consists of a fixed number of P PRBs (the number of PRBs in the RBG at the edge of the BWP may be less than P), wherein, P is a positive integer. The number of the intra-BWP RBG is $[L_{UL}/P]$, the RBG sets are sequentially allocated with indexes 0,1, $[L_{UL}/P]$— 1. The base station allocates the uplink transmission resources in units of PRB. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 5

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Claim Language		**Exemplary Citations to Zhang**
5[pre]	A method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Zhang discloses a method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE). For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[a]	transmitting bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE to the UE;	At least under Pegasus's apparent infringement theory, Zhang discloses transmitting bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE to the UE. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[a]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art

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Claim Language		**Exemplary Citations to Zhang**
		references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[b]	transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE; and	At least under Pegasus's apparent infringement theory, Zhang discloses transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[b]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[c]	receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Zhang discloses receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge

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Claim Language		**Exemplary Citations to Zhang**
		of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[d]	wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Zhang discloses wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[d]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[e]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant	At least under Pegasus's apparent infringement theory, Zhang discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Zhang discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Zhang**
	downlink control information (DCI).	*See* limitation 1[e]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 6

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Claim Language		**Exemplary Citations to Zhang**
6	The method of claim 5, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation	At least under Pegasus's apparent infringement theory, Zhang discloses the method of claim 5, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Zhang discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate

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Claim Language		**Exemplary Citations to Zhang**
	information of a second frequency resource region of the UL control channel.	this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

7. Claim 7

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Claim Language		**Exemplary Citations to Zhang**
7	The method of claim 5, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP.	At least under Pegasus's apparent infringement theory, Zhang discloses the method of claim 5, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP. For example, Zhang discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same

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Claim Language		**Exemplary Citations to Zhang**
		field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 8

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
8	The method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, Zhang discloses the method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less. For example, Zhang discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 9

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
9[pre]	A user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS), the UE comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Zhang discloses a user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS). For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[pre]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	a receiver configured to receive, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and	At least under Pegasus's apparent infringement theory, Zhang discloses a receiver configured to receive, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitations 1[a] and 1[b]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art

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Claim Language		**Exemplary Citations to Zhang**
		references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information,	At least under Pegasus's apparent infringement theory, Zhang discloses a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[c]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[c]	wherein the frequency hopping configuration information for UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and	At least under Pegasus's apparent infringement theory, Zhang discloses wherein the frequency hopping configuration information for UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values. For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[d].

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Claim Language		**Exemplary Citations to Zhang**
		To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[d]	wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).	At least under Pegasus's apparent infringement theory, Zhang discloses wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI). For example, Zhang discloses this limitation based on the following exemplary citations: *See* limitation 1[e]. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

10. Claim 10

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
10	The UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.	At least under Pegasus's apparent infringement theory, Zhang discloses the UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. For example, Zhang discloses this limitation based on the following exemplary citations: *See* claim 2. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

11. Claim 11

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
11	The UE of claim 9, wherein a number of frequency hopping	At least under Pegasus's apparent infringement theory, Zhang discloses the UE of claim 9, wherein a number of frequency hopping offset values included in the

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Claim Language		**Exemplary Citations to Zhang**
	offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.	frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP. For example, Zhang discloses this limitation based on the following exemplary citations: *See* claim 3. To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

12. Claim 12

Invalidity of U.S. Patent No. 10,594,460 in view of Zhang		
Claim Language		**Exemplary Citations to Zhang**
12	The UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting	At least under Pegasus's apparent infringement theory, Zhang discloses the UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, Zhang discloses this limitation based on the following exemplary citations: *See* claim 4.

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Claim Language		**Exemplary Citations to Zhang**
	the transmission BWP is a preset threshold value or less.	To the extent it is found that Zhang does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Zhang does not anticipate this claim, Zhang renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Zhang with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT E-11

Summary of Invalidity Analysis of U.S. Patent No. 10,594,460 ("'460 Patent") in view of R1-1801080

3GPP TSG RAN WG1 NR Ad Hoc Meeting R1-1801080 (Vancouver, Canada) ("R1-1801080") published on January 24, 2018 on 3GPP.org. *See* https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_AH/NR_AH_1801/Docs (last accessed October 29, 2024). Therefore, R1-1801080 qualifies as prior art to the '460 Patent under 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '460 Patent are invalid as expressly and/or inherently anticipated by R1-1801080.

To the extent that R1-1801080 is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '460 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of R1-1801080 in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Amended Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine R1-1801080 and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 4

<table>
<tr><th colspan="3">Invalidity of U.S. Patent No. 10,594,460 in view of R1-1801080</th></tr>
<tr><th colspan="2">Claim Language</th><th>Exemplary Citations to R1-1801080</th></tr>
<tr><td>4</td><td>The method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.</td><td>At least under Pegasus's apparent infringement theory, R1-1801080 discloses the method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, R1-1801080 discloses this limitation based on the following exemplary citations:

2.3. Frequency hopping
At the RAN1 #91 meeting, following agreements were made for frequency hopping:
Agreements:
• For PUSCH transmission with UL grant (other than Msg.3) and Type 2 UL transmission without UL grant with intra-slot FH,
○ frequency hopping offset(s) in frequency domain is/are explicitly configured by UE-specific RRC signaling
○ explicit frequency hopping flag is included into DCI format scheduling/activating UL transmission
• If the frequency hopping flag is enabled, the following number of hopping bits are taken from the resource allocation Type 1 indication field:
○ 1 bit: if the active BWP less than X1 PRB
▪ To indicate one of two RRC configured offsets
○ 2 bit: if the active BWP is larger or equal than X1
▪ To indicated one of four RRC configured offsets
○ The value of X1 is fixed in the spec with a value of [50]

Agreements:
• For Type 1 UL transmission without UL grant with intra-slot FH, a separated frequency hopping offset field from the frequency resource allocation field is explicitly configured by UE-specific RRC signaling.
○ The possible values for frequency hopping offset are the same as that for UL transmission with UL grant.

Current spec. 38.214 section 6.3 defines UE PUSCH frequency hopping procedure.
[…]
When frequency hopping on PUSCH is enabled and for resource allocation type 1, frequency offsets are configured by higher layer parameter Frequency-hopping-offsets-set:
- when the size of the active BWP is less than [50] PRBs, one of two higher layer configured offsets is indicated in the UL grant
- when the size of the active BWP is greater than [50] PRBs, one of four higher layer configured offsets is indicated in the UL grant

[6], [15] and [18] proposed to confirm the 50 PRBs as the BWP size boundary between two offsets and four offsets. Then, each value of the frequency hopping offset can be in the range of $[0, N_{BWP}^{size} - 1]$.
<u>Proposal 1:</u>
● Confirm the value 50 as the boundary number of PRBs in the active UL BWP between the bandwidths having two or four frequency offsets for frequency hopping on PUSCH.
➢ Each value of the frequency hopping offset can be any integer value between 1 and $N_{BWP}^{size} - 1$.

Page 2; see also pages 4, 10.</td></tr>
</table>

Invalidity of U.S. Patent No. 10,594,460 in view of R1-1801080		
Claim Language		**Exemplary Citations to R1-1801080**
		To the extent it is found that R1-1801080 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1801080 does not anticipate this claim, R1-1801080 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1801080 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 8

Invalidity of U.S. Patent No. 10,594,460 in view of R1-1801080		
Claim Language		**Exemplary Citations to R1-1801080**
8	The method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, R1-1801080 discloses the method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less. For example, R1-1801080 discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that R1-1801080 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1801080 does not anticipate this claim, R1-1801080 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1801080 with any of the other

Invalidity of U.S. Patent No. 10,594,460 in view of R1-1801080		
Claim Language		**Exemplary Citations to R1-1801080**
		prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 12

Invalidity of U.S. Patent No. 10,594,460 in view of R1-1801080		
Claim Language		**Exemplary Citations to R1-1801080**
12	The UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.	At least under Pegasus's apparent infringement theory, R1-1801080 discloses the UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. For example, R1-1801080 discloses this limitation based on the following exemplary citations: *See* claim 4. To the extent it is found that R1-1801080 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1801080 does not anticipate this claim, R1-1801080 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1801080 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT F-13

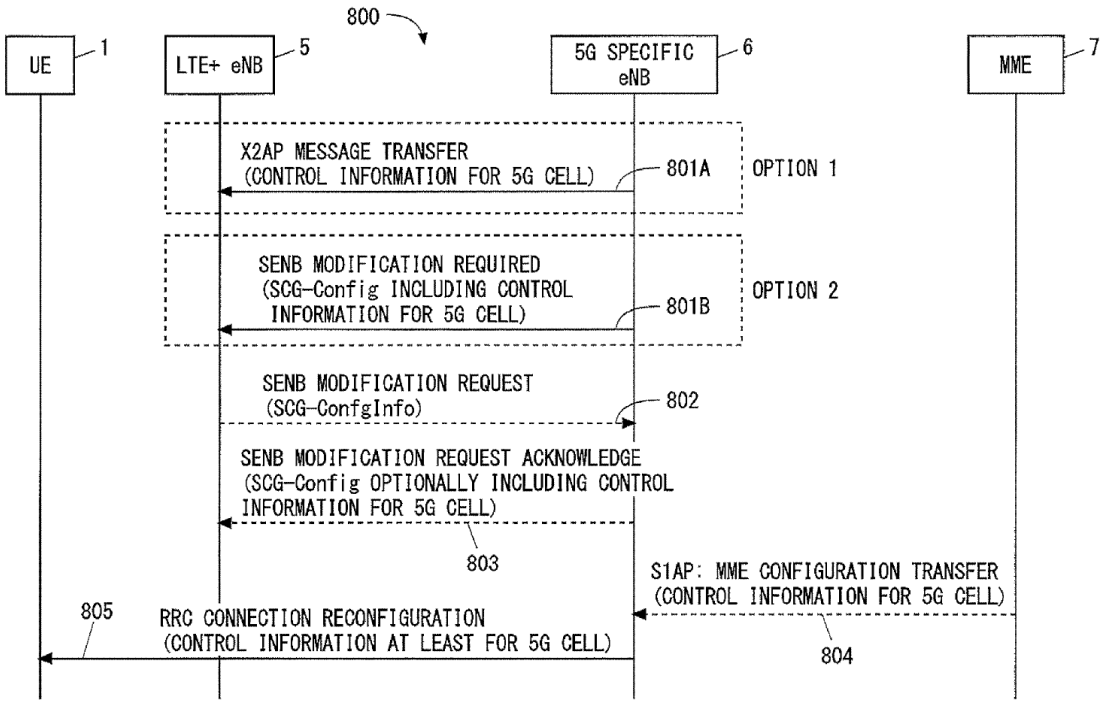
Summary of Invalidity Analysis of U.S. Patent No. 10,721,118 ("'118 Patent") in view of U.S. Patent No. 10,952,099 to Futaki et al. ("Futaki")

U.S. Patent No. 10,952,099 to Futaki et al. ("Futaki") issued on March 16, 2021 and was filed on December 14, 2016. Futaki claims priority to Japanese application JP2016-002879, filed on January 8, 2016 (the "2016 Application"). The 2016 Application supports at least Claim 1 of Futaki. By way of example only, at least the following disclosures of the 2016 Application are sufficient to support Claim 1 of Futaki. *See, e.g.*, Translation of 2016 Application at pages Fig. 3, Fig. 6, Fig. 8, Fig. 7, Fig. 12 [0001], [0008], [0020], [0023]-[0024], [0030]-[0032], [0035], [0037], [0046]-[0054], [0060]-[0066], [0072], [0077]-[0080], [0082], [0094]. Defendants reserve the right to identify any additional support. Therefore, Futaki qualifies as prior art to the '118 Patent under 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '118 Patent are invalid as expressly and/or inherently anticipated by Futaki.

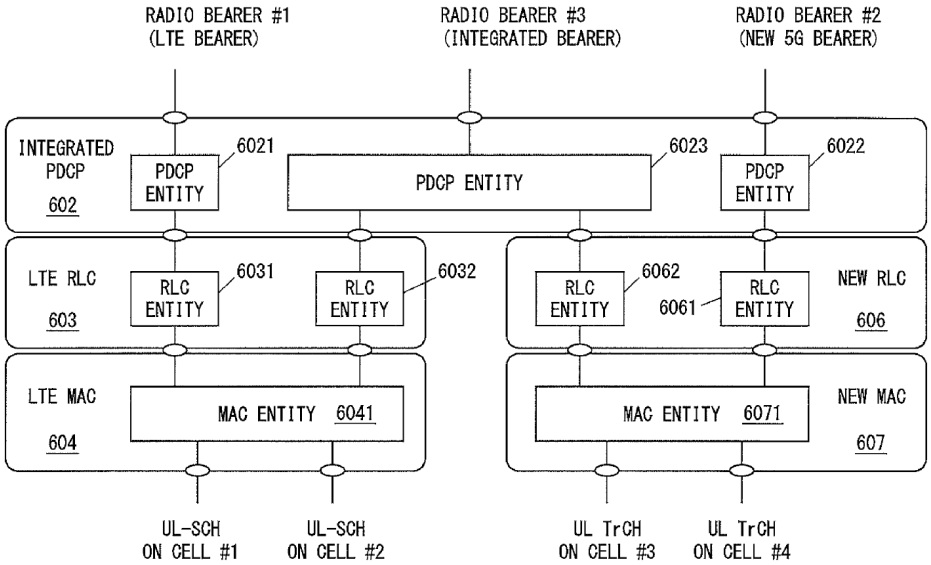
To the extent that Futaki is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '118 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Futaki in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Futaki and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

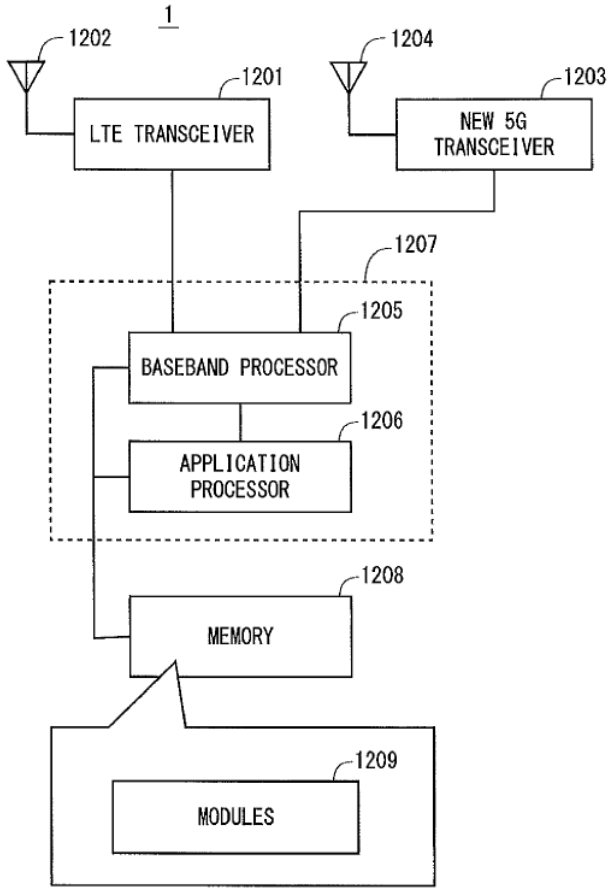
Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
	Claim Language	**Exemplary Citations to Futaki**
1[pre]	A method of a user equipment for configuring dual connectivity, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Futaki discloses "A method of a user equipment for configuring dual connectivity, the method comprising." For example, Futaki discloses this limitation based on the following exemplary citations:  Futaki at Fig. 8. "The present disclosure relates to communication between a radio station and a radio terminal using a plurality of Radio Access Technologies (RATs)." Futaki, 1:17-19.

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		"Higher frequency can provide higher-rate communication. However, because of its frequency properties, coverage of the higher frequency is more local. Therefore, high frequencies are used to boost capacity and data rates in specific areas, while wide-area coverage is provided by lower current frequencies. That is, in order to ensure the stability of New 5G RAT communication in high frequency bands, tight integration or interworking between low and high frequencies (i.e., tight integration or interworking between LTE/LTE-Advanced and New 5G RAT) is required. A 5G supporting radio terminal (i.e., 5G User Equipment (UE)) is connected to both of a low frequency band cell and a high frequency band cell (i.e., a LTE/LTE-Advanced cell and a new 5G cell) by using Carrier Aggregation (CA) or Dual Connectivity (DC), or a modified technique thereof." Futaki, 1:36-50. "FIG. 1 shows a configuration example of a radio communication network according to several embodiments including this embodiment. In the example shown in FIG. 1, the radio communication network includes a radio terminal (UE) 1 and an integrated base station (i.e., integrated eNB) 2. The UE 1 is a 5G UE and connects to both one or more LTE cells (e.g., cells 21 and 22) and one or more New 5G cells (e.g., cells 23 and 24) using CA, DC, or an enhancement thereof. In the following description, one or more LTE cells are referred to as an LTE cell group (CG) and one or more New 5G cells used by the 5G UE 1 are referred to as a New 5G CG. Each of the cells in the LTE CG and New 5G CG has been configured for the 5G UE 1 by the integrated eNB 2 and has been activated by the integrated eNB 2. In some implementations, frequency bands (e.g., F1 and F2) of the LTE CG (e.g., the cells 21 and 22) are lower frequency bands (e.g., lower than 6 GHz) and frequency bands (e.g., F3 and F4) of the New 5G CG (e.g., the cells 23 and 24) are higher frequency bands (e.g., higher than 6 GHz)." Futaki, 5:22-40. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 8, [0001], [0020].

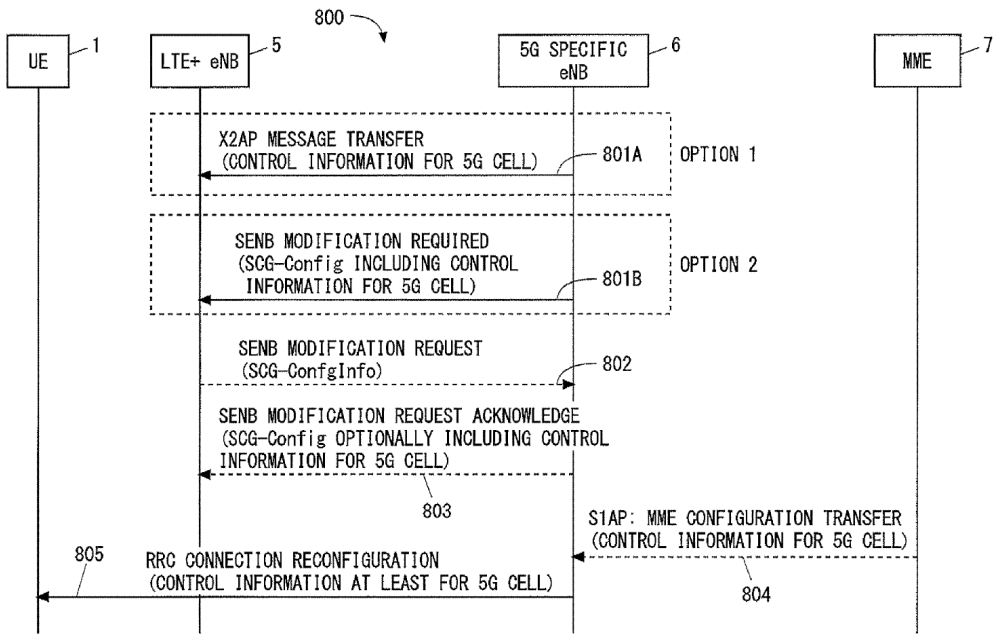
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	adding and configuring a secondary base station signaling radio bearer (SRB);	At least under Pegasus's apparent infringement theory, Futaki discloses "adding and configuring a secondary base station signaling radio bearer (SRB)." For example, Futaki discloses this limitation based on the following exemplary citations:  Futaki at Fig. 6.

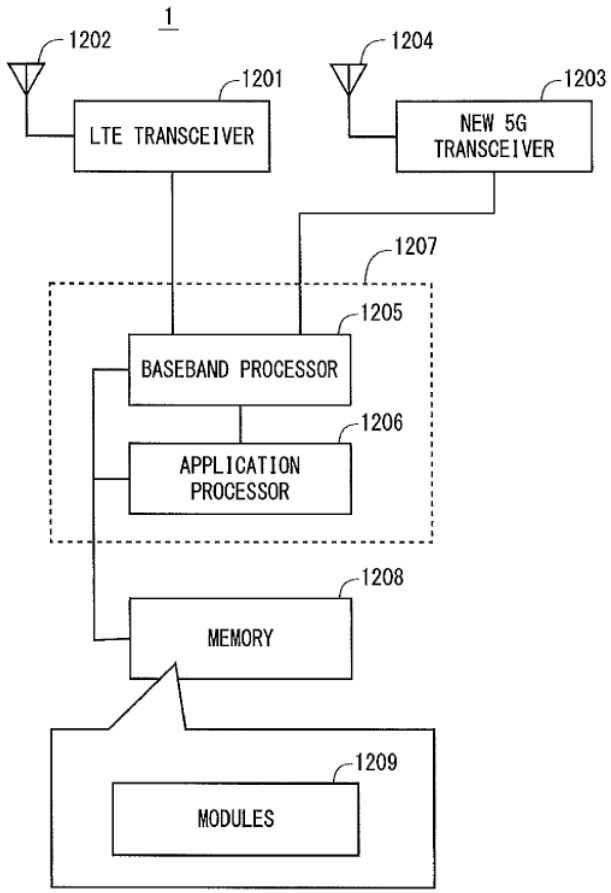
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
	Claim Language	**Exemplary Citations to Futaki**
		 Futaki at Fig. 12. "The inventors have studied the 5G radio architecture that provides tight interworking of the LTE RAT and the New 5G RAT and found some problems. For example, Non-Patent Literature 1 does not take into account a control plane specific to New 5G

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		cells. In some implementations, control plane (CP) messages specific to New 5G cells (e.g., allocation of a temporary UE ID, configuration of lower layers, signalling for service quality management, and measurement reporting) may be required. In some implementations, a signalling connection specific to 5G cells (e.g., an RRC connection and a Signaling Radio Bearer (SRB)) may be required. It may be efficient for the New-5G-cell-specific control plane (CP) messages and the 5G-cell-specific signalling connections to be transmitted via New 5G cells, not via LTE cells. For example, one of the important requirements for 5G is low latency, and accordingly it can be expected that 5G UEs will be able to perform communication on New 5G cells with latency lower than that of communication on LTE cells." Futaki, 2:43-61. "In some implementations, the 5G specific eNB 6 used in the non co-located deployments may include a New RRC layer 511 and a New PDCP layer 512. Further, the 5G specific eNB 6 may include a control interface or connection (e.g., an S1-MME interface or an S1-U interface) with a core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) for the 5G UE 1. In some implementations, the New RRC layer 511 may configure the lower layers 406-408 of the New 5G CG (e.g., New 5G cells 23 and 24) and transmit system information (i.e., Master Information Block (MIB), or System Information Blocks (SIBs), or both) via the New 5G CG. The New RRC layer 511 may configure a signalling radio bearer with the 5G UE 1, also configure the lower layers 406-408 of the New 5G CG (e.g., the New 5G cells 23 and 24) and the New PDCP layer 512, and then transmit or receive RRC messages to or from the 5G UE 1 through the New 5G CG. The New RRC layer 511 may transfer NAS messages between the core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) and the 5G UE 1. The New PDCP layer 512 provides the New RRC layer 511 with a transfer service of RRC messages via the New 5G lower layers 406-408." Futaki, 7:51-8:5. "The integrated PDCP layer 602 includes one or more PDCP entities. Each PDCP entity transports data of one radio bearer. Each PDCP entity is associated with either the user plane or the control plane depending on which radio bearer (i.e., a data radio

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		bearer (DRB) or a signalling radio bearer (SRB)) it transports data from. In the example shown in FIG. 6, the integrated PDCP layer 602 includes three PDCP entities 6021, 6022, and 6023 that correspond to three radio bearers # 1, #2, and #3, respectively. Each of the radio bearers # 1, #2, and #3 may be an SRB or a DRB." Futaki, 8:65-9:7. "The 5G CG management-related information may be information regarding a modification of a specific cell (e.g., PSCell, Special cell) within the New 5G CG (e.g., PSCell/Special cell reconfiguration, pSCellToAddMod-rlx). Further or alternatively, when the base station system adds or releases another New 5G cell (e.g., 5G SCell) for the 5G UE 1 after the base station system configures the specific New 5G cell (e.g., PSCell, Special cell) for the 5G UE 1 (that is, after the specific 5G cell becomes available), the base station system may transmit radio resource configuration information about this other New 5G cell (e.g., sCellToAddModListSRAT, sCellToReleaseListSRAT, RadioResourceConfigDedicatedSCellSRAT) as the 5G CG management-related information. That is, the information relating to addition/release of a cell within the New 5G CG and the information relating to modification of the specific New 5G cell may be transmitted on any cell within the New 5G CG." Futaki, 14:43-59. "Although basic configuration information required by the 5G UE 1 to connect to (or detect) a New 5G cell is configuration information specific to the New 5G RAT, it may be transmitted on a LTE cell. This basic configuration information may be, for example, information regarding a subframe structure (which is different from that of LTE), information regarding a TTI length, information regarding a sampling rate, or information regarding a cell type." Futaki, 14:60-67. "The information regarding the standalone operation of a New 5G cell(s) may be configuration information (e.g., Radio resource configuration for 5G/SRAT PCell) that is required to use a New 5G cell as a primary cell (PCell) instead of using a New 5G cell as a secondary cell (SCell) with the LTE PCell cell. Alternatively, the

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		information regarding the standalone operation of a New 5G cell(s) may be information (e.g., Handover to a 5G/SRAT cell or Redirection to a 5G/SRAT cell) indicating a request or an indication that a New 5G cell is to be used as the PCell. Such information may be transmitted in a signalling radio bearer (e.g., SRBx) that will be newly defined. In addition, information required to configure this SRBx may be transmitted on a New 5G cell or on a LTE cell." Futaki at 15:41-54. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 6, Fig. 12, [0008], [0030], [0035], [0063]-[0064], [0066]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	receiving from a secondary base station, a radio resource control (RRC) message including radio resource configuration information on the secondary base station or a secondary cell group through the secondary base station SRB; and	At least under Pegasus's apparent infringement theory, Futaki discloses "receiving from a secondary base station, a radio resource control (RRC) message including radio resource configuration information on the secondary base station or a secondary cell group through the secondary base station SRB; and." For example, Futaki discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		 Futaki at Fig. 8.

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
	Claim Language	**Exemplary Citations to Futaki**
		 Futaki at Fig. 12. "The 5G UE 1 may support the protocol stack shown in FIG. 4 or support another protocol stack to communicate with the radio network shown in FIG. 5. For example, the 5G UE 1 may have an RRC layer (i.e., a master RRC layer or a primary RRC layer) corresponding to the integrated RRC layer 401 of the LTE+ eNB 5 and an

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		auxiliary RRC layer (i.e., a sub RRC layer or a secondary RRC layer) corresponding to the New RRC layer 511 of the 5G specific eNB 6. For example, the sub RRC layer may perform one or both of transmission and reception (or one or both of generation and restoration) of a part of the RRC configuration information controlled by the master RRC layer. The 5G UE 1 may receive both the RRC configuration information regarding a LTE cell(s) (i.e., LTE CG) and the RRC configuration information regarding a New 5G cell(s) (i.e., New 5G CG) through an LTE cell or through a New 5G cell. Alternatively, the 5G UE 1 may receive the RRC configuration information regarding a LTE cell(s) (i.e., LTE CG) through an LTE cell and meanwhile receive the RRC configuration information regarding a New 5G cell(s) (i.e., New 5G CG) through a New 5G cell." Futaki, 8:25-45. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes the configuration information specific to the New 5G RAT (e.g., SCG configuration for 5G, Secondary RAT (sRAT) configuration). That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes the configuration information specific to the New 5G RAT. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes configuration information specific to the LTE RAT. The configuration information specific to the New 5G RAT may be any one or any combination of: Terminal capability-related information; Service-related information; and 5G CG management-related information." Futaki, 13:61-14:12. "The 5G CG management-related information may be information regarding a modification of a specific cell (e.g., PSCell, Special cell) within the New 5G CG (e.g., PSCell/Special cell reconfiguration, pSCellToAddMod-rlx). Further or alternatively, when the base station system adds or releases another New 5G cell

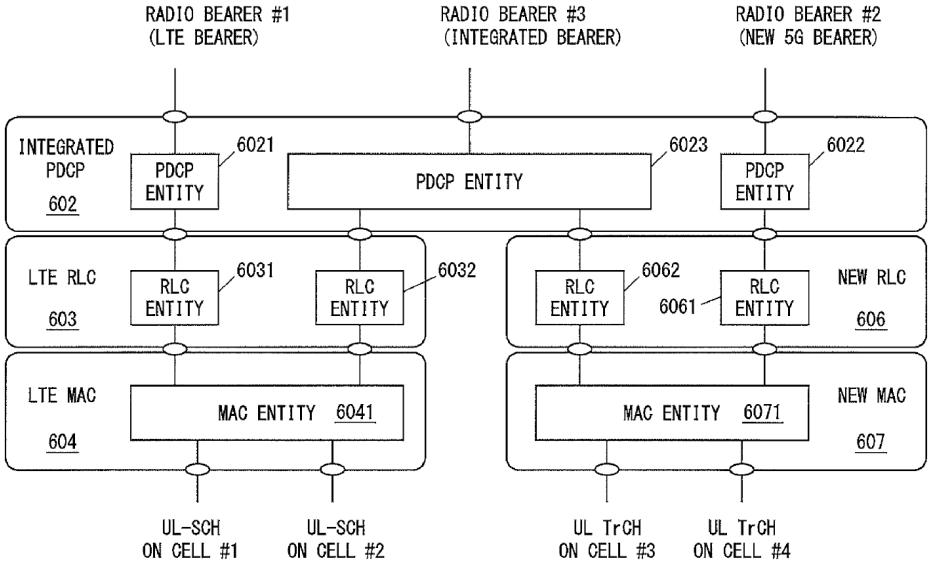
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		(e.g., 5G SCell) for the 5G UE 1 after the base station system configures the specific New 5G cell (e.g., PSCell, Special cell) for the 5G UE 1 (that is, after the specific 5G cell becomes available), the base station system may transmit radio resource configuration information about this other New 5G cell (e.g., sCellToAddModListSRAT, sCellToReleaseListSRAT, RadioResourceConfigDedicatedSCellSRAT) as the 5G CG management-related information. That is, the information relating to addition/release of a cell within the New 5G CG and the information relating to modification of the specific New 5G cell may be transmitted on any cell within the New 5G CG." Futaki, 14:43-59. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes control information newly defined by the 3GPP for New 5G cells. That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes control information newly defined for New 5G cells. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes existing control information for LTE. The control information for New 5G cells may be any one or a combination of: Core network selection-related information; and Information regarding a standalone operation of a New 5G cell(s)." Futaki, 15:1-17. "The information regarding the standalone operation of a New 5G cell(s) may be configuration information (e.g., Radio resource configuration for 5G/SRAT PCell) that is required to use a New 5G cell as a primary cell (PCell) instead of using a New 5G cell as a secondary cell (SCell) with the LTE PCell cell. Alternatively, the information regarding the standalone operation of a New 5G cell(s) may be information (e.g., Handover to a 5G/SRAT cell or Redirection to a 5G/SRAT cell) indicating a request or an indication that a New 5G cell is to be used as the PCell. Such information may be transmitted in a signalling radio bearer (e.g., SRBx) that

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		will be newly defined. In addition, information required to configure this SRBx may be transmitted on a New 5G cell or on a LTE cell." Futaki, 15:41-54. "In the above-described first to sixth implementations, the 5G UE 1 and the base station system determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message relates to the New 5G RAT (or a New 5G cell(s)). Accordingly, the 5G UE 1 and the base station system are able to transmit or receive RRC messages relating to the New 5G RAT (or a New 5G cell(s)) through any cell within a New 5G CG. This, for example, contributes to transmission of RRC messages regarding the New 5G RAT (or a New 5G cell(s)) with low latency." Futaki, 15:55-65. "In Step 805, the 5G specific eNB 6 transmits an RRC Connection Reconfiguration message containing the control-plane information (the CP message) regarding a New 5G cell(s) to the 5G UE 1 on a New 5G cell." Futaki, 18:35-38. "The baseband processor 1205 performs digital baseband signal processing (data-plane processing) and control-plane processing for radio communication. The digital baseband signal processing includes (a) data compression/decompression, (b) data segmentation/concatenation, (c) composition/decomposition of a transmission format (i.e., transmission frame), (d) channel coding/decoding, (e) modulation (i.e., symbol mapping)/demodulation, and (f) generation of OFDM symbol data (i.e., baseband OFDM signal) by Inverse Fast Fourier Transform (IFFT). Meanwhile, the control-plane processing includes communication management of layer 1 (e.g., transmission power control), layer 2 (e.g., radio resource management and hybrid automatic repeat request (HARQ) processing), and layer 3 (e.g., signalling regarding attach, mobility, and packet communication)." Futaki, 20:24-39. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 8, Fig. 12, [0032], [0060]-[0065], [0082], [0094].

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	transmitting a failure information message to a master base station in case the user equipment is unable to comply with the radio resource configuration information included in the RRC message,	At least under Pegasus's apparent infringement theory, Futaki discloses "transmitting a failure information message to a master base station in case the user equipment is unable to comply with the radio resource configuration information included in the RRC message." For example, Futaki discloses this limitation based on the following exemplary citations: "In the following, an operation of transmitting a control-plane (CP) message performed by the 5G UE 1 and the integrated eNB 2 (or the LTE+ eNB 5 and the 5G specific eNB 6) according to this embodiment will be explained. The 5G UE 1 and the base station system are configured to transmit CP messages (i.e., RRC signalling) on a New 5G cell after completion of configuration and activation of this New 5G cell (i.e., after the New 5G cell becomes available for the 5G UE 1). The 5G UE 1 and the base station system may switch the cell, to be used to transmit CP messages, from the LTE cell to the New 5G cell. Further or alternatively, the 5G UE 1 and the base station system may adaptively change the cell, to be used to transmit CP messages, between the LTE cell and the New 5G cell. The CP messages include NAS messages or RRC messages or both. The base station system is the integrated eNB 2, or a combination of the LTE+eNB 5 and the 5G specific eNB 6." Futaki, 10:40-56. "To be more specific, the 5G UE 1 is configured to transmit or receive CP messages to or from the base station system on any New 5G cell within the New 5G CG when a

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		predetermined condition is satisfied. In a similar way, the base station system is configured to transmit or receive CP message to or from the 5G UE 1 on any New 5G cell within the New 5G CG when a predetermined condition is satisfied. The predetermined condition, which is used to determine which one of the LTE CG and the New 5G CG is used to transmit a CP message, relates to at least one of the following: (a) the content or type of the CP message (b) the type of the signalling radio bearer used to transmit the CP message, (c) the transmission cause of the CP message; and (d) the type of the core network associated with the NAS message." Futaki, 10:57-11:6 "The above condition (c) may be that the transmission cause of the CP message is (or is not) a specific transmission cause. For example, the specific transmission cause may be at least one of: degradation of a radio quality of the New 5G cell; a failure of a radio link establishment in the LTE cell or the New 5G cell; a request for re-establishment of the radio link after the failure of the radio link establishment; and a response to the request for re-establishment of the radio link." Futaki, 11:27-35. "In a second implementation, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes a request message for the terminal (holding) information of the 5G UE 1 regarding the New 5G RAT (e.g., UE information request message) or depending on whether this RRC message includes a report message carrying the terminal (holding) information (e.g., UE information response message). That is, when an RRC message includes a report of (or a request for) the terminal (holding) information of the 5G UE 1 regarding the New 5G RAT, the 5G UE 1 may transmit (or receive) this RRC message on any cell within the New 5G CG. The base station system may receive (or transmit) this RRC message on any cell within the New 5G CG. In contrast, when an RRC message includes a report of (or a request for) the terminal (holding) information of the 5G UE 1 regarding the LTE RAT, the 5G UE 1

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Claim Language		**Exemplary Citations to Futaki**
		may transmit (or receive) this RRC message on any LTE cell. Further, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on the type of the terminal (holding) information to be requested or reported. The type of the terminal (holding) information may be any one or any combination of: Radio link-related information; Random access-related information; and Mobility history-related information." Futaki, 12:5-31. "The radio link-related information may be information regarding degradation of a radio quality (e.g., Radio Link Failure: RLF) in the LTE CG (e.g., PCell) or the New 5G CG (e.g., PSCell, Special cell) or information regarding a failure of radio link establishment (e.g., RRC Connection Establishment Failure: CEF, RRC Connection Re-establishment failure). For example, the information regarding degradation of a radio quality in the LTE CG may be requested or reported on the LTE CG (or the New 5G CG). In a similar way, the information regarding the degradation of a radio quality in the 5G CG may be requested or reported on the New 5G CG (or the LTE CG). In contrast, the information regarding a failure of radio link establishment may be always requested or reported on the LTE CG (or the New 5G CG). The radio link establishment may include a procedure using an RRC Connection Reconfiguration to change the configuration of the radio protocol(s) (e.g., RRC, PDCP, RLC, MAC, or PHY). Further, the 5G UE 1 may store the information regarding a failure of radio link establishment in the LTE CG and the information regarding a failure of radio link establishment in the New 5G CG separately from each other." Futaki, 12:32-53. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at [0046]-[0054]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the

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		knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	wherein the addition of the secondary base station SRB is determined by the secondary base station.	At least under Pegasus's apparent infringement theory, Futaki discloses "wherein the addition of the secondary base station SRB is determined by the secondary base station." For example, Futaki discloses this limitation based on the following exemplary citations:  Futaki at Fig. 6.

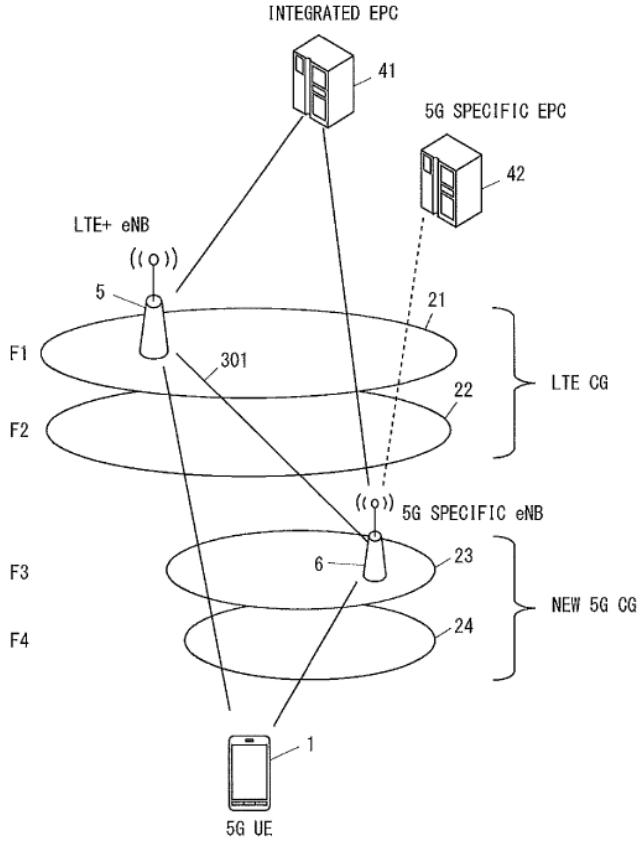
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		"In some implementations, the 5G specific eNB 6 used in the non co-located deployments may include a New RRC layer 511 and a New PDCP layer 512. Further, the 5G specific eNB 6 may include a control interface or connection (e.g., an S1-MME interface or an S1-U interface) with a core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) for the 5G UE 1. In some implementations, the New RRC layer 511 may configure the lower layers 406-408 of the New 5G CG (e.g., New 5G cells 23 and 24) and transmit system information (i.e., Master Information Block (MIB), or System Information Blocks (SIBs), or both) via the New 5G CG. The New RRC layer 511 may configure a signalling radio bearer with the 5G UE 1, also configure the lower layers 406-408 of the New 5G CG (e.g., the New 5G cells 23 and 24) and the New PDCP layer 512, and then transmit or receive RRC messages to or from the 5G UE 1 through the New 5G CG. The New RRC layer 511 may transfer NAS messages between the core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) and the 5G UE 1. The New PDCP layer 512 provides the New RRC layer 511 with a transfer service of RRC messages via the New 5G lower layers 406-408." Futaki, 7:51-8:5. "The New RRC layer 511 may depend on the integrated RRC layer 401 (i.e., have a dependency relationship) or may perform control similar to that performed by the integrated RRC layer 401 (i.e., have a similar function). In the former case (i.e., dependency relationship), the 5G specific eNB 6 (or the New RRC layer 511 thereof) may generate RRC configuration information with respect to a New 5G cell(s) (i.e., New 5G CG) in response to an instruction or a request from the LTE+ eNB 5 (or the integrated RRC layer 401 thereof). The 5G specific eNB 6 (or the New RRC layer 511 thereof) may transmit this RRC configuration information to the LTE+ eNB 5 (or the integrated RRC layer 401 thereof) and the LTE+ eNB 5 may transmit an RRC message containing this RRC configuration information (e.g., an RRC Connection Reconfiguration message) to the 5G UE 1 on an LTE cell (i.e., LTE CG). Alternatively, the 5G specific eNB 6 (or the New RRC layer 511 thereof) may transmit an RRC message containing this RRC configuration information to the 5G UE 1 on a New 5G cell." Futaki, 8:6-24.

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Claim Language		**Exemplary Citations to Futaki**
		"The data of the radio bearer # 2 is transmitted from the 5G UE 1 to the integrated eNB 2 (or the 5G specific eNB 6) via the New 5G RAT on the New 5G CG (e.g., the New 5G cells 23 and 24). Accordingly, the radio bearer # 2 may be hereinafter referred to as a New 5G bearer. When the data is transmitted on the New 5G CG managed by the 5G specific eNB 6, the radio bearer # 2 is similar to an SCG bearer in LTE Release 12 DC. Alternatively, when the data is transmitted on the New 5G CG managed by the integrated eNB 2, the radio bearer # 2 may be similar to a bearer on the SCG side of a split bearer in LTE Release 12 DC." Futaki, 9:14-24. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes the configuration information specific to the New 5G RAT (e.g., SCG configuration for 5G, Secondary RAT (sRAT) configuration). That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes the configuration information specific to the New 5G RAT. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes configuration information specific to the LTE RAT. The configuration information specific to the New 5G RAT may be any one or any combination of: Terminal capability-related information; Service-related information; and 5G CG management-related information." Futaki, 13:61-14:12. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 6, [0030-[0031], [0037], [0060]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the

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Claim Language		**Exemplary Citations to Futaki**
		knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

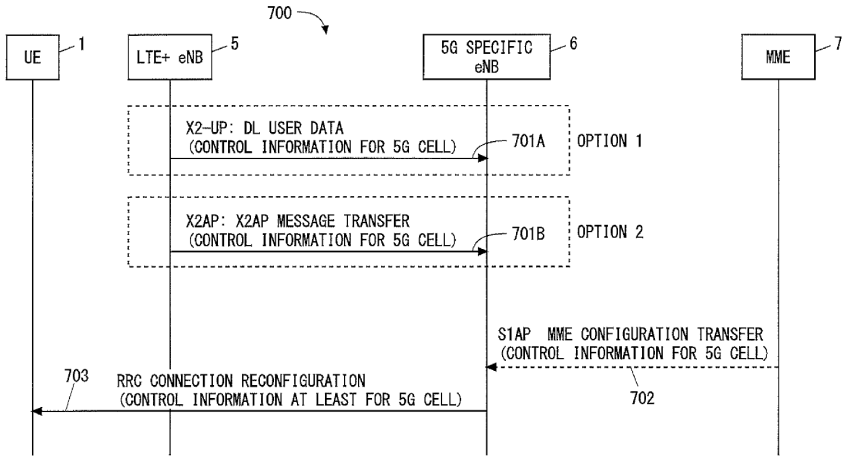
2. Claim 2

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
2[a]	The method according to claim 1, wherein the master base station and the second base station are base stations using radio access technologies different from each other.	At least under Pegasus's apparent infringement theory, Futaki discloses "The method according to claim 1, wherein the master base station and the second base station are base stations using radio access technologies different from each other." For example, Futaki discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Futaki**
		 Futaki at Fig. 3. "In the configuration examples shown in FIGS. 1 and 2, the LTE radio protocol and the New 5G radio protocol are implemented in one node (i.e., the integrated eNB 2). Accordingly, the configuration examples shown in FIGS. 1 and 2 are referred to as co-located deployments or co-located RAN. In the case of the L2 C-RAN configuration, a part of the New 5G radio protocol may be deployed in the RU. However, in another configuration example, non co-located deployments or non co-

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Claim Language		**Exemplary Citations to Futaki**
		located RAN may be employed. In the Non co-located deployments, the LTE radio protocol and the New 5G radio protocol are provided by two nodes (eNBs) different from each other. These two nodes are installed, for example, at two different sites geographically spaced apart from each other. FIG. 3 shows an example of the non co-located deployments of the radio communication network according to several embodiments including this embodiment. In the example shown in FIG. 3, the radio communication network includes a 5G UE 1, an LTE+ eNB 5, and a 5G specific eNB 6. The LTE+ eNB 5 provides an LTE CG (e.g., the cells 21 and 22) and the 5G specific eNB 6 provides a New 5G CG (e.g., the cells 23 and 24). The LTE+ eNB 5 is connected to the 5G specific eNB 6 by a communication line, such as an optical fiber link or a point-to-point radio link, and communicates with the 5G specific eNB 6 on an inter-base-station interface 301 (e.g., enhanced X2 interface). The LTE+ eNB 5 and the 5G specific eNB 6 interwork with each other to enable the 5G UE 1 to connect to both the LTE CG and the 5G CG using CA, DC, or an enhancement thereof." Futaki at 6:14-44. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 3, [0023]-[0024]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

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	Claim Language	**Exemplary Citations to Futaki**
3[a]	The method according to claim 1, wherein the addition of the secondary base station SRB is configured when the master base station performs a secondary base station addition procedure.	At least under Pegasus's apparent infringement theory, Futaki discloses "The method according to claim 1, wherein the addition of the secondary base station SRB is configured when the master base station performs a secondary base station addition procedure." For example, Futaki discloses this limitation based on the following exemplary citations:  Futaki at Fig. 7. "FIG. 7 shows an example in which the LTE+ eNB 5 sends control-plane information (i.e., CP message) regarding a New 5G cell(s) to the 5G specific eNB 6. In Step 701A or 701B, the 5G specific eNB 6 receives an X2 message containing at least control-plane information (i.e., CP message) regarding a New 5G cell(s) from the LTE+ eNB 5. This X2 message may be a DL USER DATA message of the X2 User Plane Protocol (X2-UP) (Step 701A) or may be a DL CONTROL DATA message that will be newly defined. This X2 message may be an X2 AP Message Transfer message of the X2AP (Step 701B). Alternatively, this X2 message may be an SeNB Modification Request message (e.g., MeNB to SeNB Container) defined for Dual Connectivity or

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Claim Language		**Exemplary Citations to Futaki**
		may be an X2 message (e.g., SeNB Configuration Request message) that will be newly defined." Futaki, 17:47-61. "Further or alternatively, the 5G specific eNB 6 may receive an S1AP message containing control-plane information regarding a New 5G cell(s) from the integrated EPC 41 (e.g., the MME 7) or the 5G specific EPC 42 (Step 702). This S1AP message may be an MME Configuration Transfer message, an MME Direct Information Transfer message, or another S1AP message. In Step 703, the 5G specific eNB 6 transmits an RRC Connection Reconfiguration message containing the control-plane information (i.e., CP message) regarding a New 5G cell(s), which has been received from the LTE+ eNB 5, the integrated EPC 41, or the 5G specific EPC 42, to the 5G UE 1 on a New 5G cell." Futaki, 17:62-18:6. "FIG. 8 shows an example in which the 5G specific eNB 6 sends control-plane information (i.e., CP message) regarding a New 5G cell(s) to the LTE+ eNB 5. In Step 801A or 801B, the 5G specific eNB 6 sends an X2 message containing at least control-plane information (i.e., CP message) regarding a New 5G cell(s) to the LTE+ eNB 5. This X2 message may be an X2AP Message Transfer message (Step 801A). Alternatively, this X2 message may be an SeNB Modification Required message defined for Dual Connectivity (Step 801B)." Futaki, 18:7-16. "The LTE+ eNB 5 may start an SeNB Modification procedure in response to the reception of the X2 message. For example, the LTE+ eNB 5 may send an SeNB Modification Request message (containing an RRC Container (i.e., SCG-ConfigInfo)) to the 5G specific eNB 6 (Step 802). In response to the reception of the SeNB Modification Request message, the 5G specific eNB 6 may send an SeNB Modification Request Acknowledge message (containing an RRC Container (i.e., SCG-Config)) to the LTE+ eNB 5 (Step 803). In Step 803, the 5G specific eNB 6 may send control-plane information regarding a 5G cell(s) to the LTE+ eNB 5." Futaki, 18:16-27.

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Claim Language		**Exemplary Citations to Futaki**
		The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 7, [0077]-[0080]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

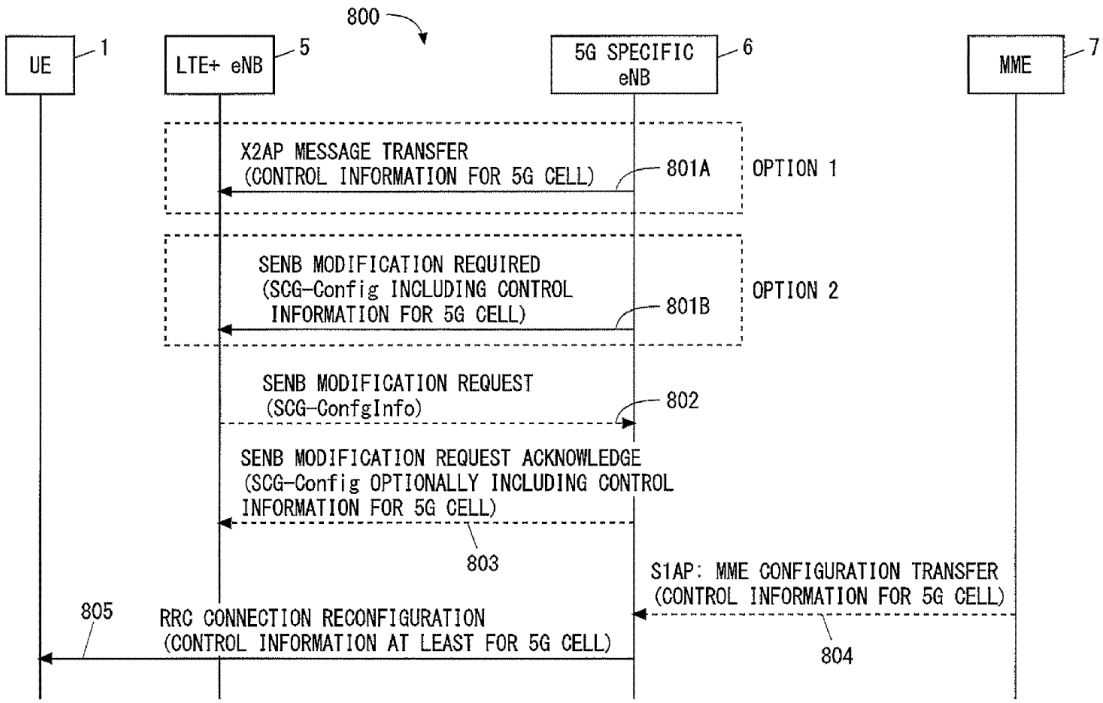
4. Claim 6

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Claim Language		**Exemplary Citations to Futaki**
6[a]	The method according to claim 1, wherein the failure information message includes cause information on the secondary base station radio resource configuration failure.	At least under Pegasus's apparent infringement theory, Futaki discloses "The method according to claim 1, wherein the failure information message includes cause information on the secondary base station radio resource configuration failure." For example, Futaki discloses this limitation based on the following exemplary citations: "To be more specific, the 5G UE 1 is configured to transmit or receive CP messages to or from the base station system on any New 5G cell within the New 5G CG when a predetermined condition is satisfied. In a similar way, the base station system is configured to transmit or receive CP message to or from the 5G UE 1 on any New 5G cell within the New 5G CG when a predetermined condition is satisfied. The predetermined condition, which is used to determine which one of the LTE CG and

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Claim Language		**Exemplary Citations to Futaki**
		the New 5G CG is used to transmit a CP message, relates to at least one of the following: (a) the content or type of the CP message (b) the type of the signalling radio bearer used to transmit the CP message, (c) the transmission cause of the CP message; and (d) the type of the core network associated with the NAS message." Futaki, 10:57-11:6. "The above condition (c) may be that the transmission cause of the CP message is (or is not) a specific transmission cause. For example, the specific transmission cause may be at least one of: degradation of a radio quality of the New 5G cell; a failure of a radio link establishment in the LTE cell or the New 5G cell; a request for re-establishment of the radio link after the failure of the radio link establishment; and a response to the request for re-establishment of the radio link." Futaki, 11:27-35. "The radio link-related information may be information regarding degradation of a radio quality (e.g., Radio Link Failure: RLF) in the LTE CG (e.g., PCell) or the New 5G CG (e.g., PSCell, Special cell) or information regarding a failure of radio link establishment (e.g., RRC Connection Establishment Failure: CEF, RRC Connection Re-establishment failure). For example, the information regarding degradation of a radio quality in the LTE CG may be requested or reported on the LTE CG (or the New 5G CG). In a similar way, the information regarding the degradation of a radio quality in the 5G CG may be requested or reported on the New 5G CG (or the LTE CG). In contrast, the information regarding a failure of radio link establishment may be always requested or reported on the LTE CG (or the New 5G CG). The radio link establishment may include a procedure using an RRC Connection Reconfiguration to change the configuration of the radio protocol(s) (e.g., RRC, PDCP, RLC, MAC, or PHY). Further, the 5G UE 1 may store the information regarding a failure of radio link establishment in the LTE CG and the information regarding a failure of radio link establishment in the New 5G CG separately from each other." Futaki, 12:32-53.

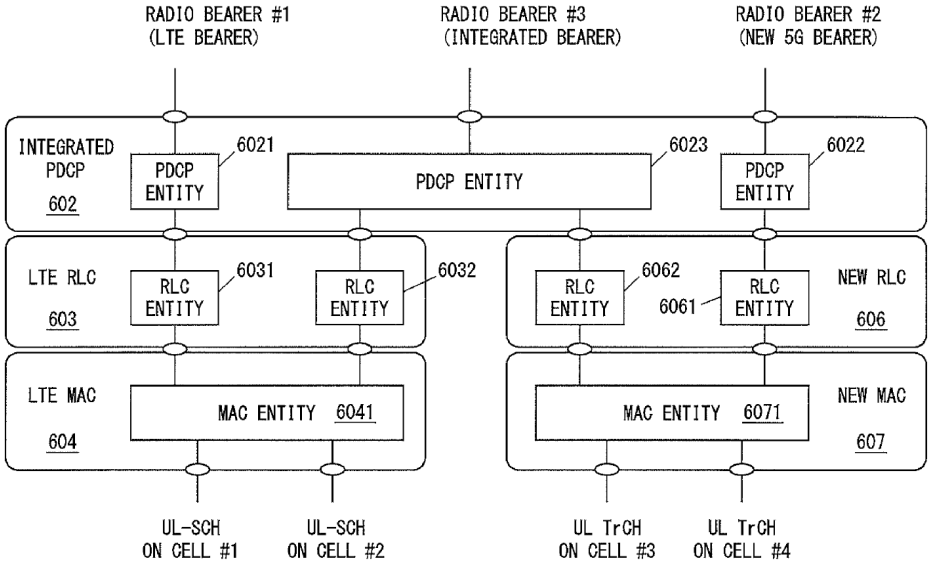
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		"In a ninth implementation, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit a CP message (i.e., an RRC message or a NAS message) depending on whether the transmission cause of this CP message indicates degradation of a radio quality of any New 5G cell. That is, the 5G UE 1 may transmit a CP message on any cell within the New 5G CG when this CP message is transmitted due to degradation of the radio quality of any New 5G cell. The base station system may receive this CP message on any cell within the New 5G CG. This, for example, contributes to transmission of CP messages regarding the New 5G RAT (or a New 5G cell(s)) with low latency. In contrast, the 5G UE 1 may transmit an RRC message containing a NAS message on any LTE cell when the transmission cause of the CP message indicates degradation of a radio quality of any LTE cell." Futaki, 16:41-56. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at [0047]-[0054], [0072]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 7

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	Claim Language	**Exemplary Citations to Futaki**
7[pre]	A method of a secondary base station for controlling dual connectivity of a user equipment, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Futaki discloses "A method of a secondary base station for controlling dual connectivity of a user equipment, the method comprising." For example, Futaki discloses this limitation based on the following exemplary citations:  Futaki at Fig. 8. "The present disclosure relates to communication between a radio station and a radio terminal using a plurality of Radio Access Technologies (RATs)." Futaki, 1:17-19.

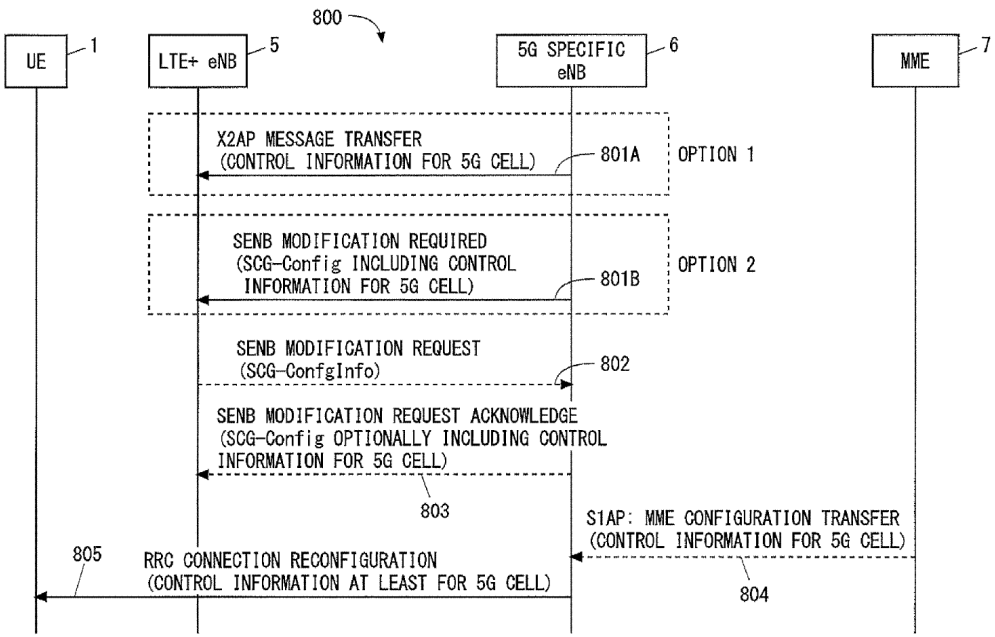
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		"Higher frequency can provide higher-rate communication. However, because of its frequency properties, coverage of the higher frequency is more local. Therefore, high frequencies are used to boost capacity and data rates in specific areas, while wide-area coverage is provided by lower current frequencies. That is, in order to ensure the stability of New 5G RAT communication in high frequency bands, tight integration or interworking between low and high frequencies (i.e., tight integration or interworking between LTE/LTE-Advanced and New 5G RAT) is required. A 5G supporting radio terminal (i.e., 5G User Equipment (UE)) is connected to both of a low frequency band cell and a high frequency band cell (i.e., a LTE/LTE-Advanced cell and a new 5G cell) by using Carrier Aggregation (CA) or Dual Connectivity (DC), or a modified technique thereof." Futaki, 1:36-50. "FIG. 1 shows a configuration example of a radio communication network according to several embodiments including this embodiment. In the example shown in FIG. 1, the radio communication network includes a radio terminal (UE) 1 and an integrated base station (i.e., integrated eNB) 2. The UE 1 is a 5G UE and connects to both one or more LTE cells (e.g., cells 21 and 22) and one or more New 5G cells (e.g., cells 23 and 24) using CA, DC, or an enhancement thereof. In the following description, one or more LTE cells are referred to as an LTE cell group (CG) and one or more New 5G cells used by the 5G UE 1 are referred to as a New 5G CG. Each of the cells in the LTE CG and New 5G CG has been configured for the 5G UE 1 by the integrated eNB 2 and has been activated by the integrated eNB 2. In some implementations, frequency bands (e.g., F1 and F2) of the LTE CG (e.g., the cells 21 and 22) are lower frequency bands (e.g., lower than 6 GHz) and frequency bands (e.g., F3 and F4) of the New 5G CG (e.g., the cells 23 and 24) are higher frequency bands (e.g., higher than 6 GHz)." Futaki, 5:22-40. *See* 1[b] The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 8, [0001], [0020].

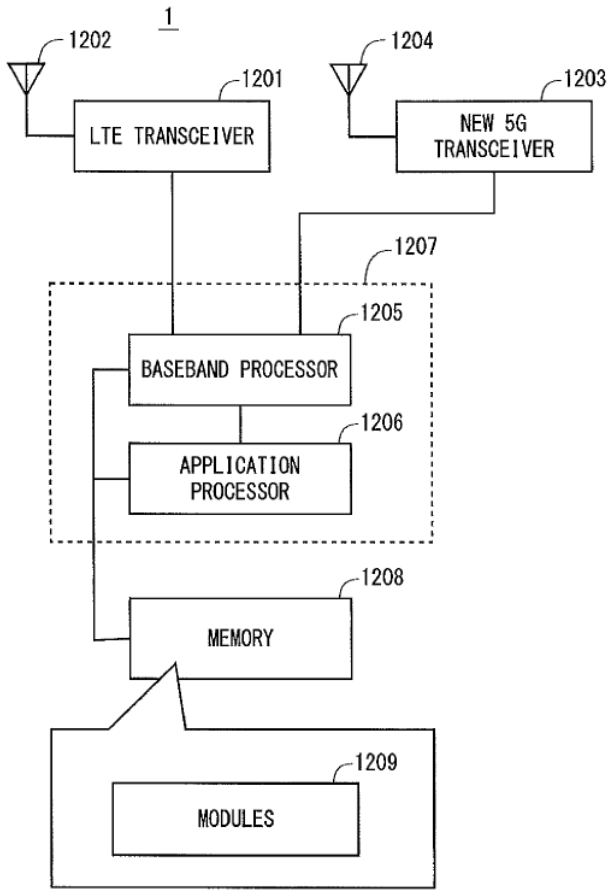
Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[a]	determining, by the secondary base station, to add a secondary base station signaling radio bearer (SRB) to the user equipment;	At least under Pegasus's apparent infringement theory, Futaki discloses "determining, by the secondary base station, to add a secondary base station signaling radio bearer (SRB) to the user equipment." For example, Futaki discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Futaki**
		 Futaki at Fig. 6. "In some implementations, the 5G specific eNB 6 used in the non co-located deployments may include a New RRC layer 511 and a New PDCP layer 512. Further, the 5G specific eNB 6 may include a control interface or connection (e.g., an S1-MME interface or an S1-U interface) with a core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) for the 5G UE 1. In some implementations, the New RRC layer 511 may configure the lower layers 406-408 of the New 5G CG (e.g., New 5G cells 23 and 24) and transmit system information (i.e., Master Information Block (MIB), or System Information Blocks (SIBs), or both) via the New 5G CG. The New RRC layer 511 may configure a signalling radio bearer with the 5G UE 1, also configure the lower layers 406-408 of the New 5G CG (e.g., the New 5G cells 23 and 24) and the New PDCP layer 512, and then transmit or receive RRC messages to or from the 5G UE 1 through the New 5G CG. The New RRC layer 511 may transfer NAS messages between the core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) and the 5G UE 1. The New PDCP layer 512 provides the New RRC

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Claim Language		**Exemplary Citations to Futaki**
		layer 511 with a transfer service of RRC messages via the New 5G lower layers 406-408." Futaki, 7:51-8:5. "The New RRC layer 511 may depend on the integrated RRC layer 401 (i.e., have a dependency relationship) or may perform control similar to that performed by the integrated RRC layer 401 (i.e., have a similar function). In the former case (i.e., dependency relationship), the 5G specific eNB 6 (or the New RRC layer 511 thereof) may generate RRC configuration information with respect to a New 5G cell(s) (i.e., New 5G CG) in response to an instruction or a request from the LTE+ eNB 5 (or the integrated RRC layer 401 thereof). The 5G specific eNB 6 (or the New RRC layer 511 thereof) may transmit this RRC configuration information to the LTE+ eNB 5 (or the integrated RRC layer 401 thereof) and the LTE+ eNB 5 may transmit an RRC message containing this RRC configuration information (e.g., an RRC Connection Reconfiguration message) to the 5G UE 1 on an LTE cell (i.e., LTE CG). Alternatively, the 5G specific eNB 6 (or the New RRC layer 511 thereof) may transmit an RRC message containing this RRC configuration information to the 5G UE 1 on a New 5G cell." Futaki, 8:6-24. "The data of the radio bearer # 2 is transmitted from the 5G UE 1 to the integrated eNB 2 (or the 5G specific eNB 6) via the New 5G RAT on the New 5G CG (e.g., the New 5G cells 23 and 24). Accordingly, the radio bearer # 2 may be hereinafter referred to as a New 5G bearer. When the data is transmitted on the New 5G CG managed by the 5G specific eNB 6, the radio bearer # 2 is similar to an SCG bearer in LTE Release 12 DC. Alternatively, when the data is transmitted on the New 5G CG managed by the integrated eNB 2, the radio bearer # 2 may be similar to a bearer on the SCG side of a split bearer in LTE Release 12 DC." Futaki, 9:14-24. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes the configuration information specific to the New 5G RAT (e.g., SCG configuration for 5G, Secondary RAT (sRAT) configuration).

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		That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes the configuration information specific to the New 5G RAT. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes configuration information specific to the LTE RAT. The configuration information specific to the New 5G RAT may be any one or any combination of: Terminal capability-related information; Service-related information; and 5G CG management-related information." Futaki, 13:61-14:12. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 6, [0030-[0031], [0037], [0060]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[b]	transmitting a radio resource control (RRC) message including radio resource configuration information on the secondary base station or a secondary cell group to the user equipment through the	At least under Pegasus's apparent infringement theory, Futaki discloses "transmitting a radio resource control (RRC) message including radio resource configuration information on the secondary base station or a secondary cell group to the user equipment through the secondary base station SRB; and." For example, Futaki discloses this limitation based on the following exemplary citations:

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	secondary base station SRB; and	 Futaki at Fig. 8.

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		 Futaki at Fig. 12. "The 5G UE 1 may support the protocol stack shown in FIG. 4 or support another protocol stack to communicate with the radio network shown in FIG. 5. For example, the 5G UE 1 may have an RRC layer (i.e., a master RRC layer or a primary RRC layer) corresponding to the integrated RRC layer 401 of the LTE+ eNB 5 and an

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		auxiliary RRC layer (i.e., a sub RRC layer or a secondary RRC layer) corresponding to the New RRC layer 511 of the 5G specific eNB 6. For example, the sub RRC layer may perform one or both of transmission and reception (or one or both of generation and restoration) of a part of the RRC configuration information controlled by the master RRC layer. The 5G UE 1 may receive both the RRC configuration information regarding a LTE cell(s) (i.e., LTE CG) and the RRC configuration information regarding a New 5G cell(s) (i.e., New 5G CG) through an LTE cell or through a New 5G cell. Alternatively, the 5G UE 1 may receive the RRC configuration information regarding a LTE cell(s) (i.e., LTE CG) through an LTE cell and meanwhile receive the RRC configuration information regarding a New 5G cell(s) (i.e., New 5G CG) through a New 5G cell." Futaki, 8:25-45. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes the configuration information specific to the New 5G RAT (e.g., SCG configuration for 5G, Secondary RAT (sRAT) configuration). That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes the configuration information specific to the New 5G RAT. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes configuration information specific to the LTE RAT. The configuration information specific to the New 5G RAT may be any one or any combination of: Terminal capability-related information; Service-related information; and 5G CG management-related information." Futaki, 13:61-14:12. "The 5G CG management-related information may be information regarding a modification of a specific cell (e.g., PSCell, Special cell) within the New 5G CG (e.g., PSCell/Special cell reconfiguration, pSCellToAddMod-rlx). Further or alternatively, when the base station system adds or releases another New 5G cell

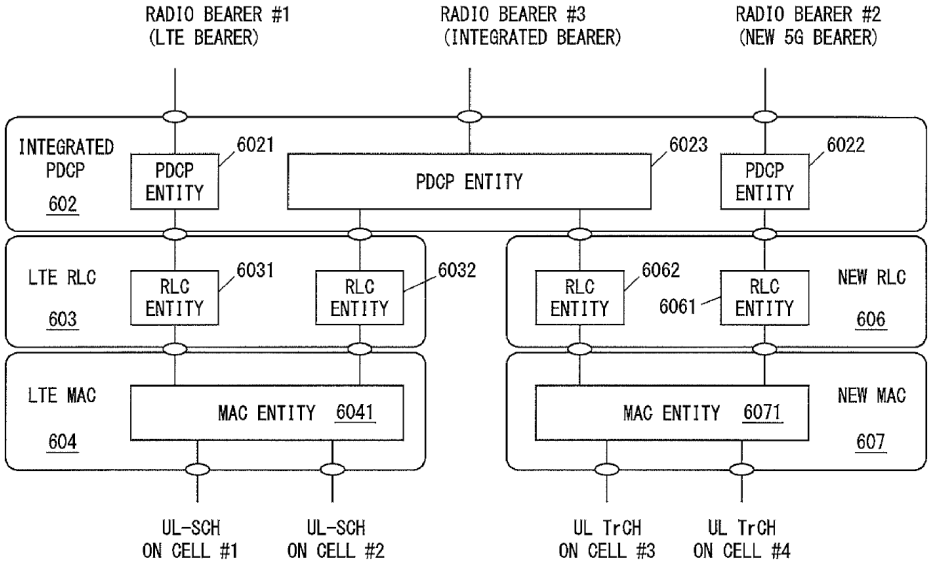
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		(e.g., 5G SCell) for the 5G UE 1 after the base station system configures the specific New 5G cell (e.g., PSCell, Special cell) for the 5G UE 1 (that is, after the specific 5G cell becomes available), the base station system may transmit radio resource configuration information about this other New 5G cell (e.g., sCellToAddModListSRAT, sCellToReleaseListSRAT, RadioResourceConfigDedicatedSCellSRAT) as the 5G CG management-related information. That is, the information relating to addition/release of a cell within the New 5G CG and the information relating to modification of the specific New 5G cell may be transmitted on any cell within the New 5G CG." Futaki, 14:43-59. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes control information newly defined by the 3GPP for New 5G cells. That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes control information newly defined for New 5G cells. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes existing control information for LTE. The control information for New 5G cells may be any one or a combination of: Core network selection-related information; and Information regarding a standalone operation of a New 5G cell(s)." Futaki, 15:1-17. "The information regarding the standalone operation of a New 5G cell(s) may be configuration information (e.g., Radio resource configuration for 5G/SRAT PCell) that is required to use a New 5G cell as a primary cell (PCell) instead of using a New 5G cell as a secondary cell (SCell) with the LTE PCell cell. Alternatively, the information regarding the standalone operation of a New 5G cell(s) may be information (e.g., Handover to a 5G/SRAT cell or Redirection to a 5G/SRAT cell) indicating a request or an indication that a New 5G cell is to be used as the PCell. Such information may be transmitted in a signalling radio bearer (e.g., SRBx) that

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		will be newly defined. In addition, information required to configure this SRBx may be transmitted on a New 5G cell or on a LTE cell." Futaki, 15:41-54. "In the above-described first to sixth implementations, the 5G UE 1 and the base station system determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message relates to the New 5G RAT (or a New 5G cell(s)). Accordingly, the 5G UE 1 and the base station system are able to transmit or receive RRC messages relating to the New 5G RAT (or a New 5G cell(s)) through any cell within a New 5G CG. This, for example, contributes to transmission of RRC messages regarding the New 5G RAT (or a New 5G cell(s)) with low latency." Futaki, 15:55-65. "In Step 805, the 5G specific eNB 6 transmits an RRC Connection Reconfiguration message containing the control-plane information (the CP message) regarding a New 5G cell(s) to the 5G UE 1 on a New 5G cell." Futaki, 18:35-38. "The baseband processor 1205 performs digital baseband signal processing (data-plane processing) and control-plane processing for radio communication. The digital baseband signal processing includes (a) data compression/decompression, (b) data segmentation/concatenation, (c) composition/decomposition of a transmission format (i.e., transmission frame), (d) channel coding/decoding, (e) modulation (i.e., symbol mapping)/demodulation, and (f) generation of OFDM symbol data (i.e., baseband OFDM signal) by Inverse Fast Fourier Transform (IFFT). Meanwhile, the control-plane processing includes communication management of layer 1 (e.g., transmission power control), layer 2 (e.g., radio resource management and hybrid automatic repeat request (HARQ) processing), and layer 3 (e.g., signalling regarding attach, mobility, and packet communication)." Futaki, 20:24-39. *See* 1[b]

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		The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 8, Fig. 12, [0032], [0060]-[0065], [0082], [0094]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[c]	receiving a response message for a radio resource configuration from the user equipment through the secondary BS SRB if the UE successfully complies with a radio resource on the secondary base station,	At least under Pegasus's apparent infringement theory, Futaki discloses "receiving a response message for a radio resource configuration from the user equipment through the secondary BS SRB if the UE successfully complies with a radio resource on the secondary base station." For example, Futaki discloses this limitation based on the following exemplary citations: "In the following, an operation of transmitting a control-plane (CP) message performed by the 5G UE 1 and the integrated eNB 2 (or the LTE+ eNB 5 and the 5G specific eNB 6) according to this embodiment will be explained. The 5G UE 1 and the base station system are configured to transmit CP messages (i.e., RRC signalling) on a New 5G cell after completion of configuration and activation of this New 5G cell (i.e., after the New 5G cell becomes available for the 5G UE 1). The 5G UE 1 and the base station system may switch the cell, to be used to transmit CP messages, from the LTE cell to the New 5G cell. Further or alternatively, the 5G UE 1 and the base station system may adaptively change the cell, to be used to transmit CP messages, between the LTE cell and the New 5G cell. The CP messages include NAS messages or RRC messages or both. The base station system is the integrated eNB 2, or a combination of the LTE+eNB 5 and the 5G specific eNB 6." Futaki, 10:40-56.

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		"To be more specific, the 5G UE 1 is configured to transmit or receive CP messages to or from the base station system on any New 5G cell within the New 5G CG when a predetermined condition is satisfied. In a similar way, the base station system is configured to transmit or receive CP message to or from the 5G UE 1 on any New 5G cell within the New 5G CG when a predetermined condition is satisfied. The predetermined condition, which is used to determine which one of the LTE CG and the New 5G CG is used to transmit a CP message, relates to at least one of the following: (a) the content or type of the CP message (b) the type of the signalling radio bearer used to transmit the CP message, (c) the transmission cause of the CP message; and (d) the type of the core network associated with the NAS message." Futaki, 10:57-11:6 "The above condition (c) may be that the transmission cause of the CP message is (or is not) a specific transmission cause. For example, the specific transmission cause may be at least one of: degradation of a radio quality of the New 5G cell; a failure of a radio link establishment in the LTE cell or the New 5G cell; a request for re-establishment of the radio link after the failure of the radio link establishment; and a response to the request for re-establishment of the radio link." Futaki, 11:27-35. "In a second implementation, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes a request message for the terminal (holding) information of the 5G UE 1 regarding the New 5G RAT (e.g., UE information request message) or depending on whether this RRC message includes a report message carrying the terminal (holding) information (e.g., UE information response message). That is, when an RRC message includes a report of (or a request for) the terminal (holding) information of the 5G UE 1 regarding the New 5G RAT, the 5G UE 1 may transmit (or receive) this RRC message on any cell within the New 5G CG. The base station

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		system may receive (or transmit) this RRC message on any cell within the New 5G CG. In contrast, when an RRC message includes a report of (or a request for) the terminal (holding) information of the 5G UE 1 regarding the LTE RAT, the 5G UE 1 may transmit (or receive) this RRC message on any LTE cell. Further, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on the type of the terminal (holding) information to be requested or reported. The type of the terminal (holding) information may be any one or any combination of: Radio link-related information; Random access-related information; and Mobility history-related information." Futaki, 12:5-31. "The radio link-related information may be information regarding degradation of a radio quality (e.g., Radio Link Failure: RLF) in the LTE CG (e.g., PCell) or the New 5G CG (e.g., PSCell, Special cell) or information regarding a failure of radio link establishment (e.g., RRC Connection Establishment Failure: CEF, RRC Connection Re-establishment failure). For example, the information regarding degradation of a radio quality in the LTE CG may be requested or reported on the LTE CG (or the New 5G CG). In a similar way, the information regarding the degradation of a radio quality in the 5G CG may be requested or reported on the New 5G CG (or the LTE CG). In contrast, the information regarding a failure of radio link establishment may be always requested or reported on the LTE CG (or the New 5G CG). The radio link establishment may include a procedure using an RRC Connection Reconfiguration to change the configuration of the radio protocol(s) (e.g., RRC, PDCP, RLC, MAC, or PHY). Further, the 5G UE 1 may store the information regarding a failure of radio link establishment in the LTE CG and the information regarding a failure of radio link establishment in the New 5G CG separately from each other." Futaki, 12:32-53. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at [0046]-[0054].

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		To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[d]	wherein the user equipment configures dual connectivity by using a master base station and the secondary base station.	At least under Pegasus's apparent infringement theory, Futaki discloses "wherein the user equipment configures dual connectivity by using a master base station and the secondary base station." For example, Futaki discloses this limitation based on the following exemplary citations: 

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		Futaki at Fig. 6. "In some implementations, the 5G specific eNB 6 used in the non co-located deployments may include a New RRC layer 511 and a New PDCP layer 512. Further, the 5G specific eNB 6 may include a control interface or connection (e.g., an S1-MME interface or an S1-U interface) with a core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) for the 5G UE 1. In some implementations, the New RRC layer 511 may configure the lower layers 406-408 of the New 5G CG (e.g., New 5G cells 23 and 24) and transmit system information (i.e., Master Information Block (MIB), or System Information Blocks (SIBs), or both) via the New 5G CG. The New RRC layer 511 may configure a signalling radio bearer with the 5G UE 1, also configure the lower layers 406-408 of the New 5G CG (e.g., the New 5G cells 23 and 24) and the New PDCP layer 512, and then transmit or receive RRC messages to or from the 5G UE 1 through the New 5G CG. The New RRC layer 511 may transfer NAS messages between the core network (e.g., the integrated EPC 41 or the 5G specific EPC 42) and the 5G UE 1. The New PDCP layer 512 provides the New RRC layer 511 with a transfer service of RRC messages via the New 5G lower layers 406-408." Futaki, 7:51-8:5. "The New RRC layer 511 may depend on the integrated RRC layer 401 (i.e., have a dependency relationship) or may perform control similar to that performed by the integrated RRC layer 401 (i.e., have a similar function). In the former case (i.e., dependency relationship), the 5G specific eNB 6 (or the New RRC layer 511 thereof) may generate RRC configuration information with respect to a New 5G cell(s) (i.e., New 5G CG) in response to an instruction or a request from the LTE+ eNB 5 (or the integrated RRC layer 401 thereof). The 5G specific eNB 6 (or the New RRC layer 511 thereof) may transmit this RRC configuration information to the LTE+ eNB 5 (or the integrated RRC layer 401 thereof) and the LTE+ eNB 5 may transmit an RRC message containing this RRC configuration information (e.g., an RRC Connection Reconfiguration message) to the 5G UE 1 on an LTE cell (i.e., LTE CG). Alternatively, the 5G specific eNB 6 (or the New RRC layer 511 thereof) may

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		transmit an RRC message containing this RRC configuration information to the 5G UE 1 on a New 5G cell." Futaki, 8:6-24. "The data of the radio bearer # 2 is transmitted from the 5G UE 1 to the integrated eNB 2 (or the 5G specific eNB 6) via the New 5G RAT on the New 5G CG (e.g., the New 5G cells 23 and 24). Accordingly, the radio bearer # 2 may be hereinafter referred to as a New 5G bearer. When the data is transmitted on the New 5G CG managed by the 5G specific eNB 6, the radio bearer # 2 is similar to an SCG bearer in LTE Release 12 DC. Alternatively, when the data is transmitted on the New 5G CG managed by the integrated eNB 2, the radio bearer # 2 may be similar to a bearer on the SCG side of a split bearer in LTE Release 12 DC." Futaki, 9:14-24. "In a sixth implementation, the base station system may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes the configuration information specific to the New 5G RAT (e.g., SCG configuration for 5G, Secondary RAT (sRAT) configuration). That is, the base station system may transmit an RRC message on any cell within the New 5G CG when this RRC message includes the configuration information specific to the New 5G RAT. The 5G UE 1 may receive this RRC message on any cell within the New 5G CG. In contrast, the base station system may transmit an RRC message on any LTE cell when this RRC message includes configuration information specific to the LTE RAT. The configuration information specific to the New 5G RAT may be any one or any combination of: Terminal capability-related information; Service-related information; and 5G CG management-related information." Futaki, 13:61-14:12. *See* 1[b] The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at Fig. 6, [0030-[0031], [0037], [0060].

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		To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 8

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8[a]	The method according to claim 7, wherein the master base station and the secondary base station are base stations using radio access technologies different from each other.	At least under Pegasus's apparent infringement theory, Futaki discloses "The method according to claim 7, wherein the master base station and the secondary base station are base stations using radio access technologies different from each other." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 2[a] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable

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		expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

7. Claim 9

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9[a]	The method according to claim 7, wherein, in case the user equipment is unable to comply with the radio resource configuration information included in the RRC message, the user equipment is configured to transmit a failure information message to the master base station.	At least under Pegasus's apparent infringement theory, Futaki discloses "The method according to claim 7, wherein, in case the user equipment is unable to comply with the radio resource configuration information included in the RRC message, the user equipment is configured to transmit a failure information message to the master base station." For example, Futaki discloses this limitation based on the following exemplary citations: "In the following, an operation of transmitting a control-plane (CP) message performed by the 5G UE 1 and the integrated eNB 2 (or the LTE+ eNB 5 and the 5G specific eNB 6) according to this embodiment will be explained. The 5G UE 1 and the base station system are configured to transmit CP messages (i.e., RRC signalling) on a New 5G cell after completion of configuration and activation of this New 5G cell (i.e., after the New 5G cell becomes available for the 5G UE 1). The 5G UE 1 and the base station system may switch the cell, to be used to transmit CP messages, from the LTE cell to the New 5G cell. Further or alternatively, the 5G UE 1 and the base station system may adaptively change the cell, to be used to transmit CP messages, between the LTE cell and the New 5G cell. The CP messages include NAS messages or RRC messages or both. The base station system is the integrated eNB 2, or a combination of the LTE+eNB 5 and the 5G specific eNB 6." Futaki, 10:40-56. "To be more specific, the 5G UE 1 is configured to transmit or receive CP messages to or from the base station system on any New 5G cell within the New 5G CG when a

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		predetermined condition is satisfied. In a similar way, the base station system is configured to transmit or receive CP message to or from the 5G UE 1 on any New 5G cell within the New 5G CG when a predetermined condition is satisfied. The predetermined condition, which is used to determine which one of the LTE CG and the New 5G CG is used to transmit a CP message, relates to at least one of the following: (a) the content or type of the CP message (b) the type of the signalling radio bearer used to transmit the CP message, (c) the transmission cause of the CP message; and (d) the type of the core network associated with the NAS message." Futaki, 10:57-11:6 "The above condition (c) may be that the transmission cause of the CP message is (or is not) a specific transmission cause. For example, the specific transmission cause may be at least one of: degradation of a radio quality of the New 5G cell; a failure of a radio link establishment in the LTE cell or the New 5G cell; a request for re-establishment of the radio link after the failure of the radio link establishment; and a response to the request for re-establishment of the radio link." Futaki, 11:27-35. "In a second implementation, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on whether this RRC message includes a request message for the terminal (holding) information of the 5G UE 1 regarding the New 5G RAT (e.g., UE information request message) or depending on whether this RRC message includes a report message carrying the terminal (holding) information (e.g., UE information response message). That is, when an RRC message includes a report of (or a request for) the terminal (holding) information of the 5G UE 1 regarding the New 5G RAT, the 5G UE 1 may transmit (or receive) this RRC message on any cell within the New 5G CG. The base station system may receive (or transmit) this RRC message on any cell within the New 5G CG. In contrast, when an RRC message includes a report of (or a request for) the terminal (holding) information of the 5G UE 1 regarding the LTE RAT, the 5G UE 1

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		may transmit (or receive) this RRC message on any LTE cell. Further, the 5G UE 1 may determine which one of the New 5G CG and the LTE CG is to be used to transmit an RRC message depending on the type of the terminal (holding) information to be requested or reported. The type of the terminal (holding) information may be any one or any combination of: Radio link-related information; Random access-related information; and Mobility history-related information." Futaki, 12:5-31. "The radio link-related information may be information regarding degradation of a radio quality (e.g., Radio Link Failure: RLF) in the LTE CG (e.g., PCell) or the New 5G CG (e.g., PSCell, Special cell) or information regarding a failure of radio link establishment (e.g., RRC Connection Establishment Failure: CEF, RRC Connection Re-establishment failure). For example, the information regarding degradation of a radio quality in the LTE CG may be requested or reported on the LTE CG (or the New 5G CG). In a similar way, the information regarding the degradation of a radio quality in the 5G CG may be requested or reported on the New 5G CG (or the LTE CG). In contrast, the information regarding a failure of radio link establishment may be always requested or reported on the LTE CG (or the New 5G CG). The radio link establishment may include a procedure using an RRC Connection Reconfiguration to change the configuration of the radio protocol(s) (e.g., RRC, PDCP, RLC, MAC, or PHY). Further, the 5G UE 1 may store the information regarding a failure of radio link establishment in the LTE CG and the information regarding a failure of radio link establishment in the New 5G CG separately from each other." Futaki, 12:32-53. The 2016 Application supports these disclosures. *See, e.g.*, Translation of 2016 Application at [0046]-[0054]. To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the

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Claim Language		**Exemplary Citations to Futaki**
		knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 10

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
10[pre]	A user equipment for configuring dual connectivity, the user equipment comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Futaki discloses "A user equipment for configuring dual connectivity, the user equipment comprising." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 1[pre] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
10[a]	a controller configured to add and configure a secondary base station signaling radio bearer (SRB);	At least under Pegasus's apparent infringement theory, Futaki discloses "a controller configured to add and configure a secondary base station signaling radio bearer (SRB)." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 1[a] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
10[b]	a receiver configured to receive from a secondary base station, a radio resource control (RRC) message including radio resource configuration information on the secondary base station or a secondary cell group through the secondary base station SRB; and	At least under Pegasus's apparent infringement theory, Futaki discloses "a receiver configured to receive from a secondary base station, a radio resource control (RRC) message including radio resource configuration information on the secondary base station or a secondary cell group through the secondary base station SRB; and." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 1[b] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
10[c]	a transmitter configured to transmit a failure information message to a master base station in case the user equipment is unable to comply with the radio resource configuration information included in the RRC message,	At least under Pegasus's apparent infringement theory, Futaki discloses "a transmitter configured to transmit a failure information message to a master base station in case the user equipment is unable to comply with the radio resource configuration information included in the RRC message." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 1[c] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
10[d]	wherein the addition of the secondary base station SRB is determined by the secondary base station.	At least under Pegasus's apparent infringement theory, Futaki discloses "wherein the addition of the secondary base station SRB is determined by the secondary base station." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 1[d]

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 11

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
11[a]	The user equipment according to claim 10, wherein the master base station and the secondary base station are base stations using radio access technologies different from each other.	At least under Pegasus's apparent infringement theory, Futaki discloses "The user equipment according to claim 10, wherein the master base station and the secondary base station are base stations using radio access technologies different from each other." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 2[a] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
		expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

10. Claim 12

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
12[a]	The user equipment according to claim 10, wherein the addition of the secondary base station SRB is configured when the master base station performs a secondary base station addition procedure.	At least under Pegasus's apparent infringement theory, Futaki discloses "The user equipment according to claim 10, wherein the addition of the secondary base station SRB is configured when the master base station performs a secondary base station addition procedure." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 3[a] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

11. Claim 15

Invalidity of U.S. Patent 10,721,118 in view of Futaki		
Claim Language		**Exemplary Citations to Futaki**
15[a]	The user equipment according to claim 10, wherein the failure information message includes cause information on the secondary base station radio resource configuration failure.	At least under Pegasus's apparent infringement theory, Futaki discloses "The user equipment according to claim 10, wherein the failure information message includes cause information on the secondary base station radio resource configuration failure." For example, Futaki discloses this limitation based on the following exemplary citations: *See* 6[a] To the extent it is found that Futaki does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Futaki does not anticipate this claim, Futaki renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Futaki with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT G-15

Summary of Invalidity Analysis of U.S. Patent No. 11,219,000 ("'000 Patent") in view of R1-1711853

R1-1711853, titled "Activation/deactivation of bandwidth part," was publicly accessible by June 29, 2017. *See* https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/NR_AH_1706/Docs. Therefore, R1-1711853 qualifies as prior art to the '000 Patent under at least 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '000 Patent are invalid as expressly and/or inherently anticipated by R1-1711853.

To the extent that R1-1711853 is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '000 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of R1-1711853 in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine R1-1711853 and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
1[pre]	A method of transmitting uplink (UL) control information by a user equipment (UE), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, R1-1711853 discloses "A method of transmitting uplink (UL) control information by a user equipment (UE), the method comprising." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "receiving, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
1[b]	determining one of UL control channel resource sets contained in the received UL control channel resource set configuration information;	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "determining one of UL control channel resource sets contained in the received UL control channel resource set configuration information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	determining one of UL control channel resources contained in the determined UL control channel resource set; and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "determining one of UL control channel resources contained in the determined UL control channel resource set." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	transmitting UL control information through the	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "transmitting UL control information through the determined UL control channel resource." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
	determined UL control channel resource,	To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
[1]e	wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information, and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[f]	wherein the UL control channel resource set configuration information is received through UE	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource set configuration information is received through UE specific radio resource control (RRC) signaling." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
	specific radio resource control (RRC) signaling.	**3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1. Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
2	The method according to claim 1, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3	The method according to claim 2, wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853	
Claim Language	**Exemplary Citations to R1-1711853**

3GPP TSG RAN1 NR Ad-Hoc#2
Qingdao, P.R. China June 27th – 30th, 2017
Agenda Item: 5.1.7

R1-1711853

Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

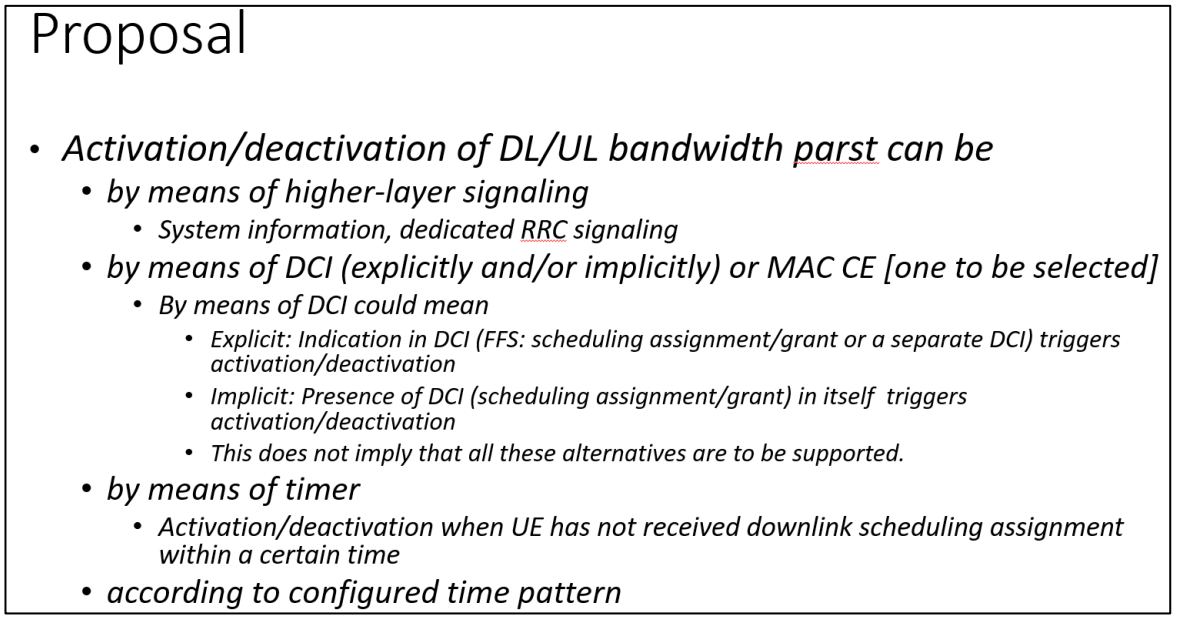
R1-1711853 at 1.

Proposal

- *Activation/deactivation of DL/UL bandwidth parst can be*
  - *by means of higher-layer signaling*
    - *System information, dedicated RRC signaling*
  - *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]*
    - *By means of DCI could mean*
      - *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation*
      - *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation*
      - *This does not imply that all these alternatives are to be supported.*
  - *by means of timer*
    - *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time*
  - *according to configured time pattern*

R1-1711853 at 2.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[a]	The method according to claim 1, further comprising: receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: **3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		 R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[b]	wherein the one of the UL control channel resources is indicated from the	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the one of the UL control channel resources is indicated from the base station through the DL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
	base station through the DL control information.	**3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1. Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 5

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
5[pre]	A method of receiving uplink (UL) control information by a base station, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, R1-1711853 discloses "A method of receiving uplink (UL) control information by a base station, the method comprising." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
5[a]	transmitting, to a user equipment (UE), UL control channel resource set configuration information for UL control information; and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "transmitting, to a user equipment (UE), UL control channel resource set configuration information for UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[b]	receiving the UL control information through one of UL control channel resources in one of UL control channel resource sets contained in the transmitted UL control channel resource set configuration information,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "receiving the UL control information through one of UL control channel resources in one of UL control channel resource sets contained in the transmitted UL control channel resource set configuration information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitations 1[b], 1[c], and 1[d] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
5[c]	wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information, and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[d]	wherein the UL control channel resource set configuration information is transmitted through UE specific radio resource control (RRC) signaling.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource set configuration information is transmitted through UE specific radio resource control (RRC) signaling." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853	
Claim Language	**Exemplary Citations to R1-1711853**

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Agenda Item: 5.1.7

R1-1711853

Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

R1-1711853 at 1.

Proposal

- *Activation/deactivation of DL/UL bandwidth parst can be*
  - *by means of higher-layer signaling*
    - *System information, dedicated RRC signaling*
  - *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]*
    - *By means of DCI could mean*
      - *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation*
      - *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation*
      - *This does not imply that all these alternatives are to be supported.*
  - *by means of timer*
    - *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time*
  - *according to configured time pattern*

R1-1711853 at 2.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
6	The method according to claim 5, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7	The method according to claim 6, wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 3 above.

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Claim Language	**Exemplary Citations to R1-1711853**

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Agenda Item: 5.1.7

R1-1711853

Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

R1-1711853 at 1.

Proposal

- *Activation/deactivation of DL/UL bandwidth parst can be*
  - *by means of higher-layer signaling*
    - *System information, dedicated RRC signaling*
  - *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]*
    - *By means of DCI could mean*
      - *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation*
      - *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation*
      - *This does not imply that all these alternatives are to be supported.*
  - *by means of timer*
    - *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time*
  - *according to configured time pattern*

R1-1711853 at 2.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[a]	The method according to claim 5, further comprising: transmitting, to the user equipment, downlink (DL) control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "transmitting, to the user equipment, downlink (DL) control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 4[a] above. **3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[b]	wherein the one of the UL control channel resources is indicated to the UE	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the one of the UL control channel resources is indicated to the UE through the DL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
	through the DL control information.	*See* limitation 4[b] above. **3GPP TSG RAN1 NR Ad-Hoc#2** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** **R1-1711853** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 9

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
9[pre]	A user equipment (UE) for transmitting uplink (UL) control information, comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, R1-1711853 discloses "A user equipment (UE) for transmitting uplink (UL) control information, comprising." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	a controller configured to determine one of UL control channel resource sets contained in the received UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "a controller configured to determine one of UL control channel resource sets contained in the received UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitations 1[b] and 1[c] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[c]	a transmitter configured to transmit the UL control information through the determined UL control channel resource,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "a transmitter configured to transmit the UL control information through the determined UL control channel resource." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[d] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[d]	wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information, and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[e]	wherein the UL control channel resource set configuration information is received through UE specific radio resource control (RRC) signaling.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource set configuration information is received through UE specific radio resource control (RRC) signaling." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above.

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Claim Language		**Exemplary Citations to R1-1711853**

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Agenda Item: 5.1.7

R1-1711853

Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

R1-1711853 at 1.

Proposal

- *Activation/deactivation of DL/UL bandwidth parst can be*
  - *by means of higher-layer signaling*
    - *System information, dedicated RRC signaling*
  - *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]*
    - *By means of DCI could mean*
      - *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation*
      - *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation*
      - *This does not imply that all these alternatives are to be supported.*
  - *by means of timer*
    - *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time*
  - *according to configured time pattern*

R1-1711853 at 2.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
10	The UE according to claim 9, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
11	The UE according to claim 10, wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 3 above.

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Claim Language	**Exemplary Citations to R1-1711853**

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Agenda Item: 5.1.7

R1-1711853

Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

R1-1711853 at 1.

Proposal

- *Activation/deactivation of DL/UL bandwidth parst can be*
  - *by means of higher-layer signaling*
    - *System information, dedicated RRC signaling*
  - *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]*
    - *By means of DCI could mean*
      - *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation*
      - *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation*
      - *This does not imply that all these alternatives are to be supported.*
  - *by means of timer*
    - *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time*
  - *according to configured time pattern*

R1-1711853 at 2.

<table>
<tr><th colspan="3">Invalidity of U.S. Patent 11,219,000 in view of R1-1711853</th></tr>
<tr><th colspan="2">Claim Language</th><th>Exemplary Citations to R1-1711853</th></tr>
<tr><td></td><td></td><td>To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.</td></tr>
<tr><td>12[a]</td><td>The UE according to claim 9, wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,</td><td>At least under Pegasus’s apparent infringement theory, R1-1711853 discloses “wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission.” For example, R1-1711853 discloses this limitation based on the following exemplary citations:

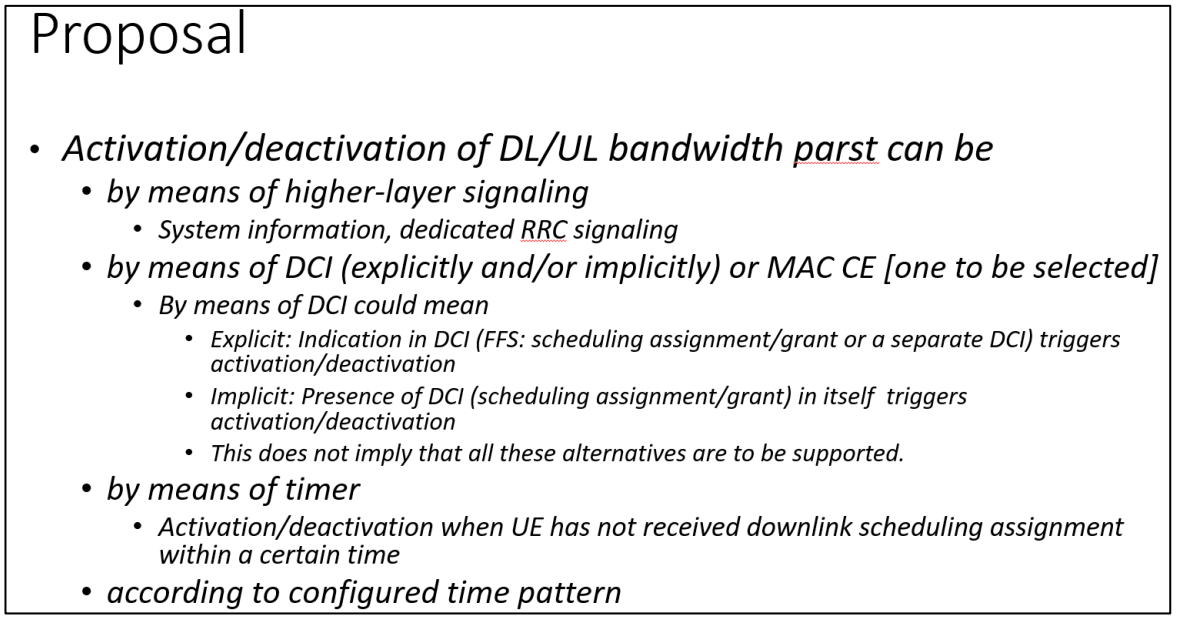
See limitation 4[a] above.

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Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

R1-1711853 at 1.</td></tr>
</table>

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<tr><th colspan="3">Invalidity of U.S. Patent 11,219,000 in view of R1-1711853</th></tr>
<tr><th colspan="2">Claim Language</th><th>Exemplary Citations to R1-1711853</th></tr>
<tr><td></td><td></td><td>


R1-1711853 at 2.

To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.</td></tr>
<tr><td>12[b]</td><td>wherein the one of the UL control channel resources is indicated from the</td><td>At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the one of the UL control channel resources is indicated from the base station through the DL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:</td></tr>
</table>

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
	base station through the DL control information.	*See* limitation 4[b] above. **3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

Invalidity of U.S. Patent 11,219,000 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT G-16

Summary of Invalidity Analysis of U.S. Patent No. 11,219,000 ("'000 Patent") in view of U.S. Patent No. 10,980,007 to Oh et al. ("Oh")

U.S. Patent No. 10,980,007 to Oh et al. ("Oh"), issued on April 13, 2021, and was filed on September 28, 2018. Oh claims priority to KR 10-2017-0127698 filed on September 29, 2017, and KR 10-2017-0154035 filed on November 17, 2017. Therefore, Oh qualifies as prior art to the '000 Patent under at least 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '000 Patent are invalid as expressly and/or inherently anticipated by Yang.

To the extent that Oh is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '000 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Oh in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Oh and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
1[pre]	A method of transmitting uplink (UL) control information by a user equipment (UE), the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Oh discloses "A method of transmitting uplink (UL) control information by a user equipment (UE), the method comprising." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The present disclosure relates generally to a wireless communication system and, more particularly, to a method and apparatus for configuring uplink control channel transmission resources in a next-generation mobile communication system. Oh at 1:20-24. In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, Oh discloses "receiving, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		(57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract. The present disclosure relates generally to a wireless communication system and, more particularly, to a method and apparatus for configuring uplink control channel transmission resources in a next-generation mobile communication system. Oh at 1:20-24.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

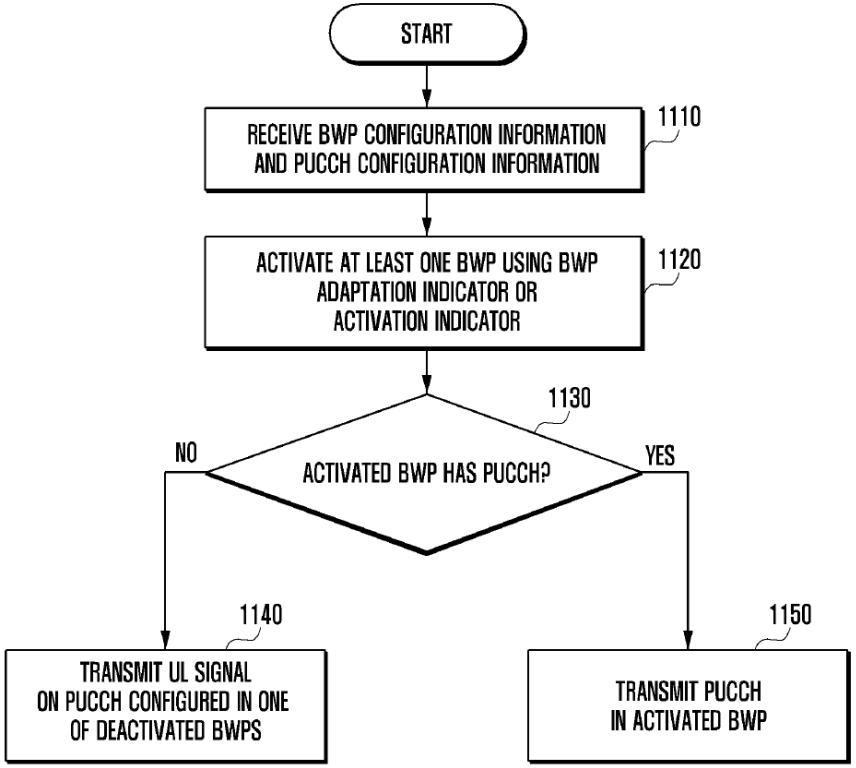
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In FIG. **4**, two CORESETs (CORESET #**1 440** and CORESET #**2 450**) are configured. CORESETs **440** and **450** may be configured to occupy specific sub-bands across the whole system bandwidth **410**. In FIG. **4**, CORESET #**1 440** is configured across two BWPs (i.e., BWP #**1 402** and BWP #**2 403**), while CORESET #**2** is configured with one BWP (i.e., BWP #**4 405**). A CORESET may span one or more OFDM symbols in the time domain and its length is specified by a number of OFDM symbols as denoted by reference numbers **460** and **470**. In FIG. **4**, the CORESET length **460** of CORESET #**1** is 2, and the CORESET length **470** of CORESET #**2** is 1. In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. Oh at 11:30-55.

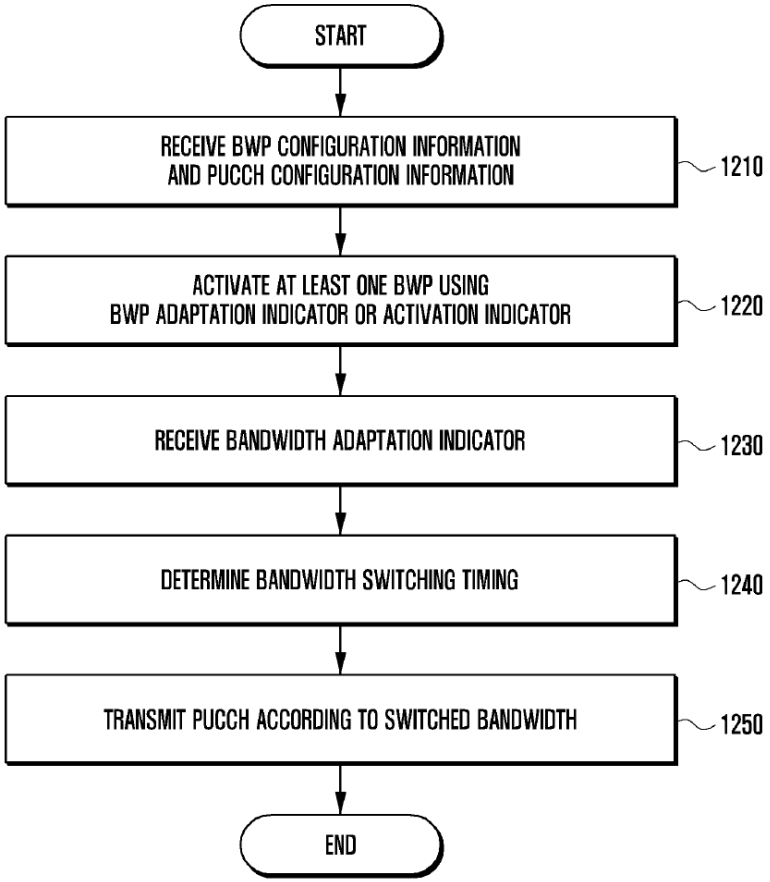
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. In 5G, a CORESET may be configured as one of a common CORESET, a UE-group common CORESET, and a UE-specific CORESET. A CORESET may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If a CORESET is configured to a UE, this means that the information on the CORESET location, CORESET sub-bands, CORESET resource allocation, and CORESET length is provided to the UE. The CORESET configuration information provided to the UE may include the following information shown in Table 1 below. Oh at 11:42-67.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		TABLE 1 Configuration information 1. RB allocation in frequency domain Configuration information 2. CORESET length in time domain (number of OFDM symbols configured for CORESET) Configuration information 3. Resource mapping scheme (time-preference mapping, frequency-preference mapping) Configuration information 4. Resource mapping scheme (Localized transmission scheme, Distributed transmission scheme Configuration information 5. Search space type (common search space, UE-group search space, UE-specific search space) Configuration information 6. Monitoring occasion (monitoring period/interval, monitoring symbol location in slot Configuration information 7. DMRS configuration information (DMRS structure, number of DMRS ports Configuration information 8. REG bundling size The CORESET configuration information may further include other information necessary for transmitting the DL control channel in addition to the aforementioned information. Oh at 12:1-18.

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2. TABLE 2 Configuration information 1. UL control channel frequency-domain RB allocation information Configuration information 2. UL control channel time-domain allocation information (start symbol location of control channel) Configuration information 3. UL control channel time-domain length (number of OFDM symbols for control channel) or format TABLE 2-continued Configuration information 4. Waveform (OFDM or DFT-S-OFDM) of UL channel Configuration information 5. Frequency hopping mode of UL control channel Oh at 15:48-16:5.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The UE may obtain PUCCH configuration information (e.g., PUCCH format, PUCCH length, sequence, frequency hopping, time/frequency resource allocation, and orthogonal sequence information) for transmitting the PUCCH conveying UCI (e.g., a SR, a DL data channel reception result (HARQ-ACK), and channel state information (CSI)) and determine the PUCCH configuration information for use in transmitting the UCI. Oh at 22:57-64. The configuration information about PUCCH #**1 1010** may include all setting values necessary for generating the PUCCH, which include a PUCCH length (or number of PUCCH symbols defined as N_PUCCH_symb), a Zadoff-Chu sequence, a Zadoff-Chu sequence group number, sequence numbers in the group, a frequency hopping configuration, numbers of symbols for first and second hopping periods or spreading factors for the first and second hopping periods (defined as N_PUCCH_SF**0** and N_PUCCH_SF**1**) when the frequency hopping is activated, and orthogonal sequence values therefor that are each configured for PUCCH #**1 1010**. Oh ay 25:16-28.

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	determining one of UL control channel resource sets contained in the received UL control channel resource set configuration information;	At least under Pegasus's apparent infringement theory, Oh discloses "determining one of UL control channel resource sets contained in the received UL control channel resource set configuration information." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The present disclosure relates generally to a wireless communication system and, more particularly, to a method and apparatus for configuring uplink control channel transmission resources in a next-generation mobile communication system. Oh at 1:20-24. Referring to FIG. **3**, a REG, as the basic unit of time and frequency resources for a control channel, is made up of one OFDM symbol **301** in the time domain and 12 subcarriers **302** (i.e. one RB), in the frequency domain. By assuming one OFDM symbol as a basic unit of control channel resources in the time domain, it may be possible to multiplex data and control channels in one subframe. The control channel is followed by a data channel to reduce processing time at a UE, thereby facilitating meeting of the latency requirement. By using 1 RB **302** as the basic unit of control channel resources in the frequency domain, it may be possible to facilitate multiplexing the control and data channels in frequency. By concatenating multiple NR-REGs **303**, it is possible to configure various control channel regions in different sizes. For example, assuming that the basic unit of DL control channel resource allocation is NR-CCE **304** in 5G, the NR-CCE **304** may be made up of a plurality of NR-REGs **303**. For example, the NR-REG **303** depicted in FIG. **3** is made up of 12 REs and, assuming one NR-CCE **304** consists of 4 NR-REGs **303**, the NR-CCE **304** consists of 48 REs. If the DL control region is configured, the control region may consist of multiple NR-CCEs **304**, and a certain DL control channel may be mapped to one or more NR-CCEs **304** according to the AL in the control region. The NR-CCEs **304** constituting the control region are distinguished by CCE numbers, which are assigned in a way of logical mapping.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at 10:32-58. In FIG. **4**, two CORESETs (CORESET #**1 440** and CORESET #**2 450**) are configured. CORESETs **440** and **450** may be configured to occupy specific sub-bands across the whole system bandwidth **410**. In FIG. **4**, CORESET #**1 440** is configured across two BWPs (i.e., BWP #**1 402** and BWP #**2 403**), while CORESET #**2** is configured with one BWP (i.e., BWP #**4 405**). A CORESET may span one or more OFDM symbols in the time domain and its length is specified by a number of OFDM symbols as denoted by reference numbers **460** and **470**. In FIG. **4**, the CORESET length **460** of CORESET #**1** is 2, and the CORESET length **470** of CORESET #**2** is 1. In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. Oh at 11:30-55.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. In 5G, a CORESET may be configured as one of a common CORESET, a UE-group common CORESET, and a UE-specific CORESET. A CORESET may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If a CORESET is configured to a UE, this means that the information on the CORESET location, CORESET sub-bands, CORESET resource allocation, and CORESET length is provided to the UE. The CORESET configuration information provided to the UE may include the following information shown in Table 1 below. Oh at 11:42-67.

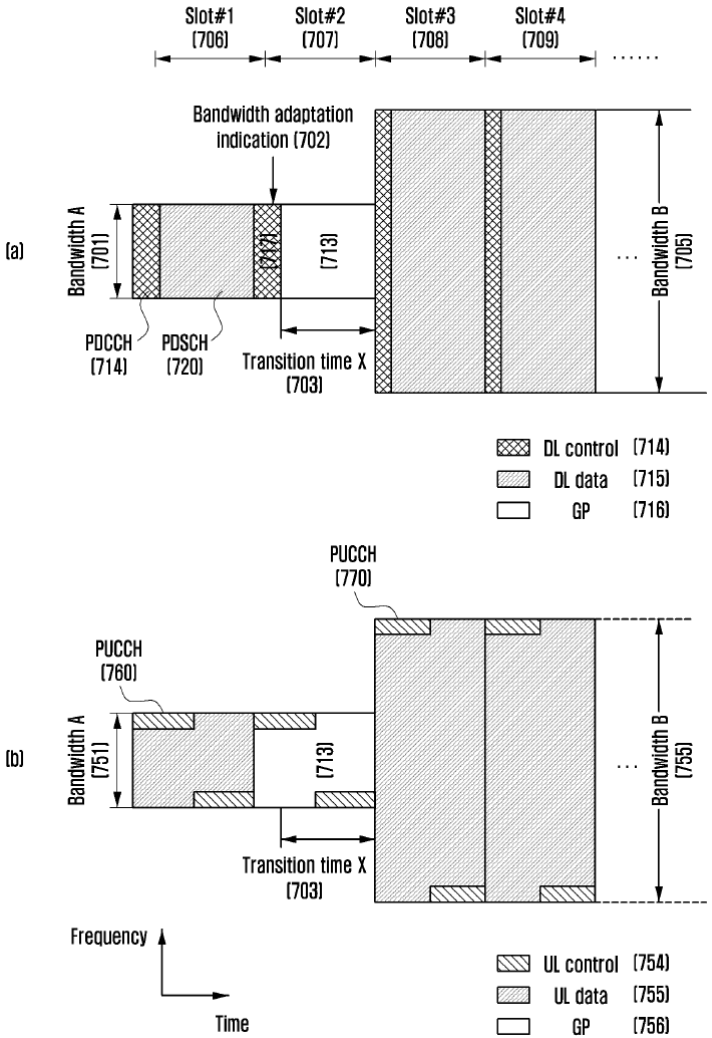
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

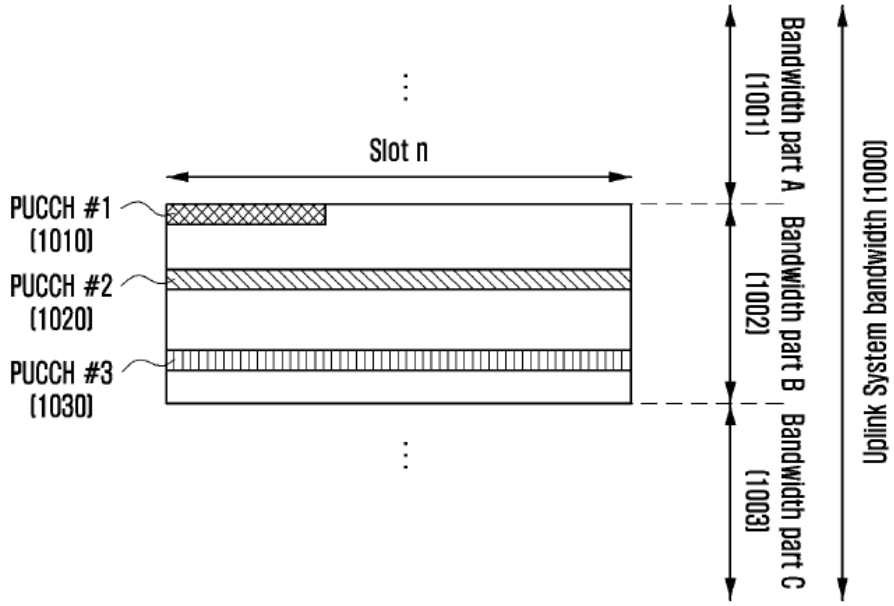
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. Oh at 16:7-18. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. As described above, the BWP A is configured with three PUCCH resources (PUCCH #**1**, PUCCH #**2**, and PUCCH #**3**) and BWP B is configured with two PUCCH resources (PUCCH #**1** and PUCCH #**2**), however the DCI **714** may indicate the PUCCH #**3** for PUCCH transmission. In this case, the UE may transmit the PUCCH on the PUCCH resources determined as a result of the modulo operation performed on the indicated control channel resources with a

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		value of the control channel resources (or PUCCH format index or PUCCH format) configured in the changed BWP B (i.e., PUCCH #**1** configured in the BWP B). Oh at 20:60-21:3. Referring to FIG. **10**, PUCCH #**1** **1010** comprises PUCCH resources for transmitting SR information associated with the first logical channel, and PUCCH #**2** **1020** comprises PUCCH resources for transmitting SR information associated with the second logical channel. If it is necessary for the UE to transmit UL data on the first logical channel, the UE may transmit the SR information to the BS on the PUCCH #**1** **1010** such that the BS configures or allocates UL data channel transmission resources appropriate for the logical channel (first logical channel) of which data the UE wants to transmit. Oh at 23:9-19.

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Claim Language	**Exemplary Citations to Oh**
	FIG. 7  Oh at Fig. 7.

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Claim Language		**Exemplary Citations to Oh**
		 Oh at Fig. 10. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
1[c]	determining one of UL control channel resources contained in the determined UL control channel resource set; and	At least under Pegasus's apparent infringement theory, Oh discloses "determining one of UL control channel resources contained in the determined UL control channel resource set." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

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Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2.

TABLE 2

Configuration information 1. UL control channel frequency-domain RB allocation information
Configuration information 2. UL control channel time-domain allocation information (start symbol location of control channel)
Configuration information 3. UL control channel time-domain length (number of OFDM symbols for control channel) or format

TABLE 2-continued

Configuration information 4. Waveform (OFDM or DFT-S-OFDM) of UL channel
Configuration information 5. Frequency hopping mode of UL control channel

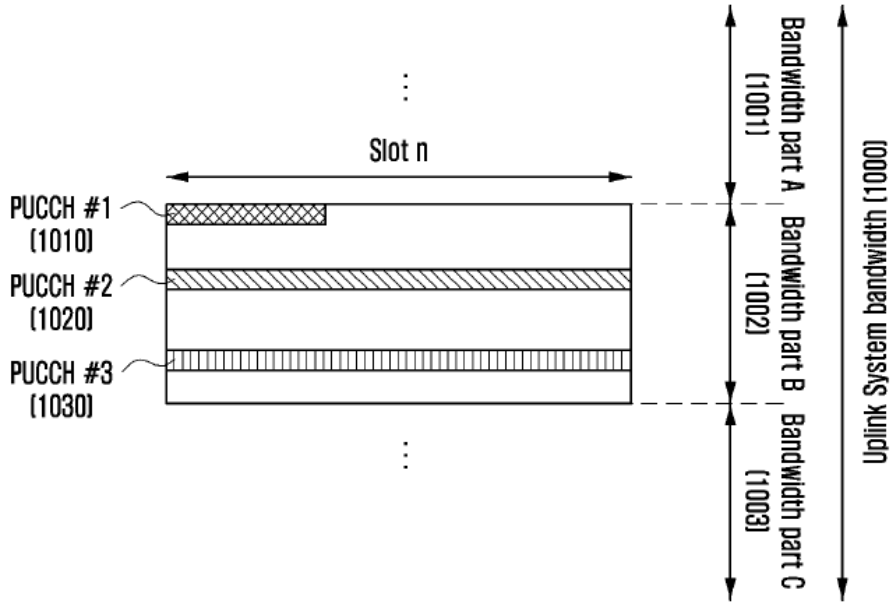
Oh at 15:48-16:5.

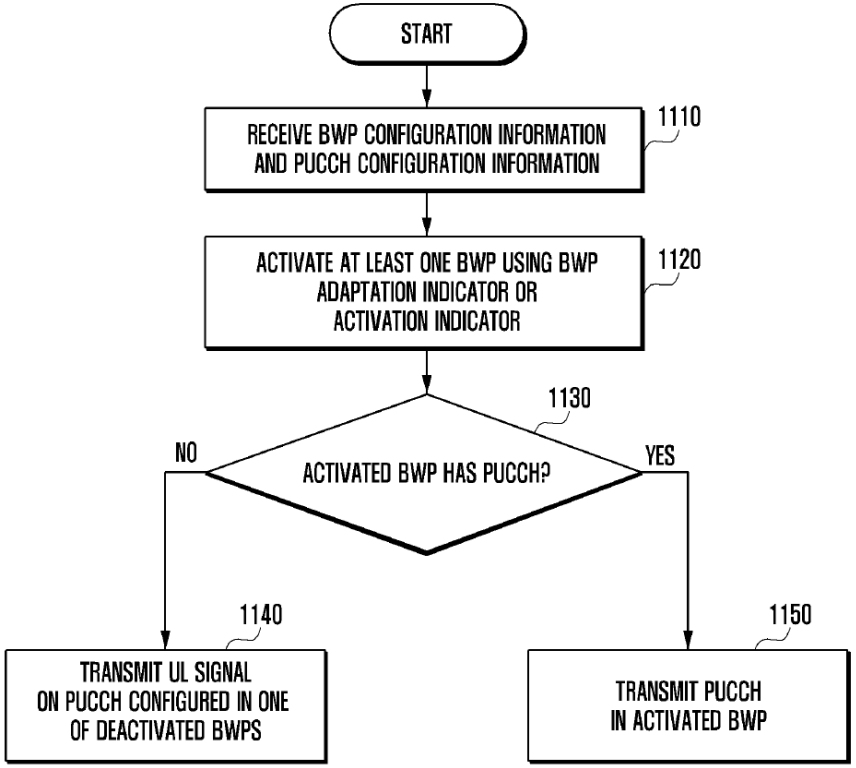
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. Oh at 16:7-18. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

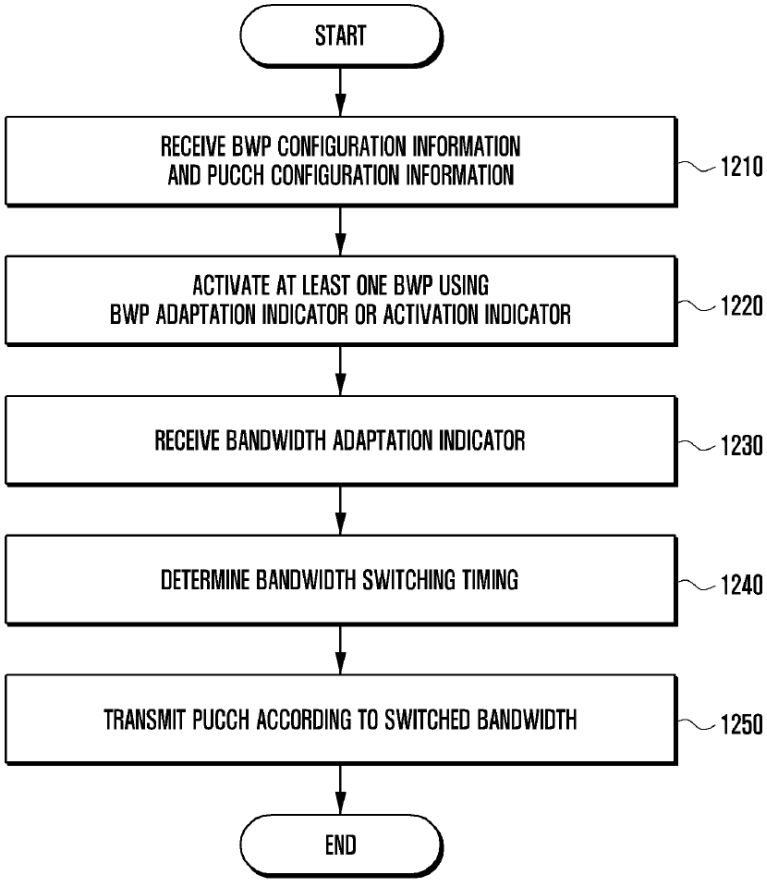
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. As described above, the BWP A is configured with three PUCCH resources (PUCCH #**1**, PUCCH #**2**, and PUCCH #**3**) and BWP B is configured with two PUCCH resources (PUCCH #**1** and PUCCH #**2**), however the DCI **714** may indicate the PUCCH #**3** for PUCCH transmission. In this case, the UE may transmit the PUCCH on the PUCCH resources determined as a result of the modulo operation performed on the indicated control channel resources with a

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		value of the control channel resources (or PUCCH format index or PUCCH format) configured in the changed BWP B (i.e., PUCCH #**1** configured in the BWP B). Oh at 20:60-21:3. Referring to FIG. **10**, PUCCH #**1** **1010** comprises PUCCH resources for transmitting SR information associated with the first logical channel, and PUCCH #**2** **1020** comprises PUCCH resources for transmitting SR information associated with the second logical channel. If it is necessary for the UE to transmit UL data on the first logical channel, the UE may transmit the SR information to the BS on the PUCCH #**1** **1010** such that the BS configures or allocates UL data channel transmission resources appropriate for the logical channel (first logical channel) of which data the UE wants to transmit. Oh at 23:9-19.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10.

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

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Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	transmitting UL control information through the determined UL control channel resource,	At least under Pegasus's apparent infringement theory, Oh discloses "transmitting UL control information through the determined UL control channel resource." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

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Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2.

TABLE 2

Configuration information 1. UL control channel frequency-domain RB allocation information
Configuration information 2. UL control channel time-domain allocation information (start symbol location of control channel)
Configuration information 3. UL control channel time-domain length (number of OFDM symbols for control channel) or format

TABLE 2-continued

Configuration information 4. Waveform (OFDM or DFT-S-OFDM) of UL channel
Configuration information 5. Frequency hopping mode of UL control channel

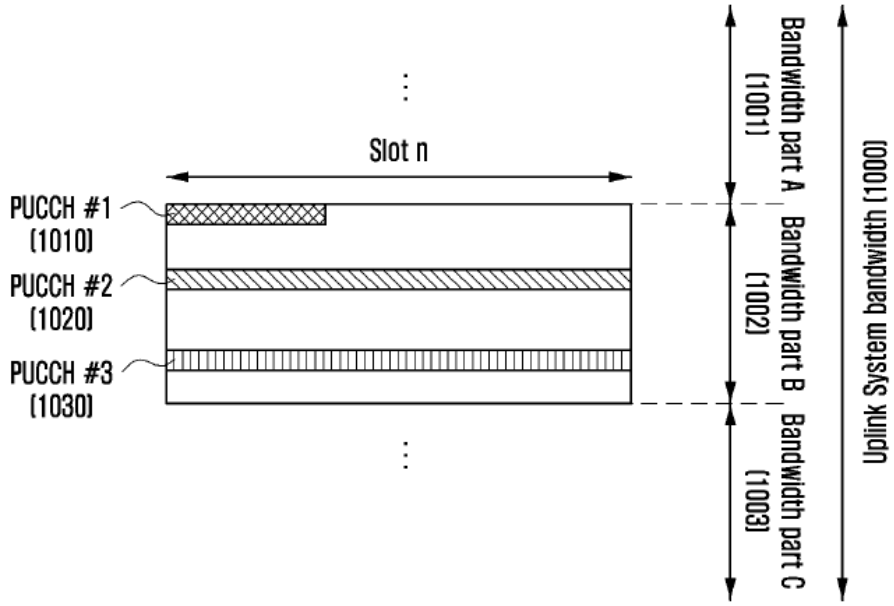
Oh at 15:48-16:5.

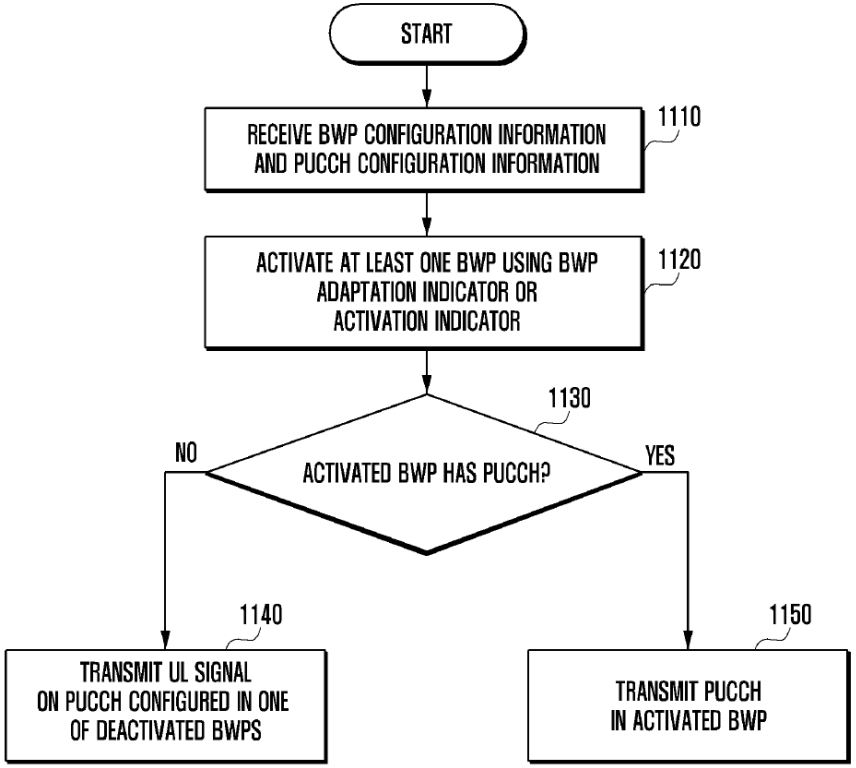
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. Oh at 16:7-18. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

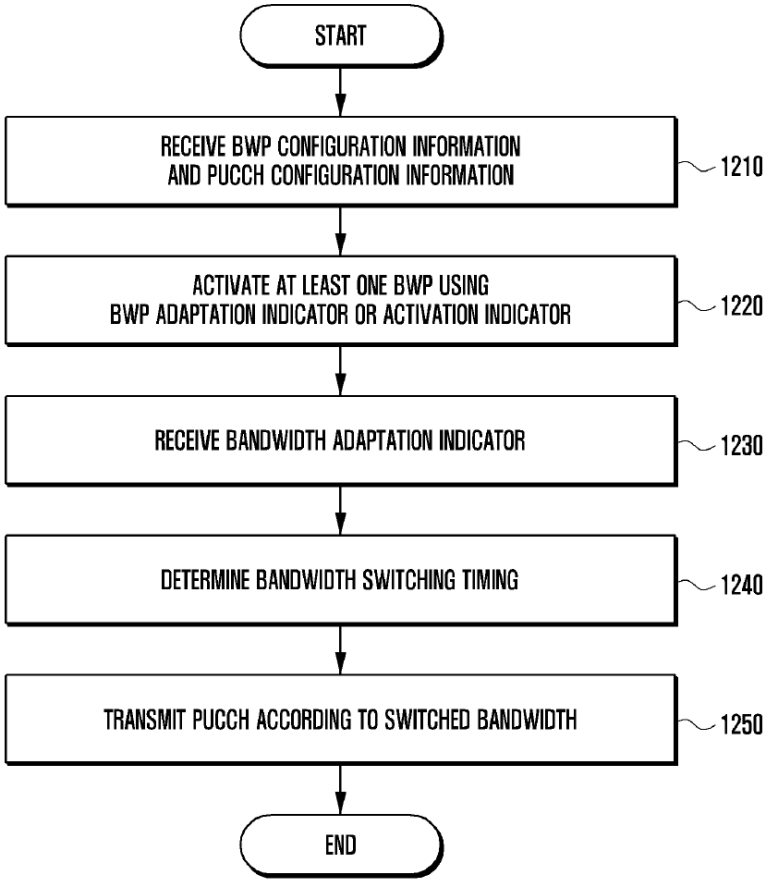
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. As described above, the BWP A is configured with three PUCCH resources (PUCCH #**1**, PUCCH #**2**, and PUCCH #**3**) and BWP B is configured with two PUCCH resources (PUCCH #**1** and PUCCH #**2**), however the DCI **714** may indicate the PUCCH #**3** for PUCCH transmission. In this case, the UE may transmit the PUCCH on the PUCCH resources determined as a result of the modulo operation performed on the indicated control channel resources with a

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		value of the control channel resources (or PUCCH format index or PUCCH format) configured in the changed BWP B (i.e., PUCCH #**1** configured in the BWP B). Oh at 20:60-21:3. Referring to FIG. **10**, PUCCH #**1** **1010** comprises PUCCH resources for transmitting SR information associated with the first logical channel, and PUCCH #**2** **1020** comprises PUCCH resources for transmitting SR information associated with the second logical channel. If it is necessary for the UE to transmit UL data on the first logical channel, the UE may transmit the SR information to the BS on the PUCCH #**1** **1010** such that the BS configures or allocates UL data channel transmission resources appropriate for the logical channel (first logical channel) of which data the UE wants to transmit. Oh at 23:9-19.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

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Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information, and	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, Oh discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Oh**
		Referring to FIG. **3**, a REG, as the basic unit of time and frequency resources for a control channel, is made up of one OFDM symbol **301** in the time domain and 12 subcarriers **302** (i.e. one RB), in the frequency domain. By assuming one OFDM symbol as a basic unit of control channel resources in the time domain, it may be possible to multiplex data and control channels in one subframe. The control channel is followed by a data channel to reduce processing time at a UE, thereby facilitating meeting of the latency requirement. By using 1 RB **302** as the basic unit of control channel resources in the frequency domain, it may be possible to facilitate multiplexing the control and data channels in frequency. By concatenating multiple NR-REGs **303**, it is possible to configure various control channel regions in different sizes. For example, assuming that the basic unit of DL control channel resource allocation is NR-CCE **304** in 5G, the NR-CCE **304** may be made up of a plurality of NR-REGs **303**. For example, the NR-REG **303** depicted in FIG. **3** is made up of 12 REs and, assuming one NR-CCE **304** consists of 4 NR-REGs **303**, the NR-CCE **304** consists of 48 REs. If the DL control region is configured, the control region may consist of multiple NR-CCEs **304**, and a certain DL control channel may be mapped to one or more NR-CCEs **304** according to the AL in the control region. The NR-CCEs **304** constituting the control region are distinguished by CCE numbers, which are assigned in a way of logical mapping. Oh at 10:32-58.

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Claim Language		**Exemplary Citations to Oh**
		The radio resources for a short PUCCH **518** are allocated by PRB such that the PUCCH are mapped to consecutive or discrete multiple PRBs in the frequency domain. The allocated PRBs should be included in a band that is equal to or narrower than the frequency band **507** supported by the UE or the UL transmission bandwidth that the BS has configured to the UE. The multiple PRBs may be allocated frequency resources configured to the UE via higher layer signaling such that the frequency resources are mapped to corresponding bit fields, and the multiple PRBs may notify the UE of the frequency resources to be used via a bit field included in the DL control channel. Oh at 13:36-47. It may also be possible to determine the DMRS transmission scheme based on the number of bits of the UCI **520**. If the number of bits of the UCI **520** is small, the UE may multiplex the DMRS **521** and the UCI **520** into a control channel as denoted by reference number **512**. In the case where the number of bits of the UCI is small, it is possible to achieve a transmission coding rate with reduced resources sufficient for UCI **520** transmission. If the number of bits of the UCI **520** is large, the UE may multiplex the DMRS **521** and UCI **520** into a control channel as denoted by reference number **514**. In the case where the number of bits of the UCI **520** is large, it is necessary to use a large amount of the resources for UCI **520** transmission at a reduced transmission coding rate. Oh at 13:57-14:3.

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Claim Language		**Exemplary Citations to Oh**
		The UE may determine whether to use the long PUCCH **503** or short PUCCH **518** in a slot or a mini-slot for transmitting the UCI **520** based on the information indicating the use of the long or short PUCCH, which is received from the BS via higher layer signaling. It may also be possible to make such a determination based on the information indicating the use of the long or short PUCCH, which is received from the BS via physical layer signaling. It may also be possible to make such a determination based on the information obtained implicitly from the number of UL symbols of the slot or mini-slot. For example, the UE may transmit the UCI **520** using the short PUCCH **518** for a case in which the number of UL symbols included in the slot or mini-slot, notified or configured by the BS, for UCI **520** transmission is 1 or 2, and the UE may transmit the UCI **520** using the long PUCCH **503** for a case in which the number of UL symbols included in the slot or mini-slot is 4 to 14. Oh at 14:4-21.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

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Claim Language		**Exemplary Citations to Oh**
		The BS may configure the PUCCH transmission resources based on the maximum frequency bandwidth supported by the UE without considering the BWP. For example, the BS may configure the PUCCH transmission resources **650** and **680** based on the maximum UL frequency bandwidth **610** of the UE. In this case, it may be possible for the UE to assume the long PUCCH **650** in the BWP #**1 602**, the short PUCCH **680** in the BWP #**4**, and no PUCCH in the BWP #**2 603** and BWP #**3 604**, based on the PUCCH transmission resources and UL BWPs configured by the BS. Although, as shown in FIG. **6**, each BWP is configured to have a type of PUCCH or nothing, it may also be possible for each BWP to be configured to have one or more types of PUCCHs. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:19-50.

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Claim Language	**Exemplary Citations to Oh**
	If the BS transmits a bandwidth adaptation indicator **702** to the UE to switch bandwidths with bandwidth B **705**, the UE performs a bandwidth adaptation operation based on the command. Bandwidths A and B may differ in size (i.e., bandwidth A may be broader or narrower than bandwidth B). In FIG. **7**, it is assumed that bandwidth B is broader than bandwidth A. Each of bandwidths A and B may be expressed by the number of PRBs or BWPs. Oh at 17:52-59. As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the

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		Oh at 18:47-67. In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable

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		expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[f]	wherein the UL control channel resource set configuration information is received through UE specific radio resource control (RRC) signaling.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource set configuration information is received through UE specific radio resource control (RRC) signaling." For example, Oh discloses this limitation based on the following exemplary citations: Multiple EPDCCHs **202** may constitute an EPDCCH set for which resources are allocated by a PRB pair. The EPDCCH set location is configured in a UE-specific manner, and the EPDCCH set location information is transmitted via radio resource control (RRC) signaling. A UE may be assigned up to two EPDCCH sets, and one EPDCCH set may be multiplexed with those of other UEs. Oh at 9:39-45. In 5G, a CORESET may be configured as one of a common CORESET, a UE-group common CORESET, and a UE-specific CORESET. A CORESET may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If a CORESET is configured to a UE, this means that the information on the CORESET location, CORESET sub-bands, CORESET resource allocation, and CORESET length is provided to the UE. The CORESET configuration information provided to the UE may include the following information shown in Table 1 below. Oh at 11:56-67.

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		Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2. Oh at 15:48-58. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

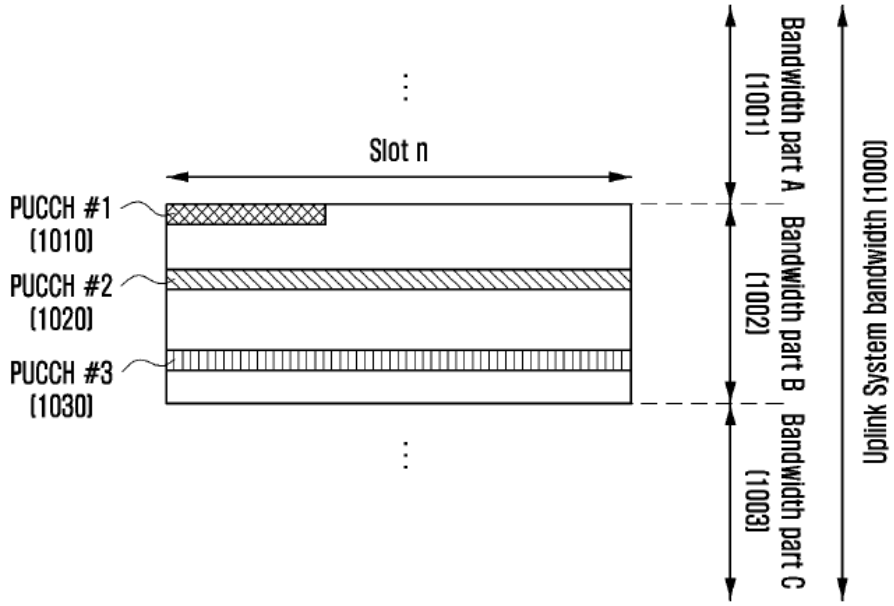
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Claim Language		**Exemplary Citations to Oh**
		The BS may transmit the bandwidth adaptation indicator **702** to the UE via at least one of physical layer signaling, MAC layer signaling, and RRC layer signaling. The physical layer signaling is characterized in that the UE is capable of processing the bandwidth adaptation indicator promptly. The BS may transmit the bandwidth adaptation indicator in a UE-specific signaling manner or UE-group common signaling manner in a cell. Oh at 18:25-32. The UE may receive multiple PUCCH configurations for transmitting the HARQ ACK corresponding to the DL data received at slot n or earlier to the BS via higher layer signaling. The DCI for scheduling the DL data channel may include an indicator indicating the PUCCH configuration for use by the UE in transmitting the HARQ ACK corresponding to the DL data channel among the multiple PUCCH configurations signaled to the UE. The UE may transmit the HARQ ACK using the PUCCH resources **1030** as indicated by the indicator. Oh at 23:35-44. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the

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Claim Language		**Exemplary Citations to Oh**
		same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
2	The method according to claim 1, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE." For example, Oh discloses this limitation based on the following exemplary citations: In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel

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		resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4. In FIG. **4**, two CORESETs (CORESET #**1 440** and CORESET #**2 450**) are configured. CORESETs **440** and **450** may be configured to occupy specific sub-bands across the whole system bandwidth **410**. In FIG. **4**, CORESET #**1 440** is configured across two BWPs (i.e., BWP #**1 402** and BWP #**2 403**), while CORESET #**2** is configured with one BWP (i.e., BWP #**4 405**). A CORESET may span one or more OFDM symbols in the time domain and its length is specified by a number of OFDM symbols as denoted by reference numbers **460** and **470**. In FIG. **4**, the CORESET length **460** of CORESET #**1** is 2, and the CORESET length **470** of CORESET #**2** is 1. In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used.

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		Oh at 11:29-55. For transmission/reception bandwidth adaptation or switching, it is necessary for the BS to configure the CORESETs to transmit the DL control channel and resources efficiently, and the PUCCH to the UE efficiently. In the case where the UE is assigned the UL and DL bandwidths in different BWPs, there is a need of a method for making it possible for the UE to configure the PUCCH resources in a BWP-specific manner, select the PUCCH resources, and switch between BWPs. Oh at 15:20-28. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2. Oh at 15:48-58.

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		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. The BS may configure the PUCCH transmission resources based on the maximum frequency bandwidth supported by the UE without considering the BWP. For example, the BS may configure the PUCCH transmission resources **650** and **680** based on the maximum UL frequency bandwidth **610** of the UE. In this case, it may be possible for the UE to assume the long PUCCH **650** in the BWP #**1 602**, the short PUCCH **680** in the BWP #**4**, and no PUCCH in the BWP #**2 603** and BWP #**3 604**, based on the PUCCH transmission resources and UL BWPs configured by the BS. Although, as shown in FIG. **6**, each BWP is configured to have a type of PUCCH or nothing, it may also be possible for each BWP to be configured to have one or more types of PUCCHs. Oh at 16:7-33.

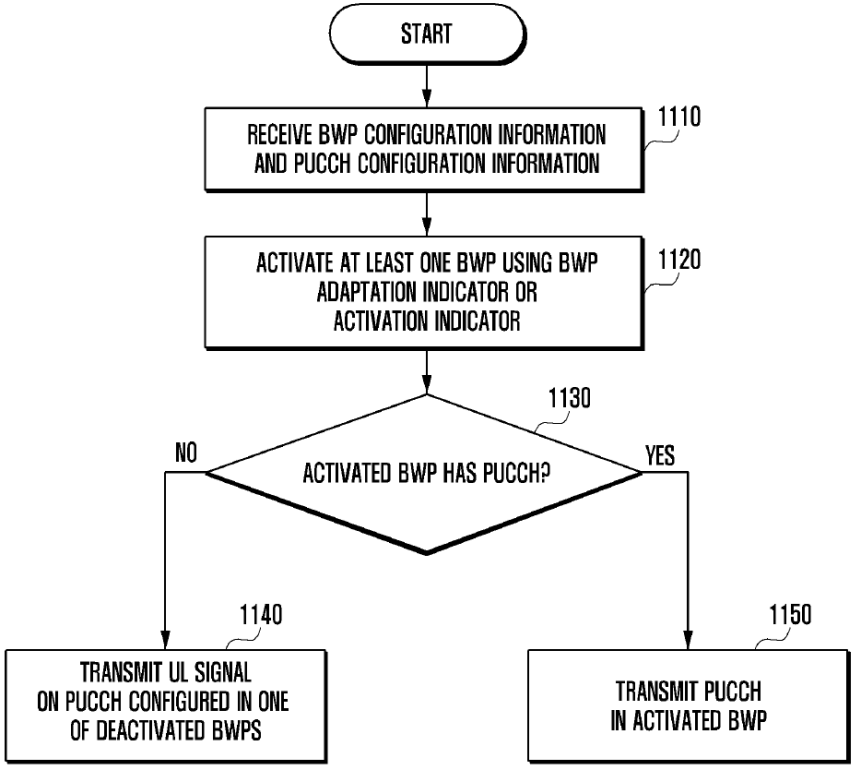
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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

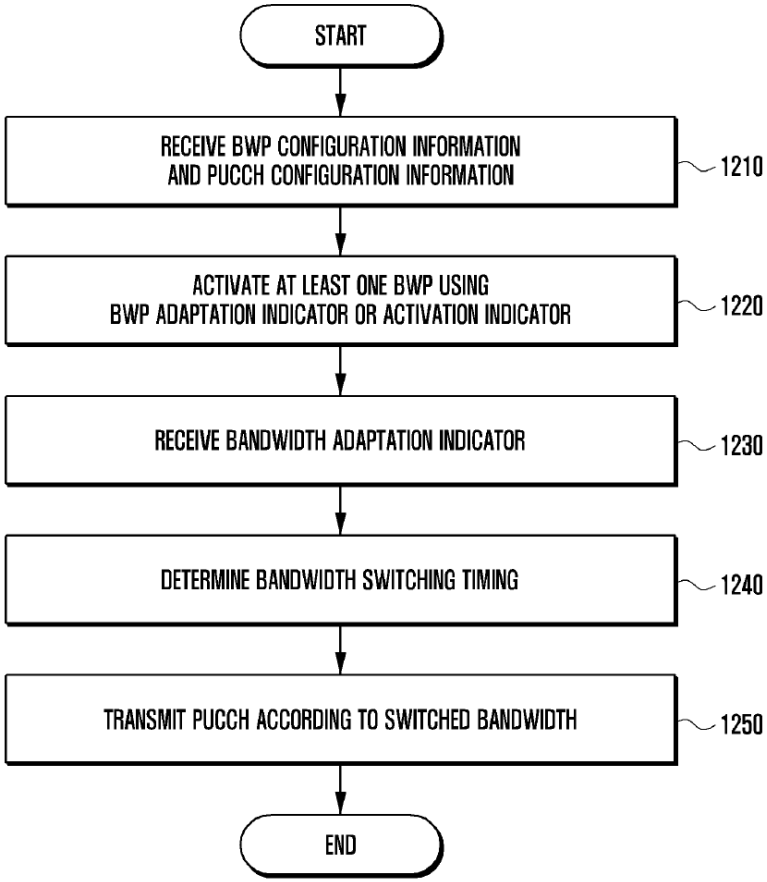
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Claim Language		**Exemplary Citations to Oh**
3	The method according to claim 2, wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Oh at 15:32-47. If it is necessary for the UE to transmit a PUCCH, the UE may activate one of the deactivated BWPs (e.g., one (BWP #**1 602**) of the deactivated BWPs if the activated BWP (BWP #**2 603**) has no configured PUCCH resources) to transmit the PUCCH. If the UE is capable of activating only one UL BWP, it may assume that the BWP (BWP #**2 603**) that is activated but has no currently configured PUCCH resources is deactivated while the BWP (BWP #**1 602**) is activated for PUCCH transmission. After transmitting the PUCCH, the UE may reactivate BWP #**2 603** and deactivate BWP #**1 602**. Oh at 16:51-61.

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		Referring to FIG. **12**, at step **1210**, the UE receives BWP configuration information (e.g., information as shown in Table 1) and PUCCH configuration information about one or more BWPs as shown in Table 2 from the BS via higher layer signaling, a broadcast channel, or a DL data channel (e.g., a DL data channel scheduled via DCI scrambled with SI-RNTI) including system information. At step **1220**, the UE activates at least one DL and UL BWP based on a BWP adaptation indicator or activation indicator included in the DCI transmitted via higher layer signaling or a DL control channel. If the DL and UL BWPs are correlated with each other, the UL BWP may be changed or activated according to the DL BWP adaptation indicator. Oh at 26:31-43.

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	 Oh at Fig. 11.

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	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

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		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[a]	The method according to claim 1, further comprising: receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, Oh discloses "receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

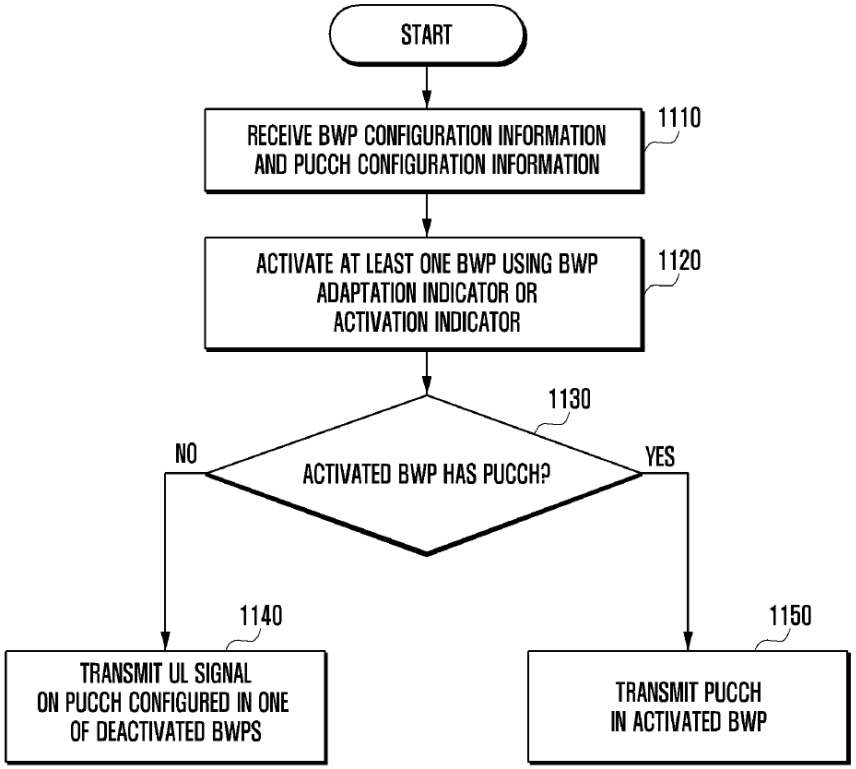
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The UE may determine whether to use the long PUCCH **503** or short PUCCH **518** in a slot or a mini-slot for transmitting the UCI **520** based on the information indicating the use of the long or short PUCCH, which is received from the BS via higher layer signaling. It may also be possible to make such a determination based on the information indicating the use of the long or short PUCCH, which is received from the BS via physical layer signaling. It may also be possible to make such a determination based on the information obtained implicitly from the number of UL symbols of the slot or mini-slot. For example, the UE may transmit the UCI **520** using the short PUCCH **518** for a case in which the number of UL symbols included in the slot or mini-slot, notified or configured by the BS, for UCI **520** transmission is 1 or 2, and the UE may transmit the UCI **520** using the long PUCCH **503** for a case in which the number of UL symbols included in the slot or mini-slot is 4 to 14. Oh at 14:4-21.

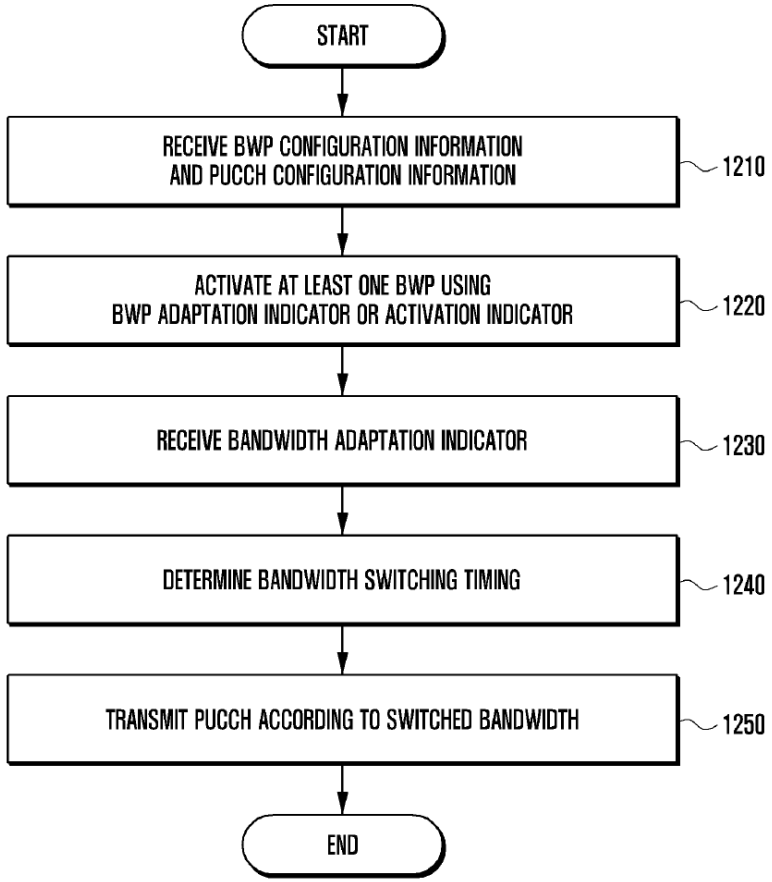
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Oh at 15:32-47.

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Claim Language		**Exemplary Citations to Oh**
		At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

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Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In a case in which the UL bandwidths configured to the UE have respective PUCCH transmission resources (i.e., bandwidth A **751** and bandwidth B **755** have the PUCCH transmission resources **760** and **770**, respectively, as shown in part (b) of FIG. **7**), Upon receipt of the DCI conveyed in the DL control channel **714** that the BS transmits at slot #**1 706**, the UE may receive DL data on the DL data channel **720** indicated via the DCI and transmit the HARQ ACK corresponding to the DL data to the BS on the PUCCH resources indicated via the DCI at a timing (e.g., slot #**3 708**) indicated via the DCI. In this case, the BS may assume that the UE transmits the HARQ ACK on the PUCCH resources of the bandwidth activated at the timing (slot #**3 708**) that should carry the HARQ ACK corresponding to the DL data **720** (i.e., PUCCH **770** of bandwidth B **755**) according to Method 1, above, thereby being able to receive the HARQ ACK corresponding to the DL data **720** successfully. Oh at 19:46-62. Referring to FIG. **12**, at step **1210**, the UE receives BWP configuration information (e.g., information as shown in Table 1) and PUCCH configuration information about one or more BWPs as shown in Table 2 from the BS via higher layer signaling, a broadcast channel, or a DL data channel (e.g., a DL data channel scheduled via DCI scrambled with SI-RNTI) including system information. At step **1220**, the UE activates at least one DL and UL BWP based on a BWP adaptation indicator or activation indicator included in the DCI transmitted via higher layer signaling or a DL control channel. If the DL and UL BWPs are correlated with each other, the UL BWP may be changed or activated according to the DL BWP adaptation indicator. Oh at 26:31-43.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resources is indicated from the base station through the DL control information." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

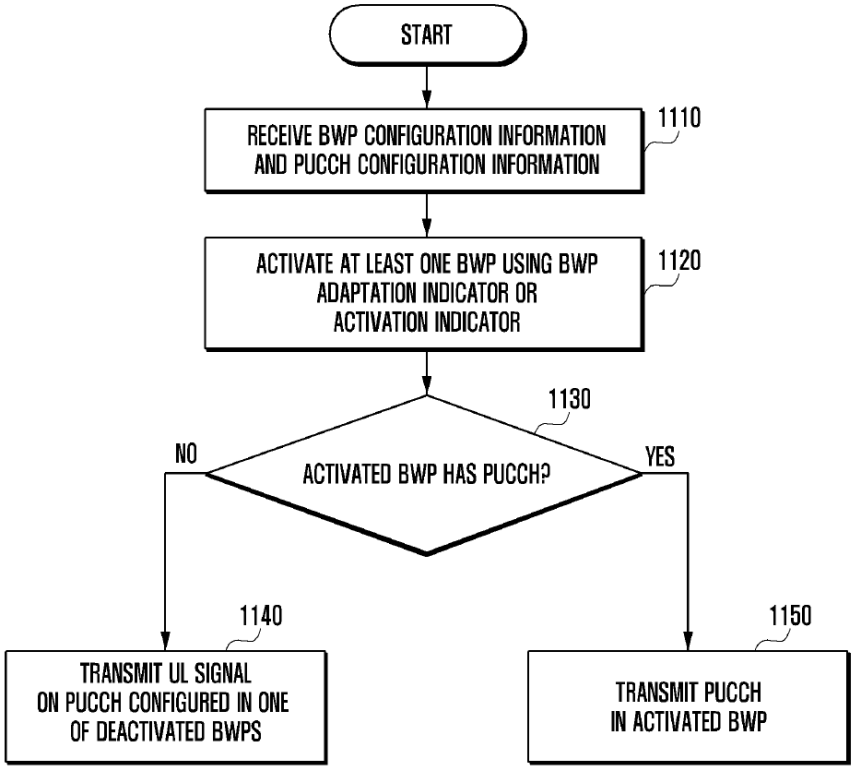
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The UE may determine whether to use the long PUCCH **503** or short PUCCH **518** in a slot or a mini-slot for transmitting the UCI **520** based on the information indicating the use of the long or short PUCCH, which is received from the BS via higher layer signaling. It may also be possible to make such a determination based on the information indicating the use of the long or short PUCCH, which is received from the BS via physical layer signaling. It may also be possible to make such a determination based on the information obtained implicitly from the number of UL symbols of the slot or mini-slot. For example, the UE may transmit the UCI **520** using the short PUCCH **518** for a case in which the number of UL symbols included in the slot or mini-slot, notified or configured by the BS, for UCI **520** transmission is 1 or 2, and the UE may transmit the UCI **520** using the long PUCCH **503** for a case in which the number of UL symbols included in the slot or mini-slot is 4 to 14. Oh at 14:4-21.

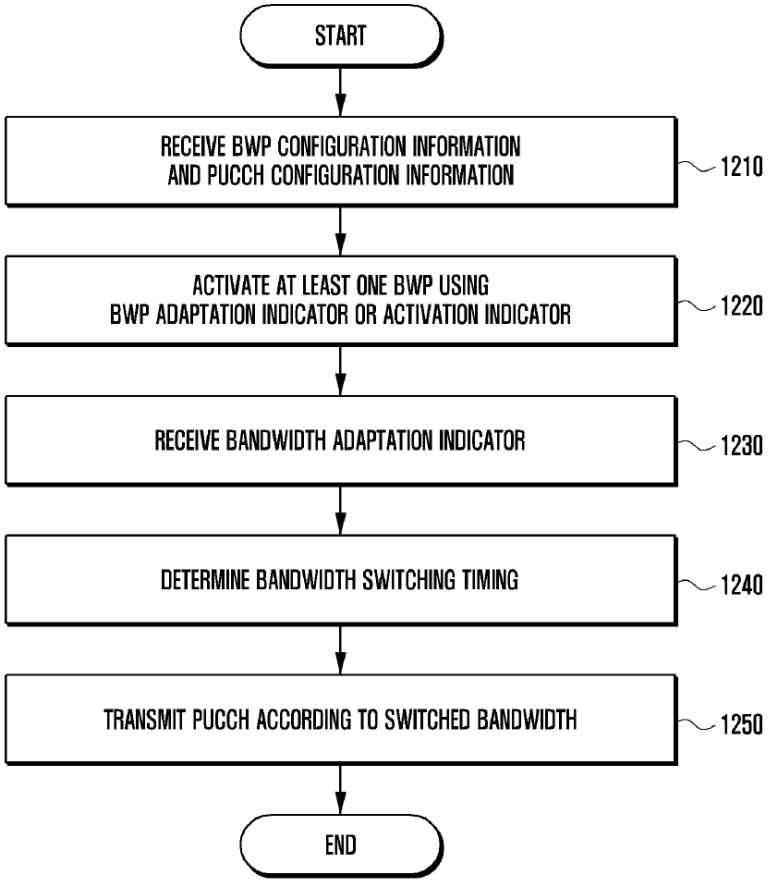
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Oh at 15:32-47.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In a case in which the UL bandwidths configured to the UE have respective PUCCH transmission resources (i.e., bandwidth A **751** and bandwidth B **755** have the PUCCH transmission resources **760** and **770**, respectively, as shown in part (b) of FIG. **7**), Upon receipt of the DCI conveyed in the DL control channel **714** that the BS transmits at slot #**1 706**, the UE may receive DL data on the DL data channel **720** indicated via the DCI and transmit the HARQ ACK corresponding to the DL data to the BS on the PUCCH resources indicated via the DCI at a timing (e.g., slot #**3 708**) indicated via the DCI. In this case, the BS may assume that the UE transmits the HARQ ACK on the PUCCH resources of the bandwidth activated at the timing (slot #**3 708**) that should carry the HARQ ACK corresponding to the DL data **720** (i.e., PUCCH **770** of bandwidth B **755**) according to Method 1, above, thereby being able to receive the HARQ ACK corresponding to the DL data **720** successfully. Oh at 19:46-62. Referring to FIG. **12**, at step **1210**, the UE receives BWP configuration information (e.g., information as shown in Table 1) and PUCCH configuration information about one or more BWPs as shown in Table 2 from the BS via higher layer signaling, a broadcast channel, or a DL data channel (e.g., a DL data channel scheduled via DCI scrambled with SI-RNTI) including system information. At step **1220**, the UE activates at least one DL and UL BWP based on a BWP adaptation indicator or activation indicator included in the DCI transmitted via higher layer signaling or a DL control channel. If the DL and UL BWPs are correlated with each other, the UL BWP may be changed or activated according to the DL BWP adaptation indicator. Oh at 26:31-43.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

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Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 5

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Claim Language		**Exemplary Citations to Oh**
5[pre]	A method of receiving uplink (UL) control information by a base station, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Oh discloses "A method of receiving uplink (UL) control information by a base station, the method comprising." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
5[a]	transmitting, to a user equipment (UE), UL control channel resource set configuration information for UL control information; and	At least under Pegasus's apparent infringement theory, Oh discloses "transmitting, to a user equipment (UE), UL control channel resource set configuration information for UL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
5[b]	receiving the UL control information through one of UL control channel resources in one of UL control channel resource sets contained in the transmitted UL control channel resource set configuration information,	At least under Pegasus's apparent infringement theory, Oh discloses "receiving the UL control information through one of UL control channel resources in one of UL control channel resource sets contained in the transmitted UL control channel resource set configuration information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitations 1[b], 1[c], and 1[d] above. In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57.

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		In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
5[c]	wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information, and	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5[d]	wherein the UL control channel resource set configuration information is transmitted through UE specific radio resource control (RRC) signaling.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource set configuration information is transmitted through UE specific radio resource control (RRC) signaling." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the

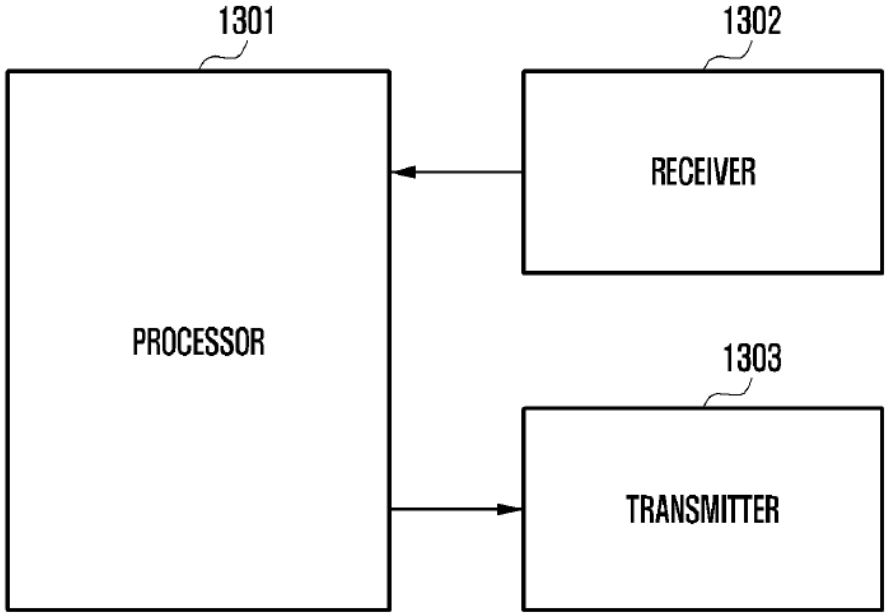
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
6	The method according to claim 5, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7	The method according to claim 6, wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 3 above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[a]	The method according to claim 5, further comprising: transmitting, to the user equipment, downlink (DL) control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, Oh discloses "transmitting, to the user equipment, downlink (DL) control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 4[a] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[b]	wherein the one of the UL control channel resources is indicated to the UE through the DL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resources is indicated to the UE through the DL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 4[b] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable

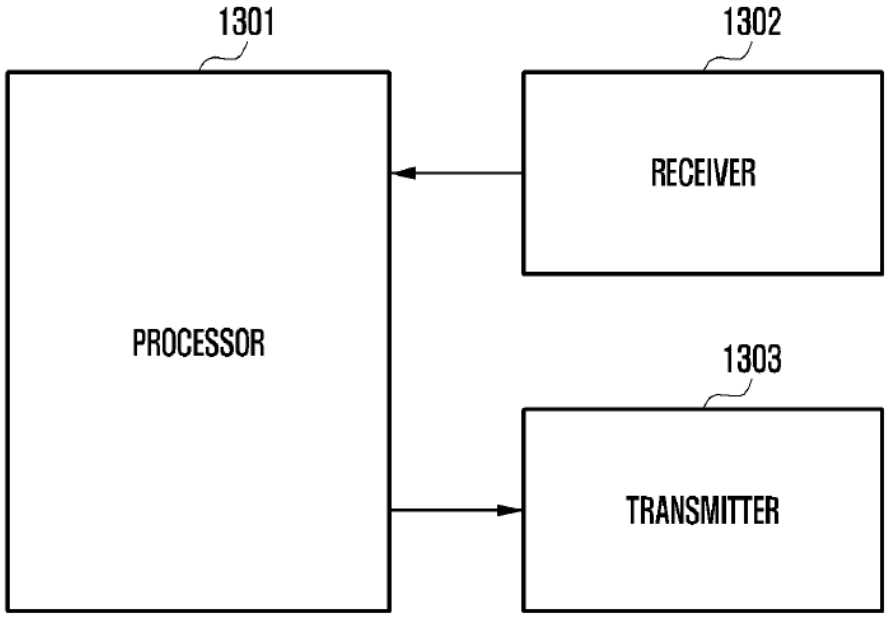
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 9

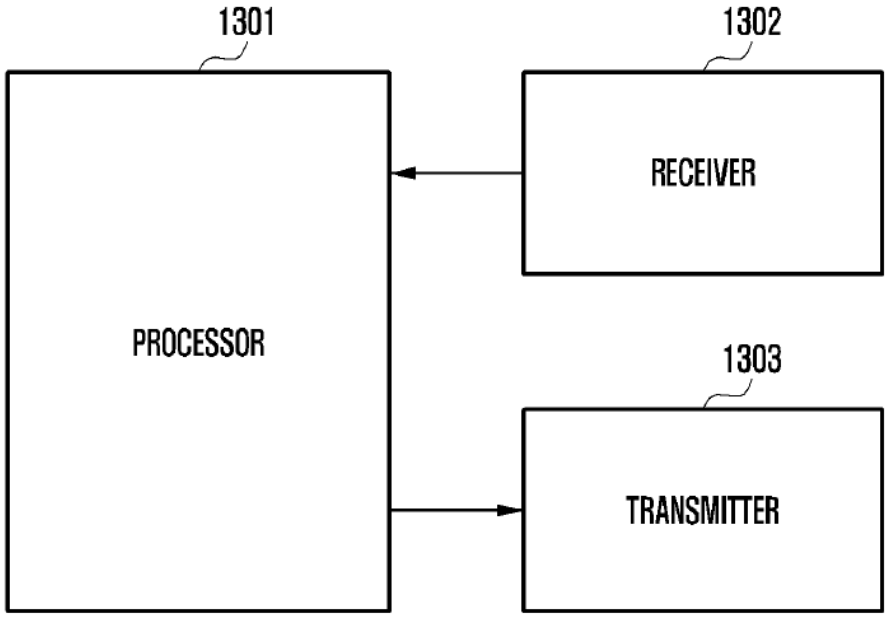
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
9[pre]	A user equipment (UE) for transmitting uplink (UL) control information, comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Oh discloses "A user equipment (UE) for transmitting uplink (UL) control information, comprising." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according

Invalidity of U.S. Patent 11,219,000 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14. 

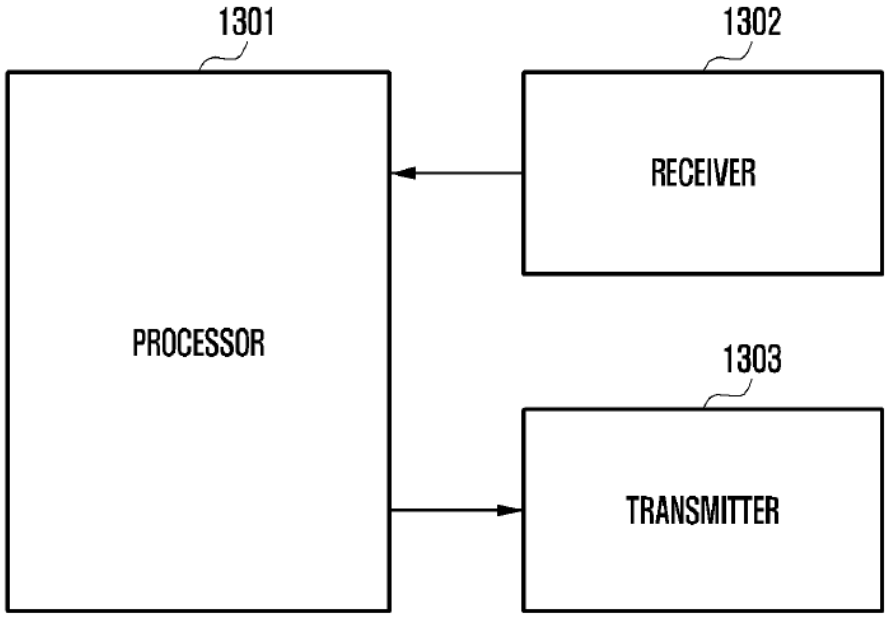
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, Oh discloses "a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14. 

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	a controller configured to determine one of UL control channel resource sets contained in the received UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and	At least under Pegasus's apparent infringement theory, Oh discloses "a controller configured to determine one of UL control channel resource sets contained in the received UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitations 1[b] and 1[c] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14. 

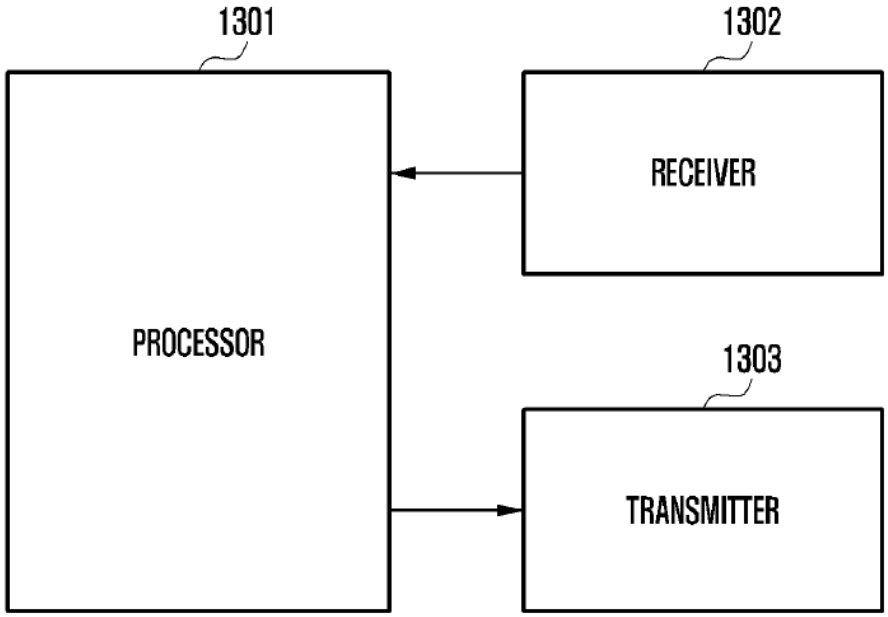
Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[c]	a transmitter configured to transmit the UL control information through the determined UL control channel resource,	At least under Pegasus's apparent infringement theory, Oh discloses "a transmitter configured to transmit the UL control information through the determined UL control channel resource." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[d] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14. 

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[d]	wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information, and	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[e]	wherein the UL control channel resource set configuration	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource set configuration information is received through UE specific radio resource

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
	information is received through UE specific radio resource control (RRC) signaling.	control (RRC) signaling." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
10	The UE according to claim 9, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the UE." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
11	The UE according to claim 10, wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 3 above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
12[a]	The UE according to claim 9, wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 4[a] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14. 

Invalidity of U.S. Patent 11,219,000 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
12[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resources is indicated from the base station through the DL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 4[b] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT H-15

Summary of Invalidity Analysis of U.S. Patent No. 10,638,463 ("'463 Patent") in view of R1-1711853

R1-1711853, titled "Activation/deactivation of bandwidth part," was publicly accessible by June 29, 2017. *See* https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/NR_AH_1706/Docs. Therefore, R1-1711853 qualifies as prior art to the '463 Patent under at least 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '463 Patent are invalid as expressly and/or inherently anticipated by R1-1711853.

To the extent that R1-1711853 is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '463 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of R1-1711853 in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine R1-1711853 and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent 10,638,463 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
1[pre]	A method of transmitting uplink (UL) control information by a user equipment, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, R1-1711853 discloses "A method of transmitting uplink (UL) control information by a user equipment, the method comprising." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "receiving, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Invalidity of U.S. Patent 10,638,463 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
1[b]	determining one of UL control channel resource sets contained in the UL control channel resource set configuration information;	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "determining one of UL control channel resource sets contained in the UL control channel resource set configuration information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	determining one of UL control channel resources contained in the determined UL control channel resource set; and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "determining one of UL control channel resources contained in the determined UL control channel resource set." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	transmitting UL control information through the	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "transmitting UL control information through the determined UL control channel resource." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 10,638,463 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
	determined UL control channel resource,	To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[f]	wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 10,638,463 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		3GPP TSG RAN1 NR Ad-Hoc#2 **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** **R1-1711853** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1. Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2.

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Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
2	The method according to claim 1, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3[a]	The method according to claim 1, further comprising receiving, from the base station, downlink (DL)	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

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control information containing information indicating the one of the UL control channel resources for the UL control information transmission,	**3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1. Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2.

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Claim Language		**Exemplary Citations to R1-1711853**
		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "the one of the UL control channel resources is indicated from the base station through the DL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: **3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

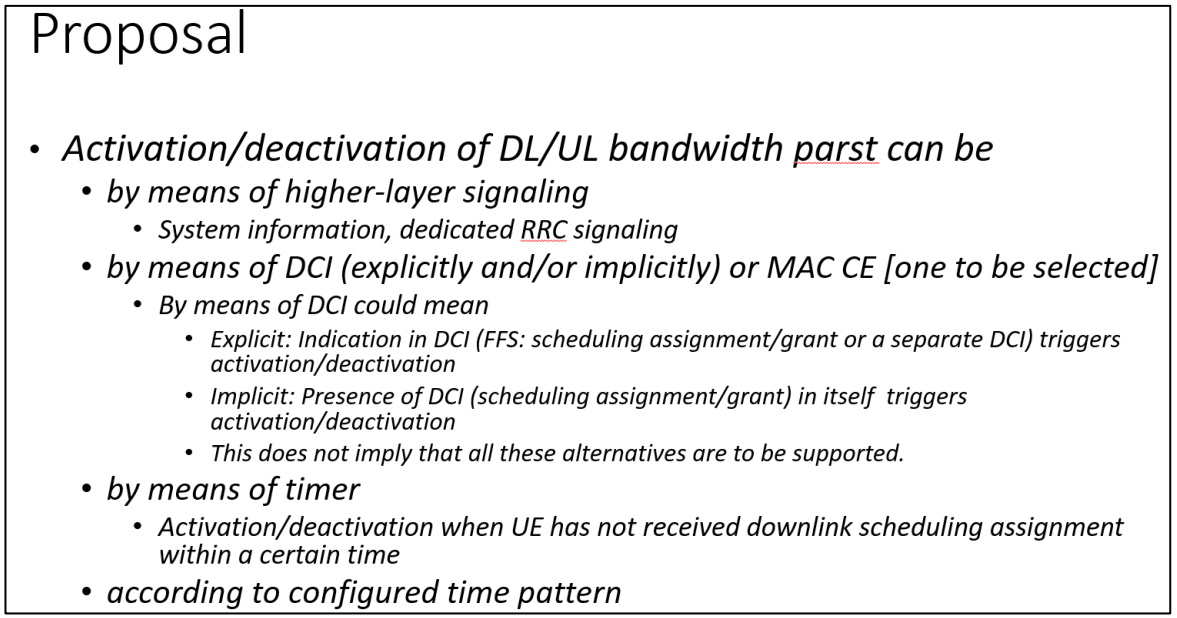
Invalidity of U.S. Patent 10,638,463 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 4

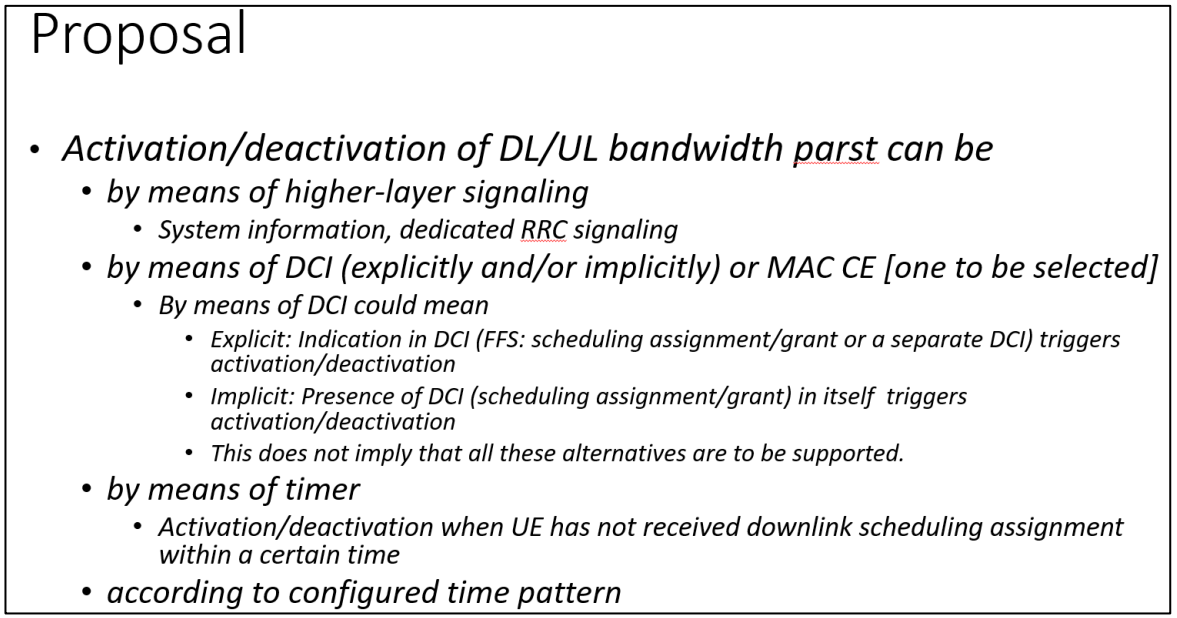
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Claim Language		**Exemplary Citations to R1-1711853**
4[pre]	A method of receiving uplink (UL) control information by a base station, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, R1-1711853 discloses "A method of receiving uplink (UL) control information by a base station, the method comprising." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[a]	transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment; and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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Claim Language		**Exemplary Citations to R1-1711853**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[b]	receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitations 1[b], 1[c], and 1[d] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[c]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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Claim Language		**Exemplary Citations to R1-1711853**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[d]	wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above.  **3GPP TSG RAN1 NR Ad-Hoc#2** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** **R1-1711853** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

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Claim Language		**Exemplary Citations to R1-1711853**
		 R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
5	The method according to claim 4, wherein the one of the UL control	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

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	channel resource sets for the UL control information transmission is determined based on a size of the UL control information.	*See* limitation 2 above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
6[a]	The method according to claim 4, further comprising transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 3[a] above. **3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

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Claim Language		**Exemplary Citations to R1-1711853**
		 R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
6[b]	wherein the one of the UL control channel resources is indicated to the user	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations:

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	equipment through the DL control information.	*See* limitation 3[a] above. **3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1.

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Claim Language		**Exemplary Citations to R1-1711853**
		Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 7

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Claim Language		**Exemplary Citations to R1-1711853**
7[pre]	A user equipment for transmitting uplink (UL) control information, comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, R1-1711853 discloses "A user equipment for transmitting uplink (UL) control information, comprising." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[a]	a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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7[b]	a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[b] and 1[c] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[c]	a transmitter configured to transmit the UL control information through the determined UL control channel resource,	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "a transmitter configured to transmit the UL control information through the determined UL control channel resource." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[d] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to R1-1711853**
7[d]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[e]	wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above.

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		3GPP TSG RAN1 NR Ad-Hoc#2 **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** **R1-1711853** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1. Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2.

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		To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8	The user equipment according to claim 7, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	The user equipment according to claim 7, wherein the receiver receives, from the base station, DL control	At least under Pegasus's apparent infringement theory, R1-1711853 discloses "wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, R1-1711853 discloses this limitation based on the following exemplary citations: *See* limitation 3[a] above.

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Claim Language	**Exemplary Citations to R1-1711853**
information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	**3GPP TSG RAN1 NR Ad-Hoc#2** **R1-1711853** **Qingdao, P.R. China June 27th – 30th, 2017** **Agenda Item: 5.1.7** Activation/deactivation of bandwidth part Ericsson, [Intel, MediaTek, OPPO] R1-1711853 at 1. Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern*

<table>
<tr><th colspan="3">Invalidity of U.S. Patent 10,638,463 in view of R1-1711853</th></tr>
<tr><th colspan="2">Claim Language</th><th>Exemplary Citations to R1-1711853</th></tr>
<tr><td></td><td></td><td>R1-1711853 at 2.

To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.</td></tr>
<tr><td>9[b]</td><td>wherein the one of the UL control channel resources is indicated from the base station through the DL control information.</td><td>At least under Pegasus’s apparent infringement theory, R1-1711853 discloses “wherein the one of the UL control channel resources is indicated from the base station through the DL control information.” For example, R1-1711853 discloses this limitation based on the following exemplary citations:

See limitation 3[b] above.

3GPP TSG RAN1 NR Ad-Hoc#2
Qingdao, P.R. China June 27th – 30th, 2017
Agenda Item: 5.1.7
R1-1711853

Activation/deactivation of bandwidth part

Ericsson, [Intel, MediaTek, OPPO]

R1-1711853 at 1.</td></tr>
</table>

Invalidity of U.S. Patent 10,638,463 in view of R1-1711853		
Claim Language		**Exemplary Citations to R1-1711853**
		Proposal • *Activation/deactivation of DL/UL bandwidth parst can be* • *by means of higher-layer signaling* • *System information, dedicated RRC signaling* • *by means of DCI (explicitly and/or implicitly) or MAC CE [one to be selected]* • *By means of DCI could mean* • *Explicit: Indication in DCI (FFS: scheduling assignment/grant or a separate DCI) triggers activation/deactivation* • *Implicit: Presence of DCI (scheduling assignment/grant) in itself triggers activation/deactivation* • *This does not imply that all these alternatives are to be supported.* • *by means of timer* • *Activation/deactivation when UE has not received downlink scheduling assignment within a certain time* • *according to configured time pattern* R1-1711853 at 2. To the extent it is found that R1-1711853 does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that R1-1711853 does not anticipate this claim, R1-1711853 renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine R1-1711853 with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT H-16

Summary of Invalidity Analysis of U.S. Patent No. 10,638,463 ("'463 Patent") in view of U.S. Patent No. 10,980,007 to Oh et al. ("Oh")

U.S. Patent No. 10,980,007 to Oh et al. ("Oh"), issued on April 13, 2021, and was filed on September 28, 2018. Oh claims priority to KR 10-2017-0127698 filed on September 29, 2017, and KR 10-2017-0154035 filed on November 17, 2017. Therefore, Oh qualifies as prior art to the '463 Patent under at least 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '463 Patent are invalid as expressly and/or inherently anticipated by Oh.

To the extent that Oh is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '463 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Oh in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Oh and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

1. Claim 1

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
1[pre]	A method of transmitting uplink (UL) control information by a user equipment, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Oh discloses "A method of transmitting uplink (UL) control information by a user equipment, the method comprising." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The present disclosure relates generally to a wireless communication system and, more particularly, to a method and apparatus for configuring uplink control channel transmission resources in a next-generation mobile communication system. Oh at 1:20-24. In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;	At least under Pegasus's apparent infringement theory, Oh discloses "receiving, from a base station, UL control channel resource set configuration information for UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		(57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract. The present disclosure relates generally to a wireless communication system and, more particularly, to a method and apparatus for configuring uplink control channel transmission resources in a next-generation mobile communication system. Oh at 1:20-24.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

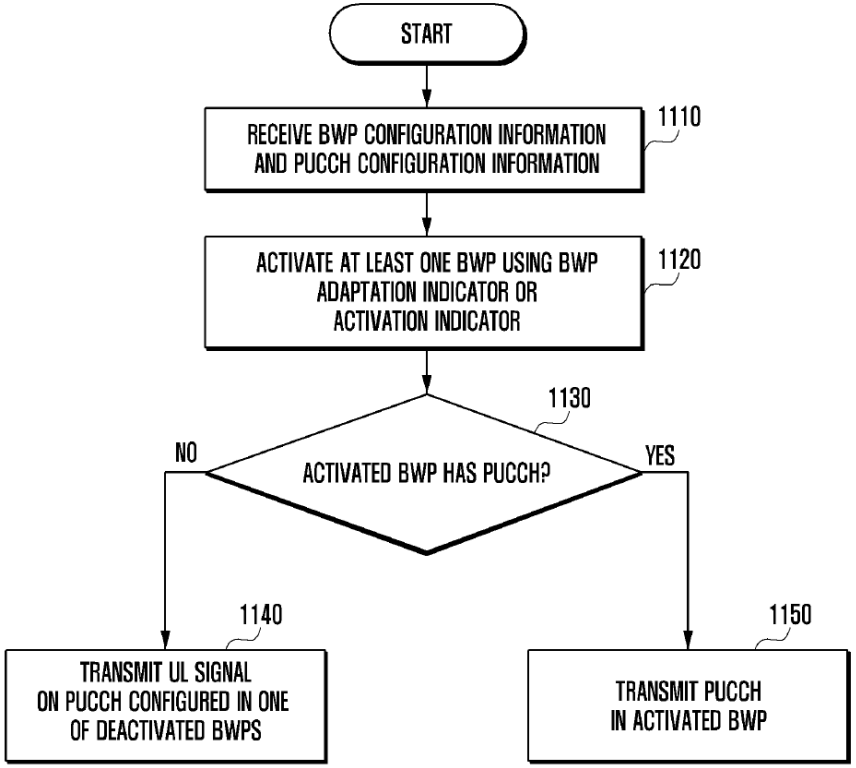
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In FIG. **4**, two CORESETs (CORESET #**1 440** and CORESET #**2 450**) are configured. CORESETs **440** and **450** may be configured to occupy specific sub-bands across the whole system bandwidth **410**. In FIG. **4**, CORESET #**1 440** is configured across two BWPs (i.e., BWP #**1 402** and BWP #**2 403**), while CORESET #**2** is configured with one BWP (i.e., BWP #**4 405**). A CORESET may span one or more OFDM symbols in the time domain and its length is specified by a number of OFDM symbols as denoted by reference numbers **460** and **470**. In FIG. **4**, the CORESET length **460** of CORESET #**1** is 2, and the CORESET length **470** of CORESET #**2** is 1. In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. Oh at 11:30-55.

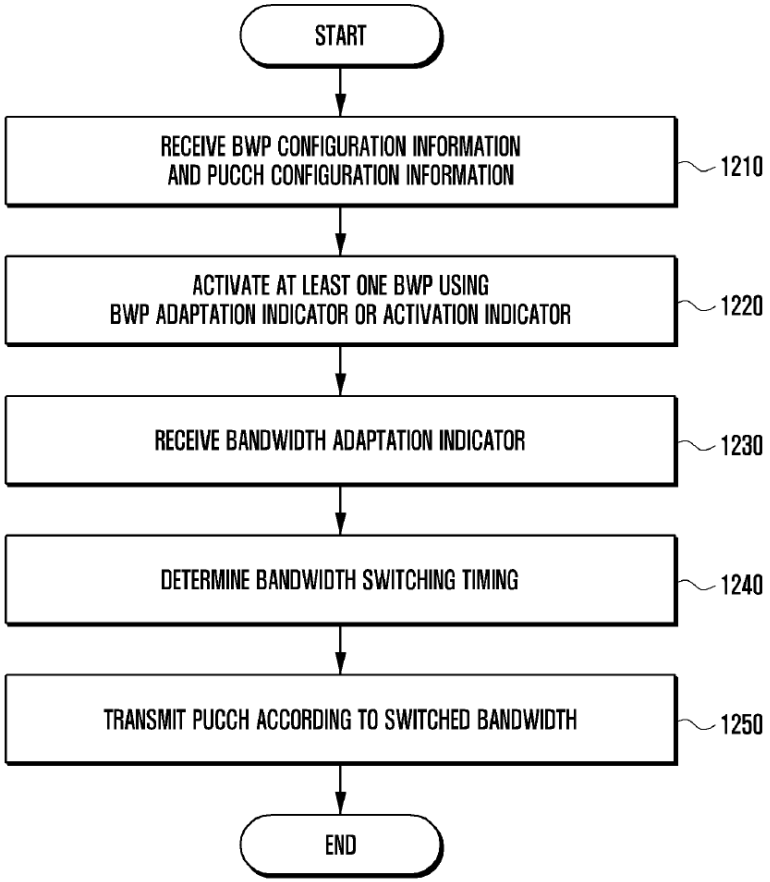
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. In 5G, a CORESET may be configured as one of a common CORESET, a UE-group common CORESET, and a UE-specific CORESET. A CORESET may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If a CORESET is configured to a UE, this means that the information on the CORESET location, CORESET sub-bands, CORESET resource allocation, and CORESET length is provided to the UE. The CORESET configuration information provided to the UE may include the following information shown in Table 1 below. Oh at 11:42-67.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		TABLE 1 Configuration information 1. RB allocation in frequency domain Configuration information 2. CORESET length in time domain (number of OFDM symbols configured for CORESET) Configuration information 3. Resource mapping scheme (time-preference mapping, frequency-preference mapping) Configuration information 4. Resource mapping scheme (Localized transmission scheme, Distributed transmission scheme Configuration information 5. Search space type (common search space, UE-group search space, UE-specific search space) Configuration information 6. Monitoring occasion (monitoring period/interval, monitoring symbol location in slot Configuration information 7. DMRS configuration information (DMRS structure, number of DMRS ports Configuration information 8. REG bundling size The CORESET configuration information may further include other information necessary for transmitting the DL control channel in addition to the aforementioned information. Oh at 12:1-18.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2. TABLE 2 Configuration information 1. UL control channel frequency-domain RB allocation information Configuration information 2. UL control channel time-domain allocation information (start symbol location of control channel) Configuration information 3. UL control channel time-domain length (number of OFDM symbols for control channel) or format TABLE 2-continued Configuration information 4. Waveform (OFDM or DFT-S-OFDM) of UL channel Configuration information 5. Frequency hopping mode of UL control channel Oh at 15:48-16:5.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The UE may obtain PUCCH configuration information (e.g., PUCCH format, PUCCH length, sequence, frequency hopping, time/frequency resource allocation, and orthogonal sequence information) for transmitting the PUCCH conveying UCI (e.g., a SR, a DL data channel reception result (HARQ-ACK), and channel state information (CSI)) and determine the PUCCH configuration information for use in transmitting the UCI. Oh at 22:57-64. The configuration information about PUCCH #**1 1010** may include all setting values necessary for generating the PUCCH, which include a PUCCH length (or number of PUCCH symbols defined as N_PUCCH_symb), a Zadoff-Chu sequence, a Zadoff-Chu sequence group number, sequence numbers in the group, a frequency hopping configuration, numbers of symbols for first and second hopping periods or spreading factors for the first and second hopping periods (defined as N_PUCCH_SF**0** and N_PUCCH_SF**1**) when the frequency hopping is activated, and orthogonal sequence values therefor that are each configured for PUCCH #**1 1010**. Oh ay 25:16-28.

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	determining one of UL control channel resource sets contained in the UL control channel resource set configuration information;	At least under Pegasus's apparent infringement theory, Oh discloses "determining one of UL control channel resource sets contained in the UL control channel resource set configuration information." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The present disclosure relates generally to a wireless communication system and, more particularly, to a method and apparatus for configuring uplink control channel transmission resources in a next-generation mobile communication system. Oh at 1:20-24. Referring to FIG. **3**, a REG, as the basic unit of time and frequency resources for a control channel, is made up of one OFDM symbol **301** in the time domain and 12 subcarriers **302** (i.e. one RB), in the frequency domain. By assuming one OFDM symbol as a basic unit of control channel resources in the time domain, it may be possible to multiplex data and control channels in one subframe. The control channel is followed by a data channel to reduce processing time at a UE, thereby facilitating meeting of the latency requirement. By using 1 RB **302** as the basic unit of control channel resources in the frequency domain, it may be possible to facilitate multiplexing the control and data channels in frequency. By concatenating multiple NR-REGs **303**, it is possible to configure various control channel regions in different sizes. For example, assuming that the basic unit of DL control channel resource allocation is NR-CCE **304** in 5G, the NR-CCE **304** may be made up of a plurality of NR-REGs **303**. For example, the NR-REG **303** depicted in FIG. **3** is made up of 12 REs and, assuming one NR-CCE **304** consists of 4 NR-REGs **303**, the NR-CCE **304** consists of 48 REs. If the DL control region is configured, the control region may consist of multiple NR-CCEs **304**, and a certain DL control channel may be mapped to one or more NR-CCEs **304** according to the AL in the control region. The NR-CCEs **304** constituting the control region are distinguished by CCE numbers, which are assigned in a way of logical mapping.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at 10:32-58. In FIG. **4**, two CORESETs (CORESET #**1 440** and CORESET #**2 450**) are configured. CORESETs **440** and **450** may be configured to occupy specific sub-bands across the whole system bandwidth **410**. In FIG. **4**, CORESET #**1 440** is configured across two BWPs (i.e., BWP #**1 402** and BWP #**2 403**), while CORESET #**2** is configured with one BWP (i.e., BWP #**4 405**). A CORESET may span one or more OFDM symbols in the time domain and its length is specified by a number of OFDM symbols as denoted by reference numbers **460** and **470**. In FIG. **4**, the CORESET length **460** of CORESET #**1** is 2, and the CORESET length **470** of CORESET #**2** is 1. In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. Oh at 11:30-55.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. In 5G, a CORESET may be configured as one of a common CORESET, a UE-group common CORESET, and a UE-specific CORESET. A CORESET may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If a CORESET is configured to a UE, this means that the information on the CORESET location, CORESET sub-bands, CORESET resource allocation, and CORESET length is provided to the UE. The CORESET configuration information provided to the UE may include the following information shown in Table 1 below. Oh at 11:42-67.

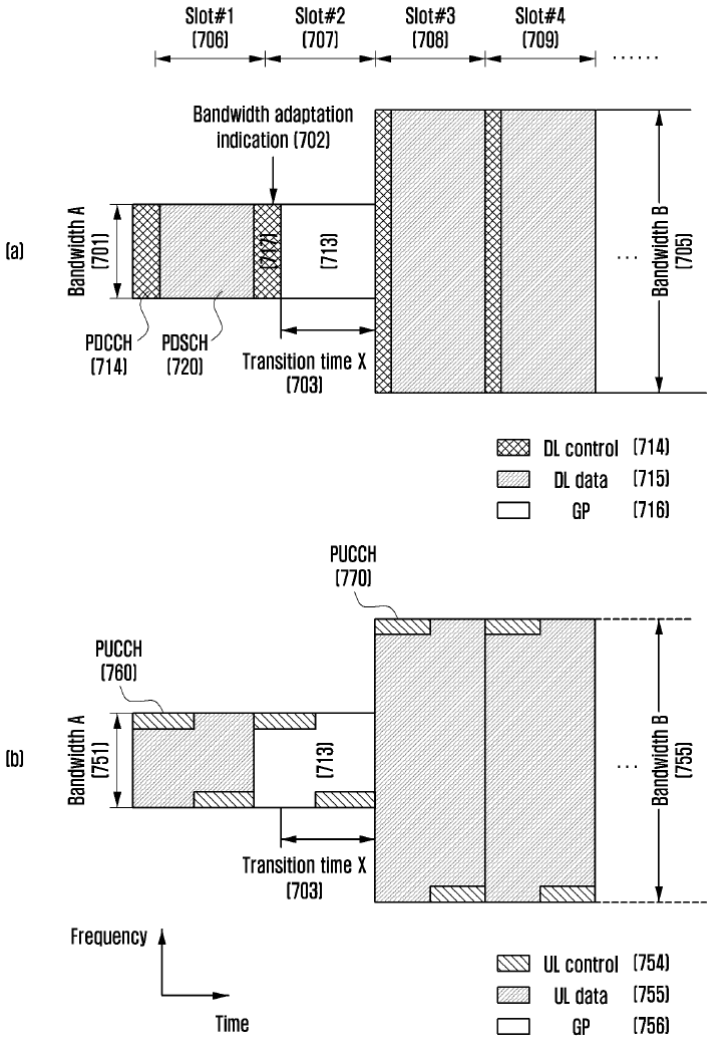
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

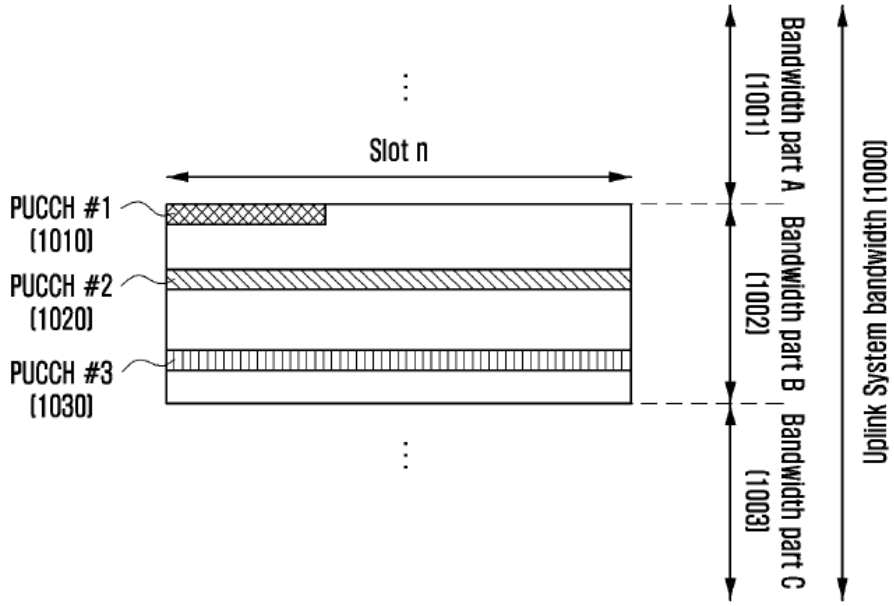
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. Oh at 16:7-18. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. As described above, the BWP A is configured with three PUCCH resources (PUCCH #**1**, PUCCH #**2**, and PUCCH #**3**) and BWP B is configured with two PUCCH resources (PUCCH #**1** and PUCCH #**2**), however the DCI **714** may indicate the PUCCH #**3** for PUCCH transmission. In this case, the UE may transmit the PUCCH on the PUCCH resources determined as a result of the modulo operation performed on the indicated control channel resources with a

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Claim Language		**Exemplary Citations to Oh**
		value of the control channel resources (or PUCCH format index or PUCCH format) configured in the changed BWP B (i.e., PUCCH #**1** configured in the BWP B). Oh at 20:60-21:3. Referring to FIG. **10**, PUCCH #**1** **1010** comprises PUCCH resources for transmitting SR information associated with the first logical channel, and PUCCH #**2** **1020** comprises PUCCH resources for transmitting SR information associated with the second logical channel. If it is necessary for the UE to transmit UL data on the first logical channel, the UE may transmit the SR information to the BS on the PUCCH #**1** **1010** such that the BS configures or allocates UL data channel transmission resources appropriate for the logical channel (first logical channel) of which data the UE wants to transmit. Oh at 23:9-19.

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Claim Language	**Exemplary Citations to Oh**
	FIG. 7  Oh at Fig. 7.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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1[c]	determining one of UL control channel resources contained in the determined UL control channel resource set; and	At least under Pegasus's apparent infringement theory, Oh discloses "determining one of UL control channel resources contained in the determined UL control channel resource set." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

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Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2.

TABLE 2

Configuration information 1. UL control channel frequency-domain RB allocation information
Configuration information 2. UL control channel time-domain allocation information (start symbol location of control channel)
Configuration information 3. UL control channel time-domain length (number of OFDM symbols for control channel) or format

TABLE 2-continued

Configuration information 4. Waveform (OFDM or DFT-S-OFDM) of UL channel
Configuration information 5. Frequency hopping mode of UL control channel

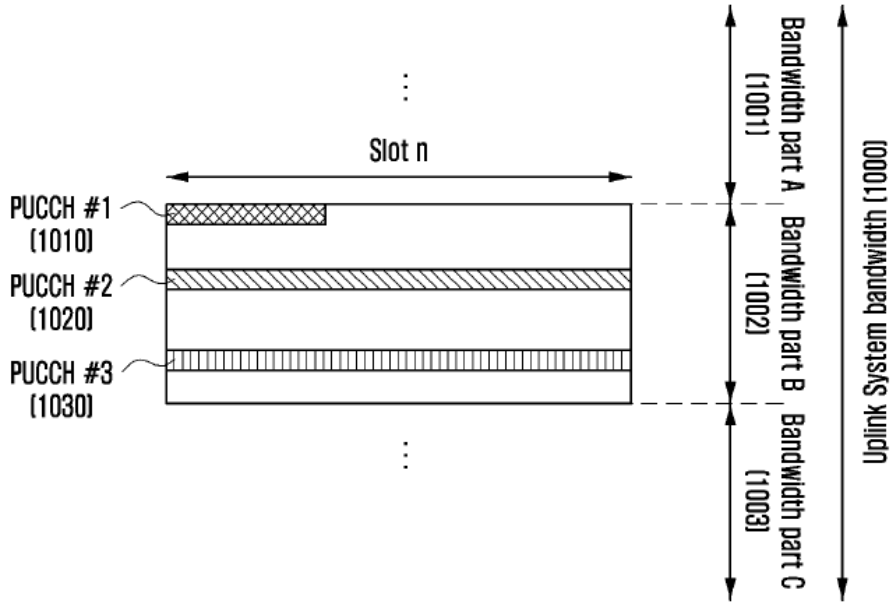
Oh at 15:48-16:5.

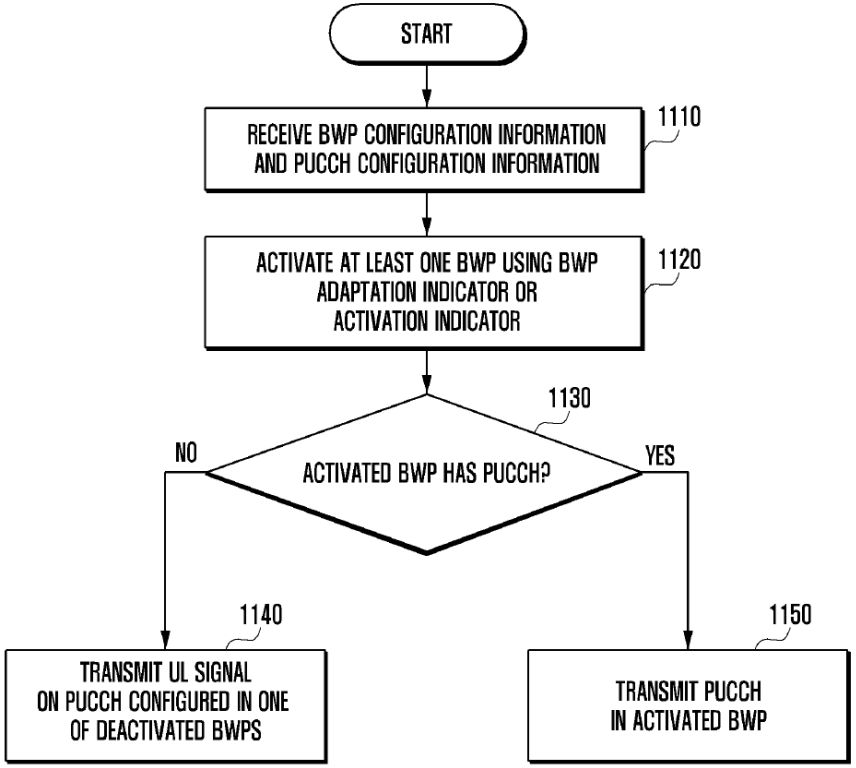
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. Oh at 16:7-18. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

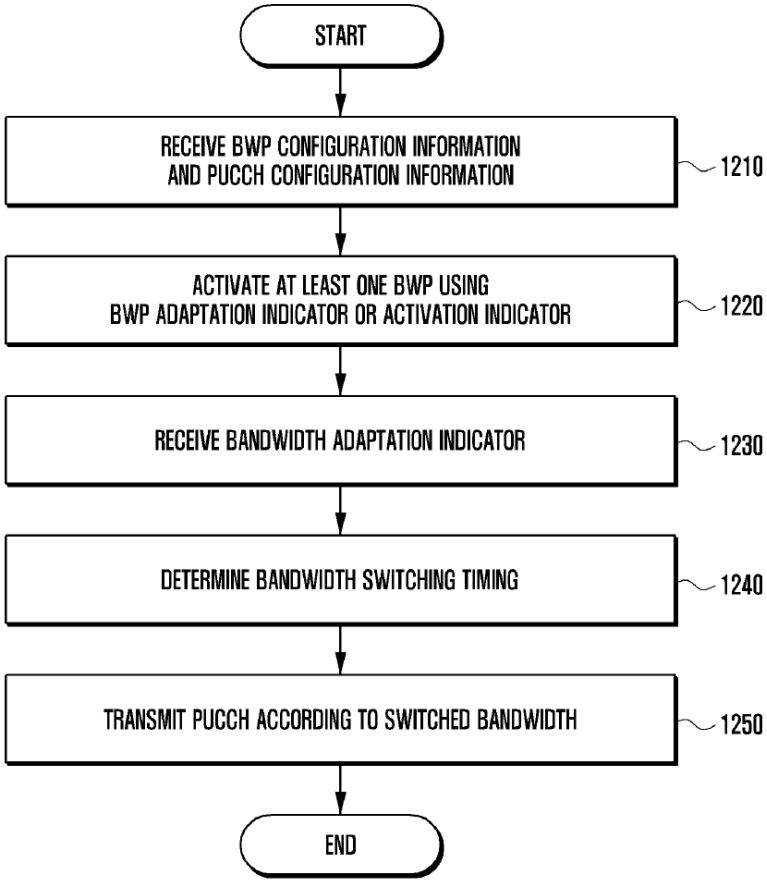
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. As described above, the BWP A is configured with three PUCCH resources (PUCCH #**1**, PUCCH #**2**, and PUCCH #**3**) and BWP B is configured with two PUCCH resources (PUCCH #**1** and PUCCH #**2**), however the DCI **714** may indicate the PUCCH #**3** for PUCCH transmission. In this case, the UE may transmit the PUCCH on the PUCCH resources determined as a result of the modulo operation performed on the indicated control channel resources with a

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Claim Language		**Exemplary Citations to Oh**
		value of the control channel resources (or PUCCH format index or PUCCH format) configured in the changed BWP B (i.e., PUCCH #**1** configured in the BWP B). Oh at 20:60-21:3. Referring to FIG. **10**, PUCCH #**1** **1010** comprises PUCCH resources for transmitting SR information associated with the first logical channel, and PUCCH #**2** **1020** comprises PUCCH resources for transmitting SR information associated with the second logical channel. If it is necessary for the UE to transmit UL data on the first logical channel, the UE may transmit the SR information to the BS on the PUCCH #**1** **1010** such that the BS configures or allocates UL data channel transmission resources appropriate for the logical channel (first logical channel) of which data the UE wants to transmit. Oh at 23:9-19.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

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Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	transmitting UL control information through the determined UL control channel resource,	At least under Pegasus's apparent infringement theory, Oh discloses "transmitting UL control information through the determined UL control channel resource." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

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Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2.

TABLE 2

Configuration information 1. UL control channel frequency-domain RB allocation information
Configuration information 2. UL control channel time-domain allocation information (start symbol location of control channel)
Configuration information 3. UL control channel time-domain length (number of OFDM symbols for control channel) or format

TABLE 2-continued

Configuration information 4. Waveform (OFDM or DFT-S-OFDM) of UL channel
Configuration information 5. Frequency hopping mode of UL control channel

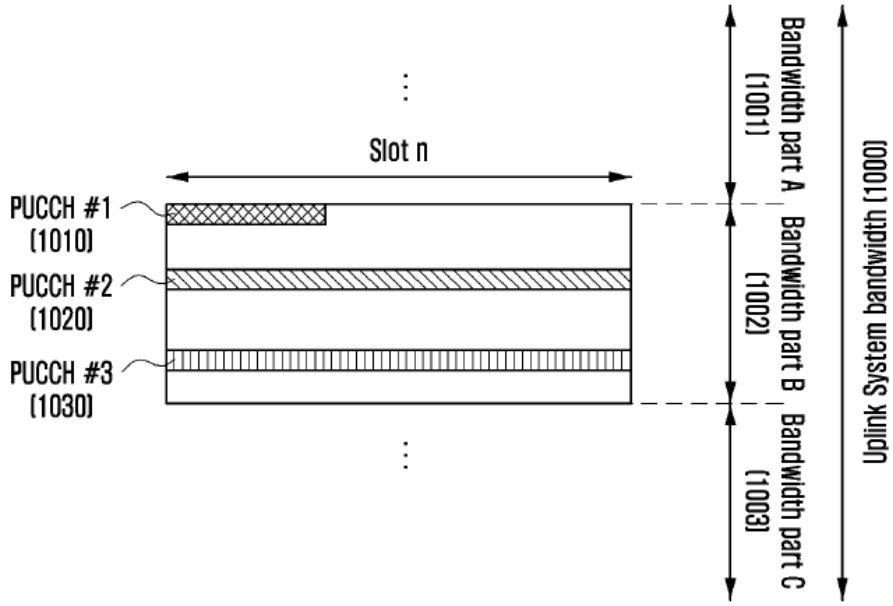
Oh at 15:48-16:5.

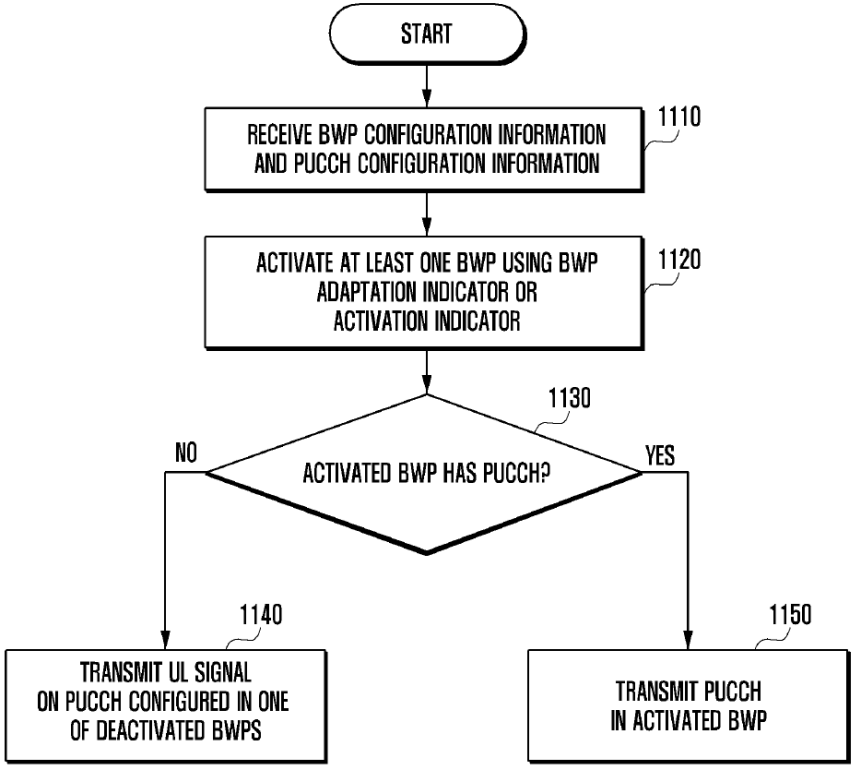
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. Oh at 16:7-18. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

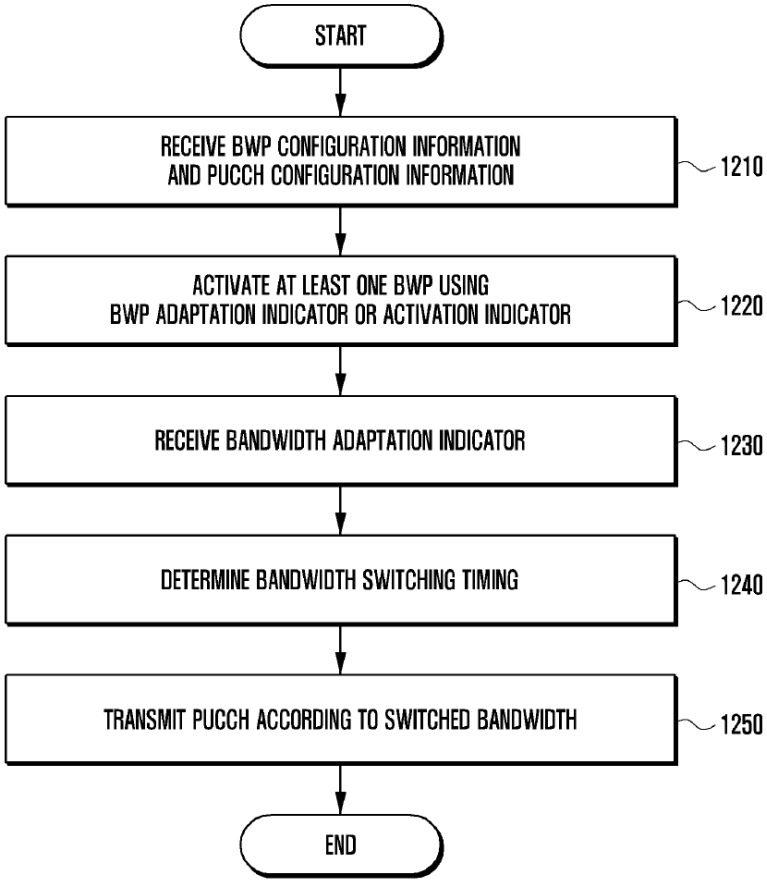
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. As described above, the BWP A is configured with three PUCCH resources (PUCCH #**1**, PUCCH #**2**, and PUCCH #**3**) and BWP B is configured with two PUCCH resources (PUCCH #**1** and PUCCH #**2**), however the DCI **714** may indicate the PUCCH #**3** for PUCCH transmission. In this case, the UE may transmit the PUCCH on the PUCCH resources determined as a result of the modulo operation performed on the indicated control channel resources with a

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Claim Language		**Exemplary Citations to Oh**
		value of the control channel resources (or PUCCH format index or PUCCH format) configured in the changed BWP B (i.e., PUCCH #**1** configured in the BWP B). Oh at 20:60-21:3. Referring to FIG. **10**, PUCCH #**1** **1010** comprises PUCCH resources for transmitting SR information associated with the first logical channel, and PUCCH #**2** **1020** comprises PUCCH resources for transmitting SR information associated with the second logical channel. If it is necessary for the UE to transmit UL data on the first logical channel, the UE may transmit the SR information to the BS on the PUCCH #**1** **1010** such that the BS configures or allocates UL data channel transmission resources appropriate for the logical channel (first logical channel) of which data the UE wants to transmit. Oh at 23:9-19.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10.

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

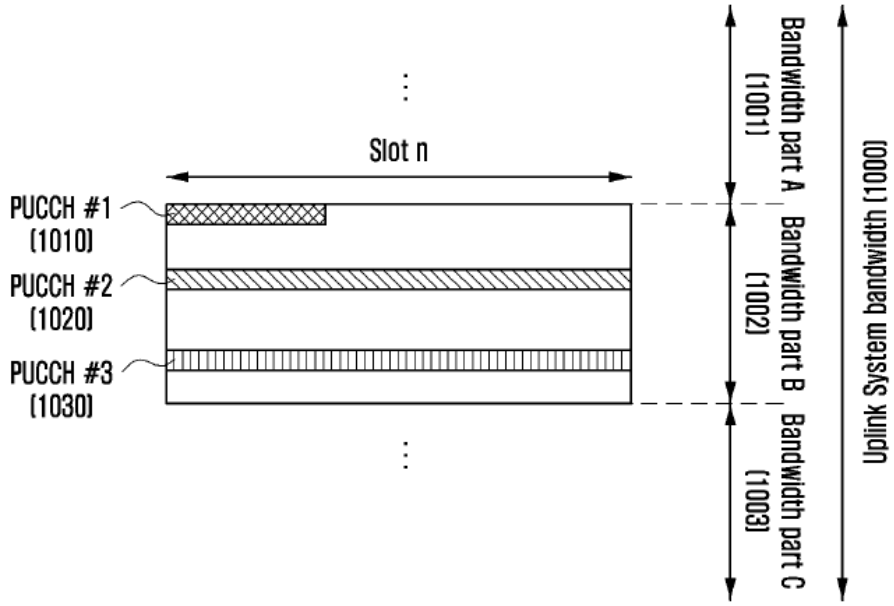
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment." For example, Oh discloses this limitation based on the following exemplary citations: In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		In FIG. **4**, two CORESETs (CORESET #**1 440** and CORESET #**2 450**) are configured. CORESETs **440** and **450** may be configured to occupy specific sub-bands across the whole system bandwidth **410**. In FIG. **4**, CORESET #**1 440** is configured across two BWPs (i.e., BWP #**1 402** and BWP #**2 403**), while CORESET #**2** is configured with one BWP (i.e., BWP #**4 405**). A CORESET may span one or more OFDM symbols in the time domain and its length is specified by a number of OFDM symbols as denoted by reference numbers **460** and **470**. In FIG. **4**, the CORESET length **460** of CORESET #**1** is 2, and the CORESET length **470** of CORESET #**2** is 1. In the 5G system, it may be possible to configure multiple CORESETs according to a BS. It may also be possible to configure multiple CORESETs according to a terminal (hereinafter, interchangeably referred to as UE). It may also be possible to assign part of the CORESETs configured in the system. Accordingly, a UE may not know all of the CORESETs configured in the system. Assuming that two CORESETs (CORESET #**1 440** and CORESET #**2 450**), can be configured in the system as shown in FIG. **4**, it may be possible to configure CORESET #**1 440** for UE #**1** and CORESET #**1 440** and CORESET #**2** for UE #**2**. In this case, the UE #**1** may not know the presence of CORESET #**2 450** unless an additional indicator is used. Oh at 11:29-55.

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Claim Language		**Exemplary Citations to Oh**
		For transmission/reception bandwidth adaptation or switching, it is necessary for the BS to configure the CORESETs to transmit the DL control channel and resources efficiently, and the PUCCH to the UE efficiently. In the case where the UE is assigned the UL and DL bandwidths in different BWPs, there is a need of a method for making it possible for the UE to configure the PUCCH resources in a BWP-specific manner, select the PUCCH resources, and switch between BWPs. Oh at 15:20-28. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information may include at least the following information, as shown below in Table 2. Oh at 15:48-58.

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Claim Language		**Exemplary Citations to Oh**
		A more detailed description is made with reference to parts (a) and (b) of FIG. **6**. The UE configured with multiple BWPs as shown in part (a) of FIG. **6** may be allocated multiple long PUCCH transmission resources **640** in one of the configured BWPs. It may also be possible that the UE is allocated each of PUCCH transmission resources **650**, **660**, **670**, and **680** in each of the configured BWPs, respectively, as shown in part (b) of FIG. **6**. It may also be possible that the UE is allocated PUCCH transmission resources in some of the configured BWPs. Here, the PUCCH transmission resources may be configured independently per BWP. The BS may configure the PUCCH transmission resources based on the maximum frequency bandwidth supported by the UE without considering the BWP. For example, the BS may configure the PUCCH transmission resources **650** and **680** based on the maximum UL frequency bandwidth **610** of the UE. In this case, it may be possible for the UE to assume the long PUCCH **650** in the BWP #**1 602**, the short PUCCH **680** in the BWP #**4**, and no PUCCH in the BWP #**2 603** and BWP #**3 604**, based on the PUCCH transmission resources and UL BWPs configured by the BS. Although, as shown in FIG. **6**, each BWP is configured to have a type of PUCCH or nothing, it may also be possible for each BWP to be configured to have one or more types of PUCCHs. Oh at 16:7-33.

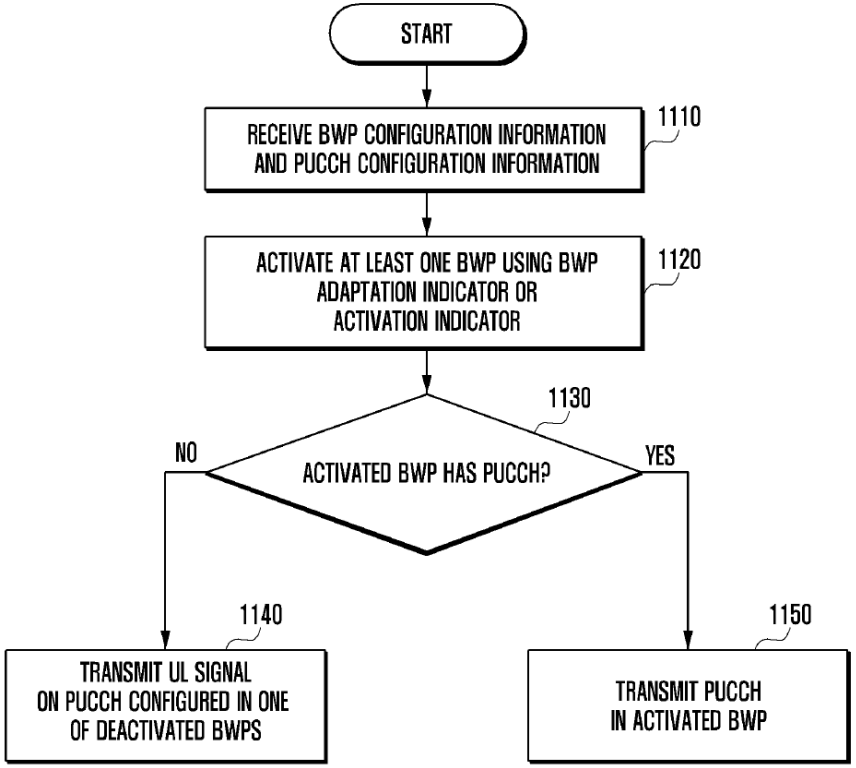
Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 10. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

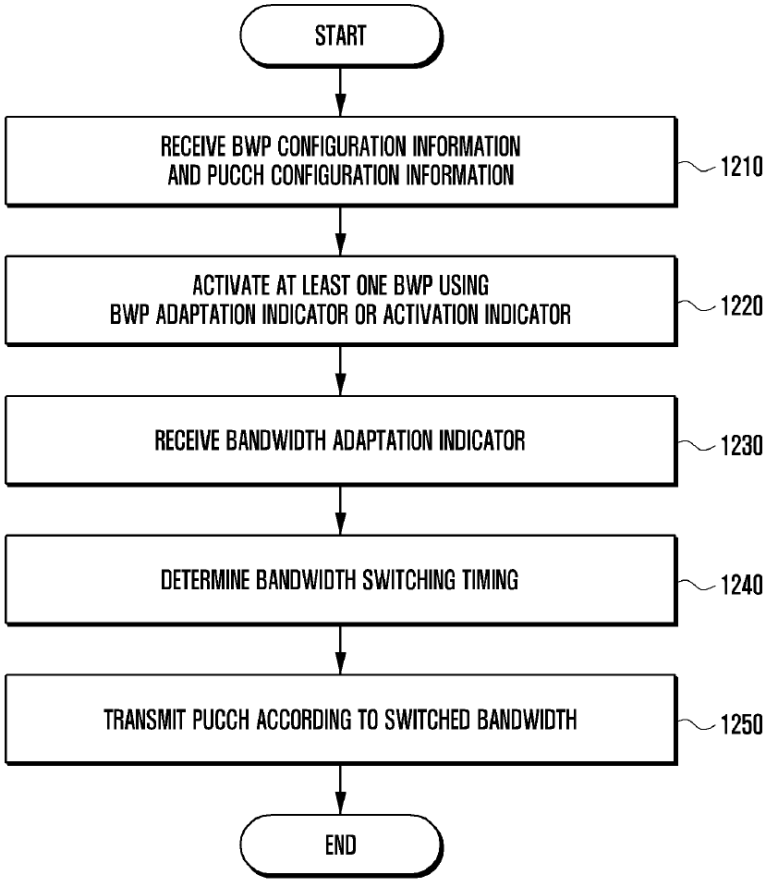
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
1[f]	wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Oh at 15:32-47. If it is necessary for the UE to transmit a PUCCH, the UE may activate one of the deactivated BWPs (e.g., one (BWP #**1 602**) of the deactivated BWPs if the activated BWP (BWP #**2 603**) has no configured PUCCH resources) to transmit the PUCCH. If the UE is capable of activating only one UL BWP, it may assume that the BWP (BWP #**2 603**) that is activated but has no currently configured PUCCH resources is deactivated while the BWP (BWP #**1 602**) is activated for PUCCH transmission. After transmitting the PUCCH, the UE may reactivate BWP #**2 603** and deactivate BWP #**1 602**. Oh at 16:51-61.

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Claim Language		**Exemplary Citations to Oh**
		Referring to FIG. **12**, at step **1210**, the UE receives BWP configuration information (e.g., information as shown in Table 1) and PUCCH configuration information about one or more BWPs as shown in Table 2 from the BS via higher layer signaling, a broadcast channel, or a DL data channel (e.g., a DL data channel scheduled via DCI scrambled with SI-RNTI) including system information. At step **1220**, the UE activates at least one DL and UL BWP based on a BWP adaptation indicator or activation indicator included in the DCI transmitted via higher layer signaling or a DL control channel. If the DL and UL BWPs are correlated with each other, the UL BWP may be changed or activated according to the DL BWP adaptation indicator. Oh at 26:31-43.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

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Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
2	The method according to claim 1, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information." For example, Oh discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Oh**
		Referring to FIG. **3**, a REG, as the basic unit of time and frequency resources for a control channel, is made up of one OFDM symbol **301** in the time domain and 12 subcarriers **302** (i.e. one RB), in the frequency domain. By assuming one OFDM symbol as a basic unit of control channel resources in the time domain, it may be possible to multiplex data and control channels in one subframe. The control channel is followed by a data channel to reduce processing time at a UE, thereby facilitating meeting of the latency requirement. By using 1 RB **302** as the basic unit of control channel resources in the frequency domain, it may be possible to facilitate multiplexing the control and data channels in frequency. By concatenating multiple NR-REGs **303**, it is possible to configure various control channel regions in different sizes. For example, assuming that the basic unit of DL control channel resource allocation is NR-CCE **304** in 5G, the NR-CCE **304** may be made up of a plurality of NR-REGs **303**. For example, the NR-REG **303** depicted in FIG. **3** is made up of 12 REs and, assuming one NR-CCE **304** consists of 4 NR-REGs **303**, the NR-CCE **304** consists of 48 REs. If the DL control region is configured, the control region may consist of multiple NR-CCEs **304**, and a certain DL control channel may be mapped to one or more NR-CCEs **304** according to the AL in the control region. The NR-CCEs **304** constituting the control region are distinguished by CCE numbers, which are assigned in a way of logical mapping. Oh at 10:32-58.

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Claim Language	**Exemplary Citations to Oh**
	The radio resources for a short PUCCH **518** are allocated by PRB such that the PUCCH are mapped to consecutive or discrete multiple PRBs in the frequency domain. The allocated PRBs should be included in a band that is equal to or narrower than the frequency band **507** supported by the UE or the UL transmission bandwidth that the BS has configured to the UE. The multiple PRBs may be allocated frequency resources configured to the UE via higher layer signaling such that the frequency resources are mapped to corresponding bit fields, and the multiple PRBs may notify the UE of the frequency resources to be used via a bit field included in the DL control channel. Oh at 13:36-47. It may also be possible to determine the DMRS transmission scheme based on the number of bits of the UCI **520**. If the number of bits of the UCI **520** is small, the UE may multiplex the DMRS **521** and the UCI **520** into a control channel as denoted by reference number **512**. In the case where the number of bits of the UCI is small, it is possible to achieve a transmission coding rate with reduced resources sufficient for UCI **520** transmission. If the number of bits of the UCI **520** is large, the UE may multiplex the DMRS **521** and UCI **520** into a control channel as denoted by reference number **514**. In the case where the number of bits of the UCI **520** is large, it is necessary to use a large amount of the resources for UCI **520** transmission at a reduced transmission coding rate. Oh at 13:57-14:3.

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Claim Language		**Exemplary Citations to Oh**
		The UE may determine whether to use the long PUCCH **503** or short PUCCH **518** in a slot or a mini-slot for transmitting the UCI **520** based on the information indicating the use of the long or short PUCCH, which is received from the BS via higher layer signaling. It may also be possible to make such a determination based on the information indicating the use of the long or short PUCCH, which is received from the BS via physical layer signaling. It may also be possible to make such a determination based on the information obtained implicitly from the number of UL symbols of the slot or mini-slot. For example, the UE may transmit the UCI **520** using the short PUCCH **518** for a case in which the number of UL symbols included in the slot or mini-slot, notified or configured by the BS, for UCI **520** transmission is 1 or 2, and the UE may transmit the UCI **520** using the long PUCCH **503** for a case in which the number of UL symbols included in the slot or mini-slot is 4 to 14. Oh at 14:4-21.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Here, the PUCCH transmission resources may be configured for all, one, or some of the BWPs. The PUCCH transmission resources may be configured per UE via UE-specific signaling, UE-group common signaling, or RRC signaling. If PUCCH transmission resources are configured to a UE, the UE is provided with information such as a control channel transmission region location, control channel sub-band, control channel resource allocation, and control channel length. The PUCCH configuration information Oh at 15:32-56.

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Claim Language		**Exemplary Citations to Oh**
		The BS may configure the PUCCH transmission resources based on the maximum frequency bandwidth supported by the UE without considering the BWP. For example, the BS may configure the PUCCH transmission resources **650** and **680** based on the maximum UL frequency bandwidth **610** of the UE. In this case, it may be possible for the UE to assume the long PUCCH **650** in the BWP #**1 602**, the short PUCCH **680** in the BWP #**4**, and no PUCCH in the BWP #**2 603** and BWP #**3 604**, based on the PUCCH transmission resources and UL BWPs configured by the BS. Although, as shown in FIG. **6**, each BWP is configured to have a type of PUCCH or nothing, it may also be possible for each BWP to be configured to have one or more types of PUCCHs. At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:19-50.

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Claim Language	**Exemplary Citations to Oh**
	If the BS transmits a bandwidth adaptation indicator **702** to the UE to switch bandwidths with bandwidth B **705**, the UE performs a bandwidth adaptation operation based on the command. Bandwidths A and B may differ in size (i.e., bandwidth A may be broader or narrower than bandwidth B). In FIG. **7**, it is assumed that bandwidth B is broader than bandwidth A. Each of bandwidths A and B may be expressed by the number of PRBs or BWPs. Oh at 17:52-59. As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the

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Claim Language		**Exemplary Citations to Oh**
		Oh at 18:47-67. In the case where the configurations of the PUCCH transmission resources (or PUCCH format index or PUCCH format) differ per BWP so as not to be mapped one by one (e.g., when BWP A is configured with 3 PUCCH resources and BWP B is configured with 2 PUCCH resources), the UE may determine the PUCCH transmission timing and resources (or PUCCH format index or PUCCH format, such as PUCCH #**1**) through a modulo operation. In the case where the UE is assigned the BWP A configured with 3 PUCCH resources and the BWP B is configured with 2 PUCCH resources, if the BWP A is activated, it may be possible to assume that the bandwidth activated at the timing when the HARQ ACK corresponding to the DL data **720** is transmitted (slot #**3**) as indicated via the DCI **714** is the BWP B. The PUCCH transmission timing and resources (or PUCCH format index or PUCCH format) used by the UE in PUCCH transmission may be determined based on a value obtained through a modulo operation between the PUCCH resources (or PUCCH format index or PUCCH format) indicated via the DCI **714** and a value of the PUCCH resources (or PUCCH format index or PUCCH format) configured in the changed BWP B. Oh at 20:38-59. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable

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Claim Language		**Exemplary Citations to Oh**
		expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3[a]	The method according to claim 1, further comprising receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, Oh discloses "receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

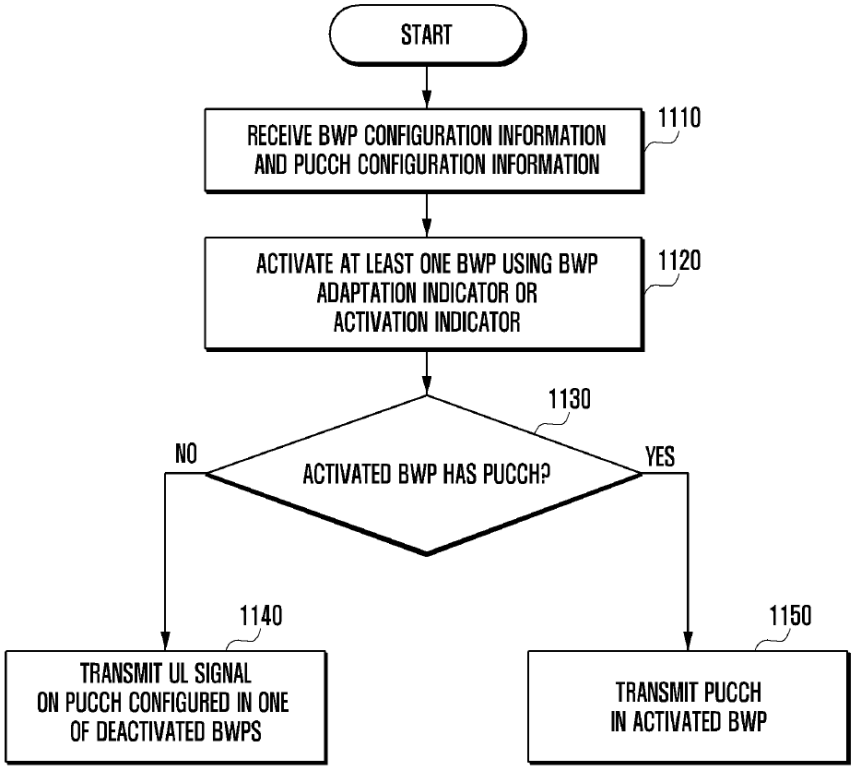
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The UE may determine whether to use the long PUCCH **503** or short PUCCH **518** in a slot or a mini-slot for transmitting the UCI **520** based on the information indicating the use of the long or short PUCCH, which is received from the BS via higher layer signaling. It may also be possible to make such a determination based on the information indicating the use of the long or short PUCCH, which is received from the BS via physical layer signaling. It may also be possible to make such a determination based on the information obtained implicitly from the number of UL symbols of the slot or mini-slot. For example, the UE may transmit the UCI **520** using the short PUCCH **518** for a case in which the number of UL symbols included in the slot or mini-slot, notified or configured by the BS, for UCI **520** transmission is 1 or 2, and the UE may transmit the UCI **520** using the long PUCCH **503** for a case in which the number of UL symbols included in the slot or mini-slot is 4 to 14. Oh at 14:4-21.

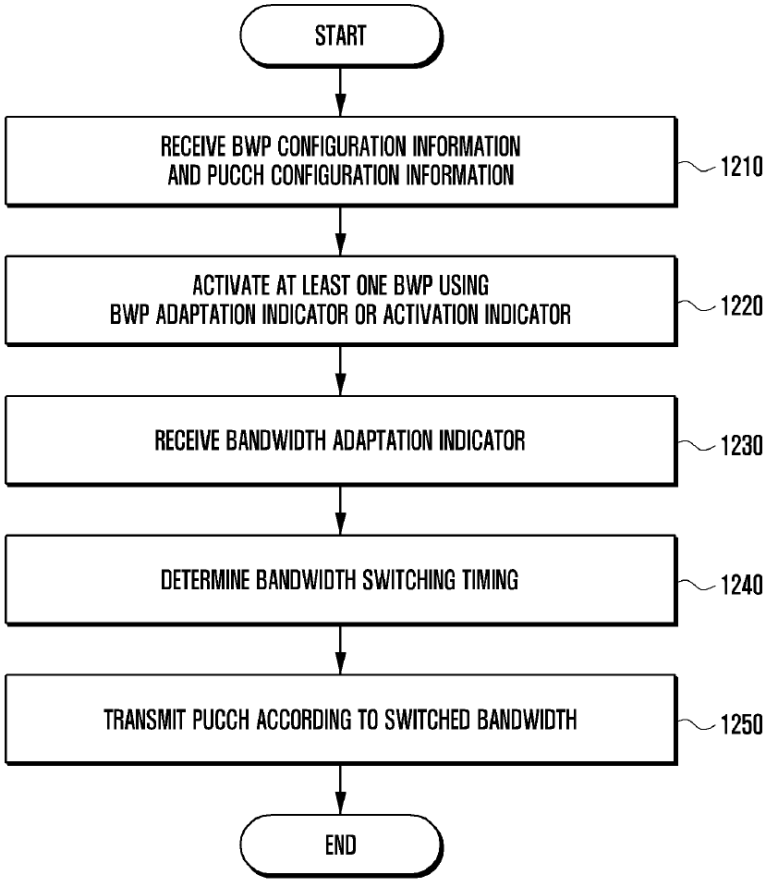
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Oh at 15:32-47.

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Claim Language		**Exemplary Citations to Oh**
		At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

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Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

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Claim Language		**Exemplary Citations to Oh**
		In a case in which the UL bandwidths configured to the UE have respective PUCCH transmission resources (i.e., bandwidth A **751** and bandwidth B **755** have the PUCCH transmission resources **760** and **770**, respectively, as shown in part (b) of FIG. **7**), Upon receipt of the DCI conveyed in the DL control channel **714** that the BS transmits at slot #**1 706**, the UE may receive DL data on the DL data channel **720** indicated via the DCI and transmit the HARQ ACK corresponding to the DL data to the BS on the PUCCH resources indicated via the DCI at a timing (e.g., slot #**3 708**) indicated via the DCI. In this case, the BS may assume that the UE transmits the HARQ ACK on the PUCCH resources of the bandwidth activated at the timing (slot #**3 708**) that should carry the HARQ ACK corresponding to the DL data **720** (i.e., PUCCH **770** of bandwidth B **755**) according to Method 1, above, thereby being able to receive the HARQ ACK corresponding to the DL data **720** successfully. Oh at 19:46-62. Referring to FIG. **12**, at step **1210**, the UE receives BWP configuration information (e.g., information as shown in Table 1) and PUCCH configuration information about one or more BWPs as shown in Table 2 from the BS via higher layer signaling, a broadcast channel, or a DL data channel (e.g., a DL data channel scheduled via DCI scrambled with SI-RNTI) including system information. At step **1220**, the UE activates at least one DL and UL BWP based on a BWP adaptation indicator or activation indicator included in the DCI transmitted via higher layer signaling or a DL control channel. If the DL and UL BWPs are correlated with each other, the UL BWP may be changed or activated according to the DL BWP adaptation indicator. Oh at 26:31-43.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "the one of the UL control channel resources is indicated from the base station through the DL control information." For example, Oh discloses this limitation based on the following exemplary citations: (57) **ABSTRACT** The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. A method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at Abstract.

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Claim Language		**Exemplary Citations to Oh**
		In accordance with an aspect of the present disclosure, a method for transmitting uplink control information in a wireless communication system is provided. The method includes receiving configuration information on a plurality of bandwidth parts (BWPs) from a base station; receiving downlink control information and downlink data from the base station; receiving BWP adaptation information which indicates a change of an active BWP from the base station; identifying an uplink control channel resource for transmitting acknowledgement information in response to the downlink data; and transmitting the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:33-45. In accordance with another aspect of the present disclosure, a terminal for transmitting uplink control information in a wireless communication system is provided. The terminal includes a transceiver and a controller coupled with the transceiver. The controller is configured to receive configuration information on a plurality of BWPs from a base station, receive downlink control information and downlink data from the base station, receive BWP adaptation information which indicates a change of an active BWP from the base station, identify an uplink control channel resource for transmitting acknowledgement information in response to the downlink data, and transmit the acknowledgement information on the identified uplink control channel resource to the base station. Oh at 2:58-3:4.

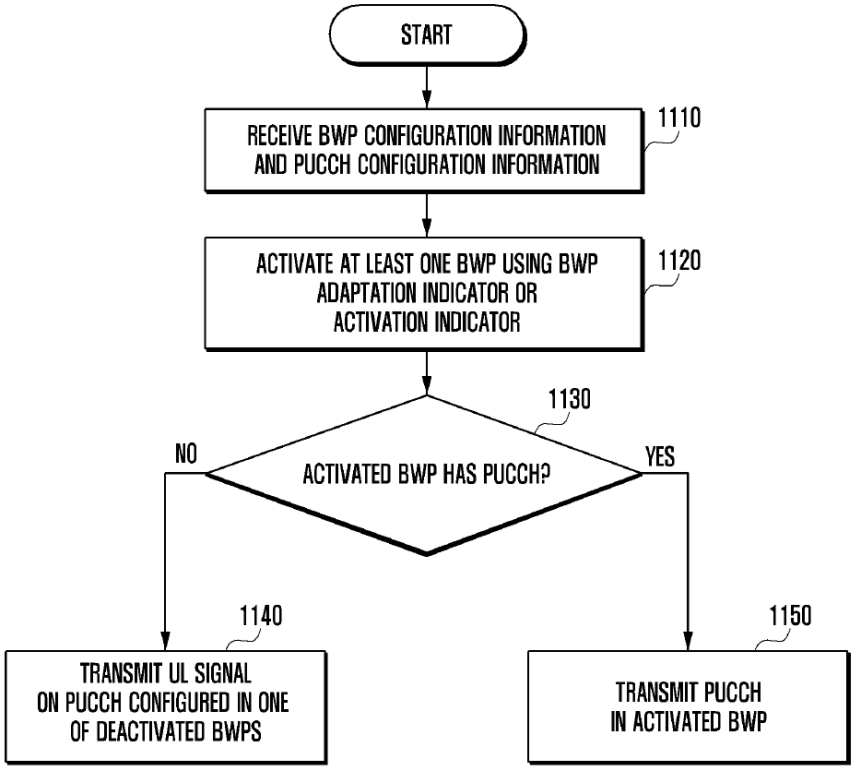
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		The UE may determine whether to use the long PUCCH **503** or short PUCCH **518** in a slot or a mini-slot for transmitting the UCI **520** based on the information indicating the use of the long or short PUCCH, which is received from the BS via higher layer signaling. It may also be possible to make such a determination based on the information indicating the use of the long or short PUCCH, which is received from the BS via physical layer signaling. It may also be possible to make such a determination based on the information obtained implicitly from the number of UL symbols of the slot or mini-slot. For example, the UE may transmit the UCI **520** using the short PUCCH **518** for a case in which the number of UL symbols included in the slot or mini-slot, notified or configured by the BS, for UCI **520** transmission is 1 or 2, and the UE may transmit the UCI **520** using the long PUCCH **503** for a case in which the number of UL symbols included in the slot or mini-slot is 4 to 14. Oh at 14:4-21.

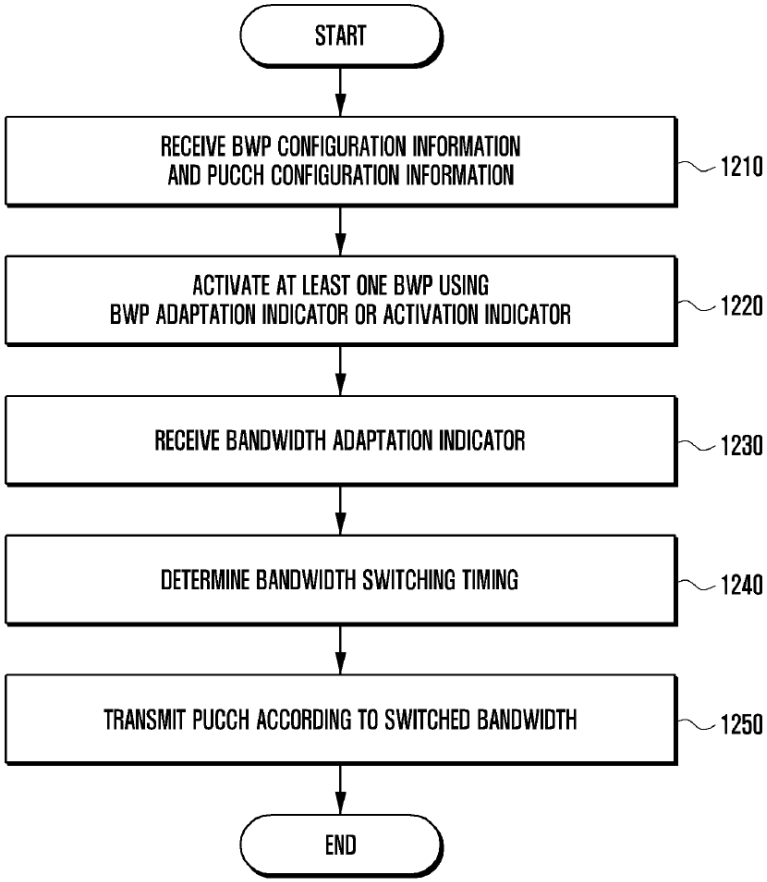
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **6** depicts a resource grid that spans the UL system bandwidth **610** in the frequency domain and one slot **620** in the time domain. Although FIG. **6** is directed to the case where one slot consists of seven OFDM symbols, the method of the present disclosure is also applicable to a case where one slot consists of fourteen OFDM symbols. In FIG. **6**, the UL system bandwidth **610** may consist of one or more UL BWPs, and the UL system bandwidth **610** is divided into 4 BWPs: BWP #**1 602**, BWP #**2 603**, BWP #**3 604**, and BWP #**4 605**. At least two of the BWPs may be combined into another BWP, such as BWP #**5 606**. The UE may activate one or more BWPs for use in a certain time period (symbol, slot, subframe, or frame). A BWP may be activated or deactivated via at least one of higher layer signaling, DCI conveyed in a DL control channel, MAC CE, and BWP activation/deactivation timer. Oh at 15:32-47.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		At least one of the information elements contained in the PUCCH configuration information as listed in Table 2 may be predefined between the BS and the UE or configured via high layer signaling or system information (e.g., a signal transmitted along with SI-RNTI) from the BS to the UE. The BS may transmit the PUCCH configuration information to the UE via higher layer signaling that is made for UL BWP configuration. In the case of configuring PUCCH transmission resources in the maximum UL bandwidth and at least one BWP supported by the UE, the BS may select one of the multiple control channel transmission resources (or PUCCH format indices or PUCCH formats) and transmit the selected control channel transmission resource information to the UE via a DL control channel. In this case, the UE may receive a DL data channel based on the DCI received on the DL control channel and transmit the acknowledgement corresponding to the DL data channel to the BS on the control channel resources indicated via the DCI. Oh at 16:33-50.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		As shown in part (b) of FIG. **7**, each of the bandwidths configured to the UE is considered to have PUCCH transmission resources (i.e., bandwidth A **751** with PUCCH transmission resources **760** and bandwidth B **755** with PUCCH transmission resources **770**). If the UE receives the DCI in slot #**1 706**, the DCI being conveyed in the DL control channel **714** transmitted by the BS, the UE may receive DL data on the DL data channel **720** indicated by the DCI and transmit to the BS a reception acknowledgement corresponding to the DL data (HARQ acknowledgement (ACK)) on the PUCCH resources at a timing (e.g., slot #**3 708**) as indicated via the DCI. Here, the UE locates the PUCCH resources, as indicated via the DCI, within the bandwidth at the timing of receiving the DCI (i.e., PUCCH resources **760** of UL bandwidth A **751** that is activated at the timing of receiving the DCI (slot #**1 706**) and should transmit the HARQ ACK corresponding to the DL data **720** in the bandwidth B **755** at the timing (slot #**3**) on the PUCCH such that the BS may assume that the UE transmits the HARQ ACK on the PUCCH resource **770** in the UL bandwidth B **755**). In this case, the BS may not receive the Oh at 18:47-67.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In a case in which the UL bandwidths configured to the UE have respective PUCCH transmission resources (i.e., bandwidth A **751** and bandwidth B **755** have the PUCCH transmission resources **760** and **770**, respectively, as shown in part (b) of FIG. **7**), Upon receipt of the DCI conveyed in the DL control channel **714** that the BS transmits at slot #**1 706**, the UE may receive DL data on the DL data channel **720** indicated via the DCI and transmit the HARQ ACK corresponding to the DL data to the BS on the PUCCH resources indicated via the DCI at a timing (e.g., slot #**3 708**) indicated via the DCI. In this case, the BS may assume that the UE transmits the HARQ ACK on the PUCCH resources of the bandwidth activated at the timing (slot #**3 708**) that should carry the HARQ ACK corresponding to the DL data **720** (i.e., PUCCH **770** of bandwidth B **755**) according to Method 1, above, thereby being able to receive the HARQ ACK corresponding to the DL data **720** successfully. Oh at 19:46-62. Referring to FIG. **12**, at step **1210**, the UE receives BWP configuration information (e.g., information as shown in Table 1) and PUCCH configuration information about one or more BWPs as shown in Table 2 from the BS via higher layer signaling, a broadcast channel, or a DL data channel (e.g., a DL data channel scheduled via DCI scrambled with SI-RNTI) including system information. At step **1220**, the UE activates at least one DL and UL BWP based on a BWP adaptation indicator or activation indicator included in the DCI transmitted via higher layer signaling or a DL control channel. If the DL and UL BWPs are correlated with each other, the UL BWP may be changed or activated according to the DL BWP adaptation indicator. Oh at 26:31-43.

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Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 11.

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 12. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

2. Claim 4

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Claim Language		**Exemplary Citations to Oh**
4[pre]	A method of receiving uplink (UL) control information by a base station, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Oh discloses "A method of receiving uplink (UL) control information by a base station, the method comprising." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above. In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

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Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
4[a]	transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment; and	At least under Pegasus's apparent infringement theory, Oh discloses "transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
4[b]	receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information,	At least under Pegasus's apparent infringement theory, Oh discloses "receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitations 1[b], 1[c], and 1[d] above. In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
4[c]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
4[d]	wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
5	The method according to claim 4, wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
6[a]	The method according to claim 4, further comprising transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, Oh discloses "transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 3[a] above.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		In accordance with another aspect of the present disclosure, a method for receiving uplink control information in a wireless communication system is provided, the method includes transmitting configuration information on a plurality of BWPs to a terminal; transmitting downlink control information and downlink data to the terminal; transmitting BWP adaptation information which indicates a change of an active BWP to the terminal; identifying an uplink control channel resource for receiving acknowledgement information in response to the downlink data; and receiving the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 2:46-57. In accordance with another aspect of the present disclosure, a base station for receiving uplink control information in a wireless communication system is provided. The base station includes a transceiver and a controller coupled with the transceiver. The controller is configured to transmit configuration information on a plurality of BWPs to a terminal, transmit downlink control information and downlink data to the terminal, transmit BWP adaptation information which indicates a change of an active BWP to the terminal, identify an uplink control channel resource for receiving acknowledgement information in response to the downlink data, and receive the acknowledgement information on the identified uplink control channel resource from the terminal. Oh at 3:5-17.

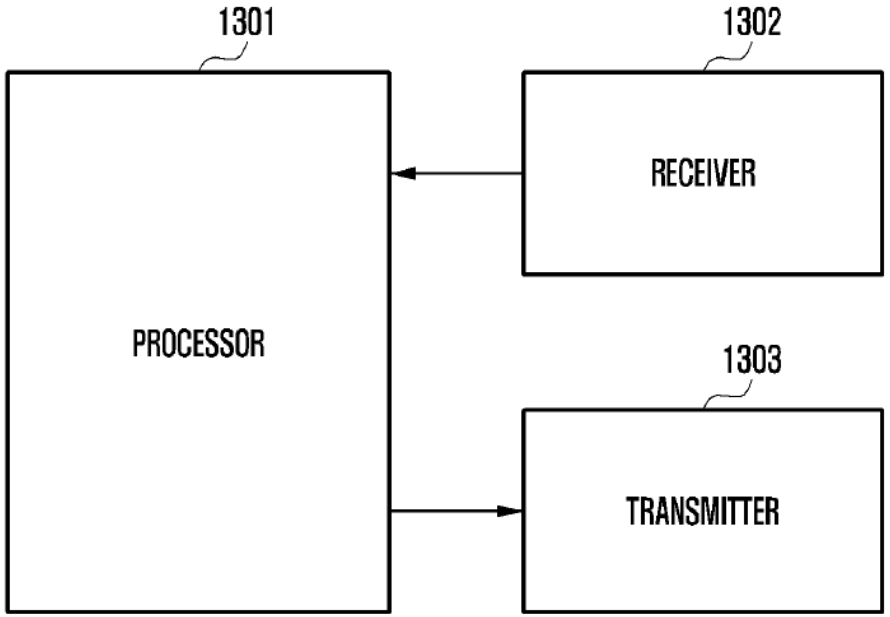
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **14** is a block diagram illustrating a configuration of a BS, according to an embodiment. Referring to FIG. **14**, the BS may include a processor **1401**, a receiver **1402**, and a transmitter **1403**. The processor **1401** may control overall operations of the BS. For example, the processor **1401** may control components differently based on the method that is performed (i.e., the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1402** and the transmitter **1403** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a terminal. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1401** and transmit the signal output from the processor **1401** over the radio channel. Oh at 27:15-35. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
6[b]	wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 3[a] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

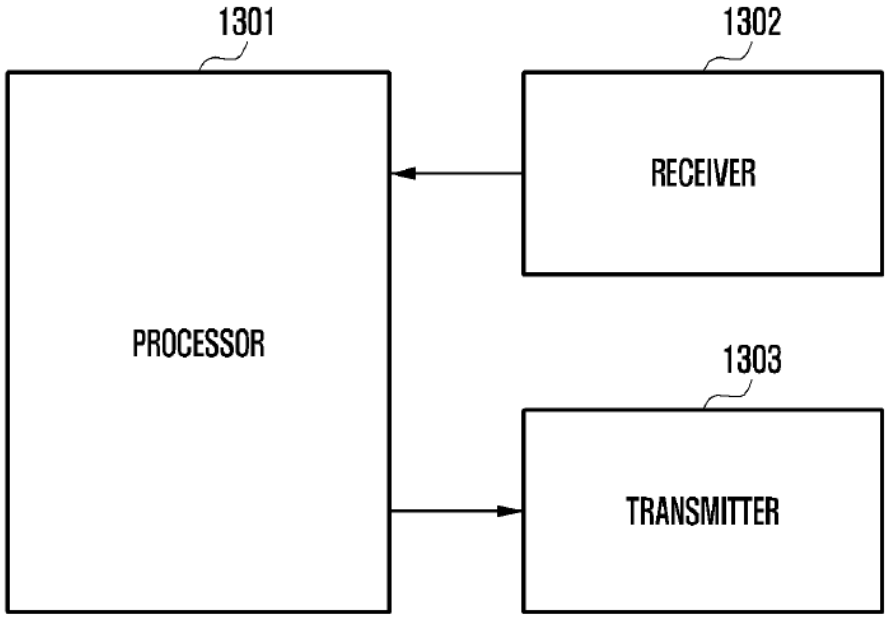
3. Claim 7

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
7[pre]	A user equipment for transmitting uplink (UL) control information, comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Oh discloses "A user equipment for transmitting uplink (UL) control information, comprising." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[pre] above.

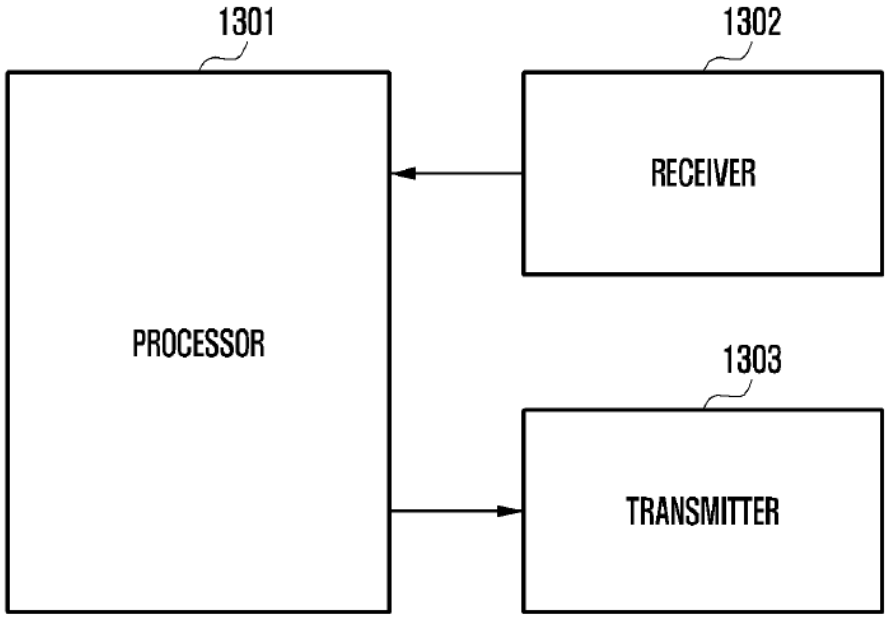
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14.

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Claim Language		**Exemplary Citations to Oh**
		 Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[a]	a receiver configured to receive, from a base	At least under Pegasus's apparent infringement theory, Oh discloses "a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL

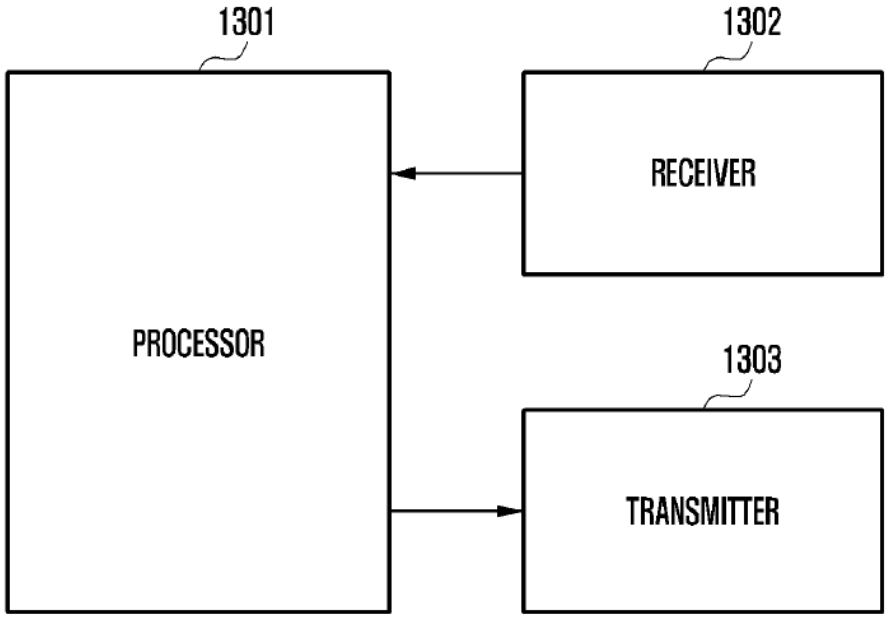
Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
	station, UL control channel resource set configuration information for UL control information transmission;	control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[a] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		 Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[b]	a controller configured to determine one of UL	At least under Pegasus's apparent infringement theory, Oh discloses "a controller configured to determine one of UL control channel resource sets contained in the UL control channel

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Claim Language		**Exemplary Citations to Oh**
	control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and	resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[b] and 1[c] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14.

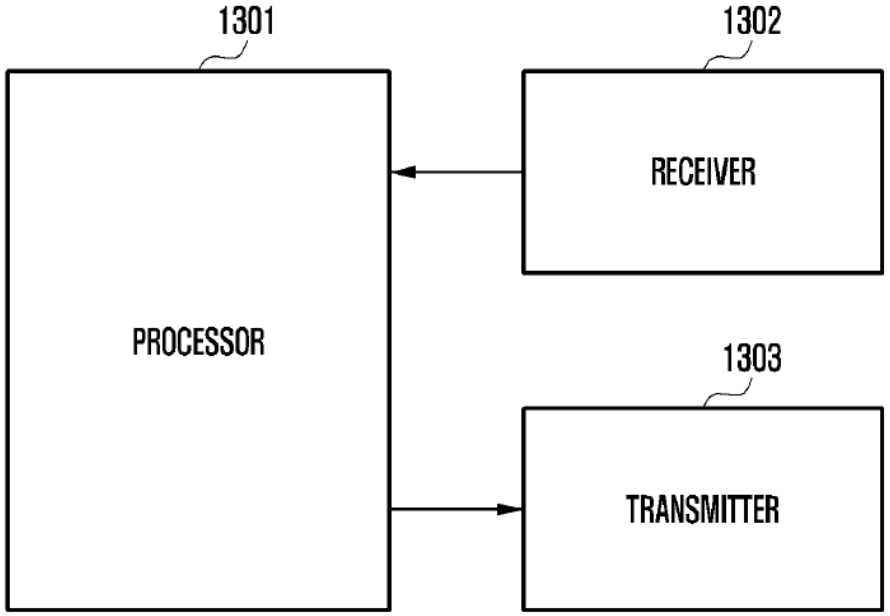
Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	 Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Oh**
7[c]	a transmitter configured to transmit the UL control information through the determined UL control channel resource,	At least under Pegasus's apparent infringement theory, Oh discloses "a transmitter configured to transmit the UL control information through the determined UL control channel resource." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[d] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14.

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		 Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[d]	wherein the UL control channel resource sets	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the

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Claim Language		**Exemplary Citations to Oh**
	are configured for each UL bandwidth part (BWP) configured for the user equipment, and	user equipment." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[e] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
7[e]	wherein the each UL BWP is activated through downlink (DL) control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the each UL BWP is activated through downlink (DL) control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 1[f] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8	The user equipment according to claim 7,	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL

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Claim Language		**Exemplary Citations to Oh**
	wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.	control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 2 above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[a]	The user equipment according to claim 7, wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 3[a] above. FIG. **13** is a block diagram illustrating a configuration of a UE, according to an embodiment. Referring to FIG. **13**, the UE may include a processor **1301**, a receiver **1302**, and a transmitter **1303**. The processor **1301** may control overall operations of the UE. For example, the processor **1301** may control components differently to perform different operations based on the method that is performed (i.e., activating the UL bandwidth and determining PUSCH transmission operations according

Invalidity of U.S. Patent 10,638,463 in view of Oh	
Claim Language	**Exemplary Citations to Oh**
	to the bandwidth configuration method, the bandwidth adaptation method, and the PUCCH transmission resource configuration method). The receiver **1302** and the transmitter **1303** may be collectively referred to as a transceiver. The transceiver may transmit and receive signals to and from a BS. The signals may include control information and data. The transceiver may include an RF transmitter for frequency-up-converting and amplifying a signal to be transmitted and an RF receiver for low-noise-amplifying and frequency-down-converting a received signal. The transceiver may output the signal received over a radio channel to the processor **1301** and transmit the signal output from the processor **1301** over the radio channel. Oh at 26:59-27:14. 

Invalidity of U.S. Patent 10,638,463 in view of Oh		
Claim Language		**Exemplary Citations to Oh**
		Oh at Fig. 13. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
9[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.	At least under Pegasus's apparent infringement theory, Oh discloses "wherein the one of the UL control channel resources is indicated from the base station through the DL control information." For example, Oh discloses this limitation based on the following exemplary citations: *See* limitation 3[b] above. To the extent it is found that Oh does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Oh does not anticipate this claim, Oh renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Oh with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT I-7

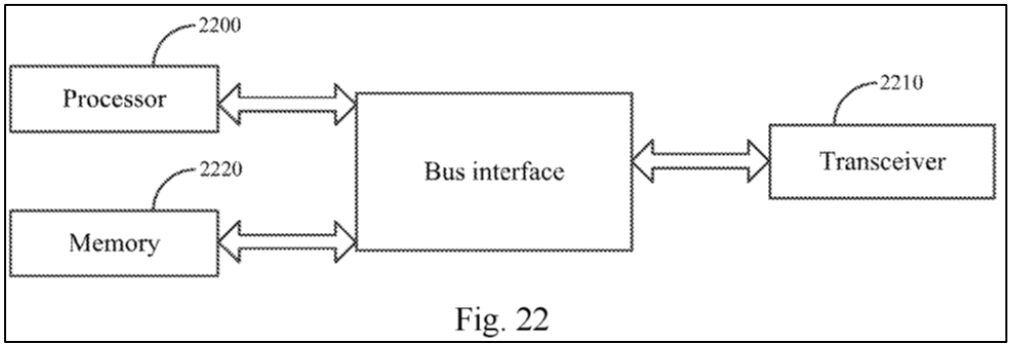
Summary of Invalidity Analysis of U.S. Patent No. 11,540,272 ("'272 Patent") in view of U.S. Patent Application No. US 2020/0187169 to Gao et al. ("Gao")

U.S. Patent Application No. US 2020/0187169 to Gao et al. ("Gao"), was filed on August 22, 2017; claims priority to CN201610849716.8, filed on September 23, 2016; published on June 11, 2020; and issued on Aril 13, 2021. Therefore, Gao qualifies as prior art to the '272 Patent under at least 35 U.S.C. §§ 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '272 Patent are invalid as expressly and/or inherently anticipated by Gao.

To the extent that Gao is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '272 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Gao in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Gao and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

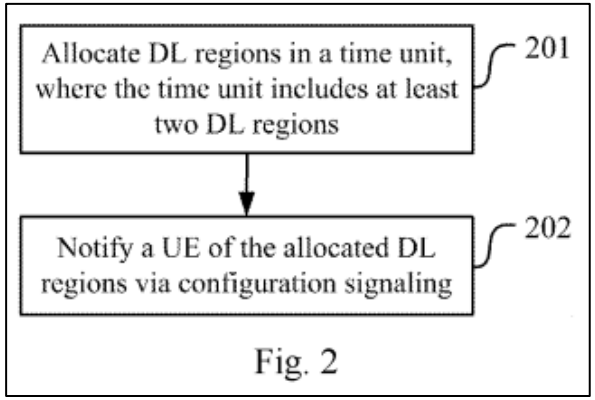
Defendants reserve the right to amend or supplement this invalidity chart at a later date.

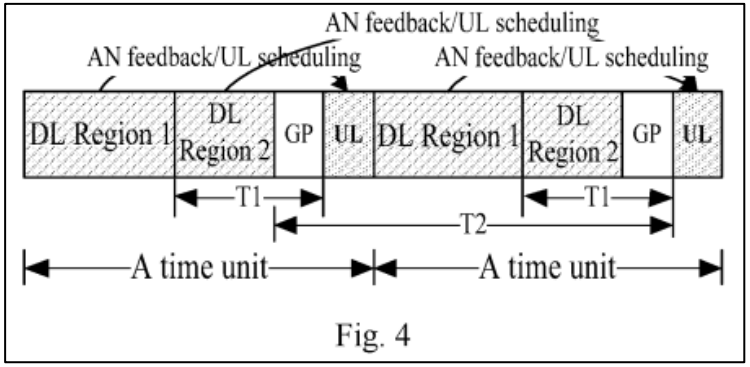
1. Claim 1

Invalidity of U.S. Patent 11,540,272 in view of Gao		
	Claim Language	**Exemplary Citations to Gao**
1[pre]	A base station, comprising: a transceiver; a receiver; and a controller which controls the transceiver and receiver thereby performing operations including:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Gao discloses a base station, comprising: a transceiver; a receiver; and a controller which controls the transceiver and receiver thereby performing operations including. For example, Gao discloses this limitation based on the following exemplary citations:  Fig. 22 Gao at Fig. 22. "FIG. 22 is a schematic structural diagram of an eNB … the eNB includes: a processor 2200 configured …to allocate DL regions in a time unit, where the time unit includes at least two DL regions; and a transceiver 2210 configured to receive and transmit data under the control of the processor 2200 to notify a UE of the allocated DL regions via configuration signaling." Gao at [0222]; *see also, id*. at [0238-253]. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the

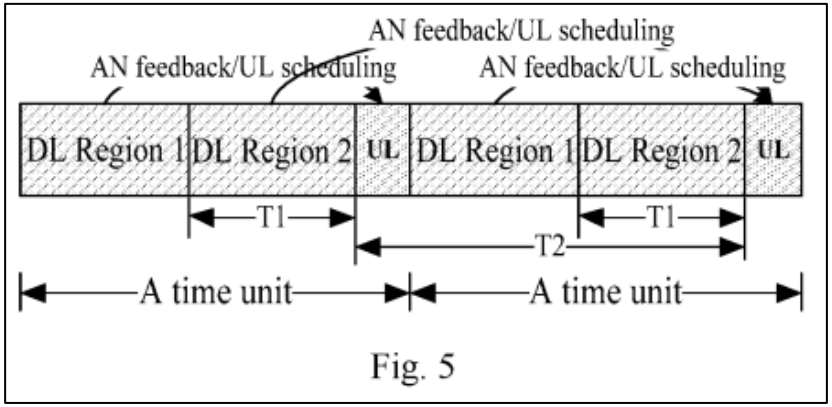
Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	transmitting, to a wireless device, a radio resource control (RRC) signal including information on one or more allocations of a time-domain resource, wherein the time-domain resource includes at least one or more orthogonal frequency-division multiplexing (OFDM) symbols,	At least under Pegasus's apparent infringement theory, Gao discloses transmitting, to a wireless device, a radio resource control (RRC) signal including information on one or more allocations of a time-domain resource, wherein the time-domain resource includes at least one or more orthogonal frequency-division multiplexing (OFDM) symbols. For example, Gao discloses this limitation based on the following exemplary citations: "Optionally, the notifying the UE of the allocated DL regions via the configuration signaling includes: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, a UL region and/or a GP region in the time unit is further notified via the configuration signaling via one of following operations: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0011-12]. "Optionally, the time unit is one or more slots, or one or more sub-frames." Gao at [0019]; *see also*, *id*. at [0204]. "Optionally, determining the DL regions allocated in the time unit according to the configuration signaling includes: determining lengths and positions of the DL regions

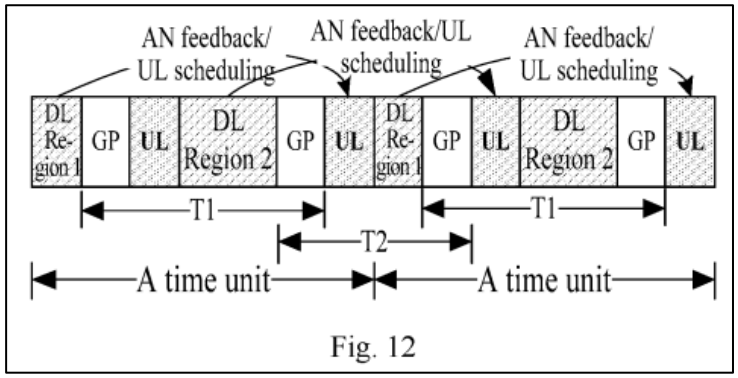
Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		in the time unit according to a notification of the configuration signaling; or determining one of a plurality of predefined patterns according to a notification of the configuration signaling, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to a notification of the configuration signaling. Optionally, determining the DL regions allocated in the time unit according to the configuration signaling further includes determining a UL region and/or a GP region in the time unit according to the configuration signaling, wherein a length and a position of the UL region in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or a start or end position of the UL region in the time unit is notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0021-22]. "Optionally, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the notifying module is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0031-32], *see also*, *id*. at [0041-42], [0051-52], [0061-62], [0095], [0106-111], [0191-192], [0206-207], [0223-224], [0239-240].

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		 Fig. 2 Gao at Fig. 2. "The operation 201 is to allocate DL regions in a time unit, where the time unit includes at least two DL regions." Gao at [0100]. "Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0137].

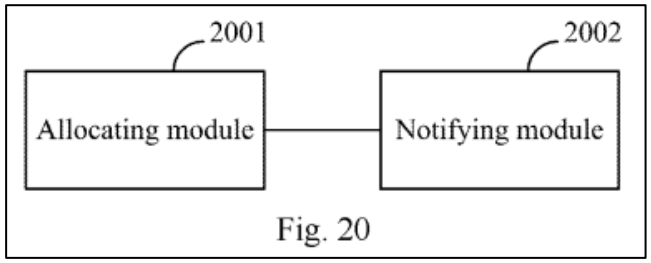
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		 Fig. 4 Gao at Fig. 4; *see also*, *id*. at Figs. 5-19 (all showing allocated DL and UL regions within time units as allocated). "FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a first embodiment of the invention, and FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the first embodiment of the invention. As illustrated in FIG. 4, for example, an eNB decides to divide a time unit into two DL regions and one UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a Timing Advance (TA) demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 5. A correspondence relationship between the DL regions and the UL region can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the time unit (where uplink transmission in the UL region may occupy only a part of Orthogonal Frequency Division Multiplexing (OFDM) or Single-Carrier Frequency Division Multiple Access (SC-FDMA) symbols or a part of mini-slots in the UL

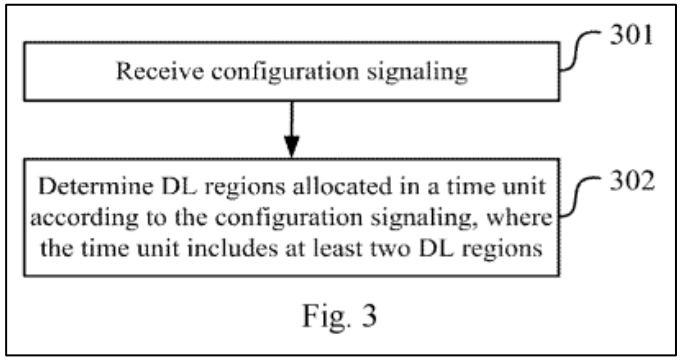
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		region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a Time Division Multiplexing (TDM) mode, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode, or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the UL region in the next time unit, as illustrated in FIG. 4 and FIG. 5. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 4 and FIG. 5. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0147]; *see also*, *id*. at [0038-42]; [0148-161].

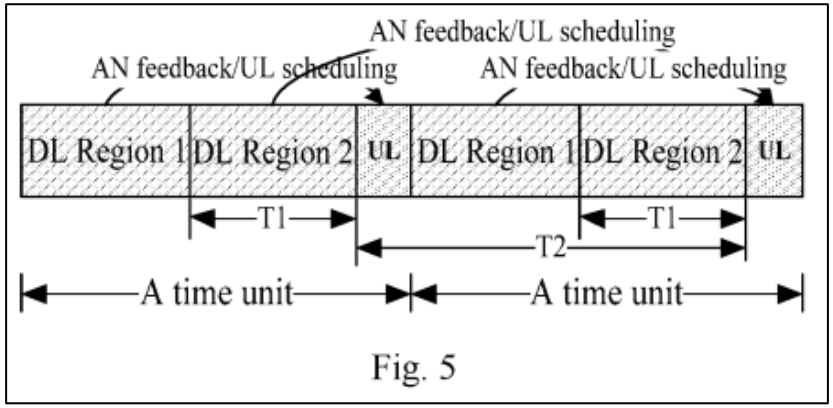
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	 Fig. 5 Gao at Fig. 5. "The UE can be notified directly of the size and the position of each DL region, and the size of the UL region can be determined implicitly according to whether there is a demand for feedback or uplink transmission; or the UE can be notified of the size and the position of each DL region, and the size and the position of the UL region, or can be notified of the size and the position of each DL region, and the size and the position of the GP; or the UE can be notified of the size and the position of the UL region, and the size and the position of the GP. Of course, alternatively a plurality of patterns of combinations of the sizes and the positions of DL regions, an UL region, and a GP region in a time unit can be predefined, and one of the patterns can be indicated via signaling." Gao at [0151]. "Of course, the eNB can further pre-configure a DL region to be detected by the UE, and this configuration can be made semi-statically via Radio Resource Control (RRC) signaling, or can be made by transmitting configuration signaling periodically, where the periodicity can be changed as needed in reality; and for example, a part of UEs are configured to detect only the DL region 1 for a downlink control channel, and the other UEs are configured to detect only the DL region 2 for a downlink control channel, so if the eNB is going into schedule uplink or downlink transmission of the

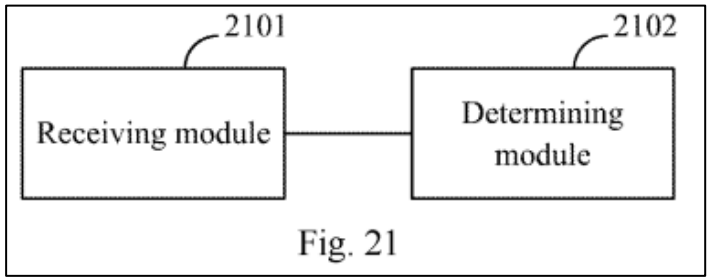
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		UEs, then it will transmit downlink control channels of these UEs in only the DL detection areas configured for these UEs." Gao at [0159].  Fig. 12 Gao at Fig. 12. "FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a second embodiment of the invention, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the second embodiment of the invention. As illustrated in FIG. 12, for example, an eNB decides to divide a time unit into two DL regions and two UL regions, and there is such a blank region or a GP region between a DL region and an UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 13. A correspondence relationship between the DL regions and the UL regions can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the second (last) UL region in the

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		time unit (where uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a TDM mode; or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second (last) DL region in a time unit is predefined or configured to schedule uplink transmission in the first UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode; or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the second (last) UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode; or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the first UL region in the next time unit, as illustrated in FIG. 12 and FIG. 13. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 12 and FIG. 13. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions, and thus different corresponding values of T, for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0170].

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		"Of course, the eNB can further pre-configure a DL region to be detected by the UE, and this configuration can be made semi-statically via RRC signaling, or can be made by transmitting configuration signaling periodically, where the periodicity can be changed as needed in reality; and for example, a part of UEs are configured to detect only the DL region 1 for a downlink control channel, and the other UEs are configured to detect only the DL region 2 for a downlink control channel, so if the eNB is going into schedule uplink or downlink transmission of the UEs, then it will transmit downlink control channels of these UEs in only the DL detection areas configured for these UEs." Gao at [0179]. "FIG. 20 is a schematic structural diagram of an apparatus for transmitting data at the eNB side according to an embodiment of the invention, and as illustrated, the apparatus can include: an allocating module 2001 configured to allocate DL regions in a time unit, where the time unit includes at least two DL regions; and a notifying module 2002 configured to notify a UE of the allocated DL regions via configuration signaling." Gao at [0190].  Gao at Fig. 20. "1. A method for transmitting data, the method comprising: allocating downlink (DL) regions in a time unit, wherein the time unit comprises at least two DL regions; and

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		notifying a User Equipment (UE) of the allocated DL regions via configuration signaling." Gao at Claim 1; *see also*, Claim 2. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[b]	wherein, based on the information, a number of OFDM symbols are determined for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH), and	At least under Pegasus's apparent infringement theory, Gao discloses wherein, based on the information, a number of OFDM symbols are determined for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH), and. For example, Gao discloses this limitation based on the following exemplary citations:  Fig. 3 Gao at Fig. 3.

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		"FIG. 3 is a schematic flow chart of a method for transmitting data at the UE side according to an embodiment of the invention, and as illustrated, the method can include the following operations. The operation 301 is to receive configuration signaling. The operation 302 is to determine DL regions allocated in a time unit according to the configuration signaling, where the time unit includes at least two DL regions." Gao at [0102-104]; *see also*, *id*. at [0109], [0152], [0172], [0180], [0192-0220].  Fig. 5 Gao at Fig. 5; *see also*, *id*. at Figs. 4, 6-19. "Particularly, a UL region corresponding to a DL region is determined according to indication information in the downlink control channel, and for example, the indication information indicates a time domain position of the UL region directly, e.g., the number of a symbol, a micro-slot, a slot, a sub-frame, etc., or can indicate a delay in addition to a predefined processing delay, where a region or the first UL region satisfying the processing delay and the delay after the end position of the downlink region is determined as a UL region corresponding to the DL region according to the delay and the processing delay." Gao at [0128]. "The eNB can notify a UE of the division above in the following implementations.

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		In an implementation, the eNB notifies the UE via higher-layer signaling." Gao at [0148-149]; *see also*, *id*. at [0150-188]. "The eNB to schedule the UE selects at least one DL region in a time unit, and transmits a downlink control channel to the UE in a downlink control channel search space of the selected DL region to schedule the UE to receive a downlink shared channel in the selected DL region, or to transmit an uplink shared channel in a corresponding UL region." Gao at [0153]. "FIG. 21 is a schematic structural diagram of an apparatus for transmitting data at the UE side according to an embodiment of the invention, and as illustrated, the apparatus can include: a receiving module 2101 configured to receive configuration signaling; and a determining module 2102 configured to determine DL regions allocated in a time unit according to the configuration signaling, where the time unit includes at least two DL regions." Gao at [205].  Gao at Fig. 21. "In an implementation, the determining module is configured to determine the DL regions allocated in the time unit according to the configuration signaling by: determining lengths and positions of the DL regions in the time unit according to the configuration signaling; or determining one of a plurality of predefined patterns according to the configuration signaling, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end

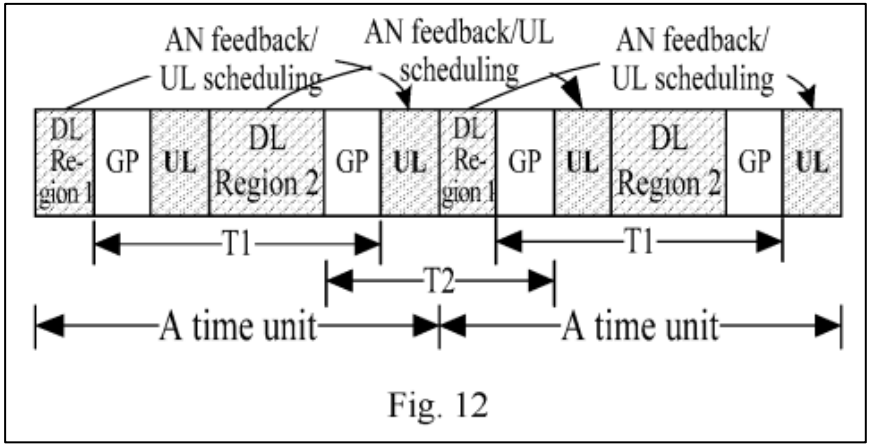
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		positions of the DL regions in the time unit according to the configuration signaling." Gao at [0206]; see also, id. at [0207-209]. "In an implementation, the apparatus further includes: a detecting module configured to detect each DL region or each detection DL region in a time unit for a downlink control channel." Gao at [0210]; *see also*, *id*. at [0211-212]. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[c]	wherein the determined number of OFDM symbols is smaller than or equal to a number of OFDM symbols included in a slot; and	At least under Pegasus's apparent infringement theory, Gao discloses wherein the determined number of OFDM symbols is smaller than or equal to a number of OFDM symbols included in a slot; and. For example, Gao discloses this limitation based on the following exemplary citations: "Particularly, a UL region corresponding to a DL region is determined according to indication information in the downlink control channel, and for example, the indication information indicates a time domain position of the UL region directly, e.g., the number of a symbol, a micro-slot, a slot, a sub-frame, etc., or can indicate a delay in addition to a predefined processing delay, where a region or the first UL region satisfying the processing delay and the delay after the end position of the downlink region is determined as a UL region corresponding to the DL region according to the delay and the processing delay." Gao at [0128].

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		"Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0137]. "The sizes of respective DL regions in a time unit may or may not be the same; and for example, there are two symbols in the first DL region, and three symbols in the second DL region." Gao at [0140]. "FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a first embodiment of the invention, and FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the first embodiment of the invention. As illustrated in FIG. 4, for example, an eNB decides to divide a time unit into two DL regions and one UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a Timing Advance (TA) demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 5. A correspondence relationship between the DL regions and the UL region can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the time unit (where uplink transmission in the UL region may occupy only a part of Orthogonal Frequency Division Multiplexing (OFDM) or Single-Carrier Frequency Division Multiple Access (SC-FDMA) symbols or a part of mini-slots in the UL

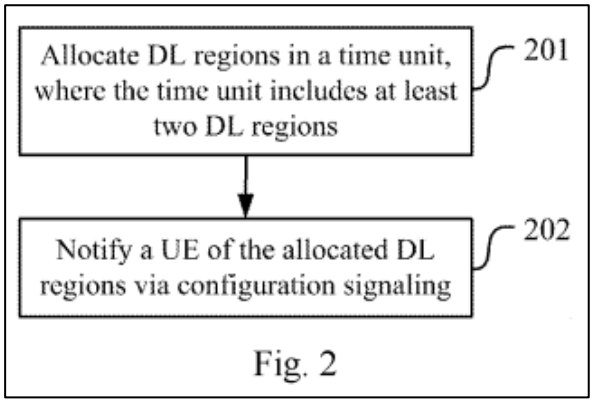
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		region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a Time Division Multiplexing (TDM) mode, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode, or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the UL region in the next time unit, as illustrated in FIG. 4 and FIG. 5. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 4 and FIG. 5. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0147]; *see also*, *id*. at [0038-42]; [0148-161].

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		"In another implementation, the eNB transmits configuration signaling over a specific resource in a predefined DL region in each time unit, or one of a plurality of time units (e.g., the first N OFDM symbols in a time unit), where the configuration signaling can be transmitted over a data channel (e.g., like a System Information Block (SIB)), or can be transmitted in a control channel (e.g., in a preset Downlink Control Information (DCI) format in a common search space)." Gao at [0150]. "FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a second embodiment of the invention, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the second embodiment of the invention. As illustrated in FIG. 12, for example, an eNB decides to divide a time unit into two DL regions and two UL regions, and there is such a blank region or a GP region between a DL region and an UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 13. A correspondence relationship between the DL regions and the UL regions can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the second (last) UL region in the time unit (where uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a TDM mode; or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second (last) DL region in a time unit is predefined or configured to schedule uplink transmission in the first UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may

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		occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode; or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the second (last) UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode; or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the first UL region in the next time unit, as illustrated in FIG. 12 and FIG. 13. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 12 and FIG. 13. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions, and thus different corresponding values of T, for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0170].

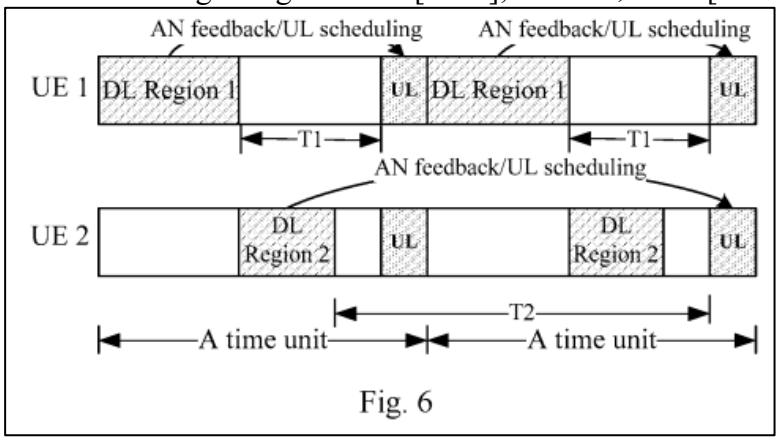
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		 Fig. 12 Gao at Fig. 12. "In an implementation, a time unit is one or more slots, or one or more sub-frames." Gao at [0204]; *see also, id*. at [0219]. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	transmitting, to the wireless device, downlink control information (DCI), including a field including a bit string,	At least under Pegasus's apparent infringement theory, Gao discloses transmitting, to the wireless device, downlink control information (DCI), including a field including a bit string. For example, Gao discloses this limitation based on the following exemplary citations:

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		"Optionally, the notifying the UE of the allocated DL regions via the configuration signaling includes: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, a UL region and/or a GP region in the time unit is further notified via the configuration signaling via one of following operations: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0011-0012]. "Optionally, the configuration signaling is transmitted via higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form." Gao at [0024]. "Optionally, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the notifying module is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE

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		determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0031-0032].  Gao at Fig. 2. "Optionally, the processor is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the processor is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0051-0052].

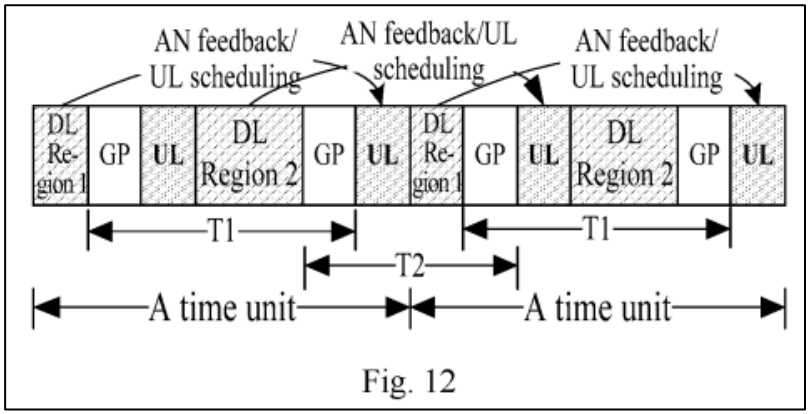
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		"In an implementation, notifying the UE of the allocated DL regions via the configuration signaling can particularly include: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Particularly, an allocation of DL regions in a time unit is determined, and the UE is notified of an allocation result via configuration signaling; where the UE is notified directly of lengths and positions of the DL regions in the time unit via the configuration signaling; or a plurality of patterns of combinations of lengths and positions of the DL regions in the time unit are predefined, and the UE is notified of one of the patterns via the configuration signaling; or the UE is notified directly of start positions of the DL regions in the time unit via the configuration signaling, and lengths of the DL regions can be obtained otherwise, e.g., through energy detection, or the UE is notified of the lengths or end positions of the DL regions via other configuration signaling; or the UE is notified directly of end positions of the DL regions in the time unit via the configuration signaling, and start positions of the DL regions can be determined through energy detection or in a predefined manner or according to a UL region and/or a GP region." Gao at [0106-0107]. "In an implementation, the UE is further notified of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling particularly as follows: the UE is notified of the length(s) and the position(s) of the UL region(s) in the time unit; or the UE is notified of one of a predefined patterns, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or the UE is notified of the start or end position(s) of the UL region(s) in the time unit; or the UE is notified of indication information so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0110].

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		"Particularly, the UE can be further notified of an allocation of the UL region(s) and/or an allocation of the GP region(s) in the time unit via the configuration signaling as follows: the UE is notified directly of the length(s) and the position(s) of the uplink region(s) in the time unit; or a plurality of patterns of combinations of the length(s) and the position(s) of the uplink region(s) in the time unit are predefined, and the UE is notified of one of the patterns via the configuration signaling; or the UE is notified directly of the start or end position(s) of the uplink region(s) in the time unit via the configuration signaling, and the length(s) of the uplink region(s) can be obtained otherwise, e.g., notified via scheduling signaling or other configuration signaling." Gao at [0111]. "In another implementation, the UL region(s) in the time unit is or are determined according to uplink scheduling signaling, or determined according to a position at which ACK/NACK for downlink transmission is fed back, that is, the uplink region(s) is or are obtained implicitly, and for example, a scheduled uplink region is determined according to uplink scheduling signaling, an uplink region for carrying ACK/NACK is determined according to the position at which the ACK/NACK for downlink transmission is fed back, etc., or the GP region(s) is are notified via configuration signaling, and the uplink region(s) is or are determined according to the GP region(s) and the downlink regions." Gao at [0112]. "Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0137]. "In another implementation, the eNB transmits configuration signaling over a specific resource in a predefined DL region in each time unit, or one of a plurality of time

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		units (e.g., the first N OFDM symbols in a time unit), where the configuration signaling can be transmitted over a data channel (e.g., like a System Information Block (SIB)), or can be transmitted in a control channel (e.g., in a preset Downlink Control Information (DCI) format in a common search space).” Gao at [0150]. “The UE can be notified directly of the size and the position of each DL region, and the size of the UL region can be determined implicitly according to whether there is a demand for feedback or uplink transmission; or the UE can be notified of the size and the position of each DL region, and the size and the position of the UL region, or can be notified of the size and the position of each DL region, and the size and the position of the GP; or the UE can be notified of the size and the position of the UL region, and the size and the position of the GP. Of course, alternatively a plurality of patterns of combinations of the sizes and the positions of DL regions, an UL region, and a GP region in a time unit can be predefined, and one of the patterns can be indicated via signaling.” Gao at [0151]; *see also, id*. at [0154-158].  Fig. 6 Gao at Fig. 6; *see also, id*. at Figs. 4-5, 7-19. “For example, in correspondence to the first scenario at the eNB side, the UE 1 detects the DL regions 1 and 2 for a downlink control channel in a downlink DCI format, and only detects a downlink control channel 1 in the downlink DCI format in

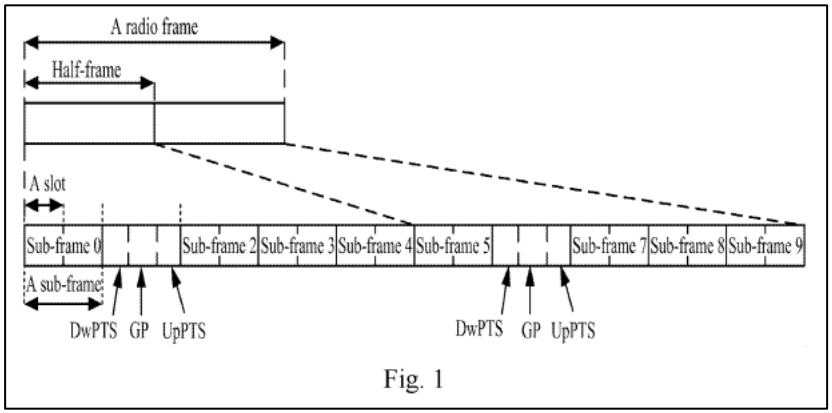
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		the DL region 1, so the UE 1 receives a corresponding downlink shared channel 1 in the DL region 1 according to scheduling information carried over the downlink control channel 1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit; and the UE 2 detects the DL regions 1 and 2 for a downlink control channel in a downlink DCI format, and only detects a downlink control channel 2 in the downlink DCI format in the DL region 2, so the UE 2 receives a corresponding downlink shared channel 2 in the DL region 2 according to scheduling information carried over the downlink control channel 2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission patterns of the UE 1 and the UE 2 are as illustrated in the "AN" feedback relationships in FIG. 6 and FIG. 7, where FIG. 6 is a schematic diagram of the first or third scenario at the UE side with a TA and/or a switching period of time in the first embodiment, and FIG. 7 is a schematic diagram of the first or third scenario at the UE side without any TA and/or switching period of time in the first embodiment." Gao at [0161]. "FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a second embodiment of the invention, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the second embodiment of the invention. As illustrated in FIG. 12, for example, an eNB decides to divide a time unit into two DL regions and two UL regions, and there is such a blank region or a GP region between a DL region and an UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 13. A correspondence relationship between the DL regions and the UL regions can be predefined or configured directly, and for example, the first DL region in a time unit is predefined

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		or configured to schedule uplink transmission in the second (last) UL region in the time unit (where uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a TDM mode; or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second (last) DL region in a time unit is predefined or configured to schedule uplink transmission in the first UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode; or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the second (last) UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode; or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the first UL region in the next time unit, as illustrated in FIG. 12 and FIG. 13. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 12 and FIG. 13. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions, and thus different corresponding values of T, for different services. In this embodiment, a time unit can be a slot or a sub-frame; or

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		course, alternatively a time unit with another length can be defined." Gao at [0170]; *see also, id*. at [0206-211].  Fig. 12 Gao at Fig. 12. "In an implementation, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit." Gao at [0191]. "In an implementation, the notifying module is further configured to notify the UE of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling by: notifying the UE of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of one of a predefined patterns, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of the start or end position(s) of the UL region(s) in the time unit; or notifying the UE of indication information so that the UE

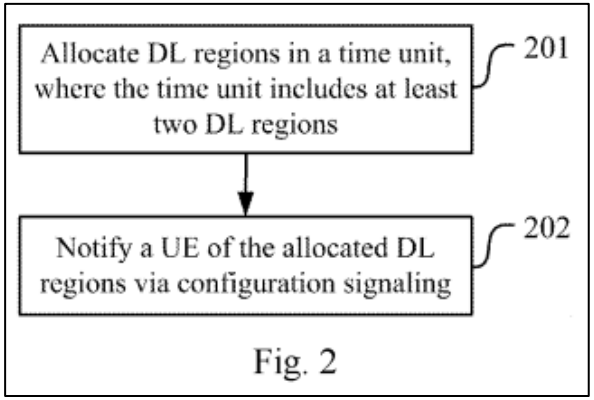
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		determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0192]. "In an implementation, the determining module is configured to determine the DL regions allocated in the time unit according to the configuration signaling by: determining lengths and positions of the DL regions in the time unit according to the configuration signaling; or determining one of a plurality of predefined patterns according to the configuration signaling, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to the configuration signaling. In an implementation, the determining module is further configured to: determine the UL region(s) and/or the GP region(s) in the time unit according to the configuration signaling, where: the length(s) and the position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or the start or end position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0206-207]. "In an implementation, the receiving module is further configured to receive the configuration signaling transmitted via higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form." Gao at [0209]. "In an implementation, the transceiver is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit.

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		In an implementation, the processor is further configured to notify the UE, through the transceiver, of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling by: notifying the UE of the length(s) and the position(s) of the UL region(s) in the time unit through the transceiver; or notifying the UE of one of a predefined patterns through the transceiver, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of the start or end position(s) of the UL region(s) in the time unit through the transceiver; or notifying the UE of indication information through the transceiver so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0223-0224]. "In an implementation, the processor is further configured to determine the UL region(s) and/or the GP region(s) in the time unit according to the configuration signaling, where: the length(s) and the position(s) of the UL region(s) in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, where each pattern includes an allocation of the length(s) and the position(s) of the UL region in the time unit; or the start or end position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0240]. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same

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		field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	wherein the bit string in the field relates to a row index of an allocation table, and	At least under Pegasus's apparent infringement theory, Gao discloses wherein the bit string in the field relates to a row index of an allocation table, and. For example, Gao discloses this limitation based on the following exemplary citations: "FIG. 1 illustrates a schematic diagram of the frame structure type 2 for an LTE TDD system, and as illustrated, there are different sub-frames or slots at the same frequency for uplink and downlink transmission in the Frame Structure type 2 (FS2) in the LTE TDD system. Each 10 ms radio frame includes two 5 ms half-frames, and each half-frame includes five sub-frames with a length of 1 ms. The sub-frames in the FS2 are categorized into downlink sub-frames, uplink sub-frames and special sub-frames, where each special sub-frame includes a Downlink Pilot Time Slot (DwPTS), a Guard Period (GP), and an Uplink Pilot Time Slot (UpPTS). Each half-frame includes at least one downlink sub-frame, at least one uplink sub-frame, and at most one special sub-frame. Seven TDD uplink-downlink configurations as depicted in Table 1, and ten special sub-frame structures as depicted in Table 2 are defined for different downlink to uplink switching periodicities and uplink-downlink allocation proportions." Gao at [0004].  Fig. 1

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		Gao at Fig. 1. "Optionally, the notifying the UE of the allocated DL regions via the configuration signaling includes: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, a UL region and/or a GP region in the time unit is further notified via the configuration signaling via one of following operations: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0011-0012]. "Optionally, determining the DL regions allocated in the time unit according to the configuration signaling includes: determining lengths and positions of the DL regions in the time unit according to a notification of the configuration signaling; or determining one of a plurality of predefined patterns according to a notification of the configuration signaling, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to a notification of the configuration signaling." Gao at [0021]. "Optionally, determining the DL regions allocated in the time unit according to the configuration signaling further includes determining a UL region and/or a GP region in the time unit according to the configuration signaling, wherein a length and a position of the UL region in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, wherein each pattern includes an allocation of a length and a position of the UL region in the

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		time unit; or a start or end position of the UL region in the time unit is notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0022]. "Optionally, the configuration signaling is transmitted via higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form." Gao at [0024]. "Optionally, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the notifying module is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0031-0032]; *see also, id*. at [0041-42].

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		 Fig. 2 Gao at Fig. 2. "Optionally, the processor is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the processor is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0051-0052]. "Optionally, the processor is configured to determine the DL regions allocated in the time unit according to the configuration signaling by: determining lengths and positions of the DL regions in the time unit according to the configuration signaling; or determining one of a plurality of predefined patterns according to the configuration

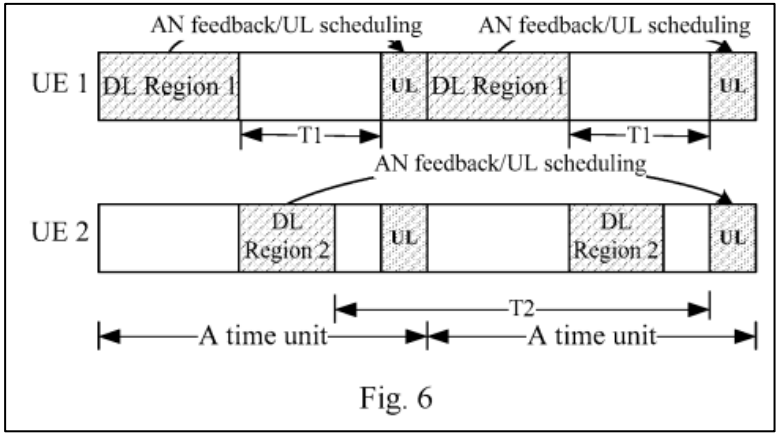
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		signaling, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to the configuration signaling. Optionally, the processor is further configured to determine a UL region and/or a GP region in the time unit according to the configuration signaling, wherein: a length and a position of the UL region in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or a start or end position of the UL region in the time unit is notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0061-62]. "In an implementation, notifying the UE of the allocated DL regions via the configuration signaling can particularly include: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Particularly, an allocation of DL regions in a time unit is determined, and the UE is notified of an allocation result via configuration signaling; where the UE is notified directly of lengths and positions of the DL regions in the time unit via the configuration signaling; or a plurality of patterns of combinations of lengths and positions of the DL regions in the time unit are predefined, and the UE is notified of one of the patterns via the configuration signaling; or the UE is notified directly of start positions of the DL regions in the time unit via the configuration signaling, and lengths of the DL regions can be obtained otherwise, e.g., through energy detection, or the UE is notified of the lengths or end positions of the DL regions via other configuration signaling; or the UE is notified directly of end positions of the DL regions in the time unit via the configuration signaling, and start positions of the DL regions can be determined through energy

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		detection or in a predefined manner or according to a UL region and/or a GP region." Gao at [0106-0107]. "In an implementation, the UE is further notified of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling particularly as follows: the UE is notified of the length(s) and the position(s) of the UL region(s) in the time unit; or the UE is notified of one of a predefined patterns, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or the UE is notified of the start or end position(s) of the UL region(s) in the time unit; or the UE is notified of indication information so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0110]. "Particularly, the UE can be further notified of an allocation of the UL region(s) and/or an allocation of the GP region(s) in the time unit via the configuration signaling as follows: the UE is notified directly of the length(s) and the position(s) of the uplink region(s) in the time unit; or a plurality of patterns of combinations of the length(s) and the position(s) of the uplink region(s) in the time unit are predefined, and the UE is notified of one of the patterns via the configuration signaling; or the UE is notified directly of the start or end position(s) of the uplink region(s) in the time unit via the configuration signaling, and the length(s) of the uplink region(s) can be obtained otherwise, e.g., notified via scheduling signaling or other configuration signaling." Gao at [0111]. "In another implementation, the UL region(s) in the time unit is or are determined according to uplink scheduling signaling, or determined according to a position at which ACK/NACK for downlink transmission is fed back, that is, the uplink region(s) is or are obtained implicitly, and for example, a scheduled uplink region is determined according to uplink scheduling signaling, an uplink region for carrying ACK/NACK is determined according to the position at which the ACK/NACK for downlink transmission is fed back, etc., or the GP region(s) is are notified via

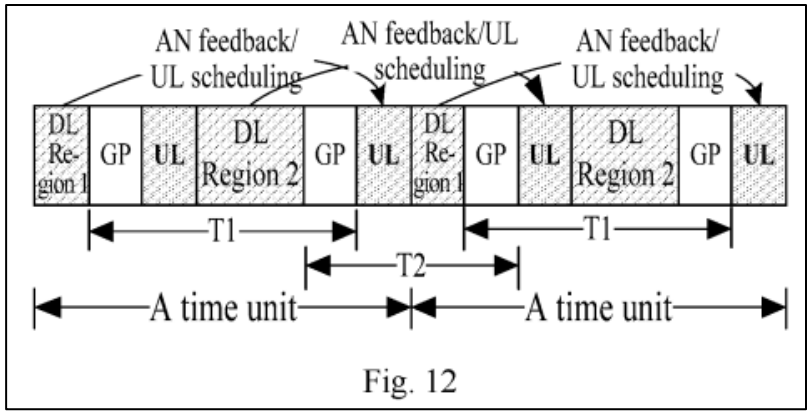
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		configuration signaling, and the uplink region(s) is or are determined according to the GP region(s) and the downlink regions." Gao at [0112]. "In an implementation, the method can further include: a feedback delay or a feedback time sequence or a feedback position index is indicated in the downlink control channel for the UE to determine a resource for feeding back ACK/NACK in a corresponding UL region; and/or, a scheduling delay or a scheduling time sequence or a scheduling position index is indicated in the downlink control channel for the UE to determine a resource for transmitting an uplink shared channel in a corresponding UL region." Gao at [0136]. "Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0137]. "FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a first embodiment of the invention, and FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the first embodiment of the invention. As illustrated in FIG. 4, for example, an eNB decides to divide a time unit into two DL regions and one UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a Timing Advance (TA) demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there

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		may be no blank component or GP component as illustrated in FIG. 5. A correspondence relationship between the DL regions and the UL region can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the time unit (where uplink transmission in the UL region may occupy only a part of Orthogonal Frequency Division Multiplexing (OFDM) or Single-Carrier Frequency Division Multiple Access (SC-FDMA) symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a Time Division Multiplexing (TDM) mode, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode, or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the UL region in the next time unit, as illustrated in FIG. 4 and FIG. 5. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 4 and FIG. 5. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback

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		relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0147]. "In another implementation, the eNB transmits configuration signaling over a specific resource in a predefined DL region in each time unit, or one of a plurality of time units (e.g., the first N OFDM symbols in a time unit), where the configuration signaling can be transmitted over a data channel (e.g., like a System Information Block (SIB)), or can be transmitted in a control channel (e.g., in a preset Downlink Control Information (DCI) format in a common search space)." Gao at [0150]. "The UE can be notified directly of the size and the position of each DL region, and the size of the UL region can be determined implicitly according to whether there is a demand for feedback or uplink transmission; or the UE can be notified of the size and the position of each DL region, and the size and the position of the UL region, or can be notified of the size and the position of each DL region, and the size and the position of the GP; or the UE can be notified of the size and the position of the UL region, and the size and the position of the GP. Of course, alternatively a plurality of patterns of combinations of the sizes and the positions of DL regions, an UL region, and a GP region in a time unit can be predefined, and one of the patterns can be indicated via signaling." Gao at [0151]; *see also, id*. at [0154-158]. "The UE receives the configuration signaling, and determines a corresponding allocation of DL regions in a time unit to determine a specific component to be detected for a downlink control channel, where the UE can further determine an allocation of a UL region according to the notification, or implicitly determine the UL region directly according to a scheduling relationship, dependent upon how the eNB configures it." Gao at [0152].

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	 Fig. 6 Gao at Fig. 6; *see also, id*. at Figs. 4-5, 7-19. "For example, in correspondence to the first scenario at the eNB side, the UE 1 detects the DL regions 1 and 2 for a downlink control channel in a downlink DCI format, and only detects a downlink control channel 1 in the downlink DCI format in the DL region 1, so the UE 1 receives a corresponding downlink shared channel 1 in the DL region 1 according to scheduling information carried over the downlink control channel 1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit; and the UE 2 detects the DL regions 1 and 2 for a downlink control channel in a downlink DCI format, and only detects a downlink control channel 2 in the downlink DCI format in the DL region 2, so the UE 2 receives a corresponding downlink shared channel 2 in the DL region 2 according to scheduling information carried over the downlink control channel 2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission patterns of the UE 1 and the UE 2 are as illustrated in the "AN" feedback relationships in FIG. 6 and FIG. 7, where FIG. 6 is a schematic diagram of the first or third scenario at the UE side with a TA and/or a switching period of time in the first embodiment, and FIG. 7 is a schematic diagram of the first or third scenario at the UE side without any TA and/or switching period of time in the first embodiment." Gao at [0161].

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		"FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a second embodiment of the invention, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the second embodiment of the invention. As illustrated in FIG. 12, for example, an eNB decides to divide a time unit into two DL regions and two UL regions, and there is such a blank region or a GP region between a DL region and an UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 13. A correspondence relationship between the DL regions and the UL regions can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the second (last) UL region in the time unit (where uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a TDM mode; or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second (last) DL region in a time unit is predefined or configured to schedule uplink transmission in the first UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode; or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the second (last) UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-

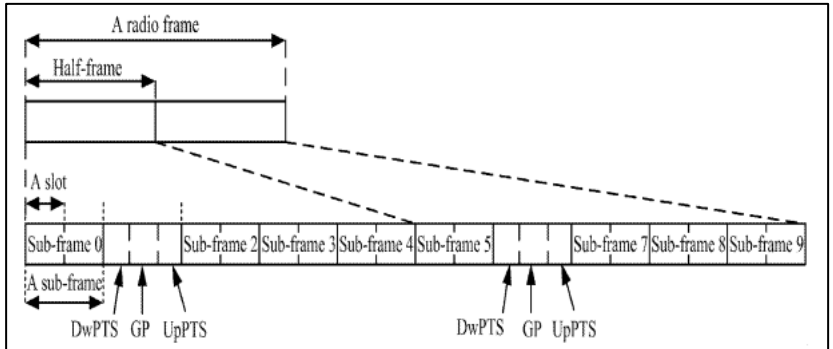
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		OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode; or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the first UL region in the next time unit, as illustrated in FIG. 12 and FIG. 13. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 12 and FIG. 13. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions, and thus different corresponding values of T, for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0170]; *see also, id*. at [0206-211].  Fig. 12 Gao at Fig. 12.

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		"In an implementation, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit." Gao at [0191]. "In an implementation, the notifying module is further configured to notify the UE of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling by: notifying the UE of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of one of a predefined patterns, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of the start or end position(s) of the UL region(s) in the time unit; or notifying the UE of indication information so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0192]. "In an implementation, the determining module is configured to determine the DL regions allocated in the time unit according to the configuration signaling by: determining lengths and positions of the DL regions in the time unit according to the configuration signaling; or determining one of a plurality of predefined patterns according to the configuration signaling, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to the configuration signaling. In an implementation, the determining module is further configured to: determine the UL region(s) and/or the GP region(s) in the time unit according to the configuration signaling, where: the length(s) and the position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or the start or

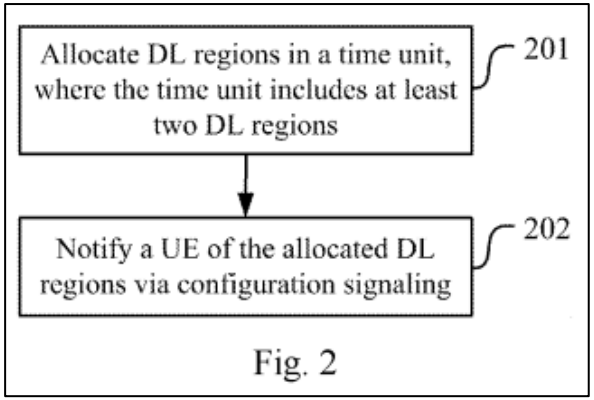
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		end position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0206-207]. "In an implementation, the receiving module is further configured to receive the configuration signaling transmitted via higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form." Gao at [0209]. "In an implementation, the transceiver is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. In an implementation, the processor is further configured to notify the UE, through the transceiver, of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling by: notifying the UE of the length(s) and the position(s) of the UL region(s) in the time unit through the transceiver; or notifying the UE of one of a predefined patterns through the transceiver, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of the start or end position(s) of the UL region(s) in the time unit through the transceiver; or notifying the UE of indication information through the transceiver so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0223-0224]. "In an implementation, the processor is further configured to determine the UL region(s) and/or the GP region(s) in the time unit according to the configuration signaling, where: the length(s) and the position(s) of the UL region(s) in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, where each pattern includes an allocation of the

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		length(s) and the position(s) of the UL region in the time unit; or the start or end position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0240]. "2. The method according to claim 1, wherein notifying the UE of the allocated DL regions via the configuration signaling comprises: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern comprises an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit." Gao at Claim 2; *see also, id*. at Claim 12. "3. The method according to claim 1, wherein an uplink (UL) region and/or a Guard Period (GP) region in the time unit is or are further notified via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a predefined patterns, wherein each pattern comprises an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at Claim 3; *see also, id*. at Claim 13; 51. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate

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		this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[f]	wherein the allocation table includes information on a starting OFDM symbol and the number of the OFDM symbols which is smaller than or equal to the number of OFDM symbols included in the slot.	At least under Pegasus's apparent infringement theory, Gao discloses wherein the allocation table includes information on a starting OFDM symbol and the number of the OFDM symbols which is smaller than or equal to the number of OFDM symbols included in the slot. For example, Gao discloses this limitation based on the following exemplary citations: "FIG. 1 illustrates a schematic diagram of the frame structure type 2 for an LTE TDD system, and as illustrated, there are different sub-frames or slots at the same frequency for uplink and downlink transmission in the Frame Structure type 2 (FS2) in the LTE TDD system. Each 10 ms radio frame includes two 5 ms half-frames, and each half-frame includes five sub-frames with a length of 1 ms. The sub-frames in the FS2 are categorized into downlink sub-frames, uplink sub-frames and special sub-frames, where each special sub-frame includes a Downlink Pilot Time Slot (DwPTS), a Guard Period (GP), and an Uplink Pilot Time Slot (UpPTS). Each half-frame includes at least one downlink sub-frame, at least one uplink sub-frame, and at most one special sub-frame. Seven TDD uplink-downlink configurations as depicted in Table 1, and ten special sub-frame structures as depicted in Table 2 are defined for different downlink to uplink switching periodicities and uplink-downlink allocation proportions." Gao at [0004].

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		 Fig. 1 Gao at Fig. 1. "Optionally, the notifying the UE of the allocated DL regions via the configuration signaling includes: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, a UL region and/or a GP region in the time unit is further notified via the configuration signaling via one of following operations: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0011-0012]. "Optionally, determining the DL regions allocated in the time unit according to the configuration signaling includes: determining lengths and positions of the DL regions in the time unit according to a notification of the configuration signaling; or determining one of a plurality of predefined patterns according to a notification of the

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		configuration signaling, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to a notification of the configuration signaling." Gao at [0021]. "Optionally, determining the DL regions allocated in the time unit according to the configuration signaling further includes determining a UL region and/or a GP region in the time unit according to the configuration signaling, wherein a length and a position of the UL region in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or a start or end position of the UL region in the time unit is notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0022]. "Optionally, the configuration signaling is transmitted via higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form." Gao at [0024]. "Optionally, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the notifying module is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region

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		in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0031-0032]; *see also, id*. at [0041-42].  Fig. 2 Gao at Fig. 2. "Optionally, the processor is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, the processor is further configured to notify the UE of a UL region and/or a GP region in the time unit via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0051-0052].

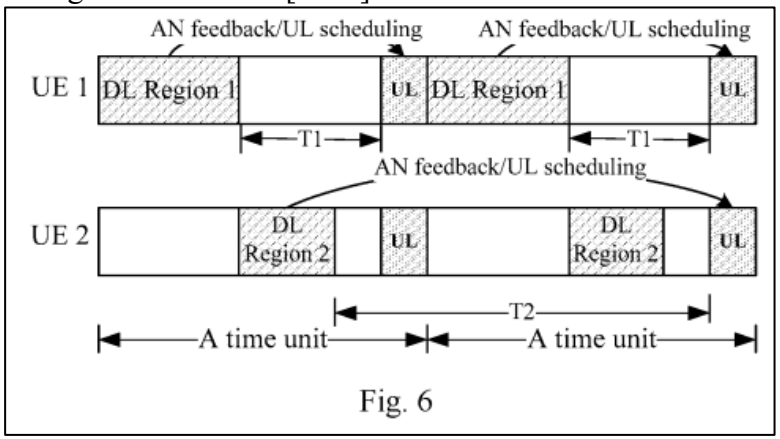
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		"Optionally, the processor is configured to determine the DL regions allocated in the time unit according to the configuration signaling by: determining lengths and positions of the DL regions in the time unit according to the configuration signaling; or determining one of a plurality of predefined patterns according to the configuration signaling, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to the configuration signaling. Optionally, the processor is further configured to determine a UL region and/or a GP region in the time unit according to the configuration signaling, wherein: a length and a position of the UL region in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or a start or end position of the UL region in the time unit is notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0061-62]. "In an implementation, notifying the UE of the allocated DL regions via the configuration signaling can particularly include: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Particularly, an allocation of DL regions in a time unit is determined, and the UE is notified of an allocation result via configuration signaling; where the UE is notified directly of lengths and positions of the DL regions in the time unit via the configuration signaling; or a plurality of patterns of combinations of lengths and positions of the DL regions in the time unit are predefined, and the UE is notified of one of the patterns via the configuration signaling; or the UE is notified directly of start positions of the DL regions in the time unit via the configuration signaling, and lengths of the DL regions can be obtained otherwise, e.g., through energy detection, or the UE is notified of the lengths or end

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		positions of the DL regions via other configuration signaling; or the UE is notified directly of end positions of the DL regions in the time unit via the configuration signaling, and start positions of the DL regions can be determined through energy detection or in a predefined manner or according to a UL region and/or a GP region." Gao at [0106-0107]. "In an implementation, the UE is further notified of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling particularly as follows: the UE is notified of the length(s) and the position(s) of the UL region(s) in the time unit; or the UE is notified of one of a predefined patterns, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or the UE is notified of the start or end position(s) of the UL region(s) in the time unit; or the UE is notified of indication information so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0110]. "Particularly, the UE can be further notified of an allocation of the UL region(s) and/or an allocation of the GP region(s) in the time unit via the configuration signaling as follows: the UE is notified directly of the length(s) and the position(s) of the uplink region(s) in the time unit; or a plurality of patterns of combinations of the length(s) and the position(s) of the uplink region(s) in the time unit are predefined, and the UE is notified of one of the patterns via the configuration signaling; or the UE is notified directly of the start or end position(s) of the uplink region(s) in the time unit via the configuration signaling, and the length(s) of the uplink region(s) can be obtained otherwise, e.g., notified via scheduling signaling or other configuration signaling." Gao at [0111]. "In another implementation, the UL region(s) in the time unit is or are determined according to uplink scheduling signaling, or determined according to a position at which ACK/NACK for downlink transmission is fed back, that is, the uplink region(s) is or are obtained implicitly, and for example, a scheduled uplink region is

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		determined according to uplink scheduling signaling, an uplink region for carrying ACK/NACK is determined according to the position at which the ACK/NACK for downlink transmission is fed back, etc., or the GP region(s) is are notified via configuration signaling, and the uplink region(s) is or are determined according to the GP region(s) and the downlink regions." Gao at [0112]. "In an implementation, the method can further include: a feedback delay or a feedback time sequence or a feedback position index is indicated in the downlink control channel for the UE to determine a resource for feeding back ACK/NACK in a corresponding UL region; and/or, a scheduling delay or a scheduling time sequence or a scheduling position index is indicated in the downlink control channel for the UE to determine a resource for transmitting an uplink shared channel in a corresponding UL region." Gao at [0136]. "Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0137]. "FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a first embodiment of the invention, and FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the first embodiment of the invention. As illustrated in FIG. 4, for example, an eNB decides to divide a time unit into two DL regions and one UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a Timing Advance (TA)

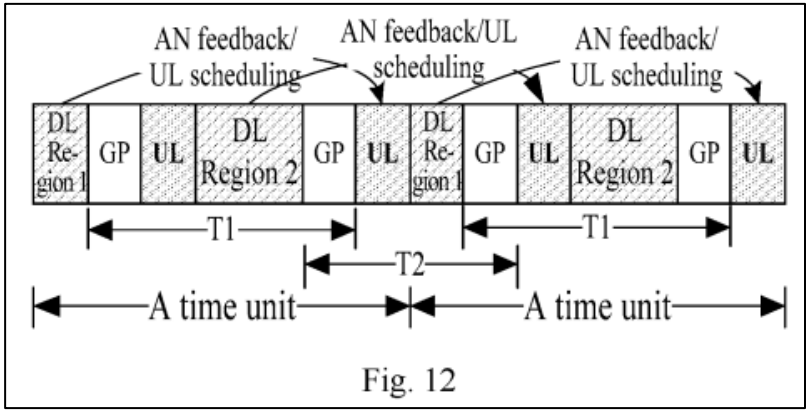
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Claim Language		**Exemplary Citations to Gao**
		demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 5. A correspondence relationship between the DL regions and the UL region can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the time unit (where uplink transmission in the UL region may occupy only a part of Orthogonal Frequency Division Multiplexing (OFDM) or Single-Carrier Frequency Division Multiple Access (SC-FDMA) symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a Time Division Multiplexing (TDM) mode, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode, or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the UL region in the next time unit, as illustrated in FIG. 4 and FIG. 5. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship

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		predefined or configured as above, as illustrated in FIG. 4 and FIG. 5. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0147]. "In another implementation, the eNB transmits configuration signaling over a specific resource in a predefined DL region in each time unit, or one of a plurality of time units (e.g., the first N OFDM symbols in a time unit), where the configuration signaling can be transmitted over a data channel (e.g., like a System Information Block (SIB)), or can be transmitted in a control channel (e.g., in a preset Downlink Control Information (DCI) format in a common search space)." Gao at [0150]. "The UE can be notified directly of the size and the position of each DL region, and the size of the UL region can be determined implicitly according to whether there is a demand for feedback or uplink transmission; or the UE can be notified of the size and the position of each DL region, and the size and the position of the UL region, or can be notified of the size and the position of each DL region, and the size and the position of the GP; or the UE can be notified of the size and the position of the UL region, and the size and the position of the GP. Of course, alternatively a plurality of patterns of combinations of the sizes and the positions of DL regions, an UL region, and a GP region in a time unit can be predefined, and one of the patterns can be indicated via signaling." Gao at [0151]; *see also, id*. at [0154-158]. "The UE receives the configuration signaling, and determines a corresponding allocation of DL regions in a time unit to determine a specific component to be detected for a downlink control channel, where the UE can further determine an allocation of a UL region according to the notification, or implicitly determine the UL

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		region directly according to a scheduling relationship, dependent upon how the eNB configures it." Gao at [0152].  Fig. 6 Gao at Fig. 6; *see also, id*. at Figs. 4-5, 7-19. "For example, in correspondence to the first scenario at the eNB side, the UE 1 detects the DL regions 1 and 2 for a downlink control channel in a downlink DCI format, and only detects a downlink control channel 1 in the downlink DCI format in the DL region 1, so the UE 1 receives a corresponding downlink shared channel 1 in the DL region 1 according to scheduling information carried over the downlink control channel 1, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit; and the UE 2 detects the DL regions 1 and 2 for a downlink control channel in a downlink DCI format, and only detects a downlink control channel 2 in the downlink DCI format in the DL region 2, so the UE 2 receives a corresponding downlink shared channel 2 in the DL region 2 according to scheduling information carried over the downlink control channel 2, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission patterns of the UE 1 and the UE 2 are as illustrated in the "AN" feedback relationships in FIG. 6 and FIG. 7, where FIG. 6 is a schematic diagram of the first or third scenario at the UE side with a TA and/or a switching period of time in the first embodiment, and FIG. 7 is a

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		schematic diagram of the first or third scenario at the UE side without any TA and/or switching period of time in the first embodiment." Gao at [0161]. "FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a second embodiment of the invention, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the second embodiment of the invention. As illustrated in FIG. 12, for example, an eNB decides to divide a time unit into two DL regions and two UL regions, and there is such a blank region or a GP region between a DL region and an UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 13. A correspondence relationship between the DL regions and the UL regions can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the second (last) UL region in the time unit (where uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a TDM mode; or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second (last) DL region in a time unit is predefined or configured to schedule uplink transmission in the first UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode; or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the second (last)

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Claim Language		**Exemplary Citations to Gao**
		UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode; or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the first UL region in the next time unit, as illustrated in FIG. 12 and FIG. 13. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 12 and FIG. 13. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions, and thus different corresponding values of T, for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0170]; *see also, id*. at [0206-211].

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	Claim Language	**Exemplary Citations to Gao**
		 Fig. 12 Gao at Fig. 12. "In an implementation, the notifying module is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit." Gao at [0191]. "In an implementation, the notifying module is further configured to notify the UE of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling by: notifying the UE of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of one of a predefined patterns, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of the start or end position(s) of the UL region(s) in the time unit; or notifying the UE of indication information so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0192].

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		"In an implementation, the determining module is configured to determine the DL regions allocated in the time unit according to the configuration signaling by: determining lengths and positions of the DL regions in the time unit according to the configuration signaling; or determining one of a plurality of predefined patterns according to the configuration signaling, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or determining start or end positions of the DL regions in the time unit according to the configuration signaling. In an implementation, the determining module is further configured to: determine the UL region(s) and/or the GP region(s) in the time unit according to the configuration signaling, where: the length(s) and the position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or the start or end position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0206-207]. "In an implementation, the receiving module is further configured to receive the configuration signaling transmitted via higher-layer signaling or physical downlink control signaling in a unicast or broadcast or multicast form." Gao at [0209]. "In an implementation, the transceiver is configured to notify the UE of the allocated DL regions via the configuration signaling by: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, where each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. In an implementation, the processor is further configured to notify the UE, through the transceiver, of the UL region(s) and/or the GP region(s) in the time unit via the configuration signaling by: notifying the UE of the length(s) and the position(s) of the

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		UL region(s) in the time unit through the transceiver; or notifying the UE of one of a predefined patterns through the transceiver, where each pattern includes an allocation of the length(s) and the position(s) of the UL region(s) in the time unit; or notifying the UE of the start or end position(s) of the UL region(s) in the time unit through the transceiver; or notifying the UE of indication information through the transceiver so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0223-0224]. "In an implementation, the processor is further configured to determine the UL region(s) and/or the GP region(s) in the time unit according to the configuration signaling, where: the length(s) and the position(s) of the UL region(s) in the time unit is notified via the configuration signaling; or one of a predefined patterns is notified via the configuration signaling, where each pattern includes an allocation of the length(s) and the position(s) of the UL region in the time unit; or the start or end position(s) of the UL region(s) in the time unit is or are notified via the configuration signaling; or indication information is notified via the configuration signaling so that the UE determines the UL region(s) in the time unit according to the indication information under a predefined rule." Gao at [0240]. "2. The method according to claim 1, wherein notifying the UE of the allocated DL regions via the configuration signaling comprises: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern comprises an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit." Gao at Claim 2; *see also, id*. at Claim 12.

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Claim Language		**Exemplary Citations to Gao**
		"3. The method according to claim 1, wherein an uplink (UL) region and/or a Guard Period (GP) region in the time unit is or are further notified via the configuration signaling by: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a predefined patterns, wherein each pattern comprises an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at Claim 3; *see also, id*. at Claim 13; 51. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

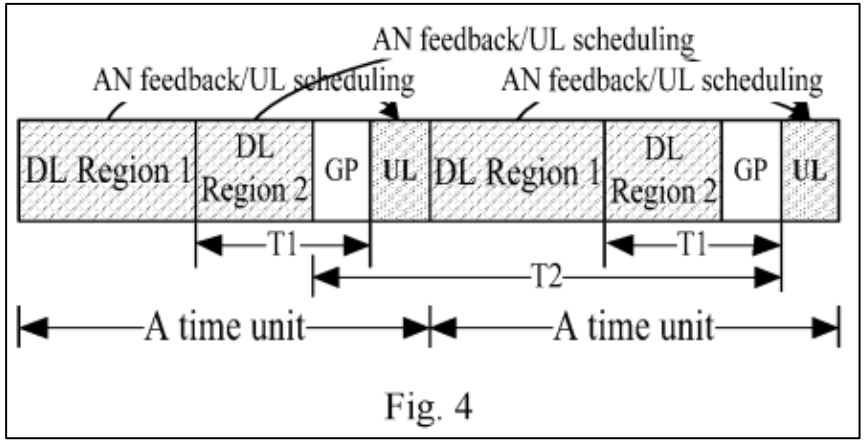
2. Claim 2

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Claim Language		**Exemplary Citations to Gao**
2[a]	The base station of claim 1, wherein the bit string is 3 bits in length.	At least under Pegasus's apparent infringement theory, Gao discloses the base station of claim 1, wherein the bit string is 3 bits in length. For example, Gao discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. "Optionally, the notifying the UE of the allocated DL regions via the configuration signaling includes: notifying the UE of lengths and positions of the DL regions in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of lengths and positions of the DL regions in the time unit; or notifying the UE of start or end positions of the DL regions in the time unit. Optionally, a UL region and/or a GP region in the time unit is further notified via the configuration signaling via one of following operations: notifying the UE of a length and a position of the UL region in the time unit; or notifying the UE of one of a plurality of predefined patterns, wherein each pattern includes an allocation of a length and a position of the UL region in the time unit; or notifying the UE of a start or end position of the UL region in the time unit; or notifying the UE of indication information so that the UE determines the UL region in the time unit according to the indication information under a predefined rule." Gao at [0011-12]; *see also, id*. at [0021-22], [0031-32], [0041-42], [0051-52], [0061-62], [0106-107], [0110-0111], [0151], [0161-164], [0168], [0181-184], [0188], [0191-192], [206-207], [0223-224], [0239-240], Claims 2, 3, 11-13, 42, 52. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the

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Claim Language		**Exemplary Citations to Gao**
		art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

3. Claim 3

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Claim Language		**Exemplary Citations to Gao**
3[a]	The base station of claim 1, wherein the DCI further includes information on one or more allocations of a frequency-domain resource.	At least under Pegasus's apparent infringement theory, Gao discloses the base station of claim 1, wherein the DCI further includes information on one or more allocations of a frequency-domain resource. For example, Gao discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. "Embodiments of the invention provide a method and apparatus for transmitting data so as to provide a solution capable of dynamically allocating uplink and downlink resources for data transmission." Gao at [0009].

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Claim Language	**Exemplary Citations to Gao**
	 Fig. 4 Gao at Fig. 4; *see also, id*. at Figs. 5-19. "The inventors have identified that during making of the invention: as there are a growing demand for mobile communication services, the International Telecommunication Union (ITU), the 3rd Generation Partnership Project (3GPP), and other organizations come to research a new wireless communication system (e.g., a 5G system). The new wireless communication system can support various coexisting types of services, e.g., an enhanced Mobile Broadband (eMBB) service, an Ultra Reliable & Low Latency Communication (URLLC) service, a Massive Machine Type Communication (mMTC) service, etc., and the amount of traffic of the same service may also vary. When uplink and downlink traffic shares the same frequency resource in a Time Division Multiplexing (TDM) mode, in order to support the different types of services and demands for the amount of traffic, a flexible and varying allocation of resources shall be supported, but there has been absent so far a related solution to transmit data over dynamically allocated uplink and downlink resources." Gao at [0095]. "In an implementation, the method can further include: a feedback delay or a feedback time sequence or a feedback position index is indicated in the downlink

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Claim Language		**Exemplary Citations to Gao**
		control channel for the UE to determine a resource for feeding back ACK/NACK in a corresponding UL region; and/or, a scheduling delay or a scheduling time sequence or a scheduling position index is indicated in the downlink control channel for the UE to determine a resource for transmitting an uplink shared channel in a corresponding UL region. Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0136-137]. "The UE detects blindly each DL region in a time unit for a downlink control channel according to the determined allocation of DL and UL regions; when a downlink control channel of the UE in a downlink DCI format is detected, the UE receives a corresponding downlink shared channel in the DL region, generates ACK/NACK feedback information ("AN" feedback as illustrated) for the downlink shared channel, and makes ACK/NACK feedback in a UL region corresponding to the DL region; and if ACK/NACK feedback is made for a plurality of DL regions in the same corresponding UL region, then ACK/NACK feedback information in the plurality of DL regions may be fed back over the same uplink channel in the UL region, or may be fed back over different uplink channels, where if there are different uplink channels, then they may be uplink channels transmitted at different instances of time, or may be uplink channels transmitted over different frequency resources at the same instance of time, or may be uplink channels transmitted over the same time and frequency resource in a code division mode. When a downlink control channel of the UE in an uplink DCI format is detected, the UE transmits a corresponding uplink shared channel in a UL region corresponding to the DL region." Gao at [0160].

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Claim Language		**Exemplary Citations to Gao**
		To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

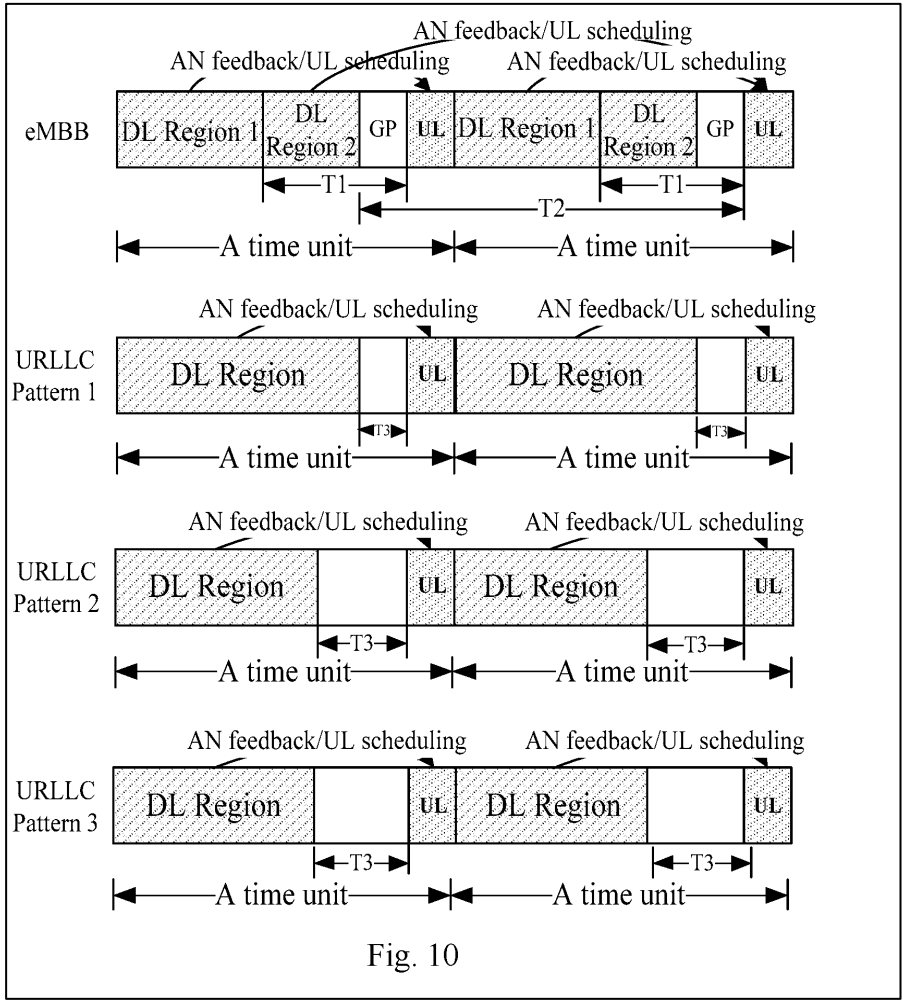
4. Claim 4

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Claim Language		**Exemplary Citations to Gao**
4[a]	The base station of claim 1, wherein the base station supports a new radio access technology (NR).	At least under Pegasus's apparent infringement theory, Gao discloses the base station of claim 1, wherein the base station supports a new radio access technology (NR). For example, Gao discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. "A drawback in the prior art lies in that there has been absent so far a solution to transmit data over dynamically allocated uplink and downlink resources, for example, in the existing 5G system." Gao at [0008]. "The inventors have identified that during making of the invention: as there are a growing demand for mobile communication services, the International Telecommunication Union (ITU), the 3rd Generation Partnership Project (3GPP), and other organizations come to research a new wireless communication system (e.g., a 5G system). The new wireless communication system can support various coexisting

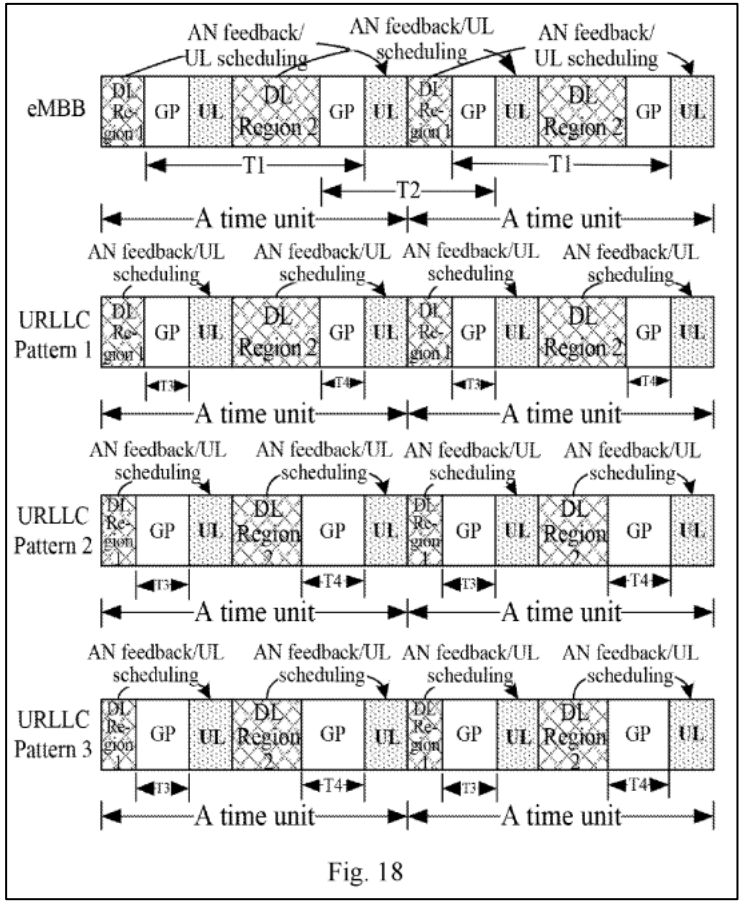
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Claim Language		**Exemplary Citations to Gao**
		types of services, e.g., an enhanced Mobile Broadband (eMBB) service, an Ultra Reliable & Low Latency Communication (URLLC) service, a Massive Machine Type Communication (mMTC) service, etc., and the amount of traffic of the same service may also vary. When uplink and downlink traffic shares the same frequency resource in a Time Division Multiplexing (TDM) mode, in order to support the different types of services and demands for the amount of traffic, a flexible and varying allocation of resources shall be supported, but there has been absent so far a related solution to transmit data over dynamically allocated uplink and downlink resources." Gao at [0095]. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

5. Claim 5

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Claim Language		**Exemplary Citations to Gao**
5[a]	The base station of claim 1, wherein the base station supports different numerologies which are	At least under Pegasus's apparent infringement theory, Gao discloses the base station of claim 1, wherein the base station supports different numerologies which are defined by a subcarrier spacing (SCS). For example, Gao discloses this limitation based on the following exemplary citations:

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defined by a subcarrier spacing (SCS).	 Fig. 10 Gao at Fig. 10; *see also, id.* at Figs. 11, 18-19. "FIG. 10 is a schematic diagram of an allocation of and a correspondence relationship between the uplink and downlink resources of the system with a TA and/or a

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		switching period of time according to the first embodiment of the invention in different services, and FIG. 11 is a schematic diagram of an allocation of and a correspondence relationship between the uplink and downlink resources of the system without any TA and/or switching period of time according to the first embodiment of the invention in different services. For example, when the pattern in this embodiment is defined for a corresponding eMBB service, if there is also a URLLC service in the system, then the patterns as illustrated in FIG. 10 and FIG. 11 may be defined for the URLLC service, that is, only one DL region and one UL region are defined in a time unit, where the DL region is the entire DL region of the eMBB service, or a subset thereof, and the UL region is the entire UL region of the eMBB service, or a subset thereof, or more than the UL region of the eMBB service, dependent upon feedback, a scheduling delay, a real demand, etc., in the URLLC service as long as feedback can be made, or an uplink shared channel can be transmitted, in the UL region in the current time unit for the last downlink scheduling unit, so that uplink scheduling or downlink feedback can be made in one time unit for the URLLC service. Of course, alternatively a uniform allocation of DL and UL regions can be defined for the eMBB and URLLC services in the system, so that the eMBB service operates according to the feedback and scheduling relationships corresponding to the process above, and downlink transmission of the URLLC service in respective DL regions in a time unit can be feedback in the UL region in the current time unit, or downlink control channels in an uplink DCI format in respective DL regions in a time unit can schedule uplink shared channels to be transmitted in the UL region in the current time unit, that is, at this time, the relationship between a DL end position and a UL start position in a time unit of the URLLC service is required to satisfy the demands for feedback and a scheduling delay, so that feedback and uplink scheduling can be made in the current time unit for all the DL regions to thereby shorten the scheduling and feedback delays; and there is the same operating flow of the URLLC service as described above according to the DL regions and the feedback/scheduling relationship defined for the URLLC service except that different feedback and scheduling delays are defined, so a repeated description thereof will be omitted here." Gao at [0168].

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	 Fig. 18 Gao at Fig. 18. "FIG. 18 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to the second embodiment of the invention in different services, and FIG. 19 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without a TA and/or

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		a switching period of time according to the second embodiment of the invention in different services. For example, when the pattern in this embodiment is defined for a corresponding eMBB service, if there is also a URLLC service in the system, then the patterns as illustrated in FIG. 18 and FIG. 19 may be defined for the URLLC service, that is, only one DL region and one UL region are defined in a time unit, where the DL region is the entire DL region of the eMBB service, or a subset thereof, and the UL region is the entire UL region of the eMBB service, or a subset thereof, or more than the UL region of the eMBB service, dependent upon feedback, a scheduling delay, a real demand, etc., in the URLLC service as long as feedback can be made, or an uplink shared channel can be transmitted, in the UL region in the current time unit for the last downlink scheduling unit, so that uplink scheduling or downlink feedback can be made in one time unit for the URLLC service. Of course, alternatively a uniform allocation of DL and UL regions can be defined for the eMBB and URLLC services in the system, so that the eMBB service operates according to the feedback and scheduling relationships corresponding to the process above, and downlink transmission of the URLLC service in respective DL regions in a time unit can be transmitted in a UL region in the current time unit, or downlink control channels in an uplink DCI format in respective DL regions in a time unit can schedule uplink shared channels to be transmitted in a UL region in the current time unit, that is, at this time, the relationship between a DL end position and a UL start position in a time unit of the URLLC service is required to satisfy the demands for feedback and a scheduling delay, so that feedback and uplink scheduling can be made in the current time unit for all the DL regions to thereby shorten the scheduling and feedback delays; and there is the same operating flow of the URLLC service as described above according to the DL regions and the feedback/scheduling relationship defined for the URLLC service except that different feedback and scheduling delays are defined, so a repeated description thereof will be omitted here." Gao at [0188]. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of

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		a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

6. Claim 6

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Claim Language		**Exemplary Citations to Gao**
6[pre]	The base station of claim 1, wherein the operations further include:	At least under Pegasus's apparent infringement theory, Gao discloses the base station of claim 1, wherein the operations further include. For example, Gao discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. *See* 6[a]–[b], *infra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Gao**
6[a]	transmitting, to the wireless device, downlink data via the PDSCH; and	At least under Pegasus's apparent infringement theory, Gao discloses transmitting, to the wireless device, downlink data via the PDSCH; and. For example, Gao discloses this limitation based on the following exemplary citations: "Optionally, the method further includes: when a downlink DCI format is used for the downlink control channel, receiving ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in a UL region corresponding to a DL region in which the downlink control channel is transmitted; or when an uplink DCI format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in a UL region corresponding to a DL region in which the downlink control channel is transmitted." Gao at [0017]. "In an implementation, the method further includes: when a downlink DCI format is used for the downlink control channel, ACK/NACK feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel is received in a UL region corresponding to the DL region in which the downlink control channel is transmitted; or when an uplink DCI format is used for the downlink control channel, an uplink shared channel corresponding to the downlink control channel is received in a UL region corresponding to the DL region in which the downlink control channel is transmitted." Gao at [0121]; *see also, id*. at [0122-123]. "Particularly, when the UE detects downlink transmission (including a downlink control channel and a downlink shared channel, for which ACK/NACK is to be fed back; where the downlink shared channel includes a downlink shared channel with a corresponding downlink control channel, and a downlink shared channel without any corresponding downlink control channel) in a DL region, the UE feeds back ACK/NACK for the downlink transmission, in a UL region corresponding to the DL region; and when the UE detects a downlink control channel in an uplink DCI format in a DL region, the UE transmits an uplink shared channel corresponding to the

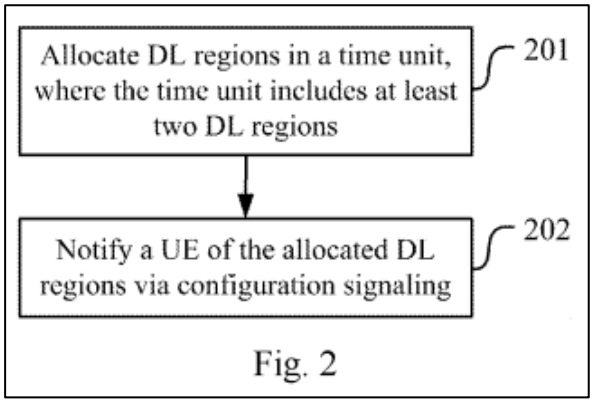
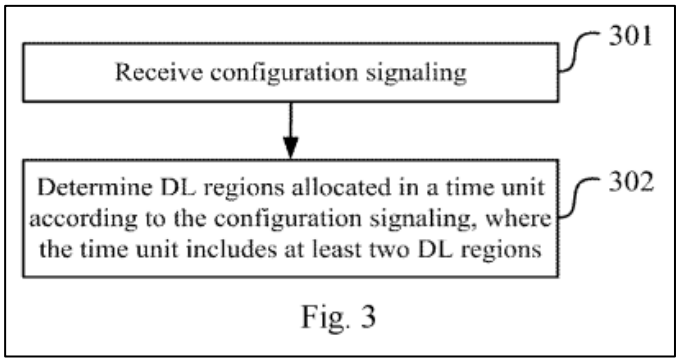
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Claim Language		**Exemplary Citations to Gao**
		downlink control channel in a UL region corresponding to the DL region." Gao at [0124]. "The eNB to schedule the UE selects at least one DL region in a time unit, and transmits a downlink control channel to the UE in a downlink control channel search space of the selected DL region to schedule the UE to receive a downlink shared channel in the selected DL region, or to transmit an uplink shared channel in a corresponding UL region. For example, in a first scenario, the eNB transmits a downlink control channel **1** in a downlink DCI format in a DL region **1** to schedule a UE **1** to receive a downlink shared channel **1** in the DL region **1**, and transmits a downlink control channel **2** in the downlink DCI format in a DL region **2** to schedule a UE **2** to receive a downlink shared channel **2** in the DL region **2**. In another example, in a second scenario, the eNB transmits a downlink control channel **1-1** in a downlink DCI format in a DL region **1** to schedule a UE **1** to receive a downlink shared channel **1-1** in the DL region **1**, transmits a downlink control channel **2-1** in the downlink DCI format in the DL region **1** to schedule a UE **2** to receive a downlink shared channel **2-1** in the DL region **1**, transmits a downlink control channel **1-2** in the downlink DCI format in a DL region **2** to schedule the UE **1** to receive a downlink shared channel **1-2** in the DL region **2**, and transmits a downlink control channel **2-2** in the downlink DCI format in the DL region **2** to schedule the UE **2** to receive a downlink shared channel **2-2** in the DL region **2**." Gao at [0153-0155]; *see also, id*. at [0156-157]. "For example, in correspondence to the first scenario at the eNB side, the UE **1** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and only detects a downlink control channel **1** in the downlink DCI format in the DL region **1**, so the UE **1** receives a corresponding downlink shared channel **1** in the DL region **1** according to scheduling information carried over the downlink control channel **1**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit; and the UE **2** detects

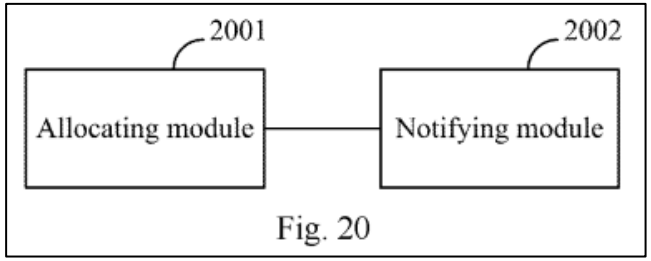
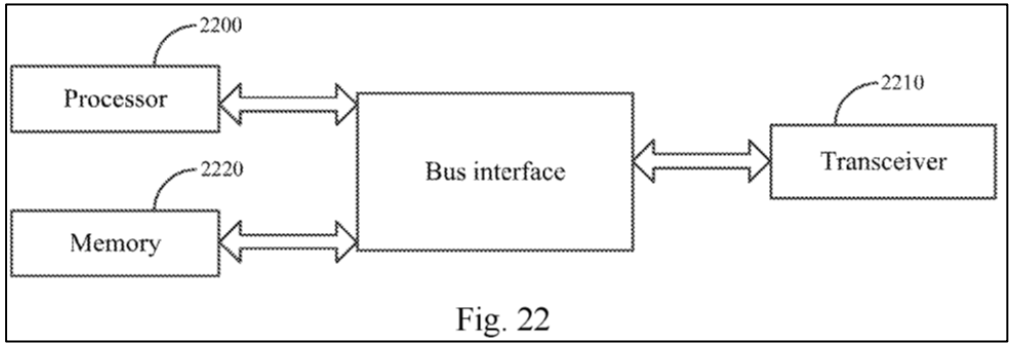
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		the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and only detects a downlink control channel **2** in the downlink DCI format in the DL region **2**, so the UE **2** receives a corresponding downlink shared channel **2** in the DL region **2** according to scheduling information carried over the downlink control channel **2**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission patterns of the UE **1** and the UE **2** are as illustrated in the "AN" feedback relationships in FIG. 6 and FIG. 7, where FIG. 6 is a schematic diagram of the first or third scenario at the UE side with a TA and/or a switching period of time in the first embodiment, and FIG. 7 is a schematic diagram of the first or third scenario at the UE side without any TA and/or switching period of time in the first embodiment. For example, in correspondence to the second scenario at the eNB side, the UE **1** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and detects a downlink control channel **1-1** in the downlink DCI format in the DL region **1**, so the UE **1** receives a corresponding downlink shared channel **1-1** in the DL region **1** according to scheduling information carried over the downlink control channel **1-1**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit; and the UE **1** detects a downlink control channel **1-2** in the downlink DCI format in the DL region **2**, so the UE **2** receives a corresponding downlink shared channel **1-2** in the DL region **2** according to scheduling information carried over the downlink control channel **1-2**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. The UE **2** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and detects a downlink control channel **2-1** in the downlink DCI format in the DL region **1**, so the UE **2** receives a corresponding downlink shared channel **2-1** in the DL region **1** according to scheduling information carried over the downlink control channel **2-1**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the time unit; and the UE **2** detects a downlink control channel **2-2** in the downlink DCI format in the DL region **2**, so the UE **2** receives a corresponding downlink shared channel **2-2** in the DL region **2** according to

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		scheduling information carried over the downlink control channel **2-2**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region in the next time unit. At this time, transmission patterns of the UE **1** and the UE **2** are as illustrated in the "AN" feedback relationships in FIG. 8 and FIG. 9, where FIG. 8 is a schematic diagram of the second or fourth scenario at the UE side with a TA and/or a switching period of time in the first embodiment, and FIG. 9 is a schematic diagram of the second or fourth scenario at the UE side without any TA and/or switching period of time in the first embodiment." Gao at [0161-0162]; *see also, id*. at [0163-164]. "The eNB to schedule the UE selects at least one DL region in a time unit, and transmits a downlink control channel to the UE in a downlink control channel search space of the selected DL region to schedule the UE to receive a downlink shared channel in the selected DL region, or to transmit an uplink shared channel in a corresponding UL region. For example, in a first scenario, the eNB transmits a downlink control channel **1** in a downlink DCI format in a DL region **1** to schedule a UE **1** to receive a downlink shared channel **1** in the DL region **1**, and transmits a downlink control channel **2** in the downlink DCI format in a DL region **2** to schedule a UE **2** to receive a downlink shared channel **2** in the DL region **2**. In another example, in a second scenario, the eNB transmits a downlink control channel **1-1** in a downlink DCI format in a DL region **1** to schedule a UE **1** to receive a downlink shared channel **1-1** in the DL region **1**, transmits a downlink control channel **2-1** in the downlink DCI format in the DL region **1** to schedule a UE **2** to receive a downlink shared channel **2-1** in the DL region **1**, transmits a downlink control channel **1-2** in the downlink DCI format in a DL region **2** to schedule the UE **1** to receive a downlink shared channel **1-2** in the DL region **2**, and transmits a downlink control channel **2-2** in the downlink DCI format in the DL region **2** to schedule the UE **2** to receive a downlink shared channel **2-2** in the DL region **2**." Gao at [0173-0175].

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		"The UE detects blindly each DL region in a time unit for a downlink control channel according to the determined allocation of DL and UL regions; when a downlink control channel of the UE in a downlink DCI format is detected, the UE receives a corresponding downlink shared channel in the DL region, generates ACK/NACK feedback information ("AN" feedback as illustrated) for the downlink shared channel, and makes ACK/NACK feedback in a UL region corresponding to the DL region; and if ACK/NACK feedback is made for a plurality of DL regions in the same corresponding UL region, then ACK/NACK feedback information in the plurality of DL regions may be fed back over the same uplink channel in the UL region, or may be fed back over different uplink channels, where if there are different uplink channels, then they may be uplink channels transmitted at different instances of time, or may be uplink channels transmitted over different frequency resources at the same instance of time, or may be uplink channels transmitted over the same time and frequency resource in a code division mode. When a downlink control channel of the UE in an uplink DCI format is detected, the UE transmits a corresponding uplink shared channel in a UL region corresponding to the DL region. For example, in correspondence to the first scenario at the eNB side, the UE **1** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and only detects a downlink control channel **1** in the downlink DCI format in the DL region **1**, so the UE **1** receives a corresponding downlink shared channel **1** in the DL region **1** according to scheduling information carried over the downlink control channel **1**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region **2** in the time unit; and the UE **2** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and only detects a downlink control channel **2** in the downlink DCI format in the DL region **2**, so the UE **2** receives a corresponding downlink shared channel **2** in the DL region **2** according to scheduling information carried over the downlink control channel **2**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region **1** in the next time unit. At this time, transmission patterns of the UE **1** and the UE **2** are as illustrated in the "AN" feedback relationships in FIG. 14 and FIG. 15, where FIG. 14 is a schematic diagram of the first or third scenario at

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		the UE side with a TA and/or a switching period of time in the second embodiment, and FIG. 15 is a schematic diagram of the first or third scenario at the UE side without any TA and/or switching period of time in the second embodiment. For example, in correspondence to the second scenario at the eNB side, the UE **1** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and detects a downlink control channel **1-1** in the downlink DCI format in the DL region **1**, so the UE **1** receives a corresponding downlink shared channel **1-1** in the DL region **1** according to scheduling information carried over the downlink control channel **1-1**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region **2** in the time unit; and the UE **1** detects a downlink control channel **1-2** in the downlink DCI format in the DL region **2**, so the UE **1** receives a corresponding downlink shared channel **1-2** in the DL region **2** according to scheduling information carried over the downlink control channel **1-2**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region **1** in the next time unit. The UE **2** detects the DL regions **1** and **2** for a downlink control channel in a downlink DCI format, and detects a downlink control channel **2-1** in the downlink DCI format in the DL region **1**, so the UE **2** receives a corresponding downlink shared channel **2-1** in the DL region **1** according to scheduling information carried over the downlink control channel **2-1**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region **2** in the time unit; and the UE **2** detects a downlink control channel **2-2** in the downlink DCI format in the DL region **2**, so the UE **2** receives a corresponding downlink shared channel **2-2** in the DL region **2** according to scheduling information carried over the downlink control channel **2-2**, generates ACK/NACK feedback information, and makes ACK/NACK feedback in the UL region **1** in the next time unit. At this time, transmission patterns of the UE **1** and the UE **2** are as illustrated in the "AN" feedback relationships in FIG. 8, where FIG. 16 is a schematic diagram of the second or fourth scenario at the UE side with a TA and/or a switching period of time in the second embodiment, and FIG. 17 is a schematic diagram of the second or fourth scenario at the UE side without any TA

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		and/or switching period of time in the second embodiment." Gao at [0180-0182]; *see also, id*. at [0183-184].  Fig. 2 Gao at Fig. 2.  Fig. 3 Gao at Fig. 3.

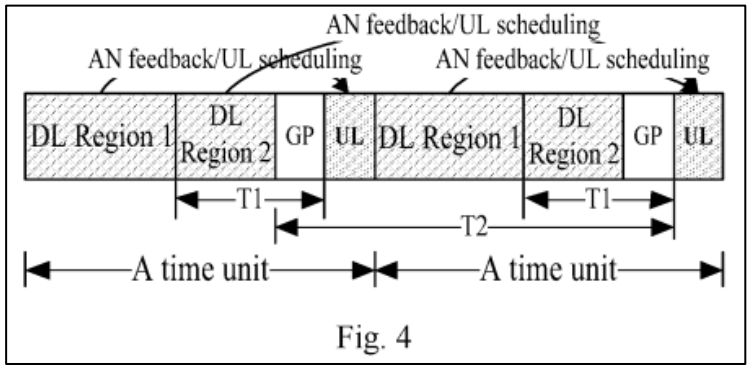
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		 Fig. 20 Gao at Fig. 20.  Fig. 22 Gao at Fig. 22. "**8**. The method according to claim 7, wherein the method further comprises: when a downlink Downlink Control Information (DCI) format is used for the downlink control channel, receiving Acknowledgement/Negative Acknowledgement (ACK/NACK) feedback for the downlink control channel, and/or ACK/NACK feedback for a downlink shared channel corresponding to the downlink control channel, in an uplink (UL) region corresponding to a DL region in which the downlink control channel is transmitted; or when an uplink Downlink Control Information (DCI) format is used for the downlink control channel, receiving an uplink shared channel corresponding to the downlink control channel in an uplink (UL) region corresponding to a

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		DL region in which the downlink control channel is transmitted." Gao at Claim 8; *see also, id*. at Claim 18, 48, 58. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
6[b]	receiving, from the wireless device, uplink data via the PUSCH.	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from the wireless device, uplink data via the PUSCH. For example, Gao discloses this limitation based on the following exemplary citations: To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

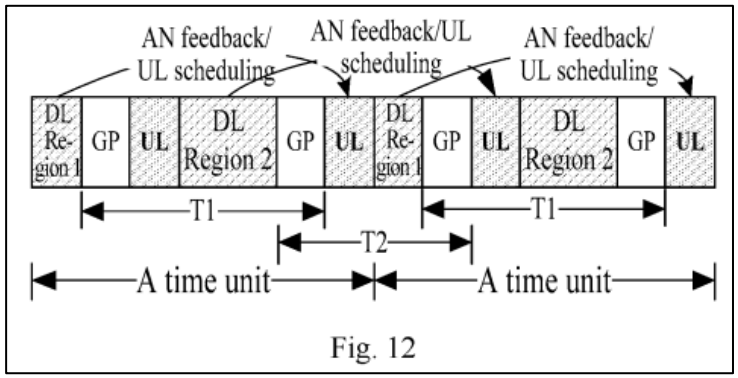
7. Claim 7

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Claim Language		**Exemplary Citations to Gao**
7[a]	The base station of claim 1, wherein the number of the OFDM symbols is a maximum of 14.	At least under Pegasus's apparent infringement theory, Gao discloses the base station of claim 1, wherein the number of the OFDM symbols is a maximum of 14. For example, Gao discloses this limitation based on the following exemplary citations: *See* claim 1, *supra*. "Particularly, a UL region corresponding to a DL region is determined according to indication information in the downlink control channel, and for example, the indication information indicates a time domain position of the UL region directly, e.g., the number of a symbol, a micro-slot, a slot, a sub-frame, etc., or can indicate a delay in addition to a predefined processing delay, where a region or the first UL region satisfying the processing delay and the delay after the end position of the downlink region is determined as a UL region corresponding to the DL region according to the delay and the processing delay." Gao at [0128]. "Particularly, the downlink control channel can indicate a feedback delay or a feedback time sequence or a feedback position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for feeding back ACK/NACK in a corresponding UL region; and the downlink control channel can indicate a scheduling delay or a scheduling time sequence or a scheduling position index for the UE to determine a resource (e.g., a symbol or a mini-slot) for transmitting an uplink shared channel in a corresponding UL region." Gao at [0137]. "The sizes of respective DL regions in a time unit may or may not be the same; and for example, there are two symbols in the first DL region, and three symbols in the second DL region." Gao at [0140]. "FIG. 4 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching

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Claim Language		**Exemplary Citations to Gao**
		period of time according to a first embodiment of the invention, and FIG. 5 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the first embodiment of the invention. As illustrated in FIG. 4, for example, an eNB decides to divide a time unit into two DL regions and one UL region, and there is such a blank region or a GP region between a DL region and the UL region that is a reserved region determined to satisfy a Timing Advance (TA) demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 5. A correspondence relationship between the DL regions and the UL region can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the time unit (where uplink transmission in the UL region may occupy only a part of Orthogonal Frequency Division Multiplexing (OFDM) or Single-Carrier Frequency Division Multiple Access (SC-FDMA) symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a Time Division Multiplexing (TDM) mode, or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second DL region in a time unit is predefined or configured to schedule uplink transmission in the UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode, or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can

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		be transmitted in a UL region in a TDM mode, or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the UL region in the next time unit, as illustrated in FIG. 4 and FIG. 5. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 4 and FIG. 5. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0147].  Fig. 4 Gao at Fig. 4. "In another implementation, the eNB transmits configuration signaling over a specific resource in a predefined DL region in each time unit, or one of a plurality of time units (e.g., the first N OFDM symbols in a time unit), where the configuration signaling can be transmitted over a data channel (e.g., like a System Information

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		Block (SIB)), or can be transmitted in a control channel (e.g., in a preset Downlink Control Information (DCI) format in a common search space).” Gao at [0150]. “FIG. 12 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system with a TA and/or a switching period of time according to a second embodiment of the invention, and FIG. 13 is a schematic diagram of an allocation of and a correspondence relationship between uplink and downlink resources of a system without any TA and/or switching period of time according to the second embodiment of the invention. As illustrated in FIG. 12, for example, an eNB decides to divide a time unit into two DL regions and two UL regions, and there is such a blank region or a GP region between a DL region and an UL region that is a reserved region determined to satisfy a TA demand of the UL, a switching period of time from the DL to the UL, etc., possibly taking into account interference between adjacent cells, and other factors. Of course, if a TA or a switching period of time or anti-interference is not required, then there may be no blank component or GP component as illustrated in FIG. 13. A correspondence relationship between the DL regions and the UL regions can be predefined or configured directly, and for example, the first DL region in a time unit is predefined or configured to schedule uplink transmission in the second (last) UL region in the time unit (where uplink transmission in the UL region may occupy only a part of OFDM or SC-FDMA symbols or a part of mini-slots in the UL region, so a plurality of uplink shared channels of the same or different UEs can be transmitted in a UL region in a TDM mode; or uplink transmission in the UL region may occupy the length of the entire UL region, and the same will apply hereinafter), the second (last) DL region in a time unit is predefined or configured to schedule uplink transmission in the first UL region in the next time unit, ACK/NACK for downlink transmission in the first DL region in a time unit (where downlink transmission in the DL region may occupy only a part of OFDM symbols or a part of mini-slots in the DL region, so a plurality of downlink transmission instances of the same or different UEs can be transmitted in a DL region in a TDM mode; or downlink transmission in the DL region may occupy the length of the entire DL region) is fed back in the second (last)

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		UL region in the time unit (an uplink channel carrying ACK/NACK feedback information for downlink transmission may occupy only a part of OFDM or SC-OFDM symbols or a part of mini-slots in the UL region, so a plurality of uplink channels, carrying ACK/NACK, of the same or different UEs can be transmitted in a UL region in a TDM mode; or the uplink channel may occupy the length of the entire UL region, and the same will apply hereinafter), and ACK/NACK for downlink transmission in the second DL region in a time unit is fed back in the first UL region in the next time unit, as illustrated in FIG. 12 and FIG. 13. Of course, alternatively the value of T can be predefined or configured, and an UL region spaced from a DL region by a period T of time after the DL region can be defined as a corresponding UL region, for the same effect of the correspondence relationship predefined or configured as above, as illustrated in FIG. 12 and FIG. 13. The length of T may vary from one DL region to another, and the value of T for defining a scheduling relationship may or may not be the same as the value of T for defining a feedback relationship. When a time unit is divided differently into DL and UL regions, the corresponding value of T will also be different, and for example, there are different allocations of DL and UL regions, and thus different corresponding values of T, for different services. In this embodiment, a time unit can be a slot or a sub-frame; or course, alternatively a time unit with another length can be defined." Gao at [0170].  Fig. 12 Gao at Fig. 12.

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Claim Language		**Exemplary Citations to Gao**
		To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

8. Claim 8

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Claim Language		**Exemplary Citations to Gao**
8[pre - c]	A wireless device, comprising: a transceiver; a receiver; and a controller which controls the transceiver and receiver thereby performing operations including:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Gao discloses a wireless device, comprising: a transceiver; a receiver; and a controller which controls the transceiver and receiver thereby performing operations including. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[pre], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art

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Claim Language		**Exemplary Citations to Gao**
		references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[d]	receiving, from a base station, a radio resource control (RRC) signal including information on one or more allocations of a time-domain resource,	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from a base station, a radio resource control (RRC) signal including information on one or more allocations of a time-domain resource. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[e]	wherein the time-domain resource includes at least one or more orthogonal frequency-division multiplexing (OFDM) symbols,	At least under Pegasus's apparent infringement theory, Gao discloses wherein the time-domain resource includes at least one or more orthogonal frequency-division multiplexing (OFDM) symbols. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate

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Claim Language		**Exemplary Citations to Gao**
		this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[f]	wherein, based on the information, a number of OFDM symbols are determined for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH), and	At least under Pegasus's apparent infringement theory, Gao discloses wherein, based on the information, a number of OFDM symbols are determined for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH), and. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[b], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[g]	wherein the determined number of OFDM symbols is smaller than or equal to a	At least under Pegasus's apparent infringement theory, Gao discloses wherein the determined number of OFDM symbols is smaller than or equal to a number of OFDM symbols included in a slot; and. For example, Gao discloses this limitation based on the following exemplary citations:

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	number of OFDM symbols included in a slot; and	*See* 1[c], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[i]	receiving, from the base station, downlink control information (DCI), including a field including a bit string,	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from the base station, downlink control information (DCI), including a field including a bit string. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[d], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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Claim Language		**Exemplary Citations to Gao**
8[j]	wherein the bit string in the field relates to a row index of an allocation table, and	At least under Pegasus's apparent infringement theory, Gao discloses wherein the bit string in the field relates to a row index of an allocation table, and. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[e], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
8[k]	wherein the allocation table includes information on a starting OFDM symbol and the number of the OFDM symbols which is smaller than or equal to the number of OFDM symbols included in the slot.	At least under Pegasus's apparent infringement theory, Gao discloses wherein the allocation table includes information on a starting OFDM symbol and the number of the OFDM symbols which is smaller than or equal to the number of OFDM symbols included in the slot. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[f], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

9. Claim 9

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Claim Language		**Exemplary Citations to Gao**
9[a]	The wireless device of claim 8, wherein the bit string is 3 bits in length.	At least under Pegasus's apparent infringement theory, Gao discloses the wireless device of claim 8, wherein the bit string is 3 bits in length. For example, Gao discloses this limitation based on the following exemplary citations: *See* 2[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

10. Claim 10

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Claim Language		**Exemplary Citations to Gao**
10[a]	The wireless device of claim 8, wherein the DCI further includes information on one or more allocations of a frequency-domain resource.	At least under Pegasus's apparent infringement theory, Gao discloses the wireless device of claim 8, wherein the DCI further includes information on one or more allocations of a frequency-domain resource. For example, Gao discloses this limitation based on the following exemplary citations: *See* 3[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

11. Claim 11

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Claim Language		**Exemplary Citations to Gao**
11[a]	The wireless device of claim 8, wherein the wireless device supports a new radio access technology (NR).	At least under Pegasus's apparent infringement theory, Gao discloses the wireless device of claim 8, wherein the wireless device supports a new radio access technology (NR). For example, Gao discloses this limitation based on the following exemplary citations: *See* 4[a], *supra*.

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Claim Language		**Exemplary Citations to Gao**
		To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

12. Claim 12

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Claim Language		**Exemplary Citations to Gao**
12[a]	The wireless device of claim 8, wherein the wireless device supports different numerologies which are defined by a subcarrier spacing (SCS).	At least under Pegasus's apparent infringement theory, Gao discloses the wireless device of claim 8, wherein the wireless device supports different numerologies which are defined by a subcarrier spacing (SCS). For example, Gao discloses this limitation based on the following exemplary citations: *See* 5[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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Claim Language		**Exemplary Citations to Gao**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

13. Claim 13

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Claim Language		**Exemplary Citations to Gao**
13[pre]	The wireless device of claim 8, wherein the operations further include:	At least under Pegasus's apparent infringement theory, Gao discloses the wireless device of claim 8, wherein the operations further include. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.*, 6[pre], *supra*. *See* 13[a]–[b], *infra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
13[a]	receiving, from the base station, downlink data via the PDSCH; and	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from the base station, downlink data via the PDSCH; and. For example, Gao discloses this limitation based on the following exemplary citations:

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Claim Language		**Exemplary Citations to Gao**
		See, e.g., 6[b], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
13[b]	transmitting, to the base station, uplink data via the PUSCH.	At least under Pegasus's apparent infringement theory, Gao discloses transmitting, to the base station, uplink data via the PUSCH. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.*, 6[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

14. Claim 14

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Claim Language		**Exemplary Citations to Gao**
14[a]	The wireless device of claim 8, wherein the number of the OFDM symbols is a maximum of 14.	At least under Pegasus's apparent infringement theory, Gao discloses the wireless device of claim 8, wherein the number of the OFDM symbols is a maximum of 14. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.*, 7[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

15. Claim 15

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Claim Language		**Exemplary Citations to Gao**
15[pre]	An operation method of wireless device, comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Gao discloses an operation method of wireless device, comprising. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[pre], *supra*.

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Claim Language		**Exemplary Citations to Gao**
		To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[a]	receiving, from a base station, a radio resource control (RRC) signal including information on one or more allocations of a time-domain resource,	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from a base station, a radio resource control (RRC) signal including information on one or more allocations of a time-domain resource. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[a]–[b], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[b]	wherein the time-domain resource includes at least one or more orthogonal frequency-	At least under Pegasus's apparent infringement theory, Gao discloses wherein the time-domain resource includes at least one or more orthogonal frequency-division

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Claim Language		**Exemplary Citations to Gao**
	division multiplexing (OFDM) symbols,	multiplexing (OFDM) symbols. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[c]	wherein, based on the information, a number of OFDM symbols are determined for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH), and	At least under Pegasus's apparent infringement theory, Gao discloses wherein, based on the information, a number of OFDM symbols are determined for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH), and. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[b], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same

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Claim Language		**Exemplary Citations to Gao**
		field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[d]	wherein the determined number of OFDM symbols is smaller than or equal to a number of OFDM symbols included in a slot; and	At least under Pegasus's apparent infringement theory, Gao discloses wherein the determined number of OFDM symbols is smaller than or equal to a number of OFDM symbols included in a slot; and. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[c], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[e]	receiving, from the base station, downlink control information (DCI), including a field including a bit string,	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from the base station, downlink control information (DCI), including a field including a bit string. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[d], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[f]	wherein the bit string in the field relates to a row index of an allocation table, and	At least under Pegasus's apparent infringement theory, Gao discloses wherein the bit string in the field relates to a row index of an allocation table, and. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[e], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
15[g]	wherein the allocation table includes information on a starting OFDM symbol and the number of the OFDM symbols which is smaller than or equal to the number of OFDM symbols included in the slot.	At least under Pegasus's apparent infringement theory, Gao discloses wherein the allocation table includes information on a starting OFDM symbol and the number of the OFDM symbols which is smaller than or equal to the number of OFDM symbols included in the slot. For example, Gao discloses this limitation based on the following exemplary citations: *See* 1[f], *supra*.

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

16. Claim 16

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
16[a]	The method of claim 15, wherein the bit string is 3 bits in length.	At least under Pegasus's apparent infringement theory, Gao discloses the method of claim 15, wherein the bit string is 3 bits in length. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.,* 2[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

17. Claim 17

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
17[a]	The method of claim 15, wherein the DCI further includes information on one or more allocations of a frequency-domain resource.	At least under Pegasus's apparent infringement theory, Gao discloses the method of claim 15, wherein the DCI further includes information on one or more allocations of a frequency-domain resource. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.,* 3[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

18. Claim 18

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
18[a]	The method of claim 15, wherein the wireless device supports a new radio access technology (NR).	At least under Pegasus's apparent infringement theory, Gao discloses the method of claim 15, wherein the wireless device supports a new radio access technology (NR). For example, Gao discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		See, e.g., 4[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

19. Claim 19

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
19[a]	The method of claim 18, wherein the wireless device supports different numerologies which are defined by a subcarrier spacing (SCS).	At least under Pegasus's apparent infringement theory, Gao discloses the method of claim 18, wherein the wireless device supports different numerologies which are defined by a subcarrier spacing (SCS). For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.,* 5[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

20. Claim 20

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
20[pre]	The method of claim 18, further comprising:	At least under Pegasus's apparent infringement theory, Gao discloses the method of claim 18, further comprising. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.,* 6[pre], *supra*. *See* 13[a]–[b], *infra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
20[a]	receiving, from the base station, downlink data via the PDSCH; and	At least under Pegasus's apparent infringement theory, Gao discloses receiving, from the base station, downlink data via the PDSCH; and. For example, Gao discloses this limitation based on the following exemplary citations:

Invalidity of U.S. Patent 11,540,272 in view of Gao		
Claim Language		**Exemplary Citations to Gao**
		See, e.g., 6[b], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
20[b]	transmitting, to the base station, uplink data via the PUSCH.	At least under Pegasus's apparent infringement theory, Gao discloses transmitting, to the base station, uplink data via the PUSCH. For example, Gao discloses this limitation based on the following exemplary citations: *See, e.g.,* 6[a], *supra*. To the extent it is found that Gao does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Gao does not anticipate this claim, Gao renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Gao with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

EXHIBIT J-08

Summary of Invalidity Analysis of U.S. Patent No. 9,894,644 in view of International Publication No. WO 2014/055878 ("Lee")

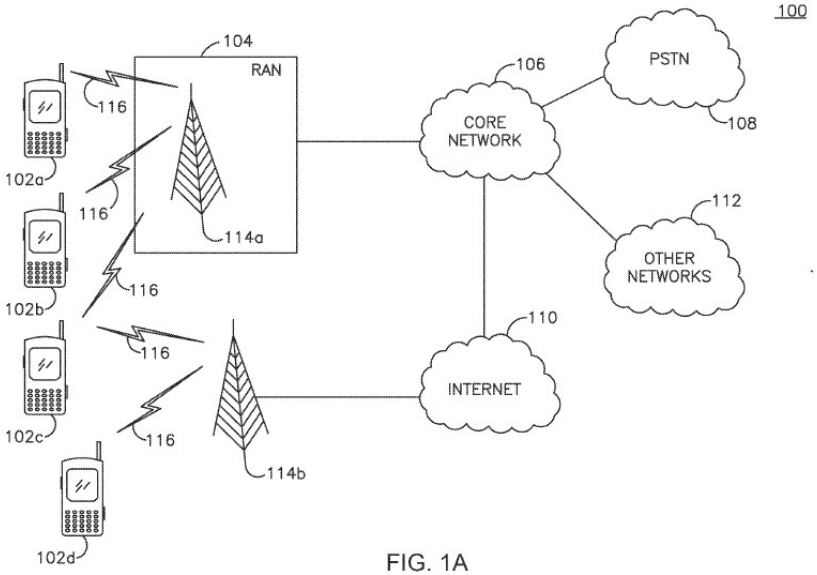
International Publication No. WO 2014/055878 ("Lee"), published on April 10, 2014, and was filed on October 4, 2013. Therefore, Lee qualifies as prior art to the '644 Patent under at least 35 U.S.C. § 102(a). As described in the following claim chart, at least under Pegasus's apparent infringement theory, the asserted claims of the '644 Patent are invalid as expressly and/or inherently anticipated by Lee.

To the extent that Lee is found not to anticipate, expressly or inherently, one or more of the asserted claims of the '644 Patent, at least under Pegasus's apparent infringement theory, these claims are invalid as obvious in view of Lee in view of the background knowledge and ordinary creativity of a person having ordinary skill in the art at the time of the alleged invention, or in combination with other prior art identified in the cover pleading, herein, or as disclosed in Defendants' Invalidity Contentions and accompanying charts and appendices. A person of ordinary skill would have been motivated to combine Lee and any other prior art references, including but not limited to the other prior art identified in the cover pleading or herein, with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

Defendants reserve the right to amend or supplement this invalidity chart at a later date.

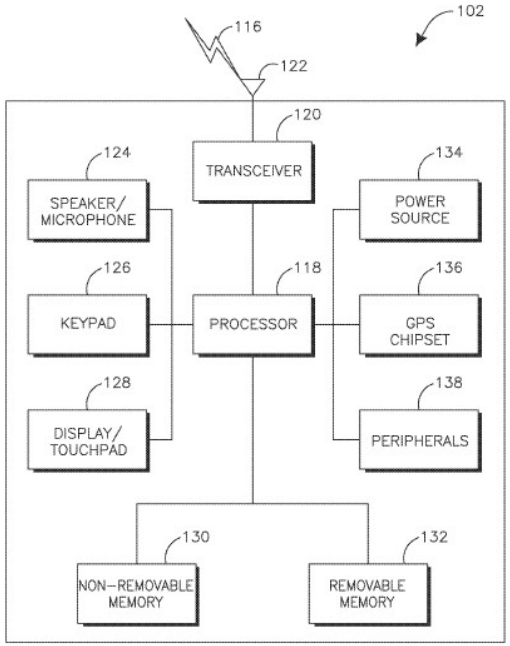
1. Claim 1

Invalidity of U.S. Patent 9,894,644 in view of Lee		
Claim Language		**Exemplary Citations to Lee**
1[pre]	A method for receiving, by a terminal, downlink control information through downlink control channels repeatedly allocated in a plurality of subframes, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Lee discloses a method for receiving, by a terminal, downlink control information through downlink control channels repeatedly allocated in a plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0023] As shown in FIG. lA, the communications system 100 may include wireless transmit/receive units (WTRUs) 102a, 102b, 102c, 102d, a radio access network (RAN) 104, a core network 106, a public switched telephone network (PSTN) 108, the Internet 110, and other networks 112, though it will be appreciated that the disclosed embodiments contemplate any number of WTRUs, base stations, networks, and/or network elements. Each of the WTRUs 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment. By way of example, the WTRUs 102a, 102b, 102c, 102d may be configured to transmit and/or receive wireless signals and may include user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a pager, a cellular telephone, a personal digital assistant (PDA), a smartphone, a laptop, a netbook, a personal computer, a wireless sensor, consumer electronics, machine to machine and the like.

Invalidity of U.S. Patent 9,894,644 in view of Lee	
Claim Language	**Exemplary Citations to Lee**
	 FIG. 1A [0034] FIG. 1B is a system diagram of an example WTRU 102. As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122, a speaker/microphone 124, a keypad 126, a display/touchpad 128, non-removable memory 130, removable memory 132, a power source 134, a global positioning system (GPS) chipset 136, and other peripherals 138. It will be appreciated that the WTRU 102 may include any sub-combination of the foregoing elements while remaining consistent with an embodiment. [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables

Invalidity of U.S. Patent 9,894,644 in view of Lee		
Claim Language		**Exemplary Citations to Lee**
		the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip. [0036] The transmit/receive element 122 may be configured to transmit signals to, or receive signals from, a base station (e.g., the base station 114a) over the air interface 116. For example, in one embodiment, the transmit/receive element 122 may be an antenna configured to transmit and/or receive RF signals. In another embodiment, the transmit/receive element 122 may be an emitter/detector configured to transmit and/or receive IR, UV, or visible light signals, for example. In yet another embodiment, the transmit/receive element 122 may be configured to transmit and receive both RF and light signals. It will be appreciated that the transmit/receive element 122 may be configured to transmit and/or receive any combination of wireless signals. [0037] In addition, although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116. [0038] The transceiver 120 may be configured to modulate the signals that are to be transmitted by the transmit/receive element 122 and to demodulate the signals that are received by the transmit/receive element 122. As noted above, the WTRU 102 may have multi-mode capabilities. Thus, the transceiver 120 may include multiple transceivers for enabling the WTRU 102 to communicate via multiple RATs, such as UTRA and IEEE 802.11, for example. [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in,

Invalidity of U.S. Patent 9,894,644 in view of Lee		
Claim Language		**Exemplary Citations to Lee**
		any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from, and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like.

Invalidity of U.S. Patent 9,894,644 in view of Lee	
Claim Language	**Exemplary Citations to Lee**
	 FIG. 1B [0051] Transmission time interval (TTI) bundling may enhance uplink (UL) coverage for a user or WTRU that experiences limited UL coverage, for example as its transmission power approaches the maximum. Using TTI bundling, the same data may be transmitted in multiple consecutive TTIs, which may allow the WTRU to extend the effective transmission time window for the data. For example up to four consecutive TTis may be bundled for frequency division duplex (FDD) LTE, which may extend the effective transmission time window by up to four times. A single transport block may be coded and transmitted with different redundancy versions (RVs) in each of the consecutive subframes, where subframe and TTI may be used interchangeably. For example, the consecutive TTis in the same TTI bundle may be assigned to consecutive RVs. The same hybrid automatic repeat request (HARQ) process number may be assigned to all TTis in a TTI bundle, and all TTis within a TTI bundle may be treated as a single resource, where a single UL grant and a

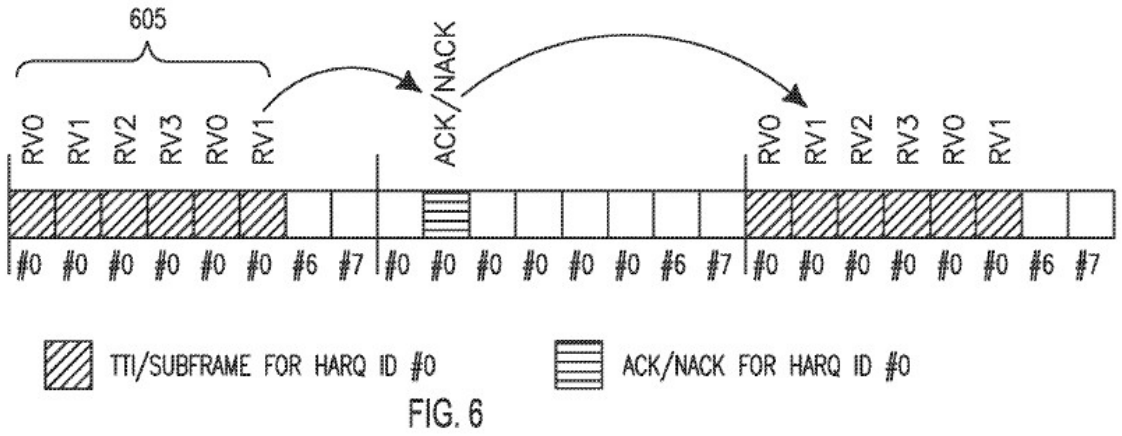
Invalidity of U.S. Patent 9,894,644 in view of Lee		
Claim Language		**Exemplary Citations to Lee**
		single acknowledgement/negative acknowledgement (ACK/NACK), (e.g., physical HARQ indicator channel (PHICH)), may be associated with them. A TTI bundling mechanism may be configured by higher layer signaling per WTRU. In FDD TTI bundling, the roundtrip time (RTT) for every re-transmission may be equal to 16 ms. When the FDD TTI bundling is activated, the WTRU may receive the UL grant for the first subframe in the TTI bundle according to the rules of an FDD UL grant, and once the UL data is transmitted in a TTI bundle, a PHICH, or other UL grant, may be expected by the WTRU according to PHICH rules corresponding to the last subframe of that TTI bundle. The rules may be for example, 3GPP Release 8 rules. [0052] FIG. 2 is a diagram of an example of TTI bundling with a TTI bundle of four consecutive TTis. In the example, HARQ ID #0 includes four bundled TTis 205, the ACK/NACK 210 is received four TTis after the last TTI of the TTI bundle 205, and re-transmission occurs sixteen TTis after the first TTI of the initial transmission. Once FDD TTI bundling is activated, the WTRU may support up to a certain number of HARQ processes, for example up to four for 3GPP Release 10. In FDD operation, all TTI bundles of the same HARQ process may have the same number of UL subframes, may have the same pattern, (for example, including consecutive UL subframes), and may be uniformly distributed in the time domain. [0092] In order to improve the coverage of channels such as the enhanced PDCCH (EPDCCH), the PDSCH, and the PUCCH, repetitive transmission may be considered as a coverage enhancement technique. In this case, the current HARQ process, such as the n+4 timing relationship (e.g., for FDD), may not be used since the reference subframe may be redefined among the repetitively transmitted subframes. In addition, the timing relationship between UL grant and PUSCH transmission may also be redefined with a new reference subframe n. The term (E)PDCCH may be used to mean PDCCH and/or EPDCCH, which may also be represented by PDCCH/EPDCCH. [0093] Described herein are methods for enhancing service coverage for data channels in the UL and DL. Given that an LC-MTC WTRU may support very low data rates with high delay tolerance in terms of quality of service, a WTRU may reduce the size of each protocol layer header for each transport block that the WTRU may receive and/or transmit.

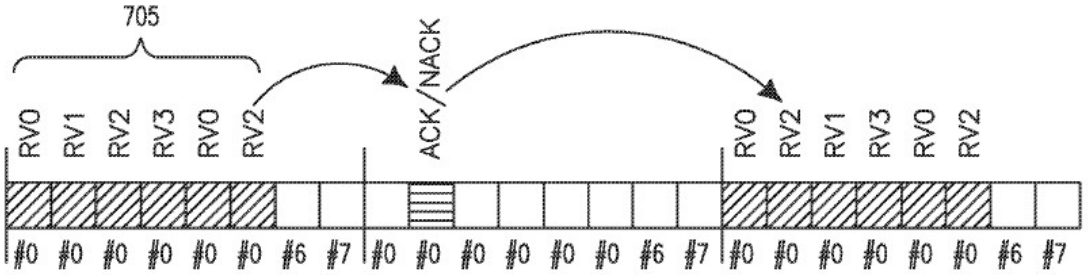
Invalidity of U.S. Patent 9,894,644 in view of Lee		
Claim Language		**Exemplary Citations to Lee**
		[0094] In an example embodiment, the PDCP and RLC may allocate a smaller sequence number (SN) size in its headers. In the PDCP, a WTRU may allocate an SN size of smaller than 7 bits. In the RLC, a WTRU may allocate an SN size of smaller than 5 bits for UM or 10 bits for AM. A WTRU may coordinate sizes of RLC and PDCP PDU s such that the resultant PDU with the header and data part may maintain octet (byte) alignment. A WTRU may have a PDCP PDU that is not byte aligned, but the RLC header and PDUs may be processed such that the resulting RLC PDU byte alignment may be maintained. [0095] In another example embodiment, a WTRU may not include the extension ("E") fields in MAC and RLC, thus further reducing the header sizes. For example, a WTRU may be configured for a data radio bearer (DRE), with a very low data rate such that small data packets, (for example, 100 bytes in the UL) may arrive into the PDCP infrequently, (for example, once every hour). A WTRU may then be configured with a small SN size, such as 2 bits, in the PDCP such that the sequence numbers may range from O to 3. In RLC, a WTRU may be configured for UM, and the RLC SDU may be segmented into 8 smaller RLC PDUs, and, relatively, the RLC SN size may be specified for 3 bits. Further, a WTRU may not include an RLC or MAC "E" bit into the header since RLC SDUs and MAC SDUs may not be concatenated into the RLC and MAC PDU (for example, 1 PDU per SDU). The WTRU may then perform L1 processing of the resultant MAC PDU for UL transmission. Given the reduced header size, the PDPC may have its header size reduced to 3 bits, its RLC reduced to 6 bits and its MAC reduced to 7 bits. The WTRU and eNB may apply the same reduction of protocol headers in the DL also. [0096] A WTRU may be configured with reduced PDCP, RLC, and MAC header configurations as part of a DRE setup procedure, which may be signaled by the RRC. For example, as part of the RRC procedure, a WTRU may be signaled to apply a 2 bit SN length in the PDCP, apply a 3 bit SN length for RLC with UM mode, and apply a bit to indicate the exclusion of the "E" bit in the MAC header. The WTRU may use a default or pre-defined set of MAC, RLC, and PDCP configurations, which may include the example header configuration defined in the RRC. The WTRU may be explicitly indicated by the network to use the coverage enhancement mode protocol layer parameters, or the WTRU may autonomously use the coverage enhancement mode parameters and signal its use to the network.

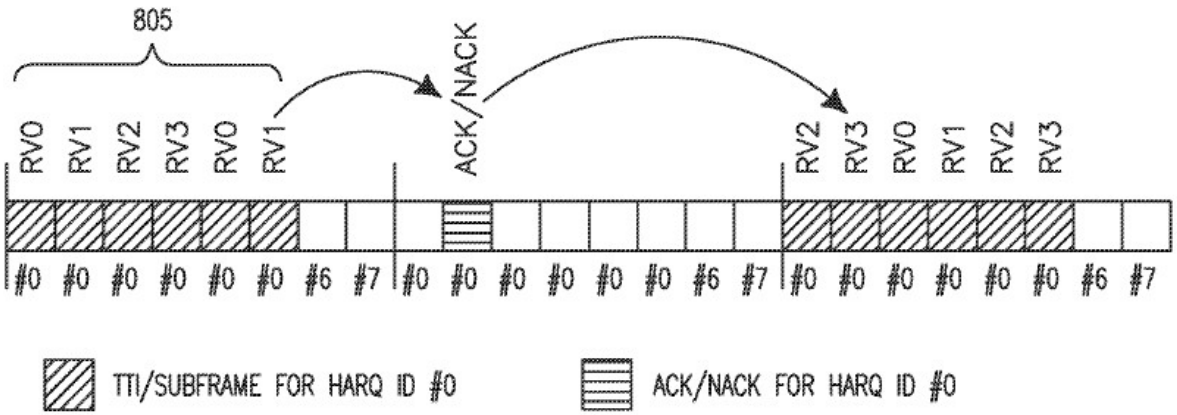
Invalidity of U.S. Patent 9,894,644 in view of Lee		
Claim Language		**Exemplary Citations to Lee**
		[0097] In another example embodiment, a WTRU/eNB may reduce RLC header size by scrambling the CRC bits, which may be appended to the MAC PDU, with the SN of the RLC PDU included in the MAC PDU. The WTRU may then remove the SN from the RLC header. For example, independently or in combination with RLC SN size reduction, the WTRU may, upon receiving a MAC PDU, descramble the CRC parity bits with possible SN values prior to performing the CRC check. The WTRU may perform the descrambling based on the entire possible SN range or based on the current RLC receiver window, excluding SN s that have already been received. Once the correct SN has been identified and the MAC PDU has been correctly received, the WTRU may pass the determined SN value to the RLC for proper PDU processing. [0098] In another example embodiment, a WTRU may scramble the CRC parity bits with MAC LCID information. For example, the WTRU may use 5 bit LCID information of the DRE to scramble the CRC parity bits if, for example, there is a single LCID associated with the MAC SDUs that are multiplexed into the MAC PDU. [0099] In another example embodiment, a WTRU may transmit and receive data on the DRE on a single HARQ process for the UL and/or DL direction. For example, given that the LC-MTC WTRU may transmit and receive data at very low data rates with high tolerance for delay, a WTRU may use a single HARQ process in each of the UL and/or DL directions. Since the WTRU may only receive a single MAC PDU at a time, the sequence numbering maintenance burden in both the RLC and PDCP layers may be reduced, further supporting the SN size reduction described above. [0100] In another example embodiment, a WTRU may use a multi-step CRC attachment and computation procedure to reduce CRC size. Here, the WTRU may reduce the overhead from CRC parity bit attachment to the data. For transmitting data, the WTRU may, in the RLC layer, calculate and attach long CRC parity bits to the RLC SDU prior to the segmentation/concatenation procedure. The WTRU may then segment the RLC SDU with CRC parity bits attached to the end of the RLC SDU. The WTRU may, in the PHY layer, calculate and attach a shorter set of CRC parity bits to each MAC PDU prior to transmission. For receiving data, the WTRU may, in the MAC layer, upon

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		reception of the MAC PDU and correct calculation of CRC, consider the reception successful and deliver the corresponding MAC SDU to the RLC. [0101] The WTRU may, in the RLC layer, upon receiving RLC PDUs and successfully reconstructing a RLC SDU, perform a CRC check based on the long CRC calculation and parity bits applied to the RLC SDU. Based on the outcome of the CRC check, if the CRC check passes, the WTRU may deliver the RLC SDU to PDCP. If the CRC check fails, the WTRU may discard the SDU and associated PDUs, for example, if the WTRU has been configured for RLC UM, or may discard the SDU and provide an indication to the transmitter side for re-transmission of the associated PDU s. For example, if the WTRU has been configured for RLC AM, the WTRU may provide an RLC STATUS PDU indicating the SNs of the RLC PDUs that may be part of the discarded RLC SDU. [0102] In an example embodiment, the WTRU may attach a 24-bit CRC to the RLC SDU prior to segmentation in the RLC. For the purpose of this example, the RLC SDU may have been segmented into 8 RLC PDU s. Subsequently, the WTRU may attach an 8-bit CRC to the MAC PDU, which may include the previously segmented RLC SDU. In relative comparison to attaching a 24-bit CRC to each MAC PDU, where the CRC overhead is 24X8 = 192 bits, the above CRC attachment procedure may yield a 24+8x8 = 88 bit CRC overhead. The CRC overhead may be further reduced, for example, if the number of segmented RLC PDU s is increased. [0103] Described herein are methods for providing coverage enhancements using TTI bundling. TTI bundling may be used since it may provide a higher received signal-to-noise ratio (SNR). [0104] In an embodiment, if a WTRU is configured with a coverage enhancement mode of operation, TTI bundling may be used with longer than four TTis, where the number of subframes for TTI bundling may be predefined or configured. In addition, the bundled subframes may be repetitively transmitted over the time, which may further enhance coverage. For example, if N_{TTI} subframes are bundled and the N_{TTI} subframes are repeatedly transmitted (N_{rep}), then N_{TTI} x N_{rep} subframes may be used, effectively, in total. In a broadcasting channel, an indication related to capacity of the coverage enhancement mode of operation may be included so that a WTRU that is

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		capable of entering coverage enhancement mode may select the coverage enhancement mode or report a preferred mode of operation, (for example, coverage enhancement mode), according to the conditions. [0105] One or more of the following may apply for a bundling size (N_{TTI}) and/or a repetition rate (N_{rep}) for the coverage enhancement mode. In an example, the bundling size and/or repetition rate may be configured via higher layers together with the transmission mode configuration. In another example, a default value of bundling size and/or repetition rate for coverage enhancement mode may be defined, and the default value may be used if a WTRU is configured for or falls under coverage enhancement mode until the WTRU receives WTRU-specific configuration of a bundling size and/or a repetition rate. In this case, the default value may be the largest value among the candidate values, or a WTRU may start to receive the PDSCH with the default value and may perform a certain number of trials of PDSCH reception. If a WTRU fails to receive the PDSCH, the WTRU may increase the bundling size and/or repetition rate with a specific step size. The step size may be predefined and may be the same irrespective of the number of failures or may be different according to the number of failures. In another eample, TTI bundling and repetition may be used together, and HARQ-ACK may not be reported until the last bundled TTI is received within the number of repetitions. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably. [0107] A WTRU may transmit/receive the same data in consecutive NTTI subframes, and the data may be coded with a different redundancy version (RV) according to the subframe index or the location of the subframe among the bundled subframes. [0108] FIG. 6 is a diagram of an example cyclic RV assignment with RV order {0, 1, 2, 3}. The RV may be changed with the order {0, 1, 2, 3} cyclically within a window so that, for example, RV-{0, 1, 2, 3, 0, 1} may be used in order, using an 8-TTI window size, if 6 subframes are bundled (605) as in the example illustrated in FIG. 6. The 8ms window size may be used when 8 HARQ processes

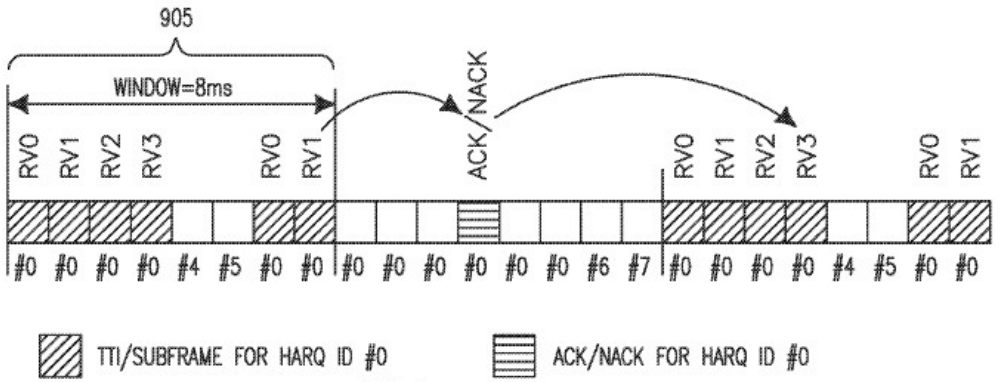
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	are used for other WTRUs not configured with TTI bundling. The window size may not be defined, thus allowing bundling any subframes while the maximum NTTI may be equal to or smaller than 8.  FIG. 6 [0109] FIG. 7 is a diagram of an example cyclic RV assignment with RV order {0, 2, 1, 3}. The RV may be changed with the order {0, 2, 1, 3} cyclically within a window so that, for example, RV-{0, 2, 1, 3, 0, 2} may be used in order when an 8 TTI window size is used if 6 subframes are bundled (705). In this case, the RV order {0, 2, 1, 3} may be used only for DL TTI bundling, the RV order {0, 2, 1, 3} may be used if the NTTI is larger than a threshold value, (for example, the threshold value may be 4, otherwise, the RV order {0, 1, 2, 3} may be used), and the RV order {0, 2, 1, 3} may be replaced with another RV order such as {1, 3, 0, 2}. More than one RV order, (for example, RV orders {0, 1, 2, 3} and {0, 2, 1, 3}), may be used for transmission and/or reception to or from one or more WTRUs. For example, one RV order, (for example, the RV order {0, 1, 2, 3}), may be used in an initial transmission and the other RV order, (for example, the RV order {0, 2, 1, 3}), may be used for a retransmission.

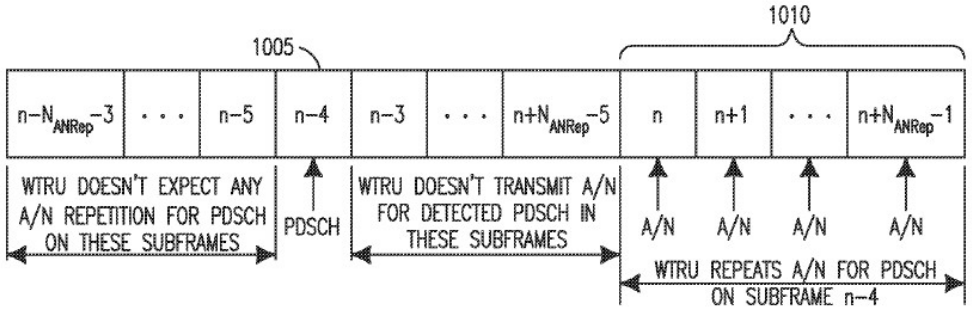
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	 FIG. 7 [0110] FIG. 8 is a diagram of an example cyclic RV assignment without window size. The RV may be cyclically changed with an RV order without window size for the retransmission case. For example, if the RV order {0, 1, 2, 3} is used and 6 subframes are bundled (805), RV-{0, 1, 2, 3, 0, 1} may be used for the initial transmission and RV-{2, 3, 0, 1, 2, 3} may be used for the first retransmission. In the example illustrated in FIG. 8, the window may not be defined if the maximum NTTI is equal to or smaller than 8. A WTRU may not transmit/receive any shared data within the subframes not configured for TTI bundling. [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher

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	layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).  FIG. 8 [0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example,

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		for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates N_{TTI}=3, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., k = N_{TTI}+4). [0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., k = N_{window} +4). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted

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		over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.

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	 FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.

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	 FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n + N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment.

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		[0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes n+l, . . ., $n + N_{ANRep}$ -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes n+l, . . ., $n + N_{ANRep}$ - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another. [0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a

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	single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair ($n_{PHICH,i}^{group}$, $n_{PHICH,i}^{seq}$) where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 9 with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle.

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	[0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH. [0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may

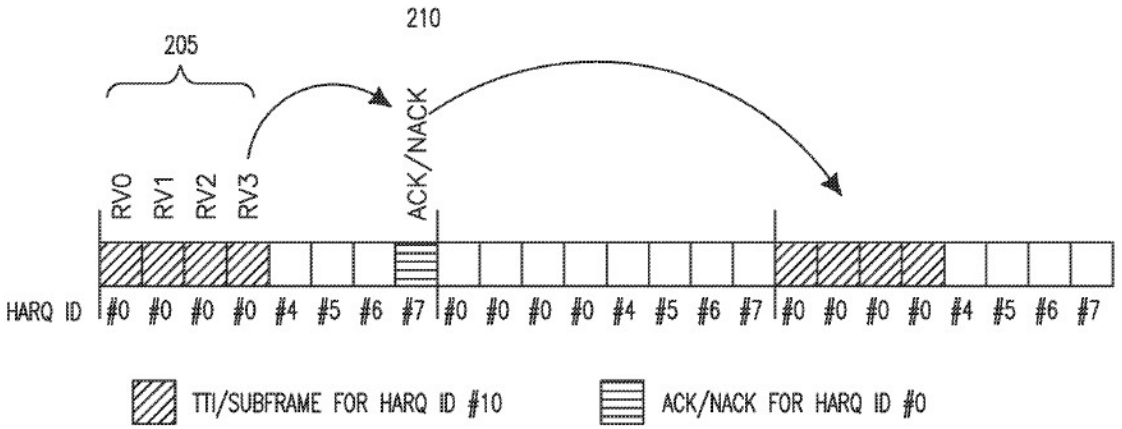
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		result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space.

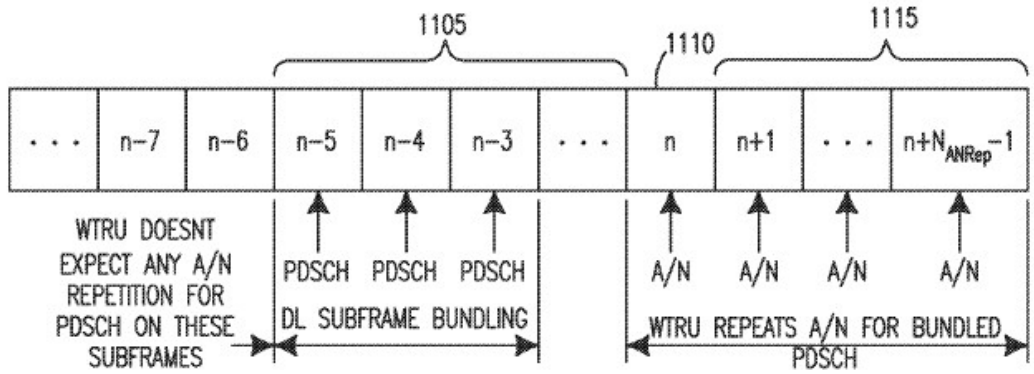
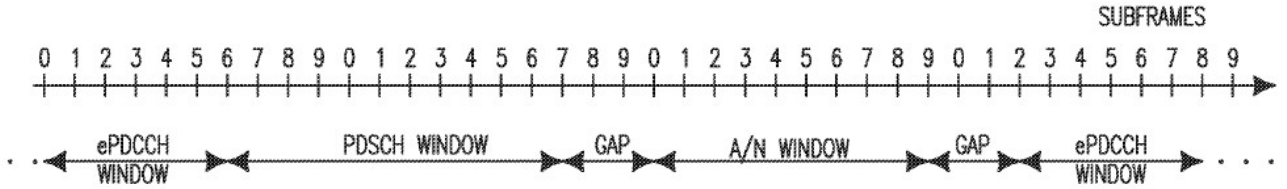
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		[0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting. [0142] A new MCS table may be defined with an N-bit MCS field, and the new MCS table may be defined with a subset of a previous release 5-bit MCS table. [0143] The resource allocation bits, according to the resource allocation type (0, 1, and/or 2), may be reduced by limiting the maximum number of PRBs used for PDSCH transmission. For example, assuming that 25 PRB pairs are available in a DL system bandwidth, the maximum number of PRBs

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		allocated in a subframe may be limited to 6 PRB pairs so that the number of bits for resource allocation may be reduced since the resource allocation indication may be needed within restricted number of PRB pairs such as 6 PRE pairs instead of 25 PRBs for example. Alternatively, the resource allocation field may not be used in a new DCI format while using higher layer signaling instead. Therefore, a DL resource allocation in a frequency domain may be a semi-static allocation, while the time allocation may be based on the (E)PDCCH. For example, a WTRU may receive PDSCH or EPDCCH in the configured PRB pairs among the PRB pairs in the system while the WTRU may be indicated to receive a PDSCH or not in the subframe via (E)PDCCH. [0144] The redundancy version may be removed or downsized in a new DCI format. For example, the redundancy version may be fixed as '0,' and no bit field for a redundancy version may be used. Assuming that a lower coding rate may be used for a new DCI format to support better coverage, the other redundancy versions {i.e., 1, 2, and 3} may not be needed and a single redundancy version may be sufficient. Therefore, a single redundancy version among {O, 1, 2, or 3} may be used as a fixed manner. Alternatively, a 1-bit redundancy version may be used so that two out of four redundancy versions may be used. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0146] The (E)CCE aggregation levels may be different so that (E)PDCCH candidates may have larger aggregation levels as compared with the legacy (E)PDCCH. For instance, the aggregation levels {2, 4, 8, 16} or {4, 8, 16, 32} may be used for coverage enhancement mode for which the (E)PDCCH coverage enhancement mode may only be applicable to a WTRU-specific search space, the PDCCH coverage enhancement mode may be used irrespective of the transmission, or the PDCCH coverage enhancement mode may be applicable for a specific DCI format and/or transmission mode.

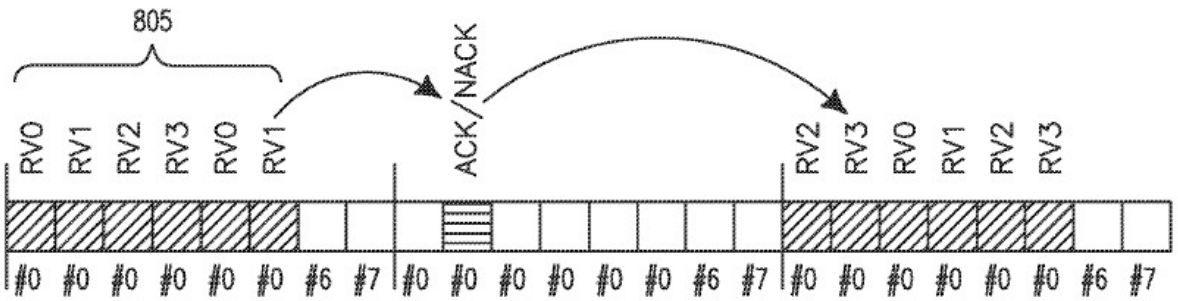
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		[0147] The (E)CCE aggregation level set for WTRU-specific or common search space may be different according to the WTRU mode of operation. The WTRU mode of operation may include coverage enhancement mode. A larger (E)CCE aggregation level set (e.g., {16, 32}) may be used if a WTRU is configured as the coverage enhancement mode of operation while the legacy (E)CCE aggregation level sets (e.g., {4, 8}) may be used if a WTRU is not configured as the coverage enhancement mode of operation. A WTRU may be configurated as coverage enhancement mode of operation via higher layer signaling or indicated during PRACH procedures. [0148] The (E)CCE aggregation level set may be configured or defined according to the PRACH resource used for PRACH preamble transmission from a WTRU. A larger (E)CCE aggregation level set may be used if a WTRU received RAR by using PRACH resource which may be used for coverage enhancement mode of operation. A smaller (E)CCE aggregation level set may be used if a WTRU received RAR by using PRACH resource which may be configured for a WTRU without coverage limitation. [0149] The (E)CCE aggregation level set may be configured or defined according to the coverage limitation level of a WTRU where the coverage limitation level may be defined by one or more of RSRP, pathloss, timing advance, and PRACH resource. For example, if pathloss or RSRP calculated at a WTRU receiver is lower than a predefined threshold, the WTRU may determin a larger (E)CCE aggregation level set among the (E)CCE aggregation level set candidates. [0150] A default WTRU-specific search space may be defined for the (E)PDCCH coverage enhancement mode, where a subset of aggregation levels may be used. For example, if {1, 2, 4, 8, 16, 32, 64} is the set of aggregation levels used for an (E)PDCCH coverage enhancement mode, a subset {2, 4, 8, 16} may be used in the default WTRU-specific search space. Therefore, a WTRU before a WTRU-specific configuration may monitor the (E)PDCCH in a default WTRU-specific search space with the subset of aggregation levels {2, 4, 8, 16}. If a WTRU fails to decode the (E)PDCCH within the default WTRU-specific search space for a certain number of trials or over a period of time, the WTRU may autonomously change the aggregation levels to a higher aggregation level set (e.g., {4, 8, 16, 32}). Alternatively, a WTRU may monitor the default WTRU-specific search space until the WTRU receives a WTRU-specific configuration from higher layer.

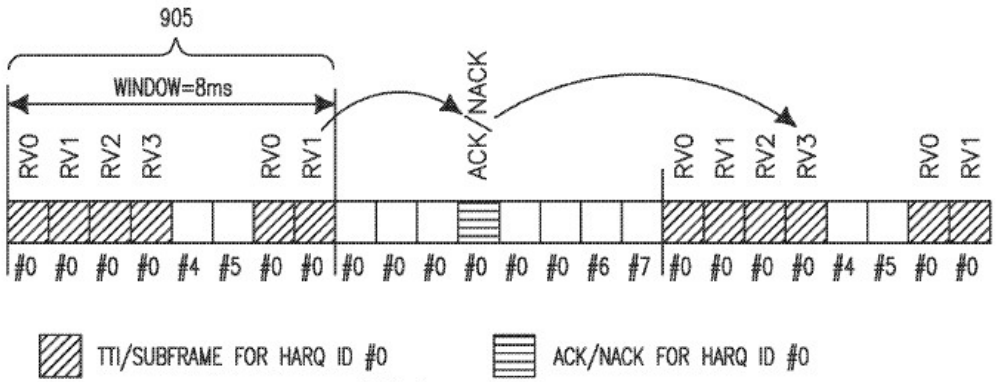
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		[0151] Two or more of default WTRU-specific search spaces (WSS) may be defined in different time/frequency resources, and the aggregation level set may be different according to the location of the default WTRU-specific search spaces. For example, two default WTRU-specific search spaces may be, for example, default WSS1 and default WSS2, and the aggregation level set {1, 2, 4, 8} may be used for the default WSS1 and the aggregation level set {16, 32, 64, 128} may be used for the default WSS2. A WTRU may be informed which default WSS the WTRU may need to monitor implicitly during the PRACH procedure. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	[0302] Described herein are applications for using a coverage enhancement mode. A WTRU may apply all embodiments and examples herein individually or in combination as part of a coverage enhancement mode of operation.  FIG. 2

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	 FIG. 11  FIG. 13 To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of

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		endeavor to address the same known problems, according to known methods which would yield predictable results.
1[a]	receiving configuration information relating to the plurality of subframes through higher layer signaling;	At least under Pegasus's apparent infringement theory, Lee discloses receiving configuration information relating to the plurality of subframes through higher layer signaling. For example, Lee discloses this limitation based on the following exemplary citations: [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).

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	 FIG. 8 [0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling.

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	 FIG. 9 [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably.

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		[0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0174] In an example for TDD, the subframe offset(s) may be a function of the TDD UL/DL configuration. [0175] In another example, multiple subframe offsets may be used for the repetition. For example, $N_{offset,1}$ and $N_{offset,2}$ may be used in order to transmit the ePBCH more frequently. The subframe offsets may be predefined as fixed numbers or configured as a function of the physical cell-ID. [0176] In another embodiment for an ePBCH, a smaller number of bits may be used for an SFN indication. For example, a 7-bit or less SFN number indicator may be used instead of an 8 bit SFN number so that the SFN number provided by the ePBCH may be the same in a longer time window. If a 7 bit SFN number indicator may be used, the 7 bit SFN number may, for example, indicate the most significant 7 bits of 10 bit SFN numbers, and a WTRU may implicitly detect the least significant 3 bit number 000, 001, 010, 011, 100, 101, 110, and 111 in each radio frame from, for example, the scrambling code of coded bits, where a broadcast channel (BCH) transport block may be coded/rate-matched and scrambled in bit level so that each radio frame may have a different part of scrambled coded bits. For a 7 bit SFN indication, the ePBCH time window may be 80 ms, which may be double the legacy PBCH time window, where the PBCH time window may be considered as the TTI for a PBCH transmission. [0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be

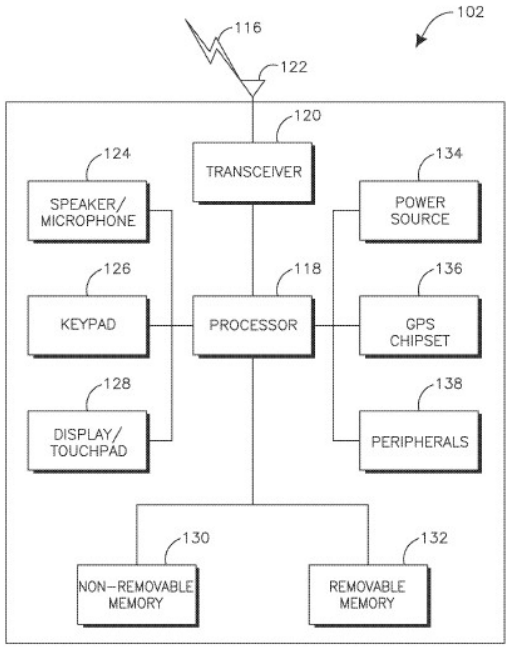
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		consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0206] The known signal may be transmitted by an eNB or cell. The signal may be transmitted in one or more of the following ways. In an example embodiment, the signal may be transmitted in one or more predefined time/frequency resources. In another example embodiment, the signal may be transmitted periodically with a predefined period, which may be a number of frames. In another example embodiment, the signal may be transmitted in a fixed or configured frame or frames within the period. The frame or frames in which the signal may be transmitted may be a function of a cell specific configuration (e.g., physical cell ID). For example, a cell with a PCI of 100 may transmit the known signal every SFN cycle, (e.g., every 1024 frames), to indicate a certain SFN, such as SFN 100, to the WTRU. [0207] In another example embodiment, the signal may be repeated in two or more of the subframes within a frame in which the signal may be transmitted. In another example embodiment, the signal may be a predefined sequence, a system information block, such as an LC-SIB or SIB1, a P-RNTI, or an SI, or an ePBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may

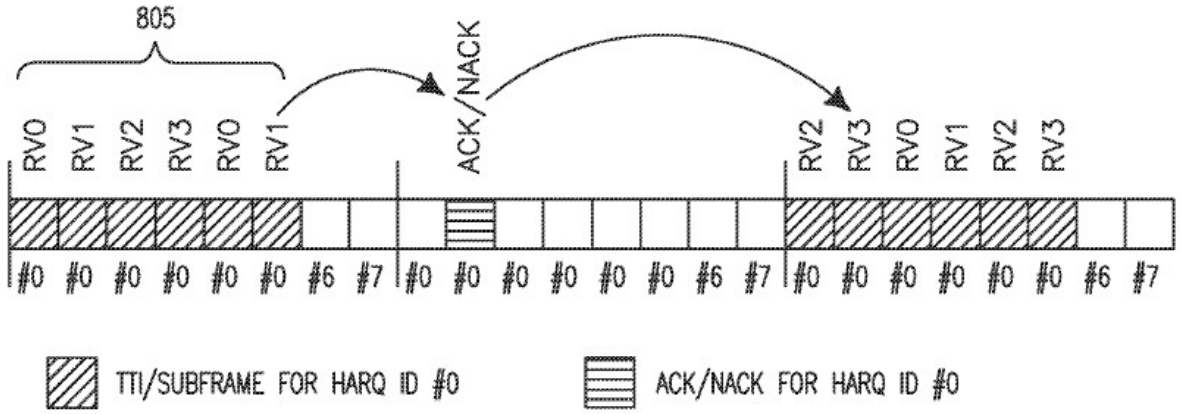
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		integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames

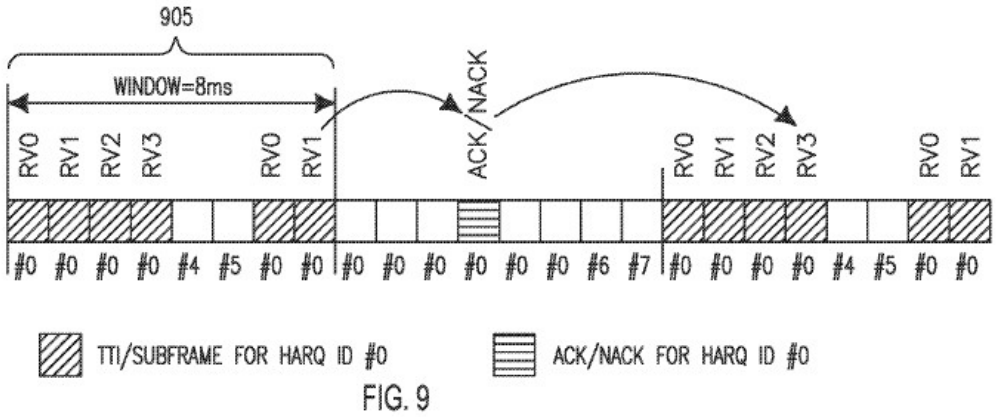
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		beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X. [0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd.

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		[0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames. [0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as

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		an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	 FIG. 1B To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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1[b]	receiving downlink control channels repeatedly allocated in the plurality of subframes and combining the received downlink control channels on the basis of the configuration information; and	At least under Pegasus's apparent infringement theory, Lee discloses receiving downlink control channels repeatedly allocated in the plurality of subframes and combining the received downlink control channels on the basis of the configuration information. For example, Lee discloses this limitation based on the following exemplary citations: [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).  FIG. 8

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	[0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling.  FIG. 9 [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over

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		multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0174] In an example for TDD, the subframe offset(s) may be a function of the TDD UL/DL configuration. [0175] In another example, multiple subframe offsets may be used for the repetition. For example, $N_{offset,1}$ and $N_{offset,2}$ may be used in order to transmit the ePBCH more frequently. The subframe offsets may be predefined as fixed numbers or configured as a function of the physical cell-ID. [0176] In another embodiment for an ePBCH, a smaller number of bits may be used for an SFN indication. For example, a 7-bit or less SFN number indicator may be used instead of an 8 bit SFN number so that the SFN number provided by the ePBCH may be the same in a longer time window. If a 7 bit SFN number indicator may be used, the 7 bit SFN number may, for example, indicate the most significant 7 bits of 10 bit SFN numbers, and a WTRU may implicitly detect the least significant 3 bit number 000, 001, 010, 011, 100, 101, 110, and 111 in each radio frame from, for example, the scrambling code of coded bits, where a broadcast channel (BCH) transport block may be coded/rate-matched and scrambled in bit level so that each radio frame may have a different part of scrambled coded bits. For a 7 bit SFN indication, the ePBCH time window may be 80 ms, which may be double the legacy PBCH time window, where the PBCH time window may be considered as the TTI for a PBCH transmission.

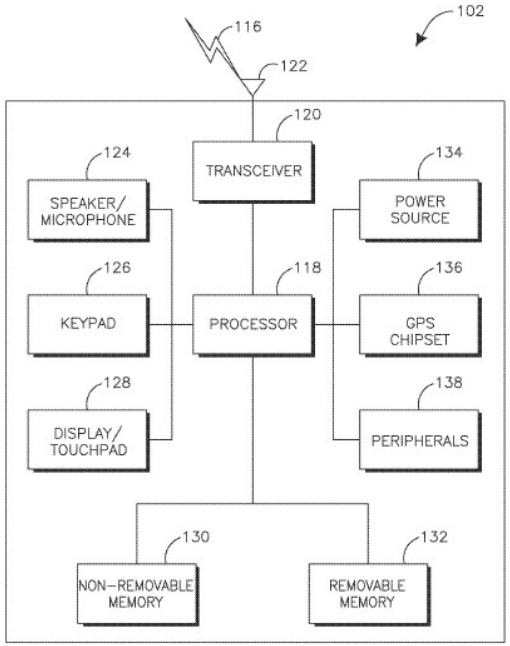
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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0206] The known signal may be transmitted by an eNB or cell. The signal may be transmitted in one or more of the following ways. In an example embodiment, the signal may be transmitted in one or more predefined time/frequency resources. In another example embodiment, the signal may be transmitted periodically with a predefined period, which may be a number of frames. In another example embodiment, the signal may be transmitted in a fixed or configured frame or frames within the period. The frame or frames in which the signal may be transmitted may be a function of a cell specific configuration (e.g., physical cell ID). For example, a cell with a PCI of 100 may transmit the known signal every SFN cycle, (e.g., every 1024 frames), to indicate a certain SFN, such as SFN 100, to the WTRU. [0207] In another example embodiment, the signal may be repeated in two or more of the subframes within a frame in which the signal may be transmitted. In another example embodiment, the signal may be a predefined sequence, a system information block, such as an LC-SIB or SIB1, a P-RNTI, or an SI, or an ePBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame.

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	[0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may

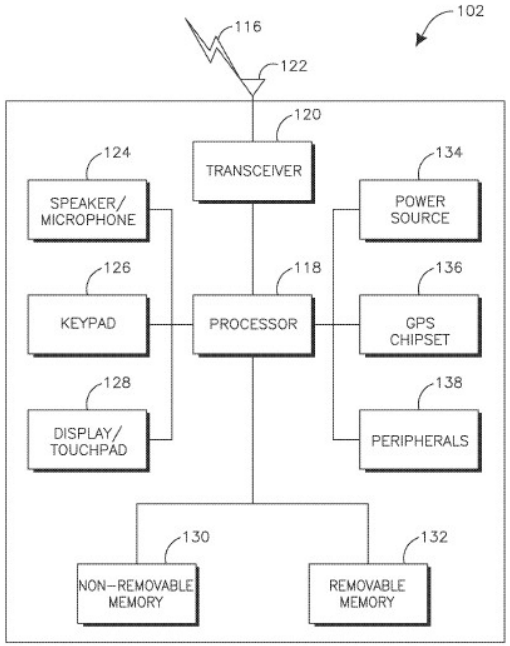
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		determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X. [0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N.

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		[0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames. [0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times

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		during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	 FIG. 1B To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

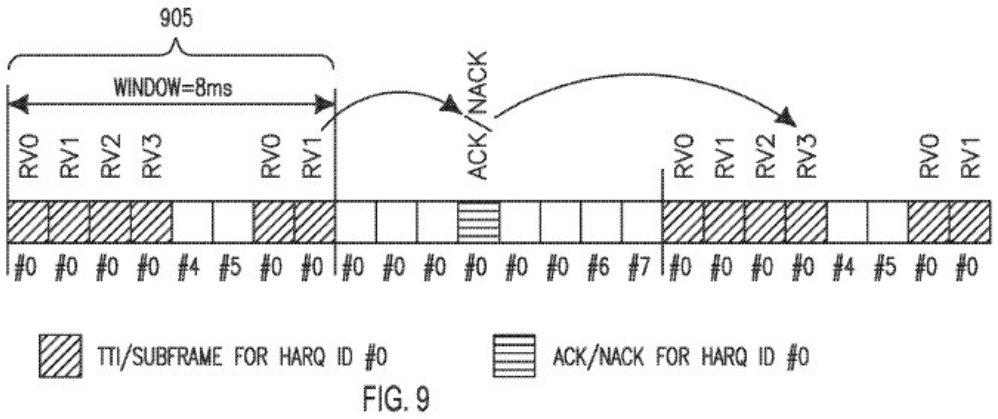
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1[c]	extracting the downlink control information from the combined downlink control channels, wherein:	At least under Pegasus's apparent infringement theory, Lee discloses extracting the downlink control information from the combined downlink control channels. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

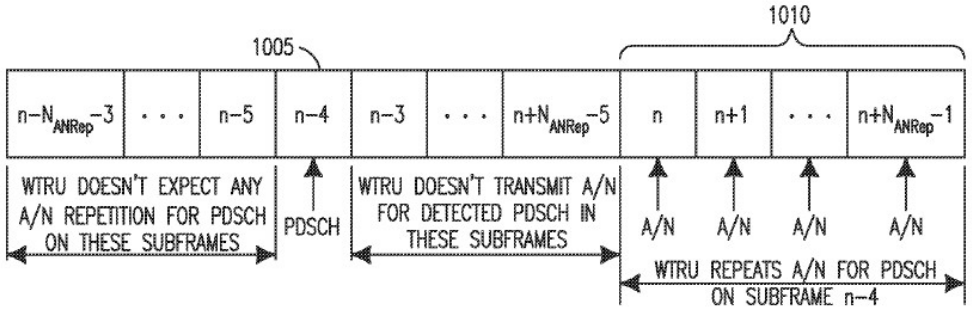
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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	[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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		[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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	example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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		+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes *n*+l, . . ., *n* + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes *n*+l, . . ., *n* + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,\mathrm{Re}\,p} - 1 \end{cases}$$, Equation 9

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	with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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		[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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	[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

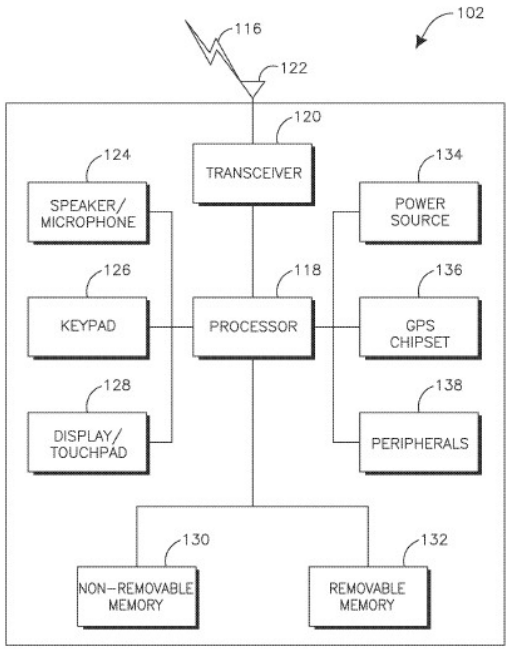
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

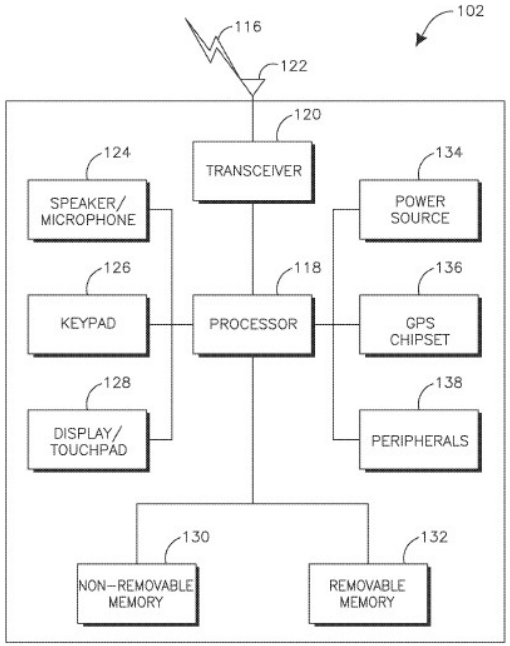
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		may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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	subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

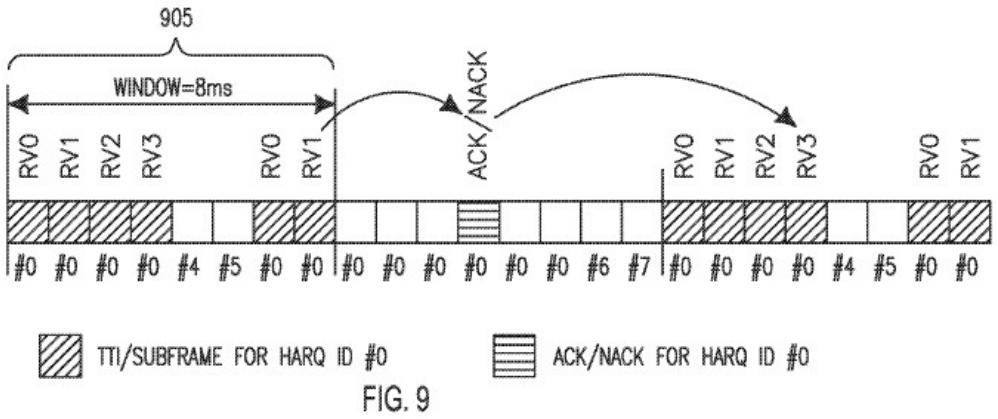
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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[d]	the configuration information comprises information on a start subframe of the plurality of subframes; and	At least under Pegasus's apparent infringement theory, Lee discloses wherein the configuration information comprises information on a start subframe of the plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

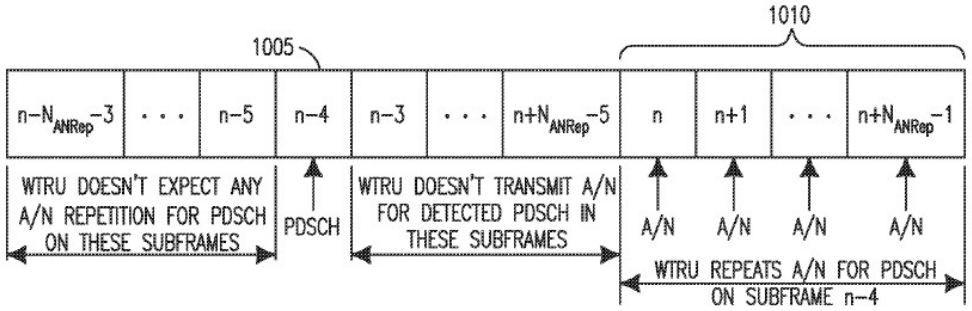
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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	[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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	[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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	example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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		+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes *n*+l, . . ., *n* + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes *n*+l, . . ., *n* + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Re\,p} - 1 \end{cases}$$, Equation 9

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	with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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		[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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	[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

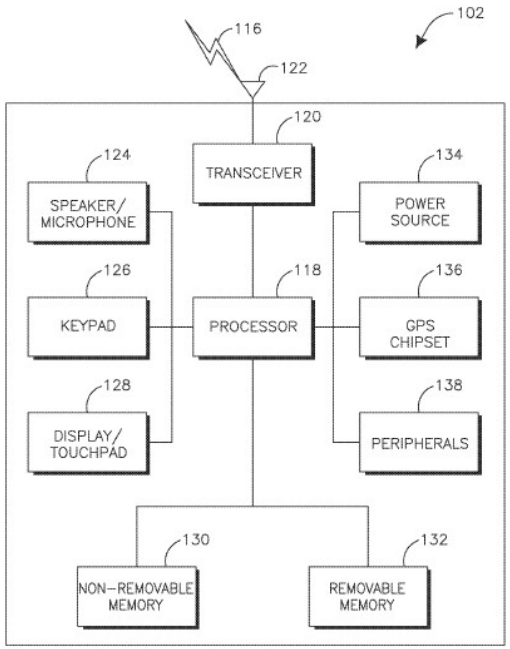
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

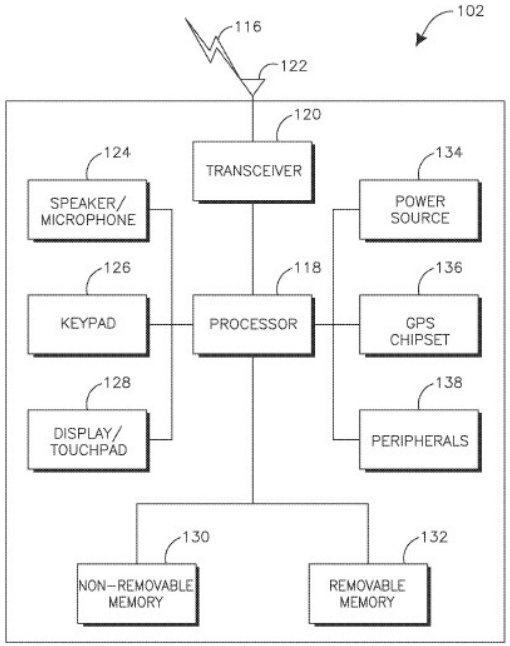
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		may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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	subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

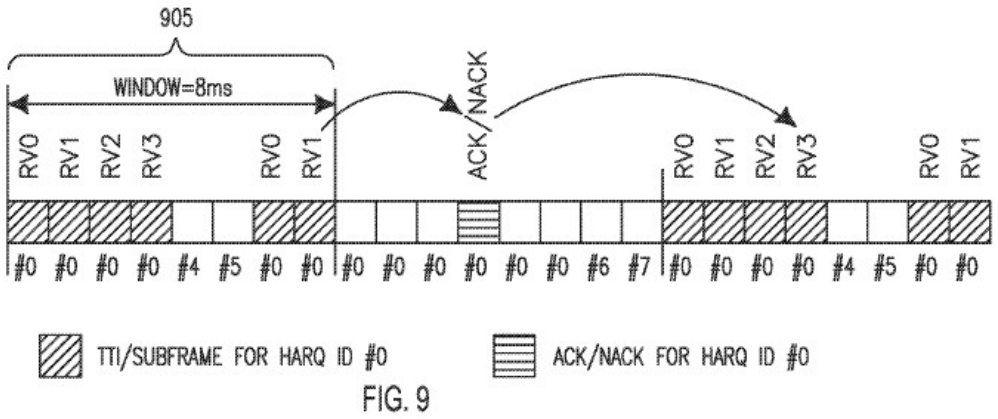
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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
1[e]	the downlink control information comprises information on the number of the plurality of subframes.	At least under Pegasus's apparent infringement theory, Lee discloses wherein the downlink control information comprises information on the number of the plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

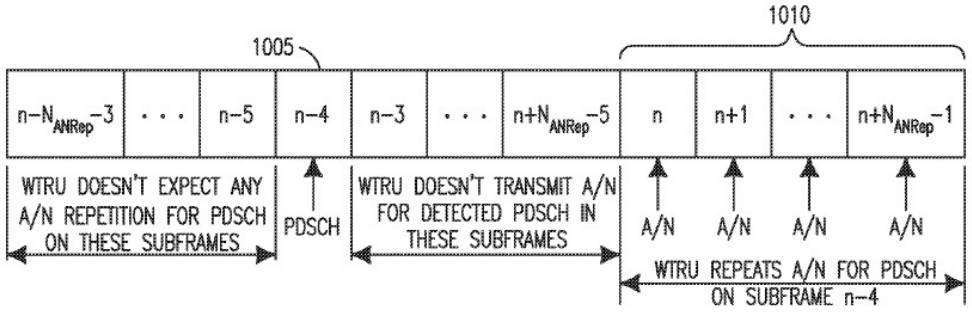
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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	[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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		[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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	example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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		+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes n+l, . . ., n + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes n+l, . . ., n + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Re\,p} - 1 \end{cases}$$, Equation 9

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	with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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		[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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		[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

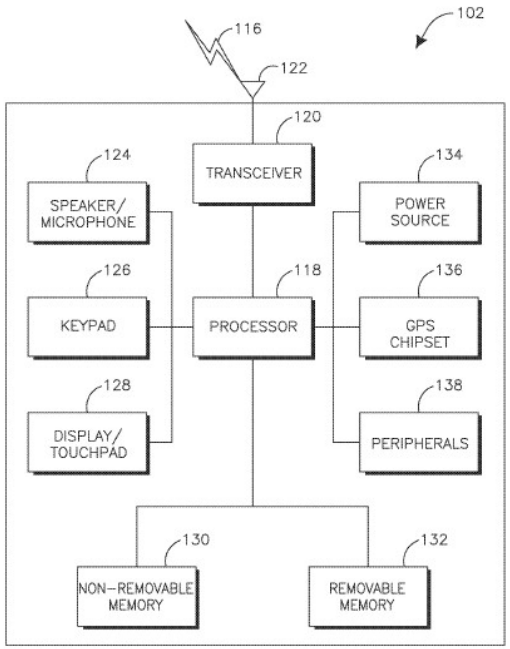
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

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		may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

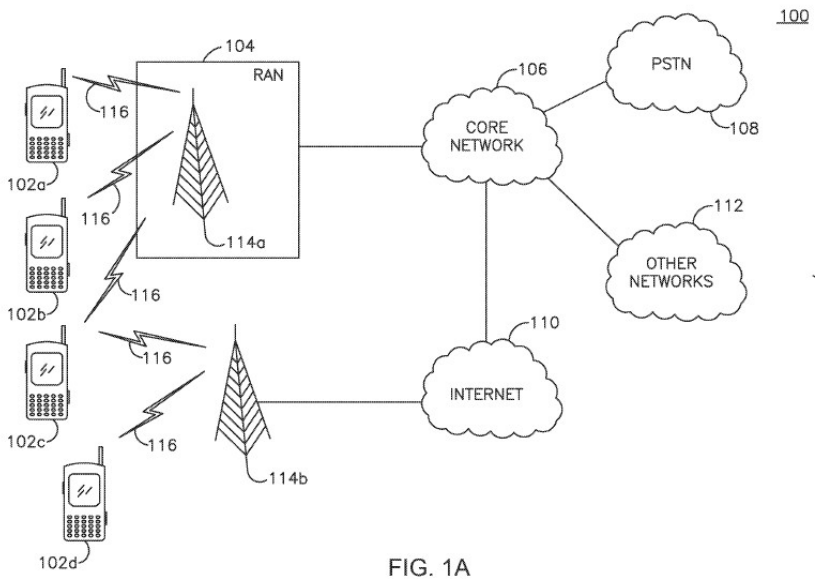
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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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		subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

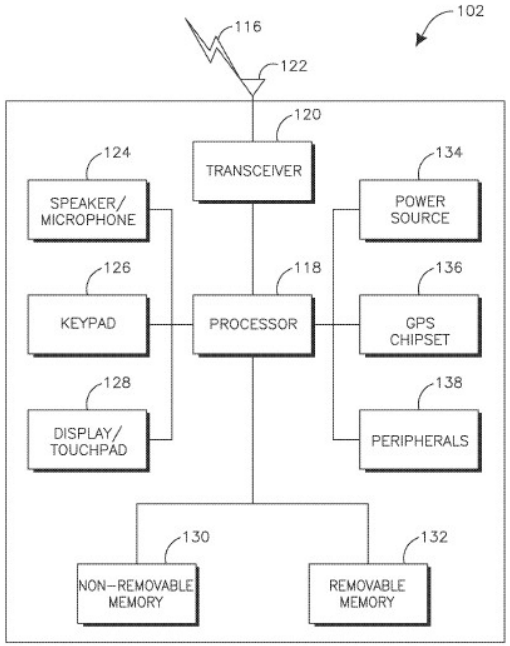
2. Claim 2

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2[pre]	A method of transmitting, by a base station, downlink control information through downlink control channels repeatedly allocated in a plurality of subframes, the method comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Lee discloses a method of transmitting, by a base station, downlink control information through downlink control channels repeatedly allocated in a plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0023] As shown in FIG. lA, the communications system 100 may include wireless transmit/receive units (WTRU s) 102a, 102b, 102c, 102d, a radio access network (RAN) 104, a core network 106, a public switched telephone network (PSTN) 108, the Internet 110, and other networks 112, though it will be appreciated that the disclosed embodiments contemplate any number of WTRUs, base stations, networks, and/or network elements. Each of the WTRU s 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment. By way of example, the WTRUs 102a, 102b, 102c, 102d may be configured to transmit and/or receive wireless signals and may include user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a pager, a cellular telephone, a personal digital assistant (PDA), a smartphone, a laptop, a netbook, a personal computer, a wireless sensor, consumer electronics, machine to machine and the like.

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	 FIG. 1A [0034] FIG. 1B is a system diagram of an example WTRU 102. As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122, a speaker/microphone 124, a keypad 126, a display/touchpad 128, non-removable memory 130, removable memory 132, a power source 134, a global positioning system (GPS) chipset 136, and other peripherals 138. It will be appreciated that the WTRU 102 may include any sub-combination of the foregoing elements while remaining consistent with an embodiment. [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding,

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		data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip. [0036] The transmit/receive element 122 may be configured to transmit signals to, or receive signals from, a base station (e.g., the base station 114a) over the air interface 116. For example, in one embodiment, the transmit/receive element 122 may be an antenna configured to transmit and/or receive RF signals. In another embodiment, the transmit/receive element 122 may be an emitter/detector configured to transmit and/or receive IR, UV, or visible light signals, for example. In yet another embodiment, the transmit/receive element 122 may be configured to transmit and receive both RF and light signals. It will be appreciated that the transmit/receive element 122 may be configured to transmit and/or receive any combination of wireless signals. [0037] In addition, although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116. [0038] The transceiver 120 may be configured to modulate the signals that are to be transmitted by the transmit/receive element 122 and to demodulate the signals that are received by the transmit/receive element 122. As noted above, the WTRU 102 may have multi-mode capabilities. Thus, the transceiver 120 may include multiple transceivers for enabling the WTRU 102 to communicate via multiple RATs, such as UTRA and IEEE 802.11, for example. [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the

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		display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from, and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like.

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	 FIG. 1B [0051] Transmission time interval (TTI) bundling may enhance uplink (UL) coverage for a user or WTRU that experiences limited UL coverage, for example as its transmission power approaches the maximum. Using TTI bundling, the same data may be transmitted in multiple consecutive TTis, which may allow the WTRU to extend the effective transmission time window for the data. For example up to four consecutive TTis may be bundled for frequency division duplex (FDD) LTE, which may extend the effective transmission time window by up to four times. A single transport block may be coded and transmitted with different redundancy versions (RVs) in each of the consecutive subframes, where subframe and TTI may be used interchangeably. For example, the consecutive TTis in the same TTI bundle may be assigned to consecutive RVs. The same hybrid automatic repeat request (HARQ) process number may be assigned to all TTis in a TTI bundle, and all TTis within a TTI bundle may be treated as a single resource, where a single UL grant and a

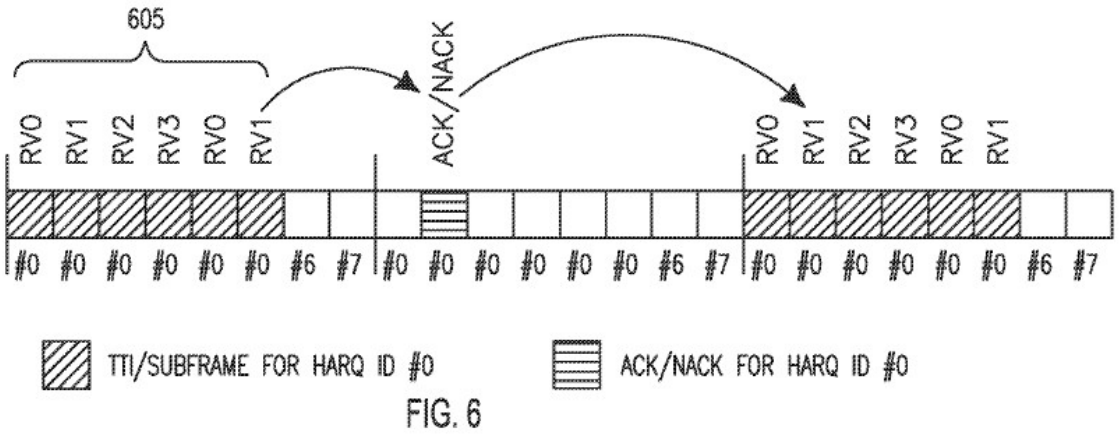
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		single acknowledgement/negative acknowledgement (ACK/NACK), (e.g., physical HARQ indicator channel (PHICH)), may be associated with them. A TTI bundling mechanism may be configured by higher layer signaling per WTRU. In FDD TTI bundling, the roundtrip time (RTT) for every re-transmission may be equal to 16 ms. When the FDD TTI bundling is activated, the WTRU may receive the UL grant for the first subframe in the TTI bundle according to the rules of an FDD UL grant, and once the UL data is transmitted in a TTI bundle, a PHICH, or other UL grant, may be expected by the WTRU according to PHICH rules corresponding to the last subframe of that TTI bundle. The rules may be for example, 3GPP Release 8 rules. [0052] FIG. 2 is a diagram of an example of TTI bundling with a TTI bundle of four consecutive TTis. In the example, HARQ ID #0 includes four bundled TTis 205, the ACK/NACK 210 is received four TTis after the last TTI of the TTI bundle 205, and re-transmission occurs sixteen TTis after the first TTI of the initial transmission. Once FDD TTI bundling is activated, the WTRU may support up to a certain number of HARQ processes, for example up to four for 3GPP Release 10. In FDD operation, all TTI bundles of the same HARQ process may have the same number of UL subframes, may have the same pattern, (for example, including consecutive UL subframes), and may be uniformly distributed in the time domain. [0092] In order to improve the coverage of channels such as the enhanced PDCCH (EPDCCH), the PDSCH, and the PUCCH, repetitive transmission may be considered as a coverage enhancement technique. In this case, the current HARQ process, such as the n+4 timing relationship (e.g., for FDD), may not be used since the reference subframe may be redefined among the repetitively transmitted subframes. In addition, the timing relationship between UL grant and PUSCH transmission may also be redefined with a new reference subframe n. The term (E)PDCCH may be used to mean PDCCH and/or EPDCCH, which may also be represented by PDCCH/EPDCCH. [0093] Described herein are methods for enhancing service coverage for data channels in the UL and DL. Given that an LC-MTC WTRU may support very low data rates with high delay tolerance in terms of quality of service, a WTRU may reduce the size of each protocol layer header for each transport block that the WTRU may receive and/or transmit.

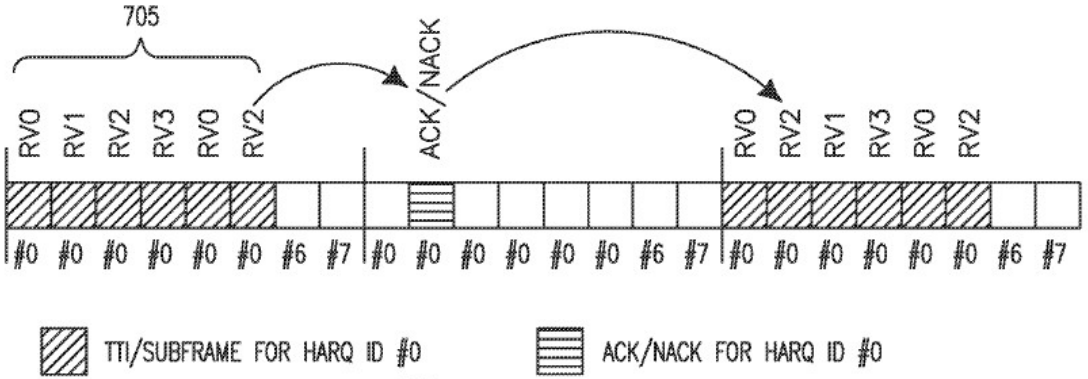
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		[0094] In an example embodiment, the PDCP and RLC may allocate a smaller sequence number (SN) size in its headers. In the PDCP, a WTRU may allocate an SN size of smaller than 7 bits. In the RLC, a WTRU may allocate an SN size of smaller than 5 bits for UM or 10 bits for AM. A WTRU may coordinate sizes of RLC and PDCP PDU s such that the resultant PDU with the header and data part may maintain octet (byte) alignment. A WTRU may have a PDCP PDU that is not byte aligned, but the RLC header and PDUs may be processed such that the resulting RLC PDU byte alignment may be maintained. [0095] In another example embodiment, a WTRU may not include the extension ("E") fields in MAC and RLC, thus further reducing the header sizes. For example, a WTRU may be configured for a data radio bearer (DRE), with a very low data rate such that small data packets, (for example, 100 bytes in the UL) may arrive into the PDCP infrequently, (for example, once every hour). A WTRU may then be configured with a small SN size, such as 2 bits, in the PDCP such that the sequence numbers may range from O to 3. In RLC, a WTRU may be configured for UM, and the RLC SDU may be segmented into 8 smaller RLC PDUs, and, relatively, the RLC SN size may be specified for 3 bits. Further, a WTRU may not include an RLC or MAC "E" bit into the header since RLC SDUs and MAC SDUs may not be concatenated into the RLC and MAC PDU (for example, 1 PDU per SDU). The WTRU may then perform L1 processing of the resultant MAC PDU for UL transmission. Given the reduced header size, the PDPC may have its header size reduced to 3 bits, its RLC reduced to 6 bits and its MAC reduced to 7 bits. The WTRU and eNB may apply the same reduction of protocol headers in the DL also. [0096] A WTRU may be configured with reduced PDCP, RLC, and MAC header configurations as part of a DRE setup procedure, which may be signaled by the RRC. For example, as part of the RRC procedure, a WTRU may be signaled to apply a 2 bit SN length in the PDCP, apply a 3 bit SN length for RLC with UM mode, and apply a bit to indicate the exclusion of the "E" bit in the MAC header. The WTRU may use a default or pre-defined set of MAC, RLC, and PDCP configurations, which may include the example header configuration defined in the RRC. The WTRU may be explicitly indicated by the network to use the coverage enhancement mode protocol layer parameters, or the WTRU may autonomously use the coverage enhancement mode parameters and signal its use to the network.

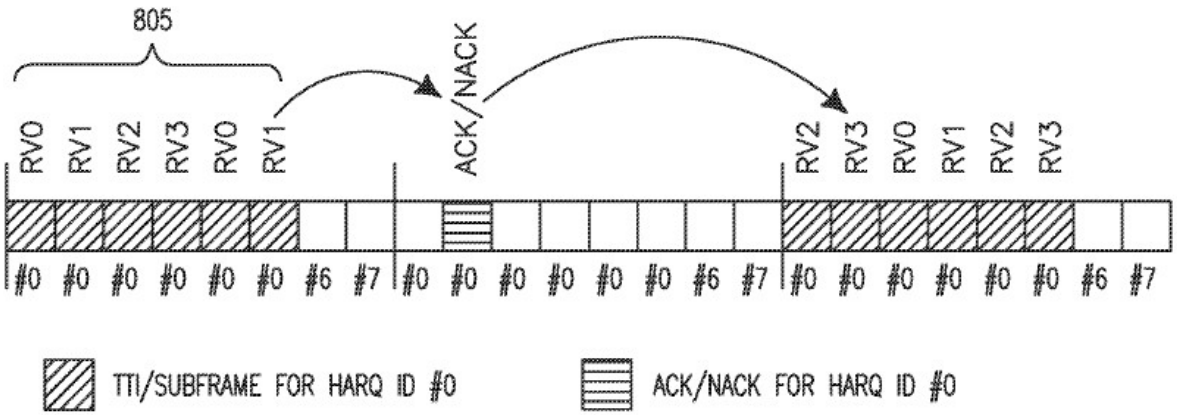
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		[0097] In another example embodiment, a WTRU/eNB may reduce RLC header size by scrambling the CRC bits, which may be appended to the MAC PDU, with the SN of the RLC PDU included in the MAC PDU. The WTRU may then remove the SN from the RLC header. For example, independently or in combination with RLC SN size reduction, the WTRU may, upon receiving a MAC PDU, descramble the CRC parity bits with possible SN values prior to performing the CRC check. The WTRU may perform the descrambling based on the entire possible SN range or based on the current RLC receiver window, excluding SN s that have already been received. Once the correct SN has been identified and the MAC PDU has been correctly received, the WTRU may pass the determined SN value to the RLC for proper PDU processing. [0098] In another example embodiment, a WTRU may scramble the CRC parity bits with MAC LCID information. For example, the WTRU may use 5 bit LCID information of the DRE to scramble the CRC parity bits if, for example, there is a single LCID associated with the MAC SDUs that are multiplexed into the MAC PDU. [0099] In another example embodiment, a WTRU may transmit and receive data on the DRE on a single HARQ process for the UL and/or DL direction. For example, given that the LC-MTC WTRU may transmit and receive data at very low data rates with high tolerance for delay, a WTRU may use a single HARQ process in each of the UL and/or DL directions. Since the WTRU may only receive a single MAC PDU at a time, the sequence numbering maintenance burden in both the RLC and PDCP layers may be reduced, further supporting the SN size reduction described above. [0100] In another example embodiment, a WTRU may use a multi-step CRC attachment and computation procedure to reduce CRC size. Here, the WTRU may reduce the overhead from CRC parity bit attachment to the data. For transmitting data, the WTRU may, in the RLC layer, calculate and attach long CRC parity bits to the RLC SDU prior to the segmentation/concatenation procedure. The WTRU may then segment the RLC SDU with CRC parity bits attached to the end of the RLC SDU. The WTRU may, in the PHY layer, calculate and attach a shorter set of CRC parity bits to each MAC PDU prior to transmission. For receiving data, the WTRU may, in the MAC layer, upon

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		reception of the MAC PDU and correct calculation of CRC, consider the reception successful and deliver the corresponding MAC SDU to the RLC. [0101] The WTRU may, in the RLC layer, upon receiving RLC PDUs and successfully reconstructing a RLC SDU, perform a CRC check based on the long CRC calculation and parity bits applied to the RLC SDU. Based on the outcome of the CRC check, if the CRC check passes, the WTRU may deliver the RLC SDU to PDCP. If the CRC check fails, the WTRU may discard the SDU and associated PDUs, for example, if the WTRU has been configured for RLC UM, or may discard the SDU and provide an indication to the transmitter side for re-transmission of the associated PDU s. For example, if the WTRU has been configured for RLC AM, the WTRU may provide an RLC STATUS PDU indicating the SNs of the RLC PDUs that may be part of the discarded RLC SDU. [0102] In an example embodiment, the WTRU may attach a 24-bit CRC to the RLC SDU prior to segmentation in the RLC. For the purpose of this example, the RLC SDU may have been segmented into 8 RLC PDU s. Subsequently, the WTRU may attach an 8-bit CRC to the MAC PDU, which may include the previously segmented RLC SDU. In relative comparison to attaching a 24-bit CRC to each MAC PDU, where the CRC overhead is 24X8 = 192 bits, the above CRC attachment procedure may yield a 24+8x8 = 88 bit CRC overhead. The CRC overhead may be further reduced, for example, if the number of segmented RLC PDU s is increased. [0103] Described herein are methods for providing coverage enhancements using TTI bundling. TTI bundling may be used since it may provide a higher received signal-to-noise ratio (SNR). [0104] In an embodiment, if a WTRU is configured with a coverage enhancement mode of operation, TTI bundling may be used with longer than four TTis, where the number of subframes for TTI bundling may be predefined or configured. In addition, the bundled subframes may be repetitively transmitted over the time, which may further enhance coverage. For example, if NTTI subframes are bundled and the N_{TTI} subframes are repeatedly transmitted (N_{rep}), then N_{TTI} x N_{rep} subframes may be used, effectively, in total. In a broadcasting channel, an indication related to capacity of the coverage enhancement mode of operation may be included so that a WTRU that is

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		capable of entering coverage enhancement mode may select the coverage enhancement mode or report a preferred mode of operation, (for example, coverage enhancement mode), according to the conditions. [0105] One or more of the following may apply for a bundling size (N_{TTI}) and/or a repetition rate (N_{rep}) for the coverage enhancement mode. In an example, the bundling size and/or repetition rate may be configured via higher layers together with the transmission mode configuration. In another example, a default value of bundling size and/or repetition rate for coverage enhancement mode may be defined, and the default value may be used if a WTRU is configured for or falls under coverage enhancement mode until the WTRU receives WTRU-specific configuration of a bundling size and/or a repetition rate. In this case, the default value may be the largest value among the candidate values, or a WTRU may start to receive the PDSCH with the default value and may perform a certain number of trials of PDSCH reception. If a WTRU fails to receive the PDSCH, the WTRU may increase the bundling size and/or repetition rate with a specific step size. The step size may be predefined and may be the same irrespective of the number of failures or may be different according to the number of failures. In another eample, TTI bundling and repetition may be used together, and HARQ-ACK may not be reported until the last bundled TTI is received within the number of repetitions. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably. [0107] A WTRU may transmit/receive the same data in consecutive NTTI subframes, and the data may be coded with a different redundancy version (RV) according to the subframe index or the location of the subframe among the bundled subframes. [0108] FIG. 6 is a diagram of an example cyclic RV assignment with RV order {0, 1, 2, 3}. The RV may be changed with the order {0, 1, 2, 3} cyclically within a window so that, for example, RV-{0, 1, 2, 3, 0, 1} may be used in order, using an 8-TTI window size, if 6 subframes are bundled (605) as in the example illustrated in FIG. 6. The 8ms window size may be used when 8 HARQ processes

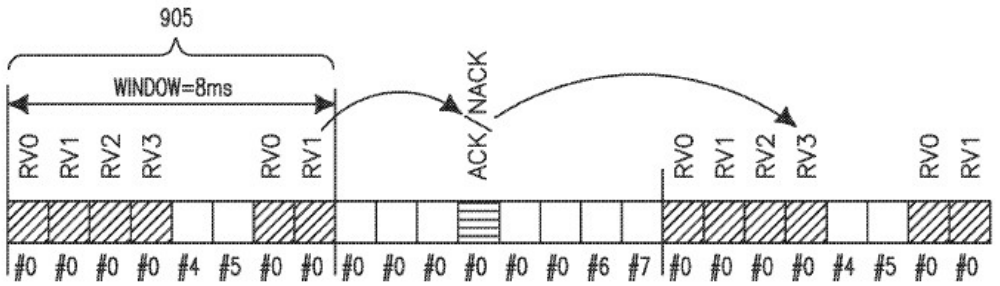
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	are used for other WTRUs not configured with TTI bundling. The window size may not be defined, thus allowing bundling any subframes while the maximum NTTI may be equal to or smaller than 8.  FIG. 6 [0109] FIG. 7 is a diagram of an example cyclic RV assignment with RV order {0, 2, 1, 3}. The RV may be changed with the order {0, 2, 1, 3} cyclically within a window so that, for example, RV-{0, 2, 1, 3, 0, 2} may be used in order when an 8 TTI window size is used if 6 subframes are bundled (705). In this case, the RV order {0, 2, 1, 3} may be used only for DL TTI bundling, the RV order {0, 2, 1, 3} may be used if the NTTI is larger than a threshold value, (for example, the threshold value may be 4, otherwise, the RV order {0, 1, 2, 3} may be used), and the RV order {0, 2, 1, 3} may be replaced with another RV order such as {1, 3, 0, 2}. More than one RV order, (for example, RV orders {0, 1, 2, 3} and {0, 2, 1, 3}), may be used for transmission and/or reception to or from one or more WTRUs. For example, one RV order, (for example, the RV order {0, 1, 2, 3}), may be used in an initial transmission and the other RV order, (for example, the RV order {0, 2, 1, 3}), may be used for a retransmission.

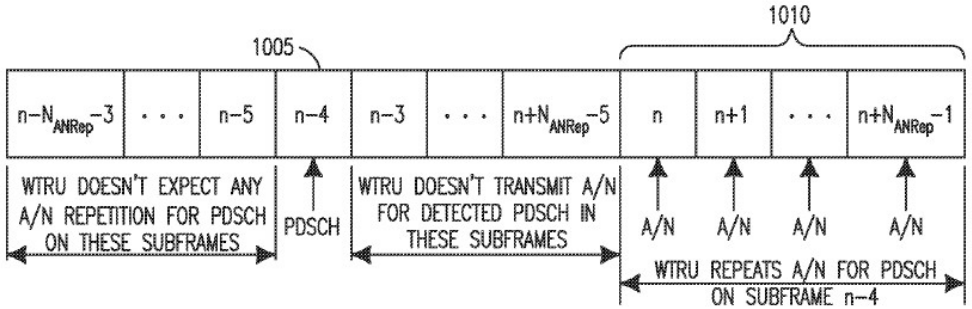
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	 FIG. 7 [0110] FIG. 8 is a diagram of an example cyclic RV assignment without window size. The RV may be cyclically changed with an RV order without window size for the retransmission case. For example, if the RV order {0, 1, 2, 3} is used and 6 subframes are bundled (805), RV-{0, 1, 2, 3, 0, 1} may be used for the initial transmission and RV-{2, 3, 0, 1, 2, 3} may be used for the first retransmission. In the example illustrated in FIG. 8, the window may not be defined if the maximum NTTI is equal to or smaller than 8. A WTRU may not transmit/receive any shared data within the subframes not configured for TTI bundling. [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher

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	layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).  FIG. 8 [0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example,

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		for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates N_{TTI}=3, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., k = N_{TTI}+4). [0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., k = N_{window} +4). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted

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		over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.

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	 FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.

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	 FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n + N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment.

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		[0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes n+l, . . ., $n + N_{ANRep}$ -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes n+l, . . ., $n + N_{ANRep}$ - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another. [0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a

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	single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 9 with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle.

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	[0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH. [0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may

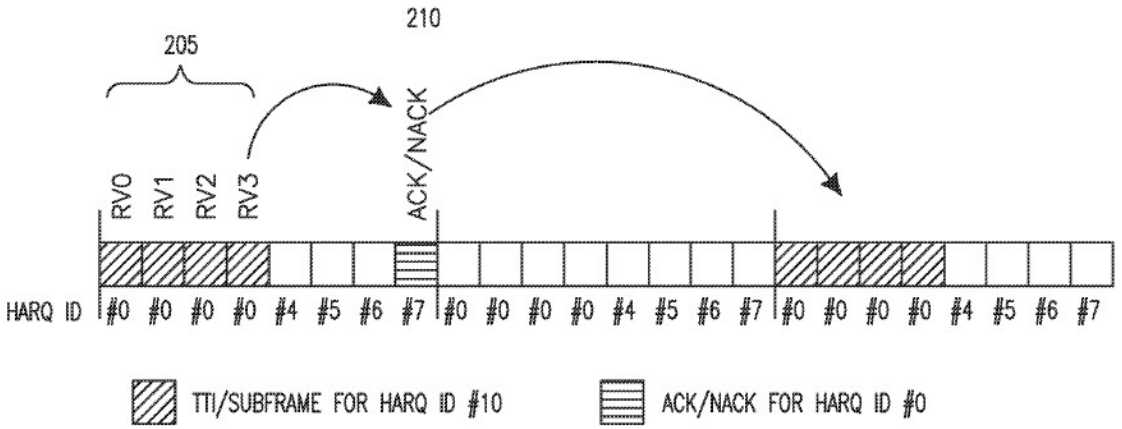
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		result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space.

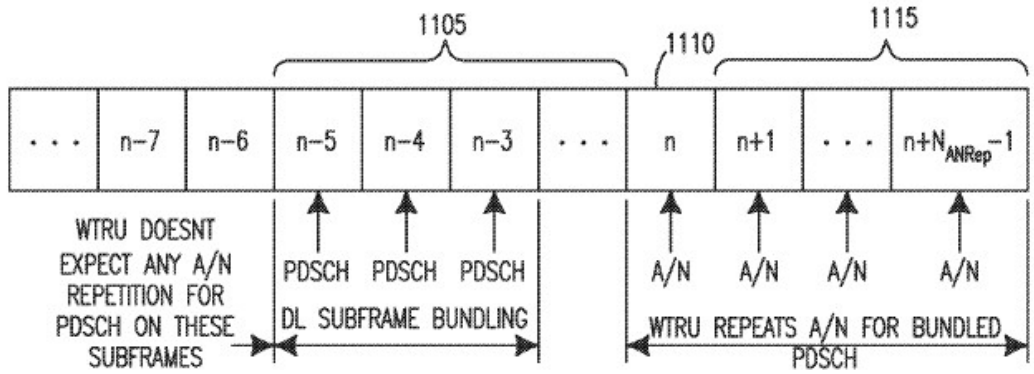
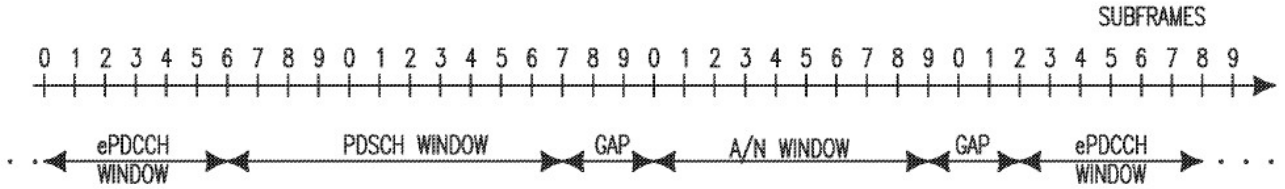
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		[0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting. [0142] A new MCS table may be defined with an N-bit MCS field, and the new MCS table may be defined with a subset of a previous release 5-bit MCS table. [0143] The resource allocation bits, according to the resource allocation type (0, 1, and/or 2), may be reduced by limiting the maximum number of PRBs used for PDSCH transmission. For example, assuming that 25 PRB pairs are available in a DL system bandwidth, the maximum number of PRBs

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		allocated in a subframe may be limited to 6 PRB pairs so that the number of bits for resource allocation may be reduced since the resource allocation indication may be needed within restricted number of PRB pairs such as 6 PRE pairs instead of 25 PRBs for example. Alternatively, the resource allocation field may not be used in a new DCI format while using higher layer signaling instead. Therefore, a DL resource allocation in a frequency domain may be a semi-static allocation, while the time allocation may be based on the (E)PDCCH. For example, a WTRU may receive PDSCH or EPDCCH in the configured PRB pairs among the PRB pairs in the system while the WTRU may be indicated to receive a PDSCH or not in the subframe via (E)PDCCH. [0144] The redundancy version may be removed or downsized in a new DCI format. For example, the redundancy version may be fixed as '0,' and no bit field for a redundancy version may be used. Assuming that a lower coding rate may be used for a new DCI format to support better coverage, the other redundancy versions {i.e., 1, 2, and 3} may not be needed and a single redundancy version may be sufficient. Therefore, a single redundancy version among {O, 1, 2, or 3} may be used as a fixed manner. Alternatively, a 1-bit redundancy version may be used so that two out of four redundancy versions may be used. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0146] The (E)CCE aggregation levels may be different so that (E)PDCCH candidates may have larger aggregation levels as compared with the legacy (E)PDCCH. For instance, the aggregation levels {2, 4, 8, 16} or {4, 8, 16, 32} may be used for coverage enhancement mode for which the (E)PDCCH coverage enhancement mode may only be applicable to a WTRU-specific search space, the PDCCH coverage enhancement mode may be used irrespective of the transmission, or the PDCCH coverage enhancement mode may be applicable for a specific DCI format and/or transmission mode.

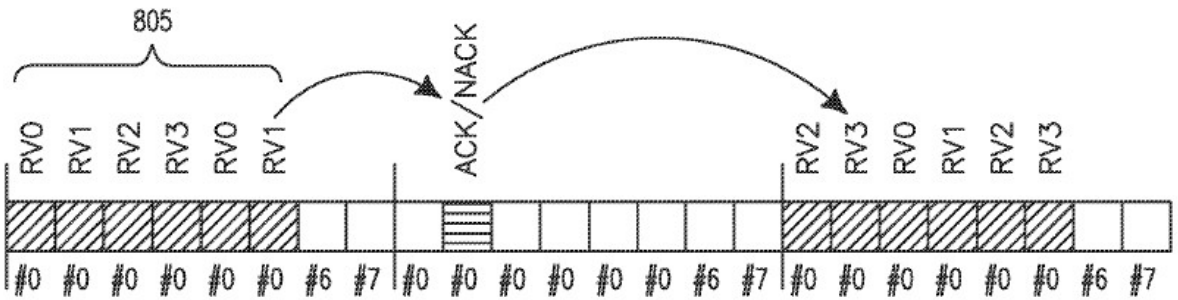
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		[0147] The (E)CCE aggregation level set for WTRU-specific or common search space may be different according to the WTRU mode of operation. The WTRU mode of operation may include coverage enhancement mode. A larger (E)CCE aggregation level set (e.g., {16, 32}) may be used if a WTRU is configured as the coverage enhancement mode of operation while the legacy (E)CCE aggregation level sets (e.g., {4, 8}) may be used if a WTRU is not configured as the coverage enhancement mode of operation. A WTRU may be configurated as coverage enhancement mode of operation via higher layer signaling or indicated during PRACH procedures. [0148] The (E)CCE aggregation level set may be configured or defined according to the PRACH resource used for PRACH preamble transmission from a WTRU. A larger (E)CCE aggregation level set may be used if a WTRU received RAR by using PRACH resource which may be used for coverage enhancement mode of operation. A smaller (E)CCE aggregation level set may be used if a WTRU received RAR by using PRACH resource which may be configured for a WTRU without coverage limitation. [0149] The (E)CCE aggregation level set may be configured or defined according to the coverage limitation level of a WTRU where the coverage limitation level may be defined by one or more of RSRP, pathloss, timing advance, and PRACH resource. For example, if pathloss or RSRP calculated at a WTRU receiver is lower than a predefined threshold, the WTRU may determin a larger (E)CCE aggregation level set among the (E)CCE aggregation level set candidates. [0150] A default WTRU-specific search space may be defined for the (E)PDCCH coverage enhancement mode, where a subset of aggregation levels may be used. For example, if {1, 2, 4, 8, 16, 32, 64} is the set of aggregation levels used for an (E)PDCCH coverage enhancement mode, a subset {2, 4, 8, 16} may be used in the default WTRU-specific search space. Therefore, a WTRU before a WTRU-specific configuration may monitor the (E)PDCCH in a default WTRU-specific search space with the subset of aggregation levels {2, 4, 8, 16}. If a WTRU fails to decode the (E)PDCCH within the default WTRU-specific search space for a certain number of trials or over a period of time, the WTRU may autonomously change the aggregation levels to a higher aggregation level set (e.g., {4, 8, 16, 32}). Alternatively, a WTRU may monitor the default WTRU-specific search space until the WTRU receives a WTRU-specific configuration from higher layer.

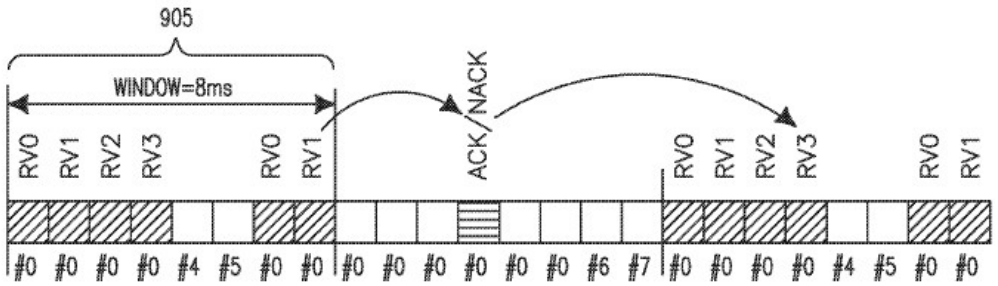
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		[0151] Two or more of default WTRU-specific search spaces (WSS) may be defined in different time/frequency resources, and the aggregation level set may be different according to the location of the default WTRU-specific search spaces. For example, two default WTRU-specific search spaces may be, for example, default WSS1 and default WSS2, and the aggregation level set {1, 2, 4, 8} may be used for the default WSS1 and the aggregation level set {16, 32, 64, 128} may be used for the default WSS2. A WTRU may be informed which default WSS the WTRU may need to monitor implicitly during the PRACH procedure. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	[0302] Described herein are applications for using a coverage enhancement mode. A WTRU may apply all embodiments and examples herein individually or in combination as part of a coverage enhancement mode of operation.  FIG. 2

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	 FIG. 11  FIG. 13 To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
2[a]	transmitting configuration information relating to the plurality of subframes through higher layer signaling; and	At least under Pegasus's apparent infringement theory, Lee discloses transmitting configuration information relating to the plurality of subframes through higher layer signaling. For example, Lee discloses this limitation based on the following exemplary citations: [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).

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	 FIG. 8 [0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling.

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	 FIG. 9 [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably.

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		[0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0174] In an example for TDD, the subframe offset(s) may be a function of the TDD UL/DL configuration. [0175] In another example, multiple subframe offsets may be used for the repetition. For example, $N_{offset,1}$ and $N_{offset,2}$ may be used in order to transmit the ePBCH more frequently. The subframe offsets may be predefined as fixed numbers or configured as a function of the physical cell-ID. [0176] In another embodiment for an ePBCH, a smaller number of bits may be used for an SFN indication. For example, a 7-bit or less SFN number indicator may be used instead of an 8 bit SFN number so that the SFN number provided by the ePBCH may be the same in a longer time window. If a 7 bit SFN number indicator may be used, the 7 bit SFN number may, for example, indicate the most significant 7 bits of 10 bit SFN numbers, and a WTRU may implicitly detect the least significant 3 bit number 000, 001, 010, 011, 100, 101, 110, and 111 in each radio frame from, for example, the scrambling code of coded bits, where a broadcast channel (BCH) transport block may be coded/rate-matched and scrambled in bit level so that each radio frame may have a different part of scrambled coded bits. For a 7 bit SFN indication, the ePBCH time window may be 80 ms, which may be double the legacy PBCH time window, where the PBCH time window may be considered as the TTI for a PBCH transmission. [0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be

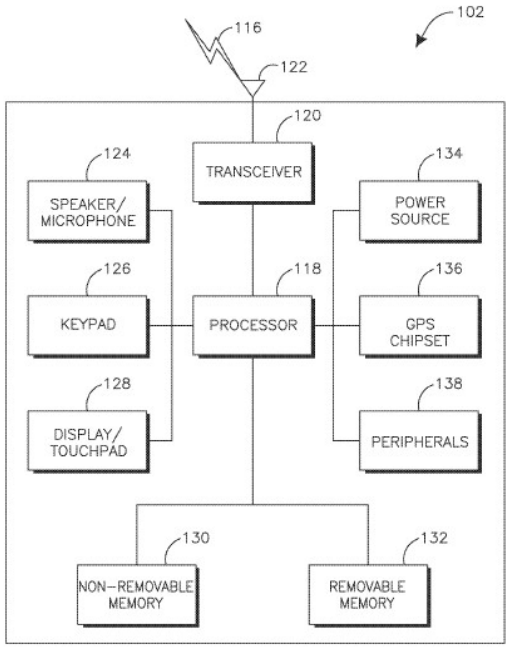
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		consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0206] The known signal may be transmitted by an eNB or cell. The signal may be transmitted in one or more of the following ways. In an example embodiment, the signal may be transmitted in one or more predefined time/frequency resources. In another example embodiment, the signal may be transmitted periodically with a predefined period, which may be a number of frames. In another example embodiment, the signal may be transmitted in a fixed or configured frame or frames within the period. The frame or frames in which the signal may be transmitted may be a function of a cell specific configuration (e.g., physical cell ID). For example, a cell with a PCI of 100 may transmit the known signal every SFN cycle, (e.g., every 1024 frames), to indicate a certain SFN, such as SFN 100, to the WTRU. [0207] In another example embodiment, the signal may be repeated in two or more of the subframes within a frame in which the signal may be transmitted. In another example embodiment, the signal may be a predefined sequence, a system information block, such as an LC-SIB or SIB1, a P-RNTI, or an SI, or an ePBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may

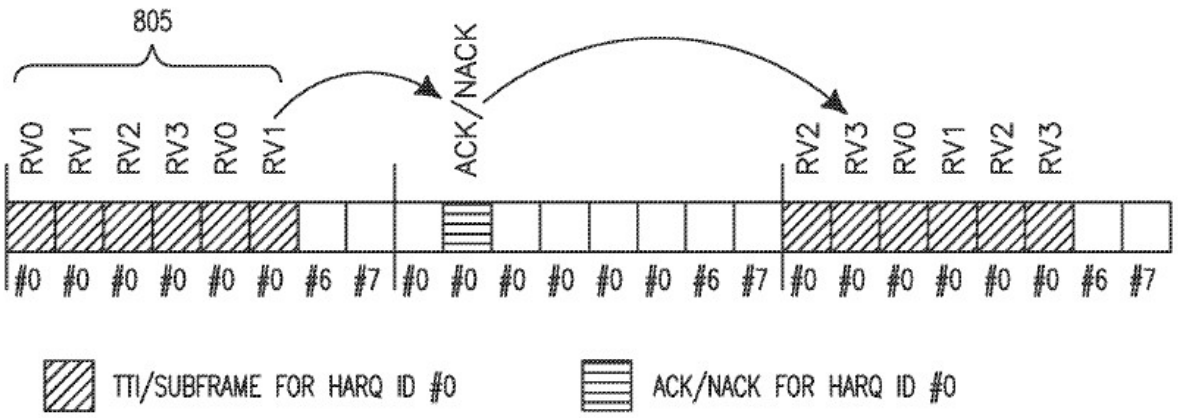
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		integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames

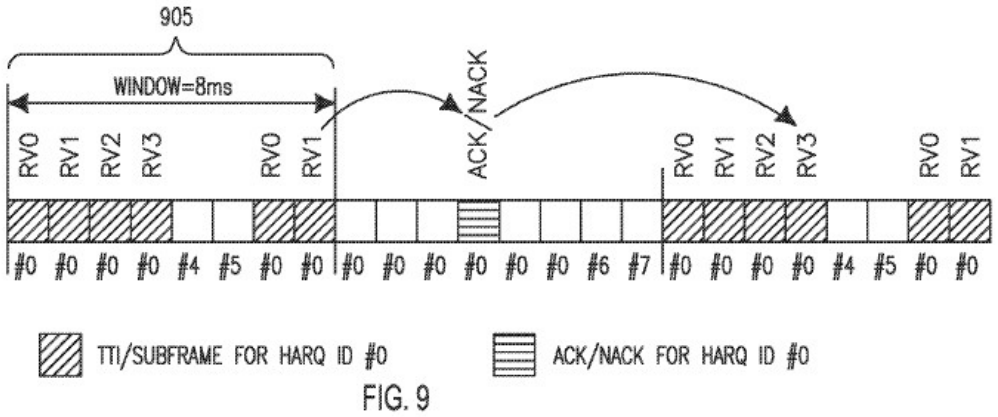
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	beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X. [0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd.

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		[0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames. [0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as

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		an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	 FIG. 1B To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

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2[b]	transmitting the downlink control information through the downlink control channels repeatedly allocated in the plurality of subframes, wherein	At least under Pegasus's apparent infringement theory, Lee discloses transmitting the downlink control information through the downlink control channels repeatedly allocated in the plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).  FIG. 8

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	[0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling.  FIG. 9 [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over

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		multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0174] In an example for TDD, the subframe offset(s) may be a function of the TDD UL/DL configuration. [0175] In another example, multiple subframe offsets may be used for the repetition. For example, $N_{offset,1}$ and $N_{offset,2}$ may be used in order to transmit the ePBCH more frequently. The subframe offsets may be predefined as fixed numbers or configured as a function of the physical cell-ID. [0176] In another embodiment for an ePBCH, a smaller number of bits may be used for an SFN indication. For example, a 7-bit or less SFN number indicator may be used instead of an 8 bit SFN number so that the SFN number provided by the ePBCH may be the same in a longer time window. If a 7 bit SFN number indicator may be used, the 7 bit SFN number may, for example, indicate the most significant 7 bits of 10 bit SFN numbers, and a WTRU may implicitly detect the least significant 3 bit number 000, 001, 010, 011, 100, 101, 110, and 111 in each radio frame from, for example, the scrambling code of coded bits, where a broadcast channel (BCH) transport block may be coded/rate-matched and scrambled in bit level so that each radio frame may have a different part of scrambled coded bits. For a 7 bit SFN indication, the ePBCH time window may be 80 ms, which may be double the legacy PBCH time window, where the PBCH time window may be considered as the TTI for a PBCH transmission.

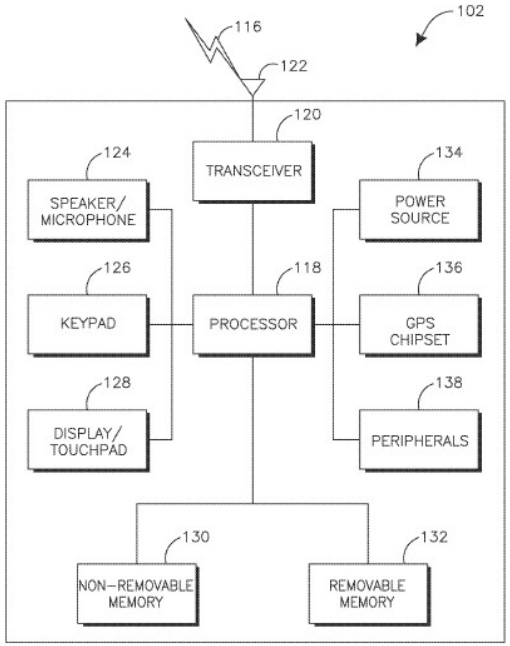
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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0206] The known signal may be transmitted by an eNB or cell. The signal may be transmitted in one or more of the following ways. In an example embodiment, the signal may be transmitted in one or more predefined time/frequency resources. In another example embodiment, the signal may be transmitted periodically with a predefined period, which may be a number of frames. In another example embodiment, the signal may be transmitted in a fixed or configured frame or frames within the period. The frame or frames in which the signal may be transmitted may be a function of a cell specific configuration (e.g., physical cell ID). For example, a cell with a PCI of 100 may transmit the known signal every SFN cycle, (e.g., every 1024 frames), to indicate a certain SFN, such as SFN 100, to the WTRU. [0207] In another example embodiment, the signal may be repeated in two or more of the subframes within a frame in which the signal may be transmitted. In another example embodiment, the signal may be a predefined sequence, a system information block, such as an LC-SIB or SIB1, a P-RNTI, or an SI, or an ePBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame.

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		[0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may

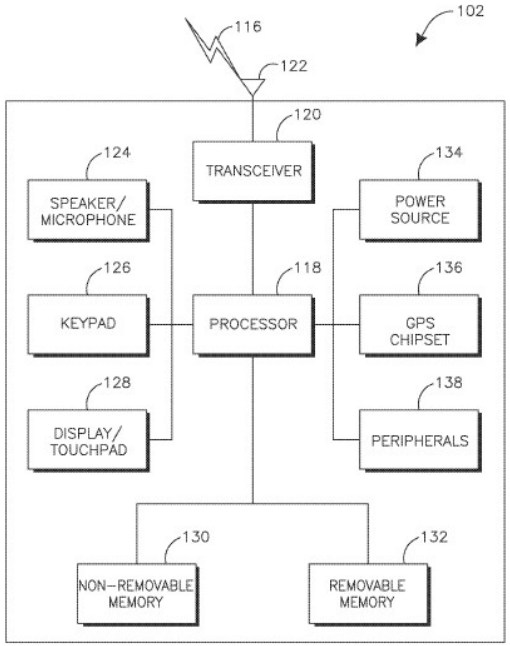
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		determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X. [0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N.

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		[0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames. [0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times

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		during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	 FIG. 1B To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

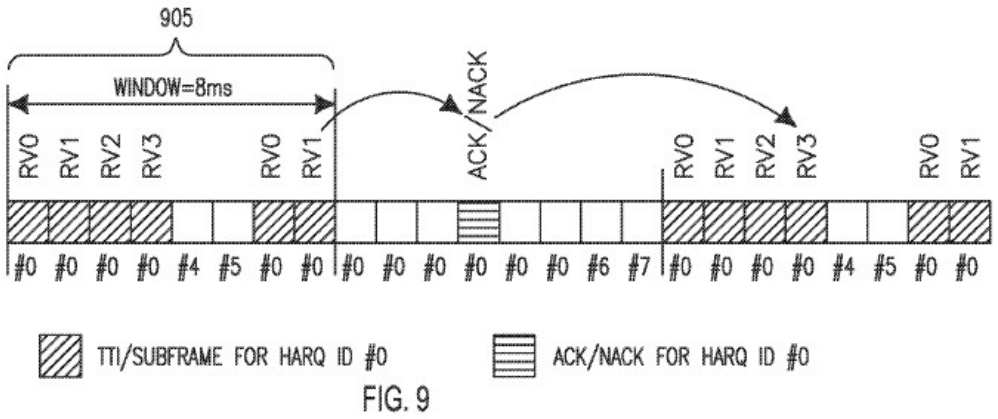
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2[c]	the configuration information comprises information on a start subframe of the plurality of subframes; and	At least under Pegasus's apparent infringement theory, Lee discloses wherein the configuration information comprises information on a start subframe of the plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

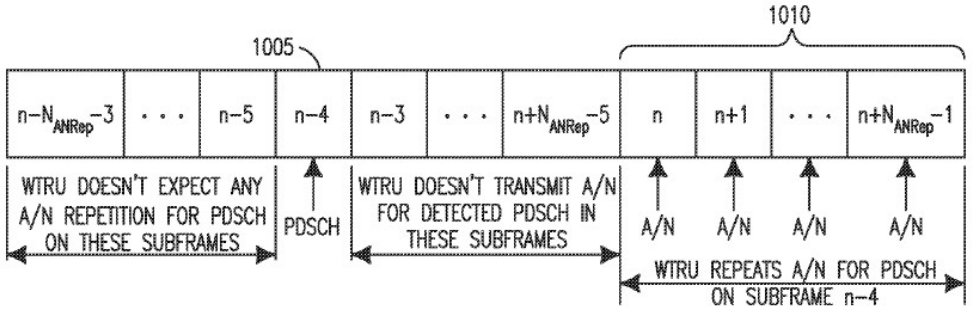
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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	[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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		[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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	example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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	+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes n+l, . . ., n + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes n+l, . . ., n + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Re\,p} - 1 \end{cases}$$, Equation 9

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	with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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		[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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		[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

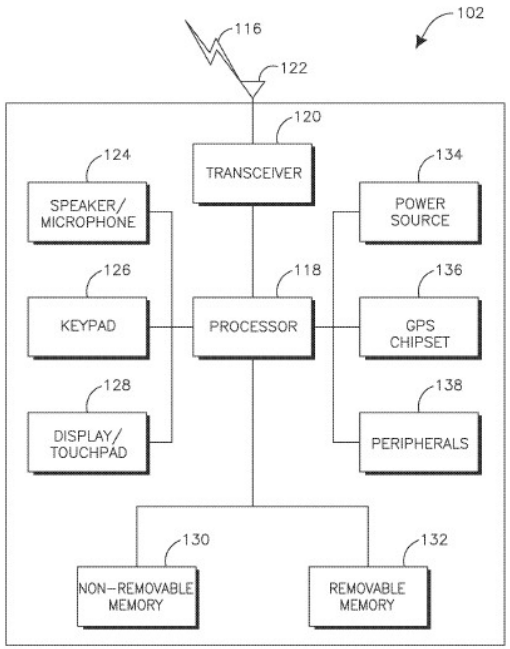
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

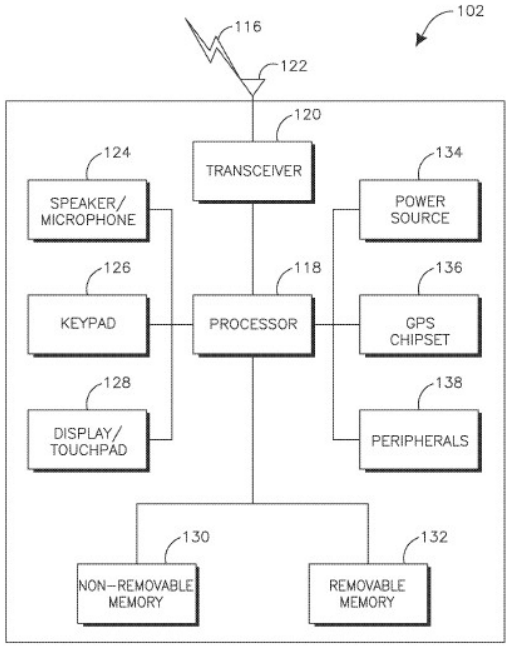
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		may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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	subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

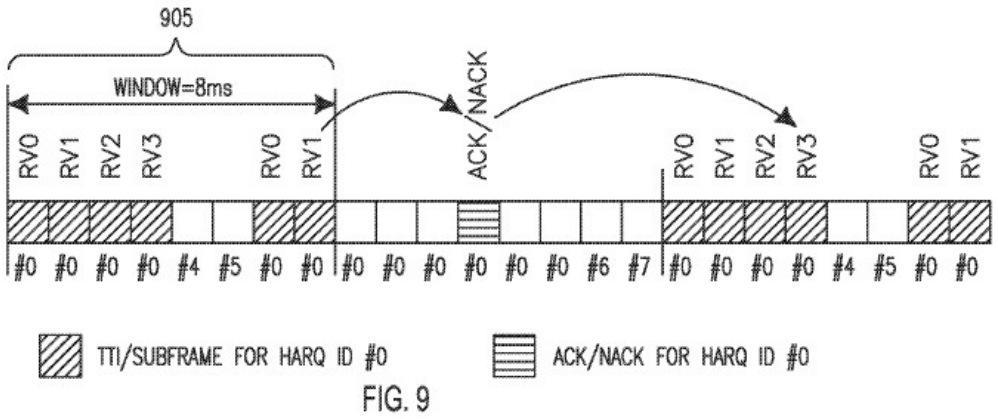
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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
2[d]	the downlink control information comprises information on the number of the plurality of subframes.	At least under Pegasus's apparent infringement theory, Lee discloses wherein the downlink control information comprises information on the number of the plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

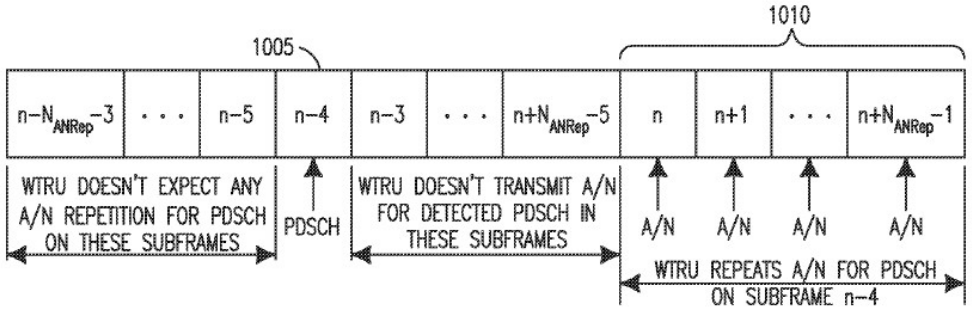
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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	[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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	[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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	example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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		+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes *n*+l, . . ., *n* + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes *n*+l, . . ., *n* + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Re\,p} - 1 \end{cases}$$, Equation 9

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	with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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		[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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		[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

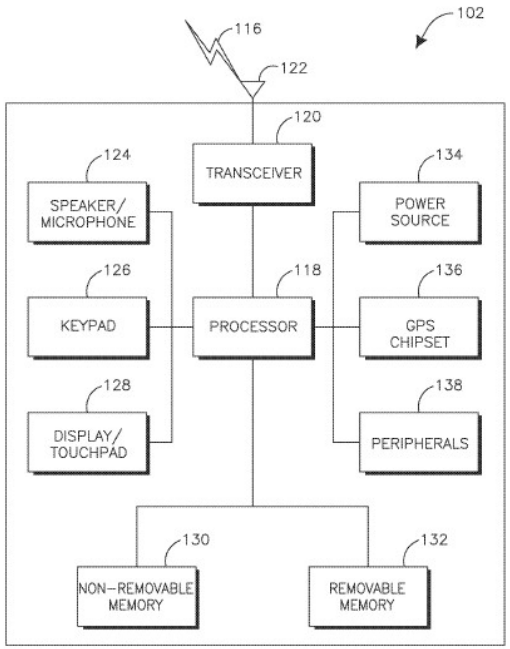
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

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	may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

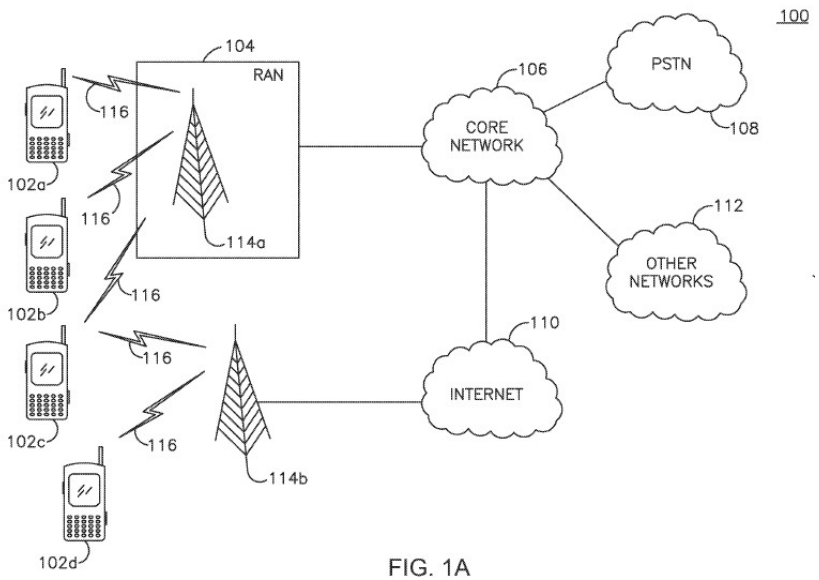
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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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	subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

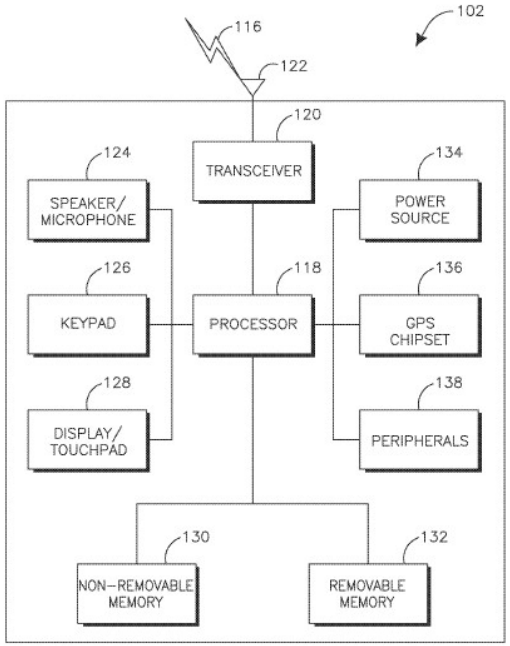
3. Claim 3

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3[pre]	A terminal for receiving downlink control information through downlink control channels repeatedly allocated in plurality of subframes, the terminal comprising:	To the extent the preamble is limiting, at least under Pegasus's apparent infringement theory, Lee discloses a terminal for receiving downlink control information through downlink control channels repeatedly allocated in plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0023] As shown in FIG. lA, the communications system 100 may include wireless transmit/receive units (WTRU s) 102a, 102b, 102c, 102d, a radio access network (RAN) 104, a core network 106, a public switched telephone network (PSTN) 108, the Internet 110, and other networks 112, though it will be appreciated that the disclosed embodiments contemplate any number of WTRUs, base stations, networks, and/or network elements. Each of the WTRU s 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment. By way of example, the WTRUs 102a, 102b, 102c, 102d may be configured to transmit and/or receive wireless signals and may include user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a pager, a cellular telephone, a personal digital assistant (PDA), a smartphone, a laptop, a netbook, a personal computer, a wireless sensor, consumer electronics, machine to machine and the like.

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	 FIG. 1A [0034] FIG. 1B is a system diagram of an example WTRU 102. As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122, a speaker/microphone 124, a keypad 126, a display/touchpad 128, non-removable memory 130, removable memory 132, a power source 134, a global positioning system (GPS) chipset 136, and other peripherals 138. It will be appreciated that the WTRU 102 may include any sub-combination of the foregoing elements while remaining consistent with an embodiment. [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding,

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		data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip. [0036] The transmit/receive element 122 may be configured to transmit signals to, or receive signals from, a base station (e.g., the base station 114a) over the air interface 116. For example, in one embodiment, the transmit/receive element 122 may be an antenna configured to transmit and/or receive RF signals. In another embodiment, the transmit/receive element 122 may be an emitter/detector configured to transmit and/or receive IR, UV, or visible light signals, for example. In yet another embodiment, the transmit/receive element 122 may be configured to transmit and receive both RF and light signals. It will be appreciated that the transmit/receive element 122 may be configured to transmit and/or receive any combination of wireless signals. [0037] In addition, although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116. [0038] The transceiver 120 may be configured to modulate the signals that are to be transmitted by the transmit/receive element 122 and to demodulate the signals that are received by the transmit/receive element 122. As noted above, the WTRU 102 may have multi-mode capabilities. Thus, the transceiver 120 may include multiple transceivers for enabling the WTRU 102 to communicate via multiple RATs, such as UTRA and IEEE 802.11, for example. [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the

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		display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from, and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like.

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	 FIG. 1B [0051] Transmission time interval (TTI) bundling may enhance uplink (UL) coverage for a user or WTRU that experiences limited UL coverage, for example as its transmission power approaches the maximum. Using TTI bundling, the same data may be transmitted in multiple consecutive TTis, which may allow the WTRU to extend the effective transmission time window for the data. For example up to four consecutive TTis may be bundled for frequency division duplex (FDD) LTE, which may extend the effective transmission time window by up to four times. A single transport block may be coded and transmitted with different redundancy versions (RVs) in each of the consecutive subframes, where subframe and TTI may be used interchangeably. For example, the consecutive TTis in the same TTI bundle may be assigned to consecutive RVs. The same hybrid automatic repeat request (HARQ) process number may be assigned to all TTis in a TTI bundle, and all TTis within a TTI bundle may be treated as a single resource, where a single UL grant and a

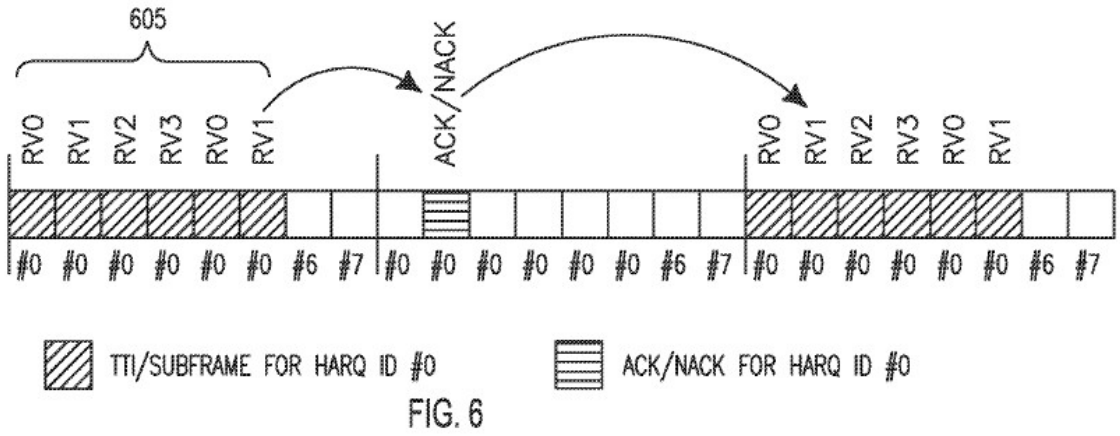
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		single acknowledgement/negative acknowledgement (ACK/NACK), (e.g., physical HARQ indicator channel (PHICH)), may be associated with them. A TTI bundling mechanism may be configured by higher layer signaling per WTRU. In FDD TTI bundling, the roundtrip time (RTT) for every re-transmission may be equal to 16 ms. When the FDD TTI bundling is activated, the WTRU may receive the UL grant for the first subframe in the TTI bundle according to the rules of an FDD UL grant, and once the UL data is transmitted in a TTI bundle, a PHICH, or other UL grant, may be expected by the WTRU according to PHICH rules corresponding to the last subframe of that TTI bundle. The rules may be for example, 3GPP Release 8 rules. [0052] FIG. 2 is a diagram of an example of TTI bundling with a TTI bundle of four consecutive TTis. In the example, HARQ ID #0 includes four bundled TTis 205, the ACK/NACK 210 is received four TTis after the last TTI of the TTI bundle 205, and re-transmission occurs sixteen TTis after the first TTI of the initial transmission. Once FDD TTI bundling is activated, the WTRU may support up to a certain number of HARQ processes, for example up to four for 3GPP Release 10. In FDD operation, all TTI bundles of the same HARQ process may have the same number of UL subframes, may have the same pattern, (for example, including consecutive UL subframes), and may be uniformly distributed in the time domain. [0092] In order to improve the coverage of channels such as the enhanced PDCCH (EPDCCH), the PDSCH, and the PUCCH, repetitive transmission may be considered as a coverage enhancement technique. In this case, the current HARQ process, such as the n+4 timing relationship (e.g., for FDD), may not be used since the reference subframe may be redefined among the repetitively transmitted subframes. In addition, the timing relationship between UL grant and PUSCH transmission may also be redefined with a new reference subframe n. The term (E)PDCCH may be used to mean PDCCH and/or EPDCCH, which may also be represented by PDCCH/EPDCCH. [0093] Described herein are methods for enhancing service coverage for data channels in the UL and DL. Given that an LC-MTC WTRU may support very low data rates with high delay tolerance in terms of quality of service, a WTRU may reduce the size of each protocol layer header for each transport block that the WTRU may receive and/or transmit.

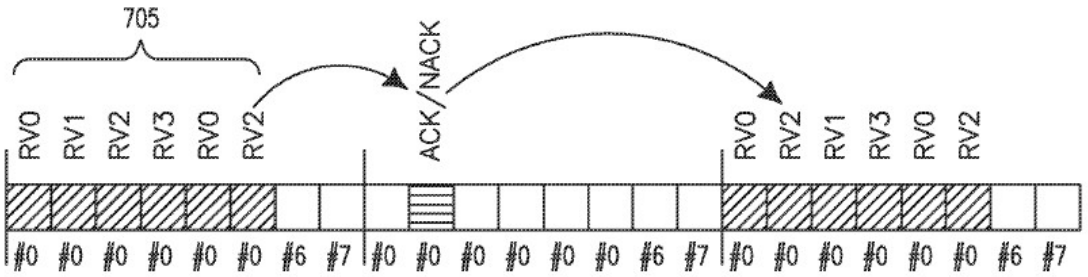
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		[0094] In an example embodiment, the PDCP and RLC may allocate a smaller sequence number (SN) size in its headers. In the PDCP, a WTRU may allocate an SN size of smaller than 7 bits. In the RLC, a WTRU may allocate an SN size of smaller than 5 bits for UM or 10 bits for AM. A WTRU may coordinate sizes of RLC and PDCP PDU s such that the resultant PDU with the header and data part may maintain octet (byte) alignment. A WTRU may have a PDCP PDU that is not byte aligned, but the RLC header and PDUs may be processed such that the resulting RLC PDU byte alignment may be maintained. [0095] In another example embodiment, a WTRU may not include the extension ("E") fields in MAC and RLC, thus further reducing the header sizes. For example, a WTRU may be configured for a data radio bearer (DRE), with a very low data rate such that small data packets, (for example, 100 bytes in the UL) may arrive into the PDCP infrequently, (for example, once every hour). A WTRU may then be configured with a small SN size, such as 2 bits, in the PDCP such that the sequence numbers may range from O to 3. In RLC, a WTRU may be configured for UM, and the RLC SDU may be segmented into 8 smaller RLC PDUs, and, relatively, the RLC SN size may be specified for 3 bits. Further, a WTRU may not include an RLC or MAC "E" bit into the header since RLC SDUs and MAC SDUs may not be concatenated into the RLC and MAC PDU (for example, 1 PDU per SDU). The WTRU may then perform L1 processing of the resultant MAC PDU for UL transmission. Given the reduced header size, the PDPC may have its header size reduced to 3 bits, its RLC reduced to 6 bits and its MAC reduced to 7 bits. The WTRU and eNB may apply the same reduction of protocol headers in the DL also. [0096] A WTRU may be configured with reduced PDCP, RLC, and MAC header configurations as part of a DRE setup procedure, which may be signaled by the RRC. For example, as part of the RRC procedure, a WTRU may be signaled to apply a 2 bit SN length in the PDCP, apply a 3 bit SN length for RLC with UM mode, and apply a bit to indicate the exclusion of the "E" bit in the MAC header. The WTRU may use a default or pre-defined set of MAC, RLC, and PDCP configurations, which may include the example header configuration defined in the RRC. The WTRU may be explicitly indicated by the network to use the coverage enhancement mode protocol layer parameters, or the WTRU may autonomously use the coverage enhancement mode parameters and signal its use to the network.

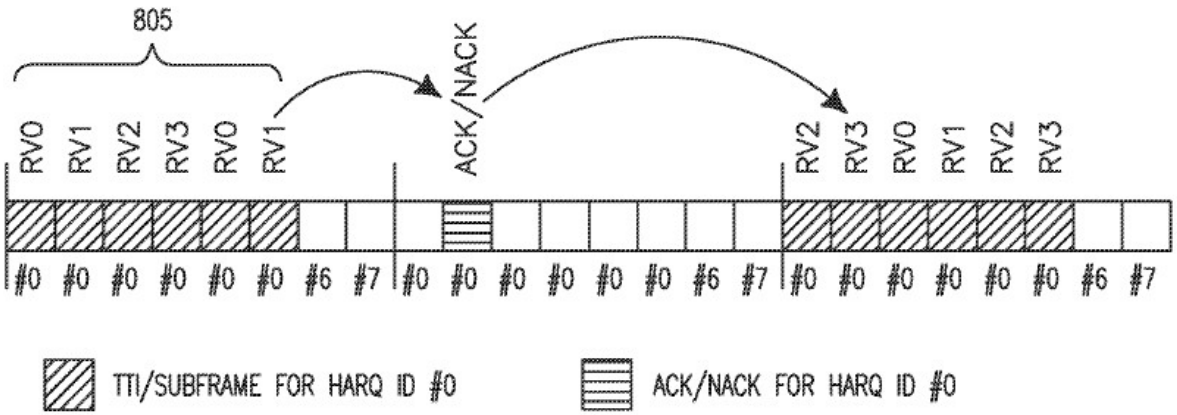
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		[0097] In another example embodiment, a WTRU/eNB may reduce RLC header size by scrambling the CRC bits, which may be appended to the MAC PDU, with the SN of the RLC PDU included in the MAC PDU. The WTRU may then remove the SN from the RLC header. For example, independently or in combination with RLC SN size reduction, the WTRU may, upon receiving a MAC PDU, descramble the CRC parity bits with possible SN values prior to performing the CRC check. The WTRU may perform the descrambling based on the entire possible SN range or based on the current RLC receiver window, excluding SN s that have already been received. Once the correct SN has been identified and the MAC PDU has been correctly received, the WTRU may pass the determined SN value to the RLC for proper PDU processing. [0098] In another example embodiment, a WTRU may scramble the CRC parity bits with MAC LCID information. For example, the WTRU may use 5 bit LCID information of the DRE to scramble the CRC parity bits if, for example, there is a single LCID associated with the MAC SDUs that are multiplexed into the MAC PDU. [0099] In another example embodiment, a WTRU may transmit and receive data on the DRE on a single HARQ process for the UL and/or DL direction. For example, given that the LC-MTC WTRU may transmit and receive data at very low data rates with high tolerance for delay, a WTRU may use a single HARQ process in each of the UL and/or DL directions. Since the WTRU may only receive a single MAC PDU at a time, the sequence numbering maintenance burden in both the RLC and PDCP layers may be reduced, further supporting the SN size reduction described above. [0100] In another example embodiment, a WTRU may use a multi-step CRC attachment and computation procedure to reduce CRC size. Here, the WTRU may reduce the overhead from CRC parity bit attachment to the data. For transmitting data, the WTRU may, in the RLC layer, calculate and attach long CRC parity bits to the RLC SDU prior to the segmentation/concatenation procedure. The WTRU may then segment the RLC SDU with CRC parity bits attached to the end of the RLC SDU. The WTRU may, in the PHY layer, calculate and attach a shorter set of CRC parity bits to each MAC PDU prior to transmission. For receiving data, the WTRU may, in the MAC layer, upon

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		reception of the MAC PDU and correct calculation of CRC, consider the reception successful and deliver the corresponding MAC SDU to the RLC. [0101] The WTRU may, in the RLC layer, upon receiving RLC PDUs and successfully reconstructing a RLC SDU, perform a CRC check based on the long CRC calculation and parity bits applied to the RLC SDU. Based on the outcome of the CRC check, if the CRC check passes, the WTRU may deliver the RLC SDU to PDCP. If the CRC check fails, the WTRU may discard the SDU and associated PDUs, for example, if the WTRU has been configured for RLC UM, or may discard the SDU and provide an indication to the transmitter side for re-transmission of the associated PDU s. For example, if the WTRU has been configured for RLC AM, the WTRU may provide an RLC STATUS PDU indicating the SNs of the RLC PDUs that may be part of the discarded RLC SDU. [0102] In an example embodiment, the WTRU may attach a 24-bit CRC to the RLC SDU prior to segmentation in the RLC. For the purpose of this example, the RLC SDU may have been segmented into 8 RLC PDU s. Subsequently, the WTRU may attach an 8-bit CRC to the MAC PDU, which may include the previously segmented RLC SDU. In relative comparison to attaching a 24-bit CRC to each MAC PDU, where the CRC overhead is 24X8 = 192 bits, the above CRC attachment procedure may yield a 24+8x8 = 88 bit CRC overhead. The CRC overhead may be further reduced, for example, if the number of segmented RLC PDU s is increased. [0103] Described herein are methods for providing coverage enhancements using TTI bundling. TTI bundling may be used since it may provide a higher received signal-to-noise ratio (SNR). [0104] In an embodiment, if a WTRU is configured with a coverage enhancement mode of operation, TTI bundling may be used with longer than four TTis, where the number of subframes for TTI bundling may be predefined or configured. In addition, the bundled subframes may be repetitively transmitted over the time, which may further enhance coverage. For example, if NTTI subframes are bundled and the N_{TTI} subframes are repeatedly transmitted (N_{rep}), then N_{TTI} x N_{rep} subframes may be used, effectively, in total. In a broadcasting channel, an indication related to capacity of the coverage enhancement mode of operation may be included so that a WTRU that is

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		capable of entering coverage enhancement mode may select the coverage enhancement mode or report a preferred mode of operation, (for example, coverage enhancement mode), according to the conditions. [0105] One or more of the following may apply for a bundling size (N_{TTI}) and/or a repetition rate (N_{rep}) for the coverage enhancement mode. In an example, the bundling size and/or repetition rate may be configured via higher layers together with the transmission mode configuration. In another example, a default value of bundling size and/or repetition rate for coverage enhancement mode may be defined, and the default value may be used if a WTRU is configured for or falls under coverage enhancement mode until the WTRU receives WTRU-specific configuration of a bundling size and/or a repetition rate. In this case, the default value may be the largest value among the candidate values, or a WTRU may start to receive the PDSCH with the default value and may perform a certain number of trials of PDSCH reception. If a WTRU fails to receive the PDSCH, the WTRU may increase the bundling size and/or repetition rate with a specific step size. The step size may be predefined and may be the same irrespective of the number of failures or may be different according to the number of failures. In another eample, TTI bundling and repetition may be used together, and HARQ-ACK may not be reported until the last bundled TTI is received within the number of repetitions. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably. [0107] A WTRU may transmit/receive the same data in consecutive NTTI subframes, and the data may be coded with a different redundancy version (RV) according to the subframe index or the location of the subframe among the bundled subframes. [0108] FIG. 6 is a diagram of an example cyclic RV assignment with RV order {0, 1, 2, 3}. The RV may be changed with the order {0, 1, 2, 3} cyclically within a window so that, for example, RV-{0, 1, 2, 3, 0, 1} may be used in order, using an 8-TTI window size, if 6 subframes are bundled (605) as in the example illustrated in FIG. 6. The 8ms window size may be used when 8 HARQ processes

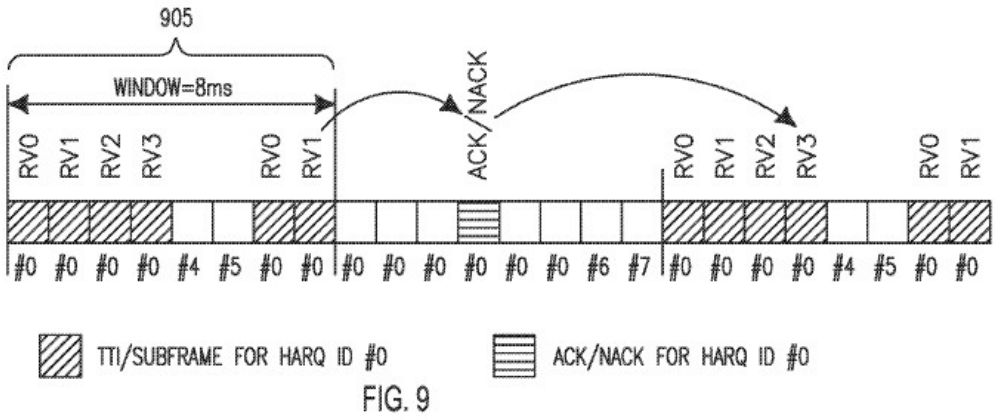
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	are used for other WTRUs not configured with TTI bundling. The window size may not be defined, thus allowing bundling any subframes while the maximum NTTI may be equal to or smaller than 8.  FIG. 6 [0109] FIG. 7 is a diagram of an example cyclic RV assignment with RV order {0, 2, 1, 3}. The RV may be changed with the order {0, 2, 1, 3} cyclically within a window so that, for example, RV-{0, 2, 1, 3, 0, 2} may be used in order when an 8 TTI window size is used if 6 subframes are bundled (705). In this case, the RV order {0, 2, 1, 3} may be used only for DL TTI bundling, the RV order {0, 2, 1, 3} may be used if the NTTI is larger than a threshold value, (for example, the threshold value may be 4, otherwise, the RV order {0, 1, 2, 3} may be used), and the RV order {0, 2, 1, 3} may be replaced with another RV order such as {1, 3, 0, 2}. More than one RV order, (for example, RV orders {0, 1, 2, 3} and {0, 2, 1, 3}), may be used for transmission and/or reception to or from one or more WTRUs. For example, one RV order, (for example, the RV order {0, 1, 2, 3}), may be used in an initial transmission and the other RV order, (for example, the RV order {0, 2, 1, 3}), may be used for a retransmission.

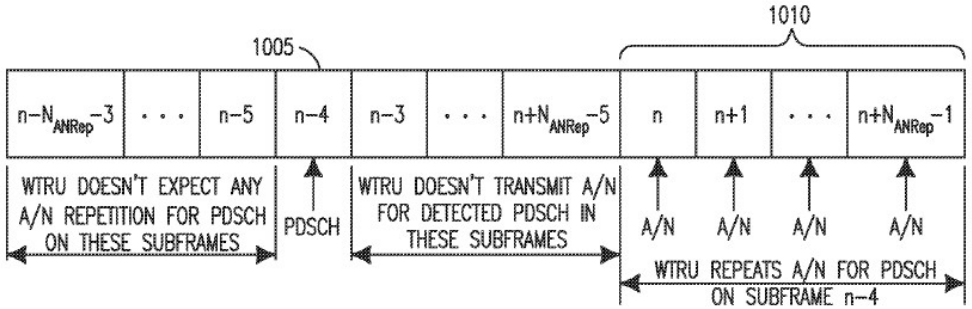
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	 FIG. 7 [0110] FIG. 8 is a diagram of an example cyclic RV assignment without window size. The RV may be cyclically changed with an RV order without window size for the retransmission case. For example, if the RV order {0, 1, 2, 3} is used and 6 subframes are bundled (805), RV-{0, 1, 2, 3, 0, 1} may be used for the initial transmission and RV-{2, 3, 0, 1, 2, 3} may be used for the first retransmission. In the example illustrated in FIG. 8, the window may not be defined if the maximum NTTI is equal to or smaller than 8. A WTRU may not transmit/receive any shared data within the subframes not configured for TTI bundling. [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher

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	layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).  FIG. 8 [0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example,

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		for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates N_{TTI}=3, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., k = N_{TTI}+4). [0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., k = N_{window} +4). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted

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		over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.

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	 FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.

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	 FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n + N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment.

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		[0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes n+l, . . ., $n + N_{ANRep}$ -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes n+l, . . ., $n + N_{ANRep}$ - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another. [0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a

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	single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 9 with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle.

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	[0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH. [0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may

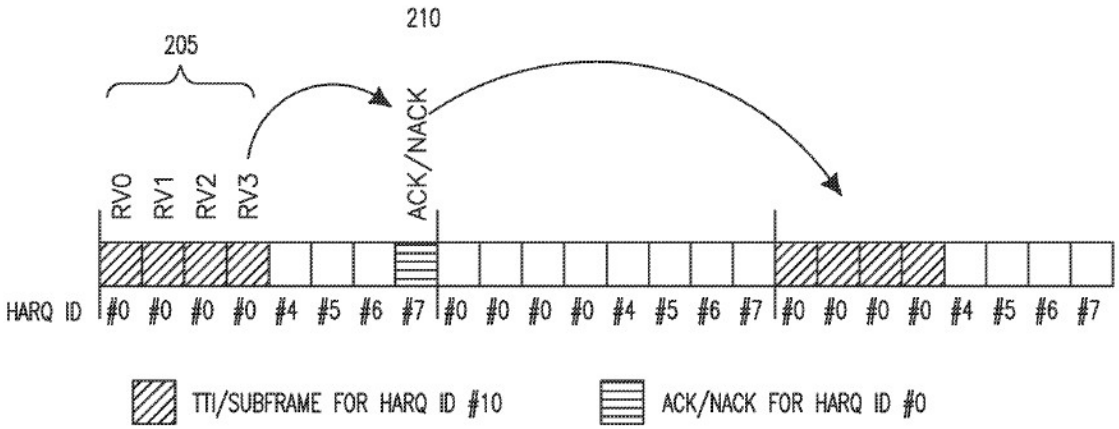
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		result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space.

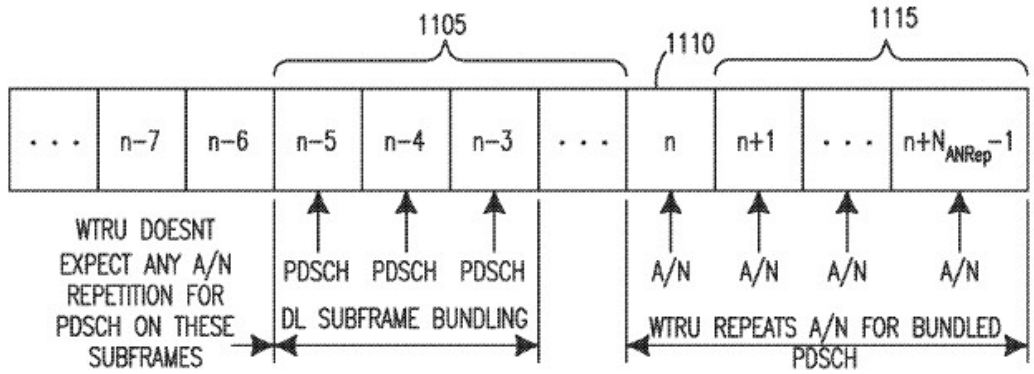
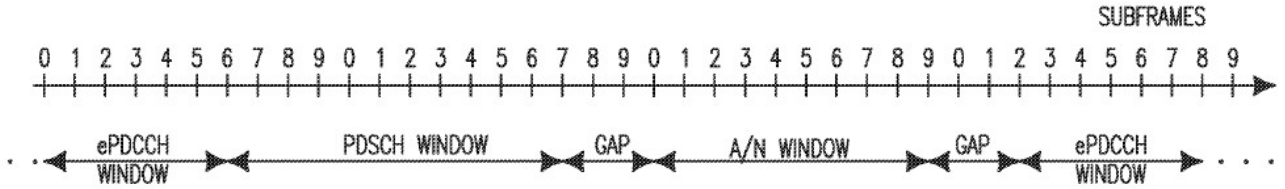
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		[0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting. [0142] A new MCS table may be defined with an N-bit MCS field, and the new MCS table may be defined with a subset of a previous release 5-bit MCS table. [0143] The resource allocation bits, according to the resource allocation type (0, 1, and/or 2), may be reduced by limiting the maximum number of PRBs used for PDSCH transmission. For example, assuming that 25 PRB pairs are available in a DL system bandwidth, the maximum number of PRBs

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		allocated in a subframe may be limited to 6 PRB pairs so that the number of bits for resource allocation may be reduced since the resource allocation indication may be needed within restricted number of PRB pairs such as 6 PRE pairs instead of 25 PRBs for example. Alternatively, the resource allocation field may not be used in a new DCI format while using higher layer signaling instead. Therefore, a DL resource allocation in a frequency domain may be a semi-static allocation, while the time allocation may be based on the (E)PDCCH. For example, a WTRU may receive PDSCH or EPDCCH in the configured PRB pairs among the PRB pairs in the system while the WTRU may be indicated to receive a PDSCH or not in the subframe via (E)PDCCH. [0144] The redundancy version may be removed or downsized in a new DCI format. For example, the redundancy version may be fixed as '0,' and no bit field for a redundancy version may be used. Assuming that a lower coding rate may be used for a new DCI format to support better coverage, the other redundancy versions {i.e., 1, 2, and 3} may not be needed and a single redundancy version may be sufficient. Therefore, a single redundancy version among {O, 1, 2, or 3} may be used as a fixed manner. Alternatively, a 1-bit redundancy version may be used so that two out of four redundancy versions may be used. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0146] The (E)CCE aggregation levels may be different so that (E)PDCCH candidates may have larger aggregation levels as compared with the legacy (E)PDCCH. For instance, the aggregation levels {2, 4, 8, 16} or {4, 8, 16, 32} may be used for coverage enhancement mode for which the (E)PDCCH coverage enhancement mode may only be applicable to a WTRU-specific search space, the PDCCH coverage enhancement mode may be used irrespective of the transmission, or the PDCCH coverage enhancement mode may be applicable for a specific DCI format and/or transmission mode.

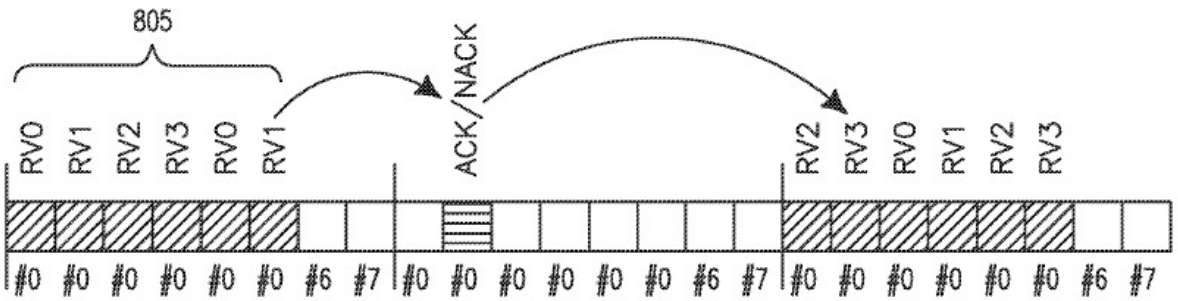
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		[0147] The (E)CCE aggregation level set for WTRU-specific or common search space may be different according to the WTRU mode of operation. The WTRU mode of operation may include coverage enhancement mode. A larger (E)CCE aggregation level set (e.g., {16, 32}) may be used if a WTRU is configured as the coverage enhancement mode of operation while the legacy (E)CCE aggregation level sets (e.g., {4, 8}) may be used if a WTRU is not configured as the coverage enhancement mode of operation. A WTRU may be configurated as coverage enhancement mode of operation via higher layer signaling or indicated during PRACH procedures. [0148] The (E)CCE aggregation level set may be configured or defined according to the PRACH resource used for PRACH preamble transmission from a WTRU. A larger (E)CCE aggregation level set may be used if a WTRU received RAR by using PRACH resource which may be used for coverage enhancement mode of operation. A smaller (E)CCE aggregation level set may be used if a WTRU received RAR by using PRACH resource which may be configured for a WTRU without coverage limitation. [0149] The (E)CCE aggregation level set may be configured or defined according to the coverage limitation level of a WTRU where the coverage limitation level may be defined by one or more of RSRP, pathloss, timing advance, and PRACH resource. For example, if pathloss or RSRP calculated at a WTRU receiver is lower than a predefined threshold, the WTRU may determin a larger (E)CCE aggregation level set among the (E)CCE aggregation level set candidates. [0150] A default WTRU-specific search space may be defined for the (E)PDCCH coverage enhancement mode, where a subset of aggregation levels may be used. For example, if {1, 2, 4, 8, 16, 32, 64} is the set of aggregation levels used for an (E)PDCCH coverage enhancement mode, a subset {2, 4, 8, 16} may be used in the default WTRU-specific search space. Therefore, a WTRU before a WTRU-specific configuration may monitor the (E)PDCCH in a default WTRU-specific search space with the subset of aggregation levels {2, 4, 8, 16}. If a WTRU fails to decode the (E)PDCCH within the default WTRU-specific search space for a certain number of trials or over a period of time, the WTRU may autonomously change the aggregation levels to a higher aggregation level set (e.g., {4, 8, 16, 32}). Alternatively, a WTRU may monitor the default WTRU-specific search space until the WTRU receives a WTRU-specific configuration from higher layer.

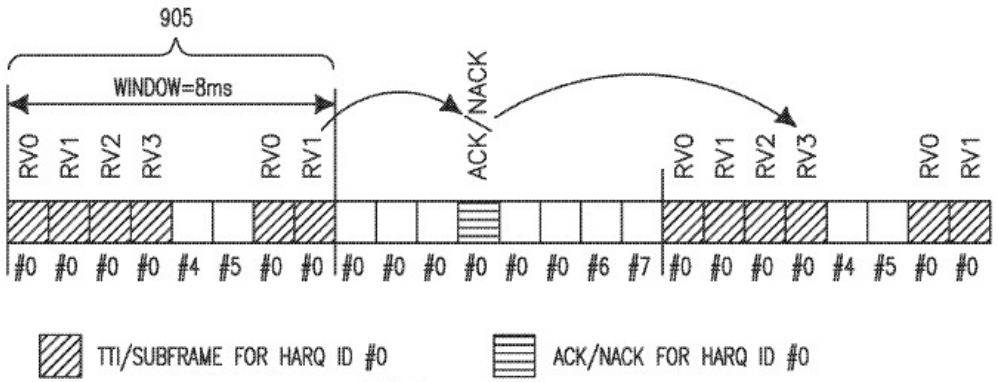
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		[0151] Two or more of default WTRU-specific search spaces (WSS) may be defined in different time/frequency resources, and the aggregation level set may be different according to the location of the default WTRU-specific search spaces. For example, two default WTRU-specific search spaces may be, for example, default WSS1 and default WSS2, and the aggregation level set {1, 2, 4, 8} may be used for the default WSS1 and the aggregation level set {16, 32, 64, 128} may be used for the default WSS2. A WTRU may be informed which default WSS the WTRU may need to monitor implicitly during the PRACH procedure. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	[0302] Described herein are applications for using a coverage enhancement mode. A WTRU may apply all embodiments and examples herein individually or in combination as part of a coverage enhancement mode of operation.  FIG. 2

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	 FIG. 11  FIG. 13 To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of

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		success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3[a]	a receiver configured to receive configuration information comprising information on a start subframe of the plurality of subframes through higher layer signaling, to receive the downlink control channels repeatedly allocated in the plurality of subframes, and to combine the received downlink control channels based on the configuration information; and	At least under Pegasus's apparent infringement theory, Lee discloses a receiver configured to receive configuration information comprising information on a start subframe of the plurality of subframes through higher layer signaling, to receive the downlink control channels repeatedly allocated in the plurality of subframes, and to combine the received downlink control channels based on the configuration information. For example, Lee discloses this limitation based on the following exemplary citations: [0111] A WTRU may transmit/receive the same data in NTTI subframes within a window, and the data may be coded with different RVs according to the subframe index or the location of the subframe among the bundled subframes. The bundled NTTI subframes may be defined as any subset of subframes within the window. In this case, the window size (N_{window}) may be defined and/or the subset of subframes for TTI bundling may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling. [0112] The window size (N_{window}) may be defined as at least one of a positive integer number, (that may have a fixed value such as 8), a positive integer number, (that may be configured via higher layer signaling), a positive integer number, (that may be defined as a function of at least one of the system parameters), or a WTRU identity number, (that may be a C-RNTI or IMSI).

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	 FIG. 8 [0113] FIG. 9 is a diagram of an example of TTI bundling with bitmap indication. The subset of subframes for TTI bundling 905 may be indicated by using a bitmap within the window, and the bitmap may be informed via higher layer signaling.

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	 FIG. 9 [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably.

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		[0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0174] In an example for TDD, the subframe offset(s) may be a function of the TDD UL/DL configuration. [0175] In another example, multiple subframe offsets may be used for the repetition. For example, $N_{offset,1}$ and $N_{offset,2}$ may be used in order to transmit the ePBCH more frequently. The subframe offsets may be predefined as fixed numbers or configured as a function of the physical cell-ID. [0176] In another embodiment for an ePBCH, a smaller number of bits may be used for an SFN indication. For example, a 7-bit or less SFN number indicator may be used instead of an 8 bit SFN number so that the SFN number provided by the ePBCH may be the same in a longer time window. If a 7 bit SFN number indicator may be used, the 7 bit SFN number may, for example, indicate the most significant 7 bits of 10 bit SFN numbers, and a WTRU may implicitly detect the least significant 3 bit number 000, 001, 010, 011, 100, 101, 110, and 111 in each radio frame from, for example, the scrambling code of coded bits, where a broadcast channel (BCH) transport block may be coded/rate-matched and scrambled in bit level so that each radio frame may have a different part of scrambled coded bits. For a 7 bit SFN indication, the ePBCH time window may be 80 ms, which may be double the legacy PBCH time window, where the PBCH time window may be considered as the TTI for a PBCH transmission. [0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be

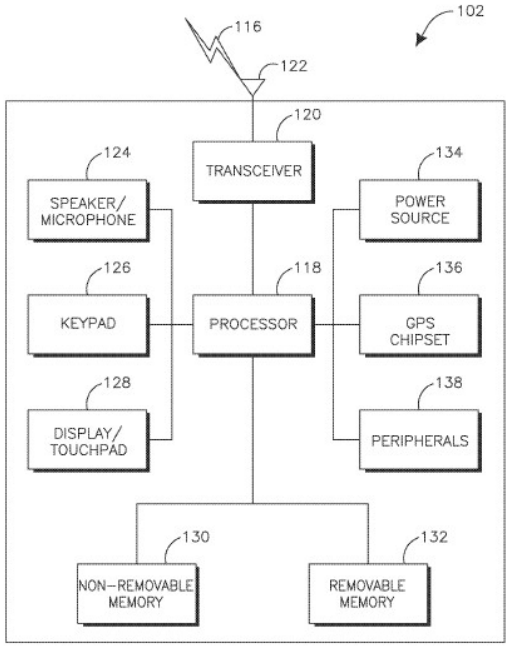
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		consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0206] The known signal may be transmitted by an eNB or cell. The signal may be transmitted in one or more of the following ways. In an example embodiment, the signal may be transmitted in one or more predefined time/frequency resources. In another example embodiment, the signal may be transmitted periodically with a predefined period, which may be a number of frames. In another example embodiment, the signal may be transmitted in a fixed or configured frame or frames within the period. The frame or frames in which the signal may be transmitted may be a function of a cell specific configuration (e.g., physical cell ID). For example, a cell with a PCI of 100 may transmit the known signal every SFN cycle, (e.g., every 1024 frames), to indicate a certain SFN, such as SFN 100, to the WTRU. [0207] In another example embodiment, the signal may be repeated in two or more of the subframes within a frame in which the signal may be transmitted. In another example embodiment, the signal may be a predefined sequence, a system information block, such as an LC-SIB or SIB1, a P-RNTI, or an SI, or an ePBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may

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		integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames

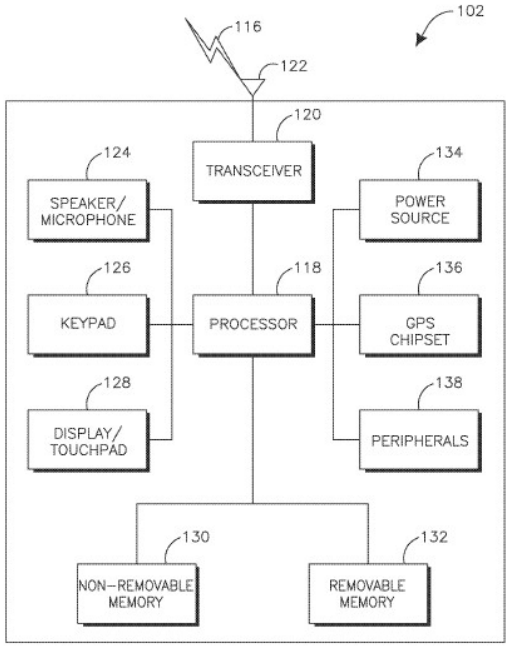
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		beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X. [0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd.

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		[0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames. [0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as

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		an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe. [0257] The PRACH resources which may be used by or may be intended for use by WTRU s which may need or benefit from coverage enhancement may be referred to as enhanced PRACH (ePRACH) resources. The ePRACH resources may be configured by the eNB, for example by signaling to a WTRU, for example by broadcast (e.g., in a LC-SIB).

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	 FIG. 1B To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.

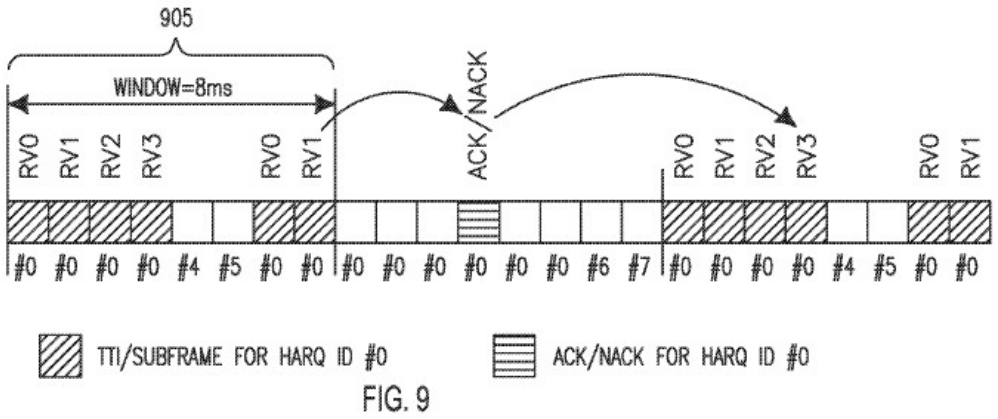
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3[b]	a controller configured to extract downlink control information from the combined downlink control channels,	At least under Pegasus's apparent infringement theory, Lee discloses a controller configured to extract downlink control information from the combined downlink control channels. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

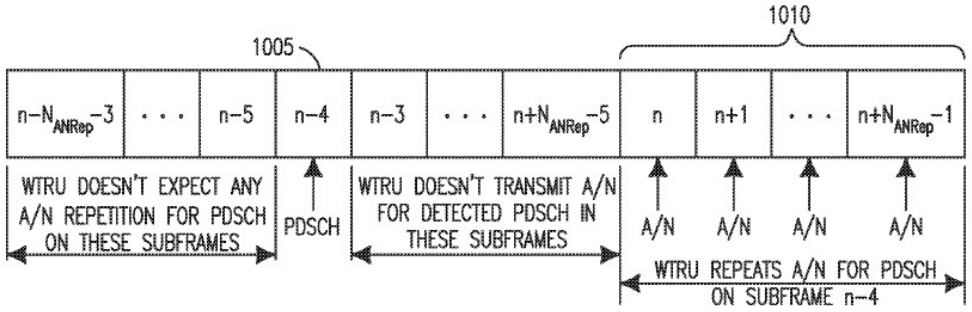
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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		[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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	[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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		example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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		+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes *n*+l, . . ., *n* + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes *n*+l, . . ., *n* + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Re\,p} - 1 \end{cases}$$, Equation 9

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	with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots, N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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		[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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		[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

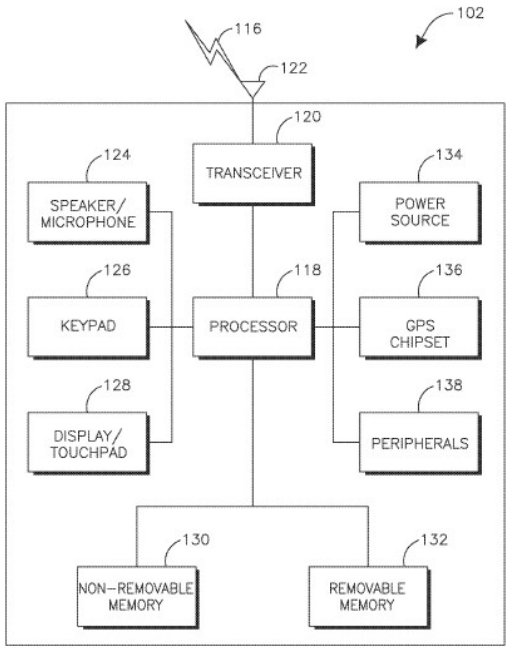
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

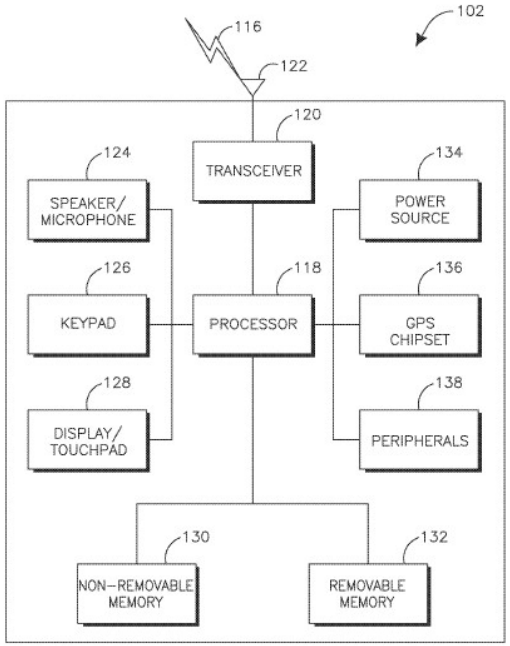
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		may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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	subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

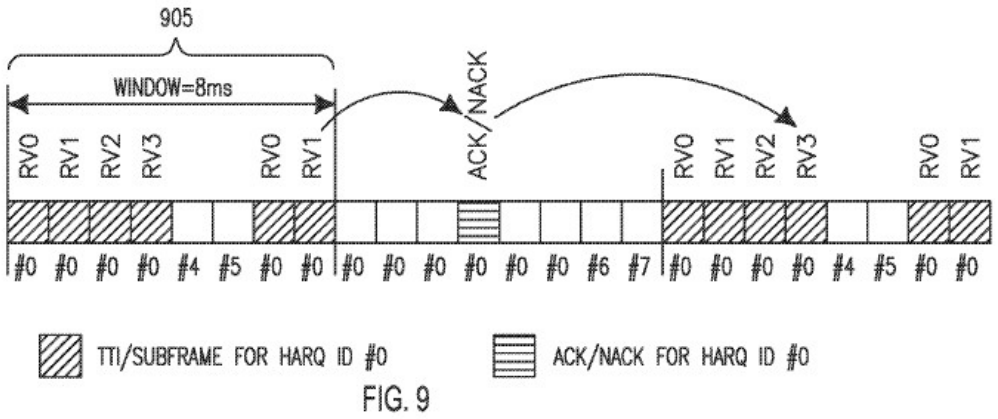
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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.
3[c]	wherein the downlink control information comprises information on the number of the plurality of subframes.	At least under Pegasus's apparent infringement theory, Lee discloses wherein the downlink control information comprises information on the number of the plurality of subframes. For example, Lee discloses this limitation based on the following exemplary citations: [0035] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Array (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

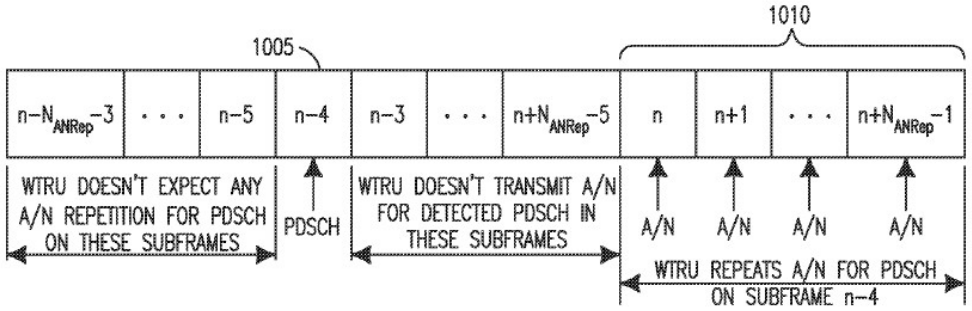
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	 FIG. 1B [0039] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as the non-removable memory 130 and/or the removable memory 132. The nonremovable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from,

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		and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown). [0040] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like. [0041] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment. [0042] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs or video), a universal serial bus (USE) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, and the like. [0106] In another embodiment, TTI bundling may be supported for up to NTTI subframes, where the NTTI subframes may be configured by an eNB in a semi-static manner. In the embodiments described herein, subframe, TTI and ms may be used interchangeably.

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		[0114] TTI bundling may be supported for up to N_{TTI} subframes, where N_{TTI} may be configured by an eNB in a dynamic manner. Here, a WTRU may be configured with a specific transmission mode supporting TTI bundling dynamically. For example, a new transmission mode (e.g., TM-x) and its associated new DCI (e.g., DCI format 1E) may be defined. In the new DCI format, indication bits for TTI bundling may be included so that, for each DL/UL data transmission, the N_{TTI} may be defined so that a WTRU may transmit/receive data N_{TTI} times according to the indication. [0115] A set of TTI bundling cases may be defined via higher layer signaling, and the indication bits in the DCI format may indicate one of the bundling sizes within the set. For example, if four TTI bundling cases are defined as $\{N_{TTr,1}=1, N_{TTr,2}=4, N_{TTr,3}=6, N_{TTr,4}=8\}$, then two bits, for example, for the indication may be used in the DCI format to inform which TTI bundling case is used for the UL and/or DL grant. A set of TTI bundling cases may be predefined and fixed for all WTRUs so that higher layer signaling may not be needed to define the set of TTI bundling cases. The indication bits may still be used to indicate which TTI bundling case is used for the UL and/or DL grant. A WTRU may be configured with TTI bundling dynamically, regardless of the transmission mode configured for PUSCH/PDSCH transmission. A WTRU may not monitor (E)PDCCH for PDSCH including DCI formats 1A/2/2A/2B and 2C in the subframe in which the WTRU may receive a PDSCH as a TTI bundled subframe. For example, if a WTRU receives a DCI containing TTI bundling indication (N_{TTI}) in subframe n for PDSCH and the TTI bundling indication which indicates $N_{TTI}=3$, the WTRU may receive PDSCH in the bundled TTis from subframe n to subframe n+2 and the WTRU may not monitor (E)PDCCH within the subframe n+ 1, and n+2. [0116] Described herein is HARQ processing with TTI bundling. In an embodiment, the bundled TTIs may have a single HARQ_ACK so that a WTRU may transmit/receive a HARQ_ACK after receiving/transmitting bundled TTIs for a PDSCH/PUSCH. A WTRU may transmit a HARQ_ACK when TTI bundling is used in the DL. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n is the last subframe within the bundled subframes associated with the PDSCH. Here, the k may be defined as a fixed positive integer number, such as k=4. A WTRU may transmit HARQ_ACK in the UL subframe n+k if the downlink subframe n includes the PDCCH or EPDCCH associated with the grant for the PDSCH. In this case, the k may be defined as a function of N_{TTI}, (e.g., $k = N_{TTI}+4$).

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	[0117] The subframe n may be the subframe including the PDCCH or EPDCCH associated with the grant for the PDSCH. Here, the k may be defined as a function of the bundling window N_{window} (e.g., $k = N_{window} + 4$). [0118] A WTRU may transmit a HARQ_ACK corresponding to the bundled DL transmission if the WTRU successfully received the PD SCH of the bundled DL transmission. [0119] A WTRU may transmit HARQ_ACK in the UL subframe m if the WTRU received a PDSCH within a time window of x ms, (for example, 8 ms). A single PDSCH may be transmitted over one or more subframes within a time window of x ms. The subframe m may be a predefined subframe, which may be located in the next radio frame of the last subframe of the window in which the corresponding PDSCH is transmitted. The PUCCH resource for HARQ_ACK transmission may be defined as a function of the first CCE and/or enhanced CCE (ECCE) index of the PDCCH/EPDCCH associated with the PDSCH. Alternatively, the PUCCH resource may be defined via higher layer signaling. The term (E)CCE may be used to mean CCE and/or ECCE, which may also be represented by CCE/ECCE. [0120] A WTRU may receive a HARQ_ACK when TTI bundling is used in the UL. A WTRU may receive HARQ_ACK in the DL subframe n+k. The UL subframe n may be the latest subframe within the bundled subframes associated with the PUSCH transmission. Here, k may be a fixed number such as 4. The DL subframe n may be the subframe in which a WTRU receives a UL grant for the associated PUSCH. Here, k may be a function of the bundling size or the bundling window. For example, $k = N_{TTI}+4$ or $k = N_{Window}+4$. [0121] The bundled TTIs may have two or more HARQ_ACKs so that a WTRU may accumulate the multiple HARQ_ACKs in order to improve the coverage. A WTRU may assume that all individual subframes within the bundled subframes may have an associated HARQ_ACK in the subframe n+k, and the multiple HARQ_ACKs may have the same HARQ indicator (HI) code so that the WTRU may add multiple HARQ_ACKs to improve the coverage. The multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For

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		example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted. [0122] A WTRU may assume that a subset of subframes within the bundled subframes may have an associated HARQ_ACK. The WTRU may assume that the subset of subframes have the same HI code. In an embodiment, the multiple HARQ_ACKs for the bundled subframes may be used when the N_{TTI} is larger than a threshold. For example, if N_{TTI} is larger than 4, then a WTRU may assume that multiple HARQ_ACKs are transmitted.  FIG. 9 [0123] FIG. 10 is a diagram illustrating example behavior of a legacy WTRU for an ACK/NACK repetition embodiment. ACK/NACK repetition has been introduced in LTE to enhance coverage for cell edge WTRUs that may be prone to power limitation and/or inter-cell interference. More specifically, if configured, a legacy WTRU may repeatedly transmit ACK/NACK information in the N_{ANRep} -1 consecutive subframes following the initial HARQ_ACK transmission. In terms of the HARQ time line when ACK/NAK repetition is enabled, upon detection of a PDSCH transmission in subframe n-4 (1005), the legacy WTRU may transmit the HARQ_ACK response in N_{ANRep} consecutive subframes (1010) starting from subframe n, unless the WTRU is repeating the

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	transmission of an HARQ_ACK in subframe n corresponding to a PDSCH transmission in subframes n - N_{ANRep} - 3, . . . , n - 5. The legacy WTRU also may ANRep not transmit any HARQ_ACK response corresponding to any detected PDSCH transmission in subframes n – 3, . . . , n + N_{ANRep} - 5.  FIG. 10 [0124] FIG. 11 is a diagram of an example of ACK/NACK repetition for DL subframe bundling. In an embodiment where subframe bundling is used in the DL to improve DL coverage, a WTRU may repeat the transmission of a single HARQ_ACK response corresponding to the whole PDSCH transmissions within the bundle on the UL. Thus, the WTRU may first collect and decode all PDSCH transmissions within the DL subframe bundle and then generate a single HARQ_ACK response for transmission on the UL. As for UL ACK/NACK timing, according to an embodiment, the WTRU may, upon detection of a PDSCH transmission within subframe(s) n-1 (1105), (where 1 is the index of the subframe within the DL subframe bundle), intended for the WTRU, transmit the initial HARQ_ACK response in UL subframe n (1110) and then repeat the HARQ_ACK response in n+1, . . ., n+N_{ANRep}-1 subframes (1115). In the example illustrated in FIG. 11, the index 1 is 3, 4 or 5, and the size of the DL subframe bundle is three. [0125] For a PDSCH transmission with a corresponding (E)PDCCH detected m subframes within the DL subframe bundle, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of the corresponding ACK/NACK response for the entire DL bundle transmission on subframes n+l, . . ., n

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		+ N_{ANRep} -1 using the PUCCH resources derived from the corresponding (E)PDCCH (E)CCE index detected in the bundled subframes. Accordingly, for every subframe within the DL subframe bundle, the WTRU may first detect the (E)PDCCH in that subframe and then derive the PUCCH index for ACK/NACK repetition in the corresponding UL subframe based on the lowest (E)CCE index used to construct the corresponding DCI assignment. [0126] The WTRU may repeat the transmission of the corresponding ACK/NACK response for the entire DL transmission on subframes *n*+l, . . ., *n* + N_{ANRep} -1 using the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the last subframe of the bundle, the PUCCH resource derived from the (E)PDCCH (E)CCE index detected in the first subframe of the bundle, or the PUCCH resource configured by higher layer signaling. [0127] For a PDSCH transmission without a corresponding (E)PDCCH detected m the bundled subframes, the WTRU may transmit the initial ACK/NACK response corresponding to the entire DL bundle transmission in UL subframe n and then may repeat the transmission of corresponding ACK/NAK response for the whole transmission on subframes *n*+l, . . ., *n* + N_{ANRep} - 1 using the PUC CH resource derived from the (E)PDCCH (E)CCE index detected in the most recent DL scheduling assignment, or the PUCCH resource configured by higher layer signaling. [0128] In LTE, ACK/NACK repetition may be limited to a repetition factor of four to enhance UL coverage. A WTRU may need to retransmit the ACK/NACK response using a higher repetition factor. The enhanced repetition factor used by the WTRU may be signaled to the WTRU through a higher layer or may be implicitly derived based on subframe bundling parameters used in the DL. For example, this may be indicated by the number of DL subframes within a bundle or a function of the number of DL subframes within a bundle. [0129] Described herein are methods that may be used by the WTRU to improve PHICH coverage in the DL. The methods or embodiments may be employed singularly or in combination with one another.

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	[0130] In an embodiment of PHICH repetition, the WTRU may receive and detect the ACK/NACK (A/N) information associated with the UL PUSCH transmission using multiple PHICH resources. In this embodiment, the ACK/NACK information transmitted on the PHICH may be associated with the UL PUSCH transmission over a single subframe. For a subframe bundling operation, the ACK/NACK feedback may be associated with the bundled PUSCH transmission over multiple subframes. The ACK/NACK feedback may also be distributed over multiple subframes or within a single subframe. This may be different from legacy WTRU operation where a WTRU may process a single PHICH resource for a given subframe corresponding to a single UL transport block. [0131] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from physical resource block (PRE) indices of the UL resource allocation. The PRB indices may be associated with the PRBs used for PUSCH transmission within a single subframe. Here, for a given subframe, a WTRU may use the lowest index PRB to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the PRB index that constitutes its UL resource allocation based on its configured PHICH repetition factor. [0132] Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ may be the PHICH group number and $n_{PHICH,i}^{seq}$ may be the orthogonal sequence index within the group for the ith PHICH resource, which may be defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA,i} + n_{DMRS}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA,i} / N_{PHICH,i}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$, Equation 8 where $$I_{PRB\_RA,i} = \begin{cases} I_{PRB\_RA}^{lowest\_index} + i \\ i = 0,\ldots,N_{PHICH\,Re\,p} - 1 \end{cases}$$, Equation 9

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		with $N_{PHICHRep}$ being the PHICH repetition factor. [0133] For a subframe bundling operation, PHICH resources may be derived from the PRB indices associated with UL transmissions over multiple UL subframes in the bundle. This approach may be different from that of the legacy WTRU behavior wherein the corresponding PHICH resource 1s exclusively associated with the last subframe in the bundle. [0134] In terms of PHICH resources, a WTRU may determine the corresponding PHICH resources from UL demodulation reference symbol (DMRS) cyclic shift associated with PUSCH transmission(s). DMRS cyclic shifts may be associated with the PUSCH transmission within a single subframe. Here, for a given subframe, the WTRU may use the cyclic shift from the DMRS field in the most recent PDCCH to determine its first PHICH resource and then determine its other assigned PHICH resources within that subframe by sequentially increasing the cyclic shifts. There may, however, be a limit of a maximum of eight cyclic shifts that may be used by the WTRU. Thus, PHICH resources may be identified by the index pair $(n_{PHICH,i}^{group}, n_{PHICH,i}^{seq})$ where $n_{PHICH,i}^{group}$ is the PHICH group number and $n_{PHICH,i}^{seq}$ is the orthogonal sequence index within the group for the ith PHICH resource as defined by: $$n_{PHICH,i}^{group} = (I_{PRB\_RA} + n_{DMRS,i}) \bmod N_{PHICH,i}^{group} + I_{PHICH} N_{PHICH,i}^{group}$$ $$n_{PHICH,i}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH,i}^{group} \rfloor + n_{DMRS,i}) \bmod 2N_{SF}^{PHICH}$$, Equation 10 where $$n_{DMRS,i} = \begin{cases} n_{DMRS} + i \\ i = 0,\ldots,N_{PHICH\,Rep} - 1 \end{cases}$$, Equation 11 with $N_{PHICHRep}$ as the PHICH repetition factor. [0135] In an embodiment of PHICH power boosting, depending on a WTRU's channel conditions, power control may be applied on the PHICH. Power boosting, together with ACK/NACK repetition using multiple PHICH resources, may considerably enhance the coverage of the PHICH.

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	[0136] In a PHICH without code-division multiplexing (CDM), a legacy PHICH group may include multiple PHICH resources that are code-division multiplexed and mapped to the same set of resource elements. This may result in power splitting across multiple PHICH resources at the transmitter. Further, due to channel estimation error at the WTRU, orthogonality among PHICH resources that are code-division multiplexed within a PHICH group may be lost, which, in turn, may result in loss of coverage. In an embodiment, a WTRU may assume that there is only one PHICH resource utilized within the PHICH group without any code-division multiplexing. [0137] In an embodiment, a PHICH, or a group of PHICHs, may be transmitted using enhanced PHICH (EPHICH). For example, a new DCI format may be defined to carry information for PHICH or a group of PHICHs. For another example, a DCI including A/N information may be transmitted in a specific (E)PDCCH location including (E)PDCCH common search space. Alternatively, a DCI including A/N information may be transmitted in a predefined (E)CCE or a higher layer configured (E)CCE. For another example, a new RNTI may be defined for detection of a DCI including A/N information. For example, a HARQ RNTI (HA-RNTI) may be defined, and if a WTRU transmitted the PUSCH in a subframe n, the WTRU may monitor a DCI that includes corresponding A/N information whose CRC may be scrambled with an HA-RNTI in the subframe n+k, where the k may be 4 in an FDD case. [0138] The location of an A/N information bit for a WTRU transmitting the PUSCH in a subframe n may be defined and may include at least one of the starting (E)CCE number of a corresponding UL grant, the starting PRB number for a PUSCH transmission, cyclic shift of the uplink DM-RS, or a higher layer configured value. The number of DCis including A/N information may be configured as the number of PHI CH groups. [0139] Described herein are coverage enhancement methods to improve coverage of an (E)PDCCH carrying DCI that includes A/N information. The (E)PDCCH has been used for DL/UL grants, broadcasting channel transmissions, paging, RACH responses, group power control, and the like. DCI formats have been introduced to support various DL/UL transmission modes, such as DCI formats 0 and 4 for UL grant, DCI formats 1A, 1B, 1C, 2, 2A, 2B, 2C for DL transmission, and DCI

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		formats 3 and 3A for group power control. Embodiments described herein may be applied for both PDCCH and EPDCCH or may only be applicable for either PDCCH or EPDCCH. Terminology typically used with respect to the PDCCH, such as CCE, resource element group (REG), PDCCH candidates, and search space, may be used interchangeably with ECCE, enhanced REG (EREG) and EPDCCH candidates and search space. [0140] In an embodiment, DCI contents may be downsized for better coverage. Since (E)PDCCH link adaptation may be based on the number of (E)CCEs, the number of (E)CCEs may be closely related to the coverage of the (E)PDCCH. For example, 1 CCE may be equivalent to the coding rate ½. Thus, the 2 CCEs may be equivalent to the coding rate ¼ because double the number of (E)PDCCH resources are used for a DCI transmission. Since there are four CCE aggregation levels available, (for example, {1, 2, 4, 8}), reducing DCI contents may increase the coverage of the (E)PDCCH in a given (E)CCE aggregation level. [0141] A new DCI format associated with DL transmission and/or UL grant may be defined, for example, for this category of WTRUs. Two or less bits may be used for HARQ process number indication, which implies that the number of HARQ processes may be reduced from 8 HARQ processes. No HARQ process number field may be included in the DCI so that a single HARQ process or a synchronous HARQ process is used. Four or less bits may be used for a modulation and coding scheme (MCS) indication. Assuming that N-bit (N<5) may be used for the MCS, the most significant bit (MSB) of the 5-bit MCS table may be assumed at the receiver, and the least significant bit (LSB) may be assumed as a predefined bit. For example, a 3-bit MCS field (N=3) may be used in a new DCI format, the three bits corresponding to the first three bits of the MCS table, and the two bit LSB may be predefined as '00'. Therefore, the three bits of the MCS table may be used with the 3-bit MCS field, and a WTRU may interpret the 3-bit MCS field as xxx00, where xxx is the MSB of the 5-bit MCS field and '00' is the 2-bit LSB. Alternatively, a 3-bit MCS field may be considered as a part of the LSB, and the MSB may be predefined. For both alternatives, the LSB part or MSB part of the 5-bit MCS field, which is not indicated by the 3-bit MCS field in the new DCI format, may be either predefined or configured by higher layer signaling and/or broadcasting.

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	[0145] In another embodiment, a repetition or extension of the (E)PDCCH format may be used to improve (E)PDCCH coverage. The repetition of (E)PDCCH may be applied in a subframe or over multiple subframes. For embodiments described herein, (E)PDCCH coverage enhancement mode, (E)PDCCH coverage extension, coverage enhancement mode, and coverage enhanced mode may be used interchangeably. [0152] The subframes may be bundled for an (E)PDCCH transmission in the (E)PDCCH coverage enhancement mode. For instance, an (E)PDCCH may be transmitted for K-subframes (where K> 1). Within the bundled subframe, the starting (E)CCE number may be the same so that a WTRU may integrate the (E)CCEs over multiple subframes without demodulation. The (E)PDCCH coverage enhancement mode may be applicable to a WTRU-specific search space. The (E)PDCCH coverage enhancement mode may be used irrespective of the transmission. The (E)PDCCH coverage enhancement mode may only be applicable for a specific DCI format and/or transmission mode. [0156] Described herein improved methods for providing enhanced or improved PBCH coverage. The PBCH may include some important information for initial access in order to allow DL signal reception at a WTRU receiver, such as DL system bandwidth, SFN number information, (for example, 8 MSBs of a 10 bit SFN), PHICH configuration, and number of common reference signal (CRS) ports. Embodiments described herein may provide robust system information for a WTRU suffering from low received SINR. Some embodiments may be based on actual PBCH coverage enhancement and other embodiments may use another container for carrying the system information. [0171] In an embodiment, a WTRU may determine the SFN of a radio frame (e.g., of one or more radio frames in a set such as a consecutive set of radio frames, e.g., the first radio frame in the set) based on information carried by the ePBCH and/or based on the frame or frames in which the WTRU may determine ePBCH to be present. The WTRU may, for example, use a window approach in which it may know what to expect regarding ePBCH (e.g., format, content, coding, and the like) in a set of subframes within a set of frames (e.g., 3 subframes in each of 4 consecutive frames) in which ePBCH may be present. The WTRU may move the window from one set of frames to the next, may attempt to decode ePBCH (which may include combining across subframes and/or frames

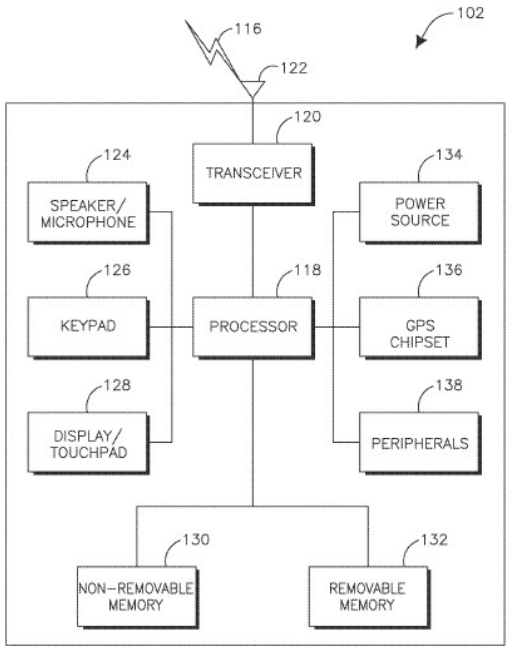
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		as needed to achieve gain), and may move the window a number such as one frame at a time until it may decode ePBCH information bits. Once the WTRU may successfully decode the ePBCH, it may obtain the SFN (e.g., SFN of the first frame of the window) from the information bits, or the WTRU may determine the SFN based on the frames in which it may have found the ePBCH, for example, based on the certain (e.g., certain known) SFNs or certain (e.g., certain known) SFN properties of the frames in which ePBCH may be found. As a variation, PBCH may be used in addition to ePBCH, for example in the case that the ePBCH signal structure in a frame is the same as the PBCH signal structure in the frame. PBCH may be treated in the same manner as if it were ePBCH and may be combined with ePBCH, for example to achieve gain. [0181] A new DCI format may be defined for the system information. For example, DCI format-x may be defined for the system information and may include one or more of the following: DL system bandwidth, PHICH configuration, SFN number. The DCI format may contain the same information provided by the legacy PBCH and that information may represented the same way (e.g., the information elements (IEs) of the MIB may be included in the DCI). The same coding chain with other DCI formats may be used for the system information DCI format-x. Predefined ECCE numbers may be used for the DCI format-x. Here, the aggregation level may be a predefined number (for example, 8), or multiple aggregation levels may be used in a blind decoding manner. [0182] The DCI format-x that may include system information may be transmitted periodically in a predefined subframe. For example, in every subframe 4 in a radio frame, the DCI format-x may be transmitted within the EPDCCH common search space, (or other search space that may be used for system information). [0183] The subframe location in a radio frame may be different, such as 2, 3, 4, or 6. Therefore, a WTRU under a coverage enhancement mode of operation may decode the DCI format-x which may include system information rather than the PBCH. [0184] In TDD, the subframe location may be defined as a function of the TDD UL/DL subframe configuration. For example, subframe 4 may be used in UL/DL subframe configuration 1, while subframe 3 may be used in UL/DL subframe configuration 2.

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		[0185] Consecutive subframes, or multiple subframes, which may be in a certain time window, may include the DCI format-x without changing the SFN number. In order to improve the coverage, the DCI format-x may be transmitted repetitively for multiple subframes which may, for example, be consecutive DL subframes. Since the SFN may not be changed in these multiple subframes, a WTRU may integrate the DCI format-x to improve the coverage. The time window may be a radio frame. The multiple subframes in which DCI format-x may be transmitted without changing the SFN number may be in the same frame. [0189] An eNB or cell may transmit, and a WTRU may receive, for example, in a channel other than the PBCH, such as the (E)PDCCH CSS or SI-PDCCH, a subset of the system information that may be included in the legacy PBCH. [0208] A WTRU may receive or attempt to receive and/or decode the signal m one or more subframes of a frame in which the signal may be transmitted. The WTRU may combine (e.g., integrate) signals from multiple such subframes within a frame in which the signal may be transmitted and may use that combination to successfully receive and/or decode the signal, for example, in a single frame. [0209] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with full resolution. For example, the signal may be transmitted in a certain frame, (e.g., frame 0), once every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU may integrate the signal over multiple frames, which may be separated by SFN cycle frames to achieve successful reception. The certain frame may be fixed or may be a function of a physical cell ID. [0210] In another embodiment, the signal may be transmitted m multiple subframes, (e.g., certain subframes or all DL subframes), of a certain frame every SFN cycle, (e.g., every 1024 frames), and may be used to indicate a certain SFN, such as 0. Upon successful reception of the signal, the WTRU may understand the frame of the reception to be the certain SFN, (e.g., SFN 0). The WTRU

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	may integrate the signal over one or more of the multiple subframes to achieve successful reception. Successful reception by the WTRU may be accomplished in one frame. The certain frame and/or subframes may be fixed or may be a function of physical cell ID. [0211] The frame or frames in which the signal may be transmitted and/or the periodicity of the transmission may indicate the SFN with reduced resolution. For example, the signal may be transmitted every N frames, where (SFN cycle)/N may be an integer. The WTRU may integrate its reception in a certain frame, such as every Nth frame, until the signal is successfully received. Since the signal may be transmitted every N frames, the resolution of the SFN may be reduced. [0212] For example, once a WTRU may successfully receive the signal, which it may accomplish by integrating signals it receives every N frames, (e.g., in certain one or more subframes every N frames), then the WTRU may understand which frames are the set of frames X, (X + N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc., but may not know which frame is which. For instance, X may be 0, another known value, or X may be a function of a physical cell ID. For example, if X=0, N=8, and the SFN cycle is 1024, the WTRU may determine which frames are the set of frames that includes frames 0, 8, 16, ... 1016 but may not know which frame is which. For another example, if X=0, N=512, and the SFN cycle = 1024, the WTRU may determine which frames are the set of frames that includes frames 0 and 512, but it may not know which is frame 0 and which is frame 512. [0213] The value of X may be provided to the WTRU via signaling, such as broadcast signaling, which may, for example, be provided in the frames in which the signal used for SFN determination may be transmitted. The WTRU may use the value of X to determine a revised set of frames beginning with 0 (e.g., 0, N, 2N, etc.). For example, if X=3, N=8, and the SFN cycle = 1024, the WTRU may recognize the set of frames that are 3, 11, 19, etc. In those frames, the WTRU may receive signaling, such as broadcast signaling, which identifies X to be 3. The WTRU may then determine which frames are the set of frames 0, 8, 16, 24, etc .. [0214] If an SIB or other control signaling may be used as the signal for SFN determination, that SIB or control signaling may include the value of X.

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		[0215] When a WTRU understands the SFN with reduced resolution, (e.g., the set of frames X, (X+N) modulo SFN cycle, (X+2*N) modulo SFN cycle, (X+3*N) modulo SFN cycle, ... , etc.), the WTRU may implicitly determine which frames are even, which are odd and the frames between the known frames. The WTRU may use that information for certain procedures, such as a random access procedure. For example, if a WTRU may know the set of frames 0, 8, 16 ... , it may also know the set of frames 1, 9, 17 ... and 2, 10, 18 ... , by shifting by one and two frames, respectively. The WTRU may, therefore, know which are the even and which are the odd subframes that may be needed for a random access procedure, such as an initial random access procedure. [0216] Acquisition or determination of a subset SFN by a WTRU may mean or result in the WTRU distinguishing one or more sets of frames, which may include every Nth frame, (where N is the period in frames of the signal), which may be used by the WTRU to determine the subset SFN. The sets of frames may be unique. There may be up to N such sets of frames. The number of elements in each set may be (SFN cycle)/N. This may be equivalent to the WTRU understanding, for each frame, the value of SFN for that frame modulo N. [0217] A WTRU may acquire or determine a subset SFN based on acquisition of an LC-SIB, pre-defined frame rules, and periodicity of the LC-SIB transmission. A WTRU may acquire or determine the subset SFN based on properly decoding SIB1. For example, SIB1 may be transmitted in SFN X, where X may be O and may be repeated every 20 ms, which may correspond to every 2 frames, (e.g., even frames). The WTRU may understand that acquisition of SIB1 may correspond to finding the even frames, which may enable the WTRU to determine which frames are even and which are odd. [0218] A WTRU may acquire or determine a subset SFN based on PRNTI detection in the common search space of PDCCH or EPDCCH given the paging density of the cell, (e.g., nB parameter in RRC), is greater than 1 frame, (e.g., nB = T/2, T/4, T/8, T/16 or T/32). [0219] A WTRU may acquire a subset SFN based on SI periodicity, which may be indicated in the SI schedule. The configuration of certain SI may allow for periodicity of up to 512 frames.

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		[0220] In another embodiment, the determination of SFN may be based on reception, (e.g., successful reception), of a full resolution SFN and/or a subset SFN. A subset SFN may be sufficient for certain procedures, such as system information acquisition, and random access, such as initial random access, (e.g., random access). [0221] The eNB or cell may transmit a signal, which may include a full resolution SFN, (e.g., 10-bit resolution for a SFN cycle of 1024), and/or a subset SFN. One or more of the following may apply to the signal. In an example, the subset SFN may represent the least significant B bits of the full resolution SFN, such as the 3 least significant bits. This may correspond to SFN modulo (2A B), which for the example of 3 bits, may be SFN modulo 8. Given successful reception of the subset SFN, the WTRU may acquire SFN modulo (2A B) for the frames in which the subset SFN may be received and may use that to understand SFN modulo (2A B) for other frames, such as all frames. [0222] In another example, the full resolution SFN may be transmitted periodically with a shorter duty cycle than the SFN cycle. For example, the signal with the full SFN may be transmitted every 8, 16, or 32, frames, among others. The subset SFN may be transmitted once or multiple times during the duty cycle of the full SFN. The full SFN and/or the subset SFN may be transmitted in one or more, including possibly all or all DL, subframes in the frames in which they are each transmitted. The full SFN and the subset SFN may be transmitted in a different number of subframes in the frames in which they are transmitted [0223] In another example, the definition of periodicity and length of signaled SFN for a cell may be a function of the acceptable tolerance to delay for the cell access procedure of the device, such as an LC-MTC device, as well as the cell specific configuration for certain SFN-based procedures, such as DRX and RACH access. The signaled SFN by a cell may be the full SFN and/or a subset of SFN, based on the periodicity of the full SFN and/or subset of SFN. [0224] A WTRU may acquire and decode a signal, which may include a full SFN or a subset SFN. A WTRU may understand which SFN to receive based on the schedule or schedules for the different SFN s. A WTRU may integrate or otherwise combine same signals (e.g., full SFN with full SFN,

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		subset SFN with subset SFN) from multiple subframes in a frame in order to successfully receive a signal. [0225] A WTRU may integrate or otherwise combine identical signals (e.g., full SFN with full SFN, subset SFN with subset SFN) from multiple frames, such as signals in frames that are separated by the periodicity of the transmission, in order to, for example, successfully receive the signal. This may be applicable to a full SFN when the periodicity is equal to the SFN cycle. This may also be applicable to the subset SFN when the periodicity is a multiple of the subset SFN cycle. For example, if the subset is 3 bits, then the subset cycle may be 8. The SFN subset signals in a given frame may be combined with SFN subset signals that are 8, or a multiple of 8, frames away from that subframe.  FIG. 1B

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		To the extent it is found that Lee does not expressly disclose this limitation, the limitation is inherent. Moreover, to the extent it is found that Lee does not anticipate this claim, Lee renders it obvious, either alone, in combination with the knowledge of a person of ordinary skill in the art, and/or in combination with other prior art references identified in the cover pleading or herein. A person of ordinary skill in the art would have been motivated to combine Lee with any of the other prior art references identified in the cover pleading or herein with a reasonable expectation of success because each of these references contains familiar elements within the same field of endeavor to address the same known problems, according to known methods which would yield predictable results.