

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC.
NOKIA OF AMERICA CORPORATION
Petitioners,

v.

ACTIVE WIRELESS TECHNOLOGIES LLC
Patent Owner.

U.S. PATENT NO. 10,531,443
Title: PHYSICAL UPLINK CONTROL CHANNEL (PUCCH) FORMAT
ADAPTION FOR 5TH GENERATION (5G) NEW RADIO (NR)

Inter Partes Review No.: IPR2024-00951

PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 10,531,443

Mail Stop “PATENT BOARD”
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. OVERVIEW	1
III. GROUNDS FOR STANDING (37 C.F.R. §42.104(A)).....	7
IV. REASONS FOR THE REQUESTED RELIEF	8
V. BACKGROUND	8
A. Summary of the '443 Patent.....	8
B. Prosecution History	8
C. Priority Date	9
D. Claim Construction	9
E. Person of Ordinary Skill in the Art (“POSITA”).....	9
F. State of the Art	10
1. Mobile Wireless Communication Systems.....	10
2. Hybrid-ARQ Acknowledgements (“HARQ-ACK”)	11
3. DCI Decoding	12
4. Search Space Configurations	13
5. U.S. Patent No. 10,735,170.....	17
6. Summary	19
VI. IDENTIFICATION OF CHALLENGES	19
A. Challenged Claims	19
B. Statutory Ground for Challenges.....	19
VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE	

UNPATENTABLE.....	20
A. Ground 1: The Challenged Claims are unpatentable over Wang.....	20
1. Overview of Wang	20
2. Detailed Application of Wang	23
a. Claim 3.....	23
[3.0] A base station (gNB), comprising:.....	23
[3.1] sending circuitry configured to send a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	25
[3.2] receiving circuitry configured to receive CBG based HARQ-ACK, wherein	29
[3.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the receiving circuitry is configured to receive one HARQ-ACK bit for the transport block, ...	32
[3.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the receiving circuitry is configured to receive HARQ-ACK bits of all CBGs.	34
b. Claim 5.....	36
[5.0] A communication method of a base station comprising:.....	37
[5.1] sending a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	37

	[5.2] receiving CBG based HARQ-ACK, wherein	37
	[5.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is received, ...	37
	[5.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are received.	37
c.	Claim 1	38
	[1.0] A user equipment (UE), comprising:	38
	[1.1] receiving circuitry configured to receive a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	38
	[1.2] transmitting circuitry configured to transmit CBG based HARQ-ACK, wherein	38
	[1.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the transmitting circuitry is configured to report one HARQ-ACK bit for the transport block, ...	38
	[1.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the transmitting circuitry is configured to report HARQ-ACK bits of all CBGs.	39
d.	Claim 2	39

	[2.0] The UE of claim 1, wherein determining circuitry configured to determine a physical uplink control channel (PUCCH) resource for transmission of the CBG based HARQ-ACK which PUCCH resource is one of a plurality PUCCH resources defined for different payload sizes.....	39
e.	Claim 4.....	41
	[4.0] A communication method of a user equipment (UE) comprising:.....	41
	[4.1] receiving a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	41
	[4.2] transmitting CBG based HARQ-ACK, wherein	41
	[4.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is transmitted, ...	41
	[4.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are transmitted.	41
B.	Ground 2: The Challenged Claims are unpatentable over Yang.	42
1.	Overview of Yang.....	42
2.	Detailed Application of Yang	45
a.	Claim 3.....	45
	[3.0] A base station (gNB), comprising:.....	45
	[3.1] sending circuitry configured to send a	

	physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	47
[3.2]	receiving circuitry configured to receive CBG based HARQ-ACK, wherein	51
[3.3]	for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the receiving circuitry is configured to receive one HARQ-ACK bit for the transport block, ...	55
[3.4]	for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the receiving circuitry is configured to receive HARQ-ACK bits of all CBGs.	60
b.	Claim 5.....	63
[5.0]	A communication method of a base station comprising:	64
[5.1]	sending a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	64
[5.2]	receiving CBG based HARQ-ACK, wherein	64
[5.3]	for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is received, ...	64
[5.4]	for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are received.	64

c.	Claim 1.....	64
	[1.0] A user equipment (UE), comprising:	65
	[1.1] receiving circuitry configured to receive a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and	65
	[1.2] transmitting circuitry configured to transmit CBG based HARQ-ACK, wherein	65
	[1.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the transmitting circuitry is configured to report one HARQ-ACK bit for the transport block, 65	
	[1.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the transmitting circuitry is configured to report HARQ-ACK bits of all CBGs.	66
d.	Claim 2.....	66
	[2.0] The UE of claim 1, wherein determining circuitry configured to determine a physical uplink control channel (PUCCH) resource for transmission of the CBG based HARQ- ACK which PUCCH resource is one of a plurality PUCCH resources defined for different payload sizes.....	66
e.	Claim 4.....	68
	[4.0] A communication method of a user equipment (UE) comprising:	69
	[4.1] receiving a physical downlink shared channel	

	(PDSCH) that includes code block groups (CBGs) of a transport block; and	69
	[4.2] transmitting CBG based HARQ-ACK, wherein	69
	[4.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is transmitted, ...	69
	[4.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are transmitted.	69
VIII.	THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION	70
A.	The Board Should Not Deny Institution Under 35 U.S.C. § 325(d)	70
B.	The Board Should Not Deny Institution Under 35 U.S.C. § 314(a).....	70
IX.	MANDATORY NOTICES UNDER 37 C.F.R. §42.8.....	73
A.	Real Party-in-Interest (37 C.F.R. § 42.8(b)(1)).....	73
B.	Related Matters (37 C.F.R. § 42.8(b)(2)).....	74
1.	Judicial Matters	74
2.	Administrative Matters:	75
3.	Related Patents.....	75
C.	Lead/Back-up Counsel (37 C.F.R. § 42.8(b)(3)):	75
D.	Notice of Service Information (37 C.F.R. § 42.8(b)(4)):.....	75
X.	CONCLUSION.....	76

CERTIFICATION OF SERVICE ON PATENT OWNER.....	1
---	---

Petitioners' Exhibit List

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 10,531,443 (the "'443 Patent")
1002	Select portions of prosecution history of the '443 Patent ("File History")
1003	Declaration of Petitioners' Expert Dr. Mark P. Mahon
1004	U.S. Pat. No. 11,206,108 ("Wang")
1005	U.S. Pat. No. 11,012,221 ("Yang")
1006	Chinese Pat. App. 201710288177.X ("Wang Foreign Priority Application")
1007	English translation of the Wang Foreign Priority Application
1008	U.S. Provisional Pat. App. 62/501,048 ("'048 Application")
1009	English translation of the '048 Application
1010	U.S. Pat. No. 10,735,170 ("'170 Patent")
1011	U.S. Pat. No. 8,223,712 ("'712 Patent")
1012	U.S. Pat. No. 9,344,259 ("'259 Patent")

I. INTRODUCTION

Pursuant to 35 U.S.C. §§ 311 *et seq.* and 37 C.F.R. §§ 42.1 *et seq.*, Ericsson Inc. and Nokia of America Corporation (collectively “Petitioners”) hereby petition for an *inter partes* review (“IPR”) of U.S. Patent No. 10,531,443 (the “’443 Patent”). Petitioners respectfully submit that claims 1-5 (the “Challenged Claims”) of the ’443 Patent are unpatentable under 35 U.S.C. §103 over the prior art herein – none of which was considered during prosecution or any IPR petition.

II. OVERVIEW

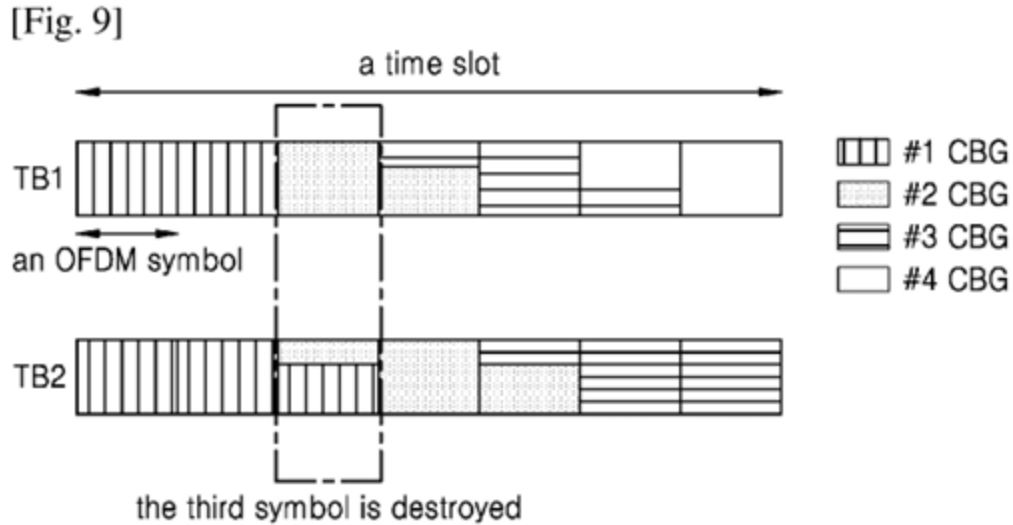
The Challenged Claims are directed to techniques for improving wireless communications between a base station (“BS”) and user equipment (“UE”) for 5th generation (“5G”) cellular communications. In particular, the Challenged Claims relate to separating a large transmission block of data into smaller blocks and providing “acknowledgements” for the successful (or unsuccessful) transmission of each smaller block.

A cellular (mobile) network is a radio network distributed over land areas called cells. EX-1003, ¶196. Each cell is served by at least one fixed-location transceiver, referred to as a BS. EX-1003, ¶196. Communications from BSs to UEs, such as cellular phones, are sent as blocks of data. EX-1003, ¶197. To ensure that the blocks have been received by the UE, the UE sends back an acknowledgement related to those blocks. EX-1003, ¶197. If the acknowledgement

indicates a successful transmission, then the processing continues, however, if the acknowledgement indicates a failed transmission, the BS re-transmits the same block to the UE again. EX-1003, ¶197. This concept of BS transmissions followed by UE acknowledgements (and possible re-transmissions) has been known and used throughout the history of wireless communications. EX-1003, ¶197.

The '443 patent relates to a specific improvement in this known sequence. In 4G LTE systems, the BS transmits blocks of data in transport blocks (“TBs”) and the UE sends an acknowledgement for each TB. EX-1003, ¶198. However, TBs may be up to 3824 bits. EX-1003, ¶198. So, if only 1 bit out of 3824 bits failed in a transmission, the BS had to re-send the entire TB. EX-1003, ¶198.

To address this issue, in 5G, the TBs may be broken up into smaller units called code block groups (“CBGs”). EX-1003, ¶199. For example, Figure 9 of one of the primary prior art herein, U.S. Pat. No. 11,206,108 (“Wang”) (EX-1004) (shown below) illustrates two TBs, each subdivided into multiple CBGs:



EX-1004, Fig. 9; *see also* EX-1003, ¶199.

The UE can evaluate each CBG for successful transmission, and send back an acknowledgement for each CBG. EX-1003, ¶201. If retransmission is needed as a result of an unsuccessful initial transmission, the BS now only needs to retransmit one of the smaller CBGs rather than the entire TB. EX-1003, ¶201.

The wireless systems may still send one acknowledgement bit for the entire TB, but now may also send individual bits for each CBG, if desired. EX-1003, ¶202. Thus, the Challenged Claims relate to the fundamentally unpatentable concept of breaking up larger blocks into smaller sub-blocks and sending acknowledgements on a more refined basis for each CBG within each TB. EX-1003, ¶205.

The Challenged Claims also include criteria to specify whether to send an acknowledgement for the TB or the CBGs. EX-1003, ¶203. The transmissions

from the BS to the UE can be either “common,” such that they are meant to be received by all UEs in the cell, or “user-specific,” such that they are meant only for a particular UE within the cell. EX-1003, ¶203. These transmissions are referenced as being in a “common search space” (“CSS”) or a “UE-specific search space” (“USS”). EX-1003, ¶203.

The Challenged Claims recite the design choice of using (1) the 1-bit acknowledgement per TB for CSS transmissions and (2) the 1-bit acknowledgement per CBG for USS transmissions. EX-1003, ¶204. Notably, the ’443 patent does not teach any advantage to this particular design choice. EX-1003, ¶204.

The ’443 patent uses specific terminology to describe this basic and known process above. EX-1003, ¶205. Specifically, the BS sends a physical downlink shared channel (“PDSCH”) message to a UE which includes CBGs of a TB, and in return, receives CBG based hybrid-ARQ acknowledgements (“HARQ-ACK”) feedback. EX-1003, ¶205. The control channel format and resource for HARQ-ACK feedback may be determined by the scheduling space for CBG-based HARQ-ACK, such that if a PDSCH is scheduled in CSS, the UE will report only one HARQ-ACK bit per TB, but if the PDSCH is scheduled in USS, the UE will report HARQ-ACK bits for all CBGs received. EX-1001, 2:61-3:3; EX-1003, ¶205.

The following series of annotated Figures 1 graphically depicts Challenged

Claim 3. EX-1003, ¶206. As shown below, the BS (highlighted in yellow) includes both sending circuitry (outlined in red) to send downlink channels, like a PDSCH, that include CBGs of a TB and receiving circuitry (outlined in blue) to receive CBG based HARQ-ACK:

FIG. 1

The CBG-based HARQ-ACK feedback may then be configured based upon the scheduling space, such that if a PDSCH (green arrow shown below) is scheduled in CSS the UE may report (purple arrow) only one bit per TB (EX-1001,

2:63-66; *see also* EX-1001, 5:61-6:3), but if the PDSCH (green arrow) is scheduled in USS the UE may report (purple arrow) HARQ-ACK bits for all transmitted CBGs (EX-1001, 2:66-3:2; *see also* EX-1001, 5:61-6:3):

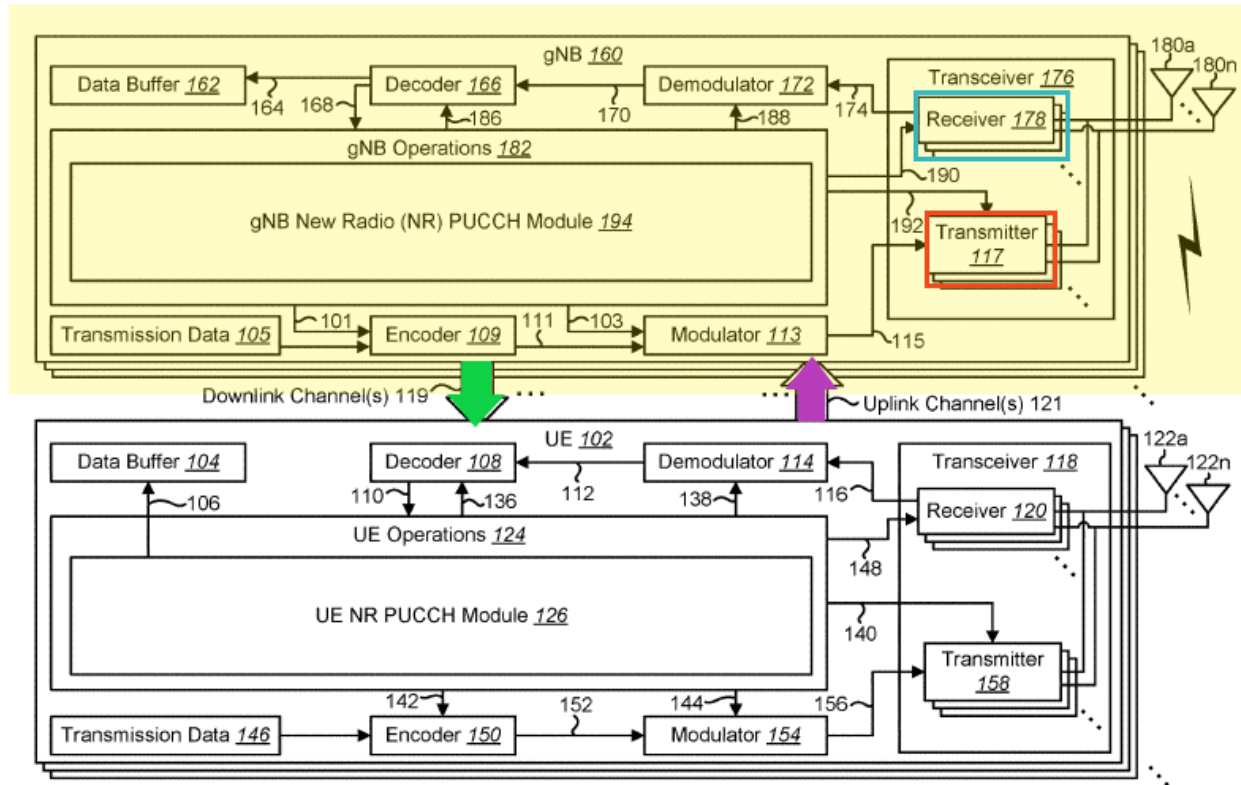


FIG. 1

EX-1001, Fig. 1; EX-1003, ¶208.

During prosecution, the (then-pending) claims issued without rejection. Section V.B, *infra*. The primary references cited herein (Wang, EX-1004 and Yang, EX-1005) each teach the concept allegedly missing from the prior art during prosecution: configuring CBG-based HARQ-ACK feedback based upon scheduling space (either CSS or USS). EX-1003, ¶217.

Wang states that:

the single bit HARQ-ACK feedback method is adopted by the DCI in the common search space (CSS) fixedly while the multi-bit HARQ-ACK feedback method is adopted by the DCI in a user-specific search space (USS) fixedly.

EX-1004, 12:53-57; EX-1003, ¶217. Yang states that:

for DL/UL data transmission scheduled through DCI (or TM-dedicated DCI format set/used for specific TM only) transmission based not on CSS but on USS, a CBG-unit retransmission scheduling and per-CBG A/N [(HARQ-ACK)] feedback configuration operation is applicable/configurable. On the other hand, for DL/UL data (and/or Msg3/4) transmission scheduled through CSS based DCI (or TM-common DCI format) transmission, a TB-unit retransmission scheduling and per-TB (TB level) A/N feedback operation is applicable/configurable (i.e., TB-level A/N feedback is configured).

EX-1005, 37:63-38:6; EX-1003, ¶219.

Thus, Wang and Yang independently render obvious the Challenged Claims as detailed in Grounds 1 and 2 respectively, *infra*. EX-1003, ¶221. Accordingly, Petitioners respectfully request that the Board institute IPR and cancel the Challenged Claims.

III. GROUNDS FOR STANDING (37 C.F.R. §42.104(A))

Petitioners certify that the '443 Patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR on the grounds identified herein. 37 C.F.R. §42.104(a).

IV. REASONS FOR THE REQUESTED RELIEF

As explained below and in the attached Declaration of Petitioners' Expert (EX-1003), the Challenged Claims were obvious over the prior art to a person of ordinary skill in the art ("POSITA") at the invention time.

V. BACKGROUND

A. Summary of the '443 Patent

As shown in the Overview, the '443 Patent claims the well-known concept of differentiating HARQ-ACK bit reporting based upon search space configuration. Section II, *supra*.

B. Prosecution History

The '443 Patent issued from U.S. Pat. App. No. 16/008,492 filed June 14, 2018 claiming priority through continuation applications to U.S. Provisional Pat. App. No. 62/520,520 filed June 15, 2017 (the "Priority Date"). EX-1003, ¶207.

During prosecution, the (then-pending) claims issued without rejection. *See generally* EX-1002. In the Notice of Allowance, the Examiner stated:

the cited prior art fails to teach individually or in combination, for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the transmitting circuitry is configured to report one HARQ-ACK bit for the transport block, and for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the transmitting circuitry is configured to report HARQ-ACK bits of all CBGs.

EX-1002, pp. 6; EX-1003, ¶214.

C. Priority Date

For purposes of this Petition, Petitioners do not challenge that the Challenged Claims are entitled to the priority date established by the '520 Provisional because each cited references is prior art to the Challenged Claims regardless of whether the Challenged Claims are entitled to the '520 Provisional filing date.

D. Claim Construction

For this Petition's purposes, Petitioners propose that each claim term be given its plain and ordinary meaning. The prior art herein meets each claim limitation under any reasonable construction. EX-1003, ¶240.

E. Person of Ordinary Skill in the Art ("POSITA")

A POSITA at the Priority Date would have been familiar with wireless communications networks, equipment, and integrated circuit chips, and would have had at least a working knowledge of communication protocols used in LTE and 5G radio access networks ("RAN"). A POSITA would have at least a Bachelor's degree in Electrical Engineering or an equivalent field, and at least two years of work experience in design, development, and/or testing wireless telecommunication systems. A POSITA would have had familiarity with the wireless standards and protocols related to data transmission and network

management. To the extent a POSITA would have had a more advanced degree, such as a Master's degree in Electrical Engineering or related field, then a POSITA may have had less work experience. EX-1003, ¶39.

F. State of the Art

The following section describes the relevant state of the art as of the priority date. The prior art references, and the discussions of what was known to a POSITA, provide the factual support for the general description of the state of the art, assist in understanding how a POSITA understood the prior art, and provide the motivation to modify or combine the teachings of references.

1. Mobile Wireless Communication Systems

As the '443 Patent acknowledges, the 3rd Generation Partnership Project ("3GPP") defines global technical specifications and reports for present and future wireless communication systems. EX-1001, 3:22-27; EX-1003, ¶169. These standards are used by equipment manufacturers – both for BS and UE – to ensure that the devices may communicate with one another. EX-1001, 3:22-36; EX-1003, ¶169.

A BS communicates with various UEs over radio channels. EX-1010, 4:36-42; EX-1003, ¶170. These radio channels are referred to as physical channels, and may be categorized either as downlink physical channels, which refer to information sent from the BS to the UE, or uplink physical channels, which refer to

information sent from the UE to the BS. EX-1010, 6:45-7:39; EX-1003, ¶170. The physical channels may further be categorized as shared or control channels. EX-1010, 6:45-7:39; EX-1003, ¶170. Thus, there may be four physical channels: physical downlink shared channel (“PDSCH”); physical downlink control channel (“PDCCH”); physical uplink shared channel (“PUSCH”); and physical uplink control channel (“PUCCH”). EX-1010, 6:45-7:39; EX-1003, ¶170.

2. Hybrid-ARQ Acknowledgements (“HARQ-ACK”)

Over these shared physical channels, blocks of data, referred to as TBs are sent, which are composed of multiple code blocks (“CBs”). EX-1010, 31:16-17; EX-1003, ¶172. These CBs may be further grouped into CBGs, such that a TB may comprise one or more CBGs. EX-1010, 31:16-37; EX-1003, ¶172. After decoding, each CB is checked for correctness with a cyclic redundancy check (“CRC”). EX-1010, 11:12-30; EX-1003, ¶172. CRC is a sequence of bits attached to a CB in the transmitter prior to encoding and is used for error detection. EX-1010, 16:33-54; EX-1003, ¶172. The CRC is checked in the receiver after the decoder to confirm whether or not the transmitted CB has been successfully received. EX-1010, 16:33-54; EX-1003, ¶172. If the CRC attached to the CB matches the one calculated by the receiver, the CB is considered to be error free. EX-1010, 16:33-54; EX-1003, ¶172.

Following CRC, a hybrid automatic repeat request (HARQ) indicator is sent

from the receiver device to the transmitter device to indicate a positive acknowledgement (ACK) or negative acknowledgement (NACK) of data sent using the shared channels. EX-1010, 16:9-17:3; EX-1003, ¶173. Upon receiving the ACK signal, the transmitter device transmits the next block of data (*i.e.*, new data), but if the NACK signal is received, the transmitter device retransmits the data. EX-1010, 16:9-17:3; EX-1003, ¶173.

3. DCI Decoding

To support the transmission of downlink and uplink transport channels Downlink Shared Channel (DL-SCH) and Uplink Shared Channel (UL-SCH) control signaling is required. EX-1010, 10:56-11:11; EX-1003, ¶175. This control signaling enables a UE to successfully receive, demodulate, and decode the DL-SCH. EX-1010, 10:56-11:11; EX-1003, ¶175. The Downlink Control Information (DCI) is transmitted through the PDCCH and includes information about the DL-SCH resource allocation (the set of resource blocks containing the DL-SCH), transport format and information related to the DL-SCH HARQ. EX-1010, 10:56-11:11; EX-1003, ¶175.

To form the PDCCH payload the DCI undergoes channel coding: addition of a CRC attachment followed by convolutional coding and rate matching according to PDCCH format capacity. EX-1010, 11:12-30; EX-1003, ¶176. The coded DCI bits (*i.e.*, PDCCH payload), are then mapped to Control Channel Elements

(“CCEs”) according to the PDCCH format. EX-1010, 11:12-58; EX-1003, ¶176. These coded bits are then converted to complex modulated symbols. Finally, the modulated symbols are interleaved and mapped to physical Resource Elements (“REs”). EX-1010, 11:12-58; EX-1003, ¶176.

After performing deinterleaving, deprecoding, symbol combining, symbol demodulation and descrambling at the receiver, the UE is required to perform blind decoding of the PDCCH payload as it is not aware of the detailed control channel structure, including the number of control channels and the number of CCEs to which each control channel is mapped. EX-1010, 12:4-15; EX-1003, ¶177.

Multiple PDCCHs can be transmitted in a single subframe which may and may not be all relevant to a particular UE. EX-1010, 12:4-15; EX-1003, ¶177. The UE finds the PDCCH specific to it by monitoring a set of PDCCH candidates (a set of consecutive CCEs on which a PDCCH could be mapped) in every subframe. EX-1010, 12:4-26; EX-1003, ¶177. The UE uses its Radio Network Temporary Identifier (“RNTI”) to try and decode candidates. EX-1010, 11:12-30; EX-1003, ¶177. The RNTI is used to demask a PDCCH candidate's CRC. EX-1010, 11:12-30; EX-1003, ¶177. If no CRC error is detected the UE determines that PDCCH carries its own control information. EX-1010, 11:12-30; EX-1003, ¶177.

4. Search Space Configurations

Once the DCI message is generated and channel coded according to the

required DCI and PDCCH format, PDCCH multiplexing, scrambling, modulation, precoding, interleaving and layer mapping are performed to form complex symbols. EX-1010, 11:12-58; EX-1003, ¶179. These complex symbols are now ready to be mapped onto REs. The REs are defined in terms of REGs/CCEs allocated to a transmission. EX-1010, 11:12-58; EX-1003, ¶179. The number of CCEs allocated is given by the PDCCH format. EX-1010, 11:12-58; EX-1003, ¶179. The control region of a subframe is a collection of CCEs and can contain PDCCHs for multiple UEs thus the UE has to monitor a large area to extract its own control information. EX-1010, 11:12-58; EX-1003, ¶179. As the UE is not explicitly informed of the detailed control channel structure it has to blindly attempt to decode the control region. EX-1010, 11:12-12:15; EX-1003, ¶179. Unfortunately, this may impose a substantial burden on the UE as at large bandwidths the control region may be very large. This may exceed practical hardware limitations and lead to increased cost and/or reduced performance of the UE. EX-1003, ¶179.

To simplify the decoding task at the UE, the whole control region is subdivided into common and UE-specific search spaces which the UE should monitor (attempt to decode each of the PDCCHs). EX-1010, 11:59-12:3; EX-1003, ¶180. Each space comprises 2, 4 or 6 PDCCH candidates whose data length depends on the PDCCH format; each PDCCH must be transmitted on 1, 2, 4 or 8 CCE(s) (1

CCE = 9 REGs = 9*4 REs = 72 bits). EX-1010, 11:31-12:3; EX-1003, ¶180

The PDCCH candidates consist of consecutive CCEs. EX-1010, 11:31-12:3; EX-1003, ¶181. The candidates within the PDCCH candidate set do not have to be unique, especially for smaller bandwidths. EX-1010, 11:31-12:3; EX-1003, ¶181. The common and UE-specific search spaces can overlap with each other. EX-1011, 1:26-2:3; EX-1003, ¶181. The size of search space is determined by the number of PDCCH candidates and the size of CCE aggregation level. EX-1011, 1:26-2:3; EX-1003, ¶181. That is, the size of the search space is integer times the size of CCE aggregation level or the number of PDCCH candidates. EX-1011, 1:26-2:3; EX-1003, ¶181.

The CSS carries the common control information and is monitored by all UEs in a cell. EX-1011, 1:26-2:3; EX-1003, ¶182. The number of CCE aggregation levels supported by the common search space is limited to two, *i.e.* 4 and 8, as compared to the USS where four CCE aggregation levels are possible. EX-1011, 1:26-2:3; EX-1003, ¶182. This reduces the burden on UE for decoding common control information compared to decoding UE-specific control information. EX-1003, ¶182. The common control space is used to carry important initial information including paging information, system information and random access procedures. EX-1011, 1:26-2:3; EX-1003, ¶182.

When searching the common control space the decoder always starts

decoding from the first CCE. EX-1011, 1:26-2:3; EX-1003, ¶183. This restriction further simplifies the common search. EX-1003, ¶183. The decoding is done on every possible PDCCH candidate set for given PDCCH format until it successfully decodes the PDCCH present in CSS. EX-1011, 1:26-2:3; EX-1003, ¶183.

The USS carries control information specific to a particular UE and is monitored by at least one UE in a cell. EX-1012, 9:10-10:19; EX-1003, ¶184. Unlike the CSS, the starting location of the USS may be varied for each subframe or UE. EX-1012, 9:10-10:19; EX-1003, ¶184. The starting location of the USS is determined in every subframe using a hash function. EX-1012, 9:10-10:19; EX-1003, ¶184.

In the USS the UE finds its PDCCH by monitoring a set of PDCCH candidates (a set of consecutive CCEs on which PDCCH could be mapped) in every subframe. EX-1012, 9:10-10:19; EX-1003, ¶185. If no CRC error is detected when the UE uses its RNTI to demask the CRC (16-bit value also refers as C-RNTI) on a PDCCH, the UE determines that PDCCH carries its own control information. EX-1012, 9:10-10:19; EX-1003, ¶185. The PDCCH candidate sets correspond to different PDCCH formats. There are 4 PDCCH formats: 0, 1, 2 or 3. EX-1012, 9:10-10:19; EX-1003, ¶185. If the UE fails to decode any PDCCH candidates for a given PDCCH format it tries to decode candidates for other PDCCH formats. EX-1012, 9:10-10:19; EX-1003, ¶185. This process is repeated

for all possible PDCCH formats until all directed PDCCHs are successfully decoded in USS. EX-1012, 9:10-10:19; EX-1003, ¶185.

5. U.S. Patent No. 10,735,170

U.S. Patent No. 10,735,170 (“’170 Patent”) to Yang et al. summarizes the state of the art as of the Priority Date. EX-1003, ¶187. The ’170 Patent was filed on August 6, 2015 and issued on August 4, 2020. EX-1010. The ’170 Patent “provides an HARQ-ACK feedback method and device,” whereby UE “detects downlink grant downlink control information and performs HARQ-ACK feedback for downlink data corresponding to the downlink control information.” EX-1010, Abstract; EX-1003, ¶187.

The ’170 Patent explains that “[a] UE ... detects DL grant DL control information and performs HARQ-ACK feedback for DL data corresponding to the DL control information.” EX-1010, 2:17-20; EX-1003, ¶188. Accordingly, the ’170 Patent discloses “a method of performing acknowledgement/negative acknowledgement (ACK/NACK) feedback by a user equipment (UE), comprising: detecting downlink control information (DCI) for a cell configured in an unlicensed band; and receiving downlink (DL) data through a physical downlink shared channel (PDSCH) according to the DCI.” EX-1010, 2:24-29; EX-1003, ¶188.

The ’170 Patent explains that UE comprises “a radio frequency (RF) unit

configured to receive or transmit a signal and a processor configured to control the RF unit.” EX-1010, 2:36-38; EX-1003, ¶189. “The processor may be configured to control the RF unit to receive downlink (DL) data through a physical downlink shared channel (PDSCH) according to the DCI” and “to transmit ACK or NACK as the ACK/NACK information according to a result of decoding the DL data.” EX-1010, 2:40-51; EX-1003, ¶189.

The ’170 Patent explains that when a transport block for one data transmission transmitted through the PDSCH may be further segmented into a plurality of code blocks or code block groups. EX-1010, 31:16-21; EX-1003, ¶190. In such instances, and with respect to the HARQ-ACK feedback transmission, the ’170 Patent explains that rather than transmitting HARQ-ACK on a transport block basis, it may be desirable to also configure/transmit the HARQ-ACK feedback transmission “on a code block basis or on a code block group basis, for effective retransmission and error recovery.” EX-1010, 31:16-21; EX-1003, ¶190.

Accordingly, as clear in the ’170 Patent, as of the Priority Date, a POSITA knew that a UE was configured to receive downlink (DL) data, such as a TB comprising a plurality of CBs or CBGs, through a PDSCH according to the DCI received through a PDCCH and transmit HARQ-ACK information according to a result of decoding the DL data on a TB, CB or CBG basis. EX-1003, ¶191.

6. Summary

Thus, a POSITA as of the Priority Date knew that BSs (also referenced as “gNBs”) transmits TBs to UEs over PDSCH and that the transmitted TBs were further broken down by CBs and CBGs. EX-1003, ¶192. A POSITA also knew that HARQ-ACK bits could be transmitted back to the BS to indicate whether the data had been successfully received or not – either on a TB-basis or for each individual CBG. EX-1003, ¶192.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

This Petition challenges claims 1- 5.

B. Statutory Ground for Challenges

Ground	Claims	Basis	Reference
1	1-5	§ 103	U.S. Pat. No. 11,206,108 (“Wang”)
2	1-5	§ 103	U.S. Pat. No. 11,012,221 (“Yang”)

Ground 1:

U.S. Pat. No. 11,206,108 (“Wang”) was filed on January 3, 2018, issued on December 21, 2021, and claims priority to Chinese Application No. 201710288177.X (“Wang Foreign Priority Application”) filed April 27, 2017. Wang, including the Wang Foreign Priority Application, is prior art under 35 U.S.C. § 102(a)(2).

Ground 2:

U.S. Pat. No. 11,012,221 (“Yang”) was filed on March 8, 2018, issued on

May 18, 2021, and claims priority to U.S. Provisional Application No. 62/501,048 (“’048 Application”) filed May 3, 2017. Yang, including the ‘048 Application, is prior art under 35 U.S.C. § 102(a)(2).

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE²

A. Ground 1: The Challenged Claims are Unpatentable Over Wang

Ground 1 is that Wang renders the identified claims obvious.

1. Overview of Wang

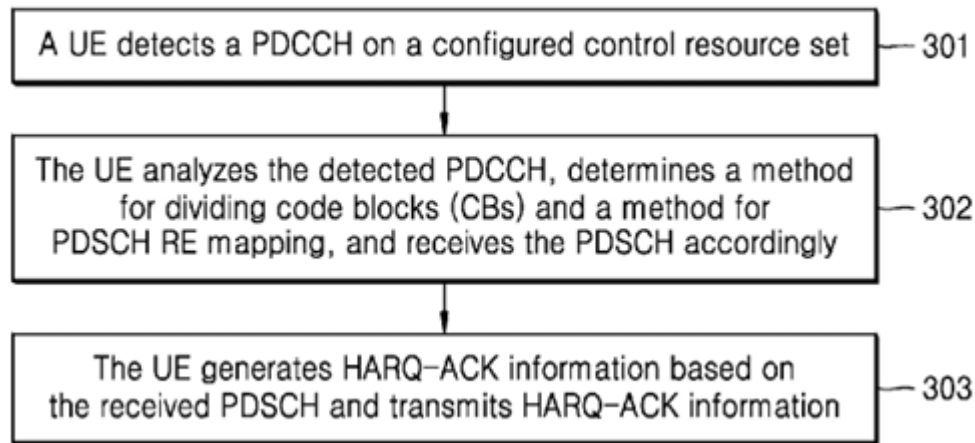
Wang discloses a method for enhancing the performance of data transmission within a wireless communications network. EX-1003, ¶224. Wang discloses a UE detecting a PDCCH on a configured control resource set, determining by the UE a method for dividing CBs and a method for receiving the PDSCH according to the PDCCH and generating, by the UE, HARQ-ACK information according to the PDSCH and transmitting the HARQ-ACK information to a BS. EX-1004, 3:11-21; EX-1003, ¶224.

Wang’s Figure 3, reproduced below, depicts a UE detecting a PDCCH from a BS. EX-1004, 7:20-27; EX-1003, ¶224. The UE analyzes the detected PDCCH, determines a method for dividing CBs depending on a DCI carried by the received PDCCH, and receives the PDSCH. EX-1004, 7:28-56; EX-1003, ¶224. At step

² Each Ground is in view of a POSITA’s knowledge.

303, the UE generates HARQ-ACK information based on the received PDSCH and transmits the HARQ-ACK information to the BS. EX-1004, 7:57-59; EX-1003, ¶224.

[Fig. 3]



EX-1004, Fig. 3; EX-1003, ¶224.

Based upon the difference between the various DCI carried by the received PDCCH, Wang recognizes that in some instances it may be desirable to implement a single bit HARQ-ACK feedback method, while in other instances it may be desirable to adopt a multi-bit HARQ-ACK feedback method. EX-1004, 12:48-57; EX-1003, ¶226. Specifically, Wang suggests adopting the single bit HARQ-ACK feedback method for a DCI in a CSS, while utilizing the multi-bit HARQ-ACK feedback method for a DCI in USS. EX-1004, 12:48-57; EX-1003, ¶226.

The Wang Foreign Priority Application contains the same disclosure. EX-1003, ¶227. Specifically, the Wang Foreign Priority Application explains that the HARQ-ACK feedback is divided into two situations: single-bit or multi-bit. EX-

1007, pp. 13; EX-1003, ¶227. With respect to the single-bit HARQ-ACK feedback situation, the Wang Foreign Priority Application explains that “the HARQ-ACK information is that one-bit HARQ-ACK information is fed back to one TB.” EX-1007, pp. 13; EX-1003, ¶227. Conversely, with respect to the multi-bit HARQ-ACK feedback situation, the Wang Foreign Priority Application explains that “the UE may feed back HARQ-ACK information to each CBG.” EX-1007, pp. 25; EX-1003, ¶227. The Wang Foreign Priority Application discloses that one method to differentiate between the single-bit or multi-bit HARQ-ACK feedback methods, is based upon DCI and search space configurations. EX-1007, pp. 13 (“whether or not the single-bit or multi-bit HARQ-ACK information is generated is determined according to one or more of the following parameters: ... a DCI format; ... a downlink control channel search space”); EX-1003, ¶227. Specifically, such that “the DCI in the common search space (CSS) is fixedly subjected to the single-bit HARQ-ACK feedback method, ... [while] the DCI in a user specific search space (USS) is fixedly subjected to the multi-bit HARQ-ACK feedback method.” EX-1007, pp. 26; EX-1003, ¶227. This method of differentiating between a single-bit HARQ-ACK feedback situation and a multi-bit HARQ-ACK feedback situation disclosed in the Wang Foreign Priority Application is illustrated in Figure 3 below, which is substantively identical to Figure 3 of Wang depicted above:

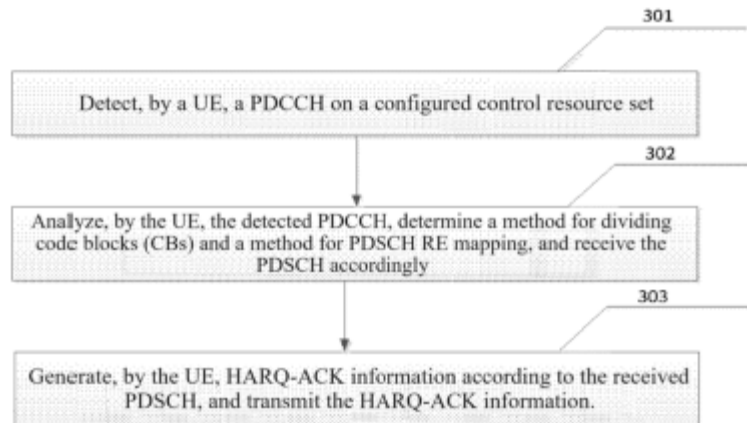


FIG. 3

EX-1007, Fig. 3; EX-1003, ¶227.

As detailed below, both Wang and the Wang Foreign Priority Application teach all elements found in the Challenged Claims. EX-1003, ¶229.

2. Detailed Application of Wang

a. Claim 3

[3.0] A base station (gNB), comprising:

If the preamble is limiting, Wang discloses³ this element. EX-1003, ¶241. A POSITA would understand that a base station in a 5G wireless network architecture could be referred to as a gNB. EX-1003, ¶242. Specifically, Wang discloses a BS for use in a wireless communication system for transmitting and receiving signals to a UE. EX-1004, 5:60-62.

³ As used throughout this Petition, “discloses” encompasses what a reference would teach, suggest, or render obvious to a POSITA.

In a wireless communication system, downlink transmission refers to transmitting a signal from *a base station to a UE (user equipment)*. A downlink signal includes a data signal, a control signal, and a reference signal (pilot). Here, *the base station transmits downlink data in a physical downlink shared channel (PDSCH), or transmits downlink control information in a downlink control channel. Uplink transmission refers to transmitting a signal from the UE to the base station*. An uplink signal also includes a data signal, a control signal and a reference signal. Here, *the UE transmits uplink data in a physical uplink shared channel (PUSCH), or transmits uplink control information in a physical uplink control channel (PUCCH)....*

EX-1004, 5:60-6:8;⁴ *see also* EX-1004, 37:33-34 (“*A terminal* for transmitting and receiving data...”); EX-1004, 38:35-36 (“*A base station* for transmitting and receiving data...”). EX-1003, ¶243-244.

The Wang Foreign Priority Application also discloses this element. EX-1007, pp. 9.

the base station transmits downlink data over a physical downlink shared channel (PDSCH), or transmits downlink control information over a downlink control channel. ... the UE transmits uplink data over a physical uplink shared channel (PUSCH), or sends uplink control information over a physical uplink control channel (PUCCH).

⁴ All emphasis added unless otherwise stated.

EX-1007, pp. 9. EX-1003, ¶246.

Wang thus discloses element 3.0. EX-1003 ¶248.

[3.1] sending circuitry configured to send a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Wang discloses this element. EX-1003, ¶249. Wang discloses a BS with sending circuitry configured to send downlink transmissions, including “downlink data in a physical downlink shared channel (PDSCH)” for reception by a UE. EX-1004, 5:64-65; *see also* 6:5-6 (“[t]he base station may dynamically schedule the PDSCH transmission”); 23:23-24 (“[t]he base station transmits a TB, which is divided into 4 CBGs”). A POSITA would understand that BSs that transmits data over a PDSCH would include sending circuitry to effectuate that downlink transmission. EX-1003, ¶249.

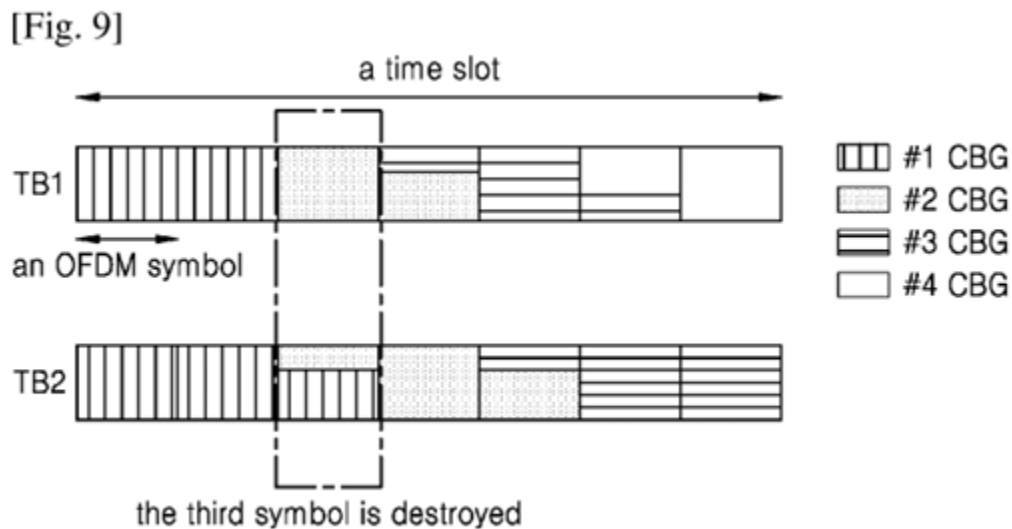
Wang discloses that the PDSCH transmitted by the BS for reception by the UE includes a TB, which may further comprise CBGs. EX-1004, 4:61-65; *see also* 36:54-55 (“***the PDSCH includes code block groups (CBGs) or a transport block***”). Wang elaborates, explaining that within that TB, the:

TB may be divided into multiple CBs firstly and then the multiple CBs are grouped into several CBGs; alternatively, the TB may be divided into multiple CBGs firstly, and each CBG may be further divided into one or more CBs. In particular, when data is retransmitted, the base station may retransmit the entire TB, or may

only retransmit a portion of the CB or CBG of the current TB....

EX-1004, 7:46-53. EX-1003, ¶250.

Wang's Figure 9 (below) illustrates CB/CBG mapping of the PDSCH of two TBs according to an embodiment of Wang. As seen below, the TBs transmitted via PDSCH may comprise multiple CBGs:

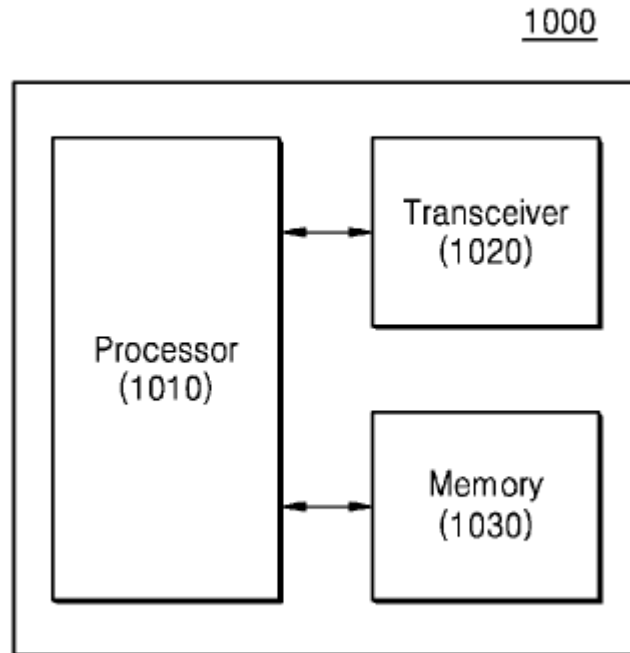


EX-1004, Fig. 9. EX-1003, ¶252.

Wang further discloses that the BS transmission of a PDSCH that includes CBGs of a TB is received by the UE. EX-1003 ¶255. Wang's Figure 10 (below) illustrates a UE that includes "a processor 1010, a transceiver 1020 and a memory 1030." EX-1004, 35:34-35. "The transceiver 1020 may be connected to the processor 1010 and transmit and/or receive a signal." EX-1004, 35:63-64. "The signal may include control information and data." EX-1004, 35:64-65. "The processor 1010 may control the transceiver to receive the PDSCH according to the

PDCCH.” EX-1004, 35:51-53.

[Fig. 10]



EX-1004, Fig. 10; *see also* EX-1004, 7:28-31 (“the UE ... *receives the PDSCH* accordingly”). A POSITA would understand Wang’s disclosure of a transceiver 1020 connected to the processor 1010 to *receive signals*, including receiving the PDSCH, to be receiving circuitry for the UE. EX-1003 ¶¶255-56.

Accordingly, Wang discloses both a (1) base station with sending circuitry configured to send a PDSCH that includes CBGs of a TB; and a (2) UE with receiving circuitry configured to receive a PDSCH that includes CBGs of a TB. EX-1003 ¶258.

The Wang Foreign Priority Application discloses a BS configured to send via sending circuitry, downlink transmissions, including “downlink data over a

physical downlink shared channel (PDSCH)” for reception by a UE via receiving circuitry. EX-1007, pp. 9 (“downlink transmission refers to *transmitting of signals from a base station to user equipment (UE)*”); EX-1007, pp. 9 (“*the base station transmits* downlink data over a physical downlink shared channel (PDSCH)”); EX-1007, pp. 17 (“[a]nalyze, by *the UE... and receive the PDSCH* accordingly”). EX-1003, ¶259.

The PDSCH transmitted by the base station and received by the UE includes a TB, and that TB may further include CBGs. EX-1007, pp. 15 (“*receiving the PDSCH includes: receiving the retransmitted CB, CBG*, or ... receiving the whole retransmitted TB”); *see also* EX-1007, pp. 42 (“[t]he *base station transmits a TB, which is divided into 4 CBGs*”). EX-1003, ¶259.

Like Wang’s Figure 9, Figure 9 of the Wang Foreign Priority Application illustrates the CBGs of two TBs transmitted via PDSCH:

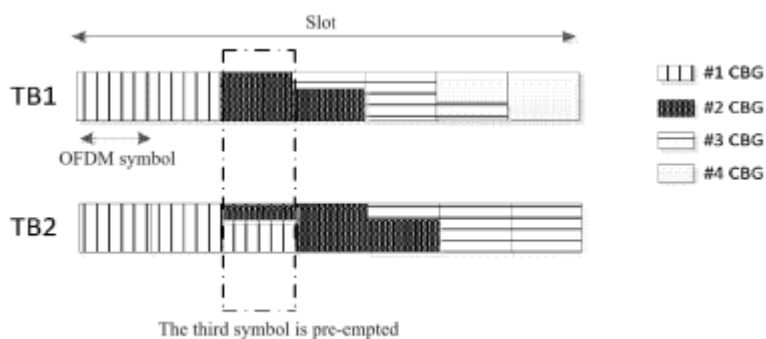


FIG. 9

EX-1007, Fig. 9. EX-1003 ¶260.

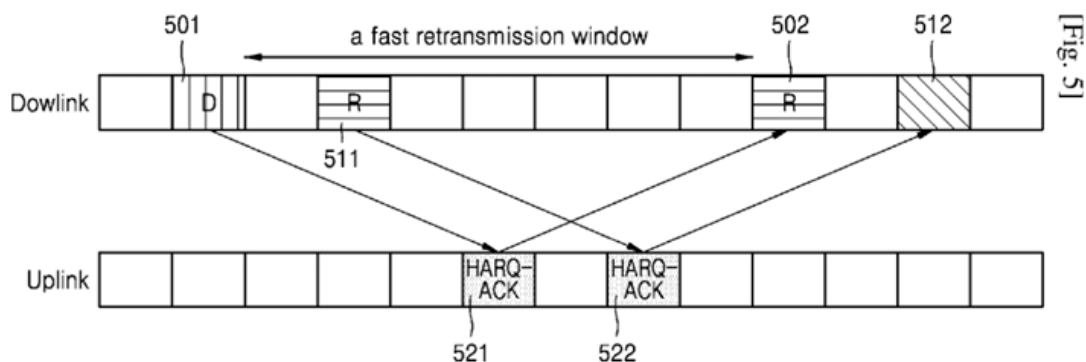
Wang thus discloses or render obvious element 3.1. EX-1003 ¶262.

***[3.2] receiving circuitry configured to receive CBG based HARQ-ACK,
wherein***

Wang discloses this element. EX-1003, ¶263. Wang discloses a BS that may “receiv[e] HARQ-ACK information of each CBG” transmitted by a UE. EX-1004, 12:13-14; *see also* EX-1004, 38:35-43 (“***A base station for*** transmitting and ***receiving data***, the base station comprising...at least one processor configured to execute the stored instructions to...receive, from the terminal, HARQ-ACK information generated according to the PDSCH”). A POSITA would understand that a base station that receives HARQ-ACK information would teach receiving circuitry to effectuate that reception. EX-1003, ¶263-65.

Wang’s UE processor is configured to execute stored instructions to “generate HARQ-ACK information according to the PDSCH and control the transceiver to transmit the HARQ-ACK information.” EX-1004, 5:37-46; *see also* EX-1004, 7:57-59 (“[t]he UE generates HARQ-ACK information based on the received PDSCH and transmits the HARQ-ACK information”). The HARQ-ACK feedback transmitted by the UE is CBG based. EX-1004, 12:13-14 (“after receiving HARQ-ACK information of each CBG”); EX-1004, 12:18-19 (“the UE may feed back the HARQ-ACK information for each CBG separately”). EX-1003, ¶264.

Wang’s Figure 5 illustrates a HARQ retransmission based upon the affected CBG (EX-1004, 16:20-38):



EX-1004, Fig. 5. EX-1003, ¶266.

As detailed for element 3.1, Wang’s Figure 10 details a UE with a transceiver controlled by a processor. EX-1004, 35:34-65. “The processor 1010 may generate HARQ-ACK information according to the PDSCH.” EX-1004, 35:53-54. *“The processor 1010 may control the transceiver to transmit the HARQ-ACK information.”* EX-1004, 35:54-56. *See also* EX-1004, 7:57-59 (“[t]he UE ... *transmits the HARQ-ACK* information”). A POSITA would understand Wang’s disclosure of a transceiver 1020 connected to a processor 1010 to *transmit a signal output*, including HARQ-ACK information, to be transmitting circuitry. EX-1003, ¶270.

Accordingly, Wang discloses both (1) a BS with receiving circuitry configured to receive CBG based HARQ-ACK; and (2) a UE with transmitting circuitry configured to transmit CBG based HARQ-ACK. EX-1003, ¶271.

The Wang Foreign Priority Application supports this disclosure in Wang,

explaining that the UE is responsible for generating “and transmitting the HARQ-ACK information.” EX-1007, pp. 12. The UE “is configured to generate HARQ-ACK information according to the detected PDSCH” and the “HARQ-ACK transmitting module is configured to transmit the HARQ-ACK information.” EX-1007, pp. 16; *see also* EX-1007, pp. 18 (“[g]enerate, by the UE, HARQ-ACK information according to the received PDSCH, and transmit the HARQ-ACK information”). EX-1003, ¶272.

The HARQ-ACK is CBG based. EX-1007, pp. 25 (“the UE may feed back the HARQ-ACK information to each CBG”). The Wang Foreign Priority Application goes on to explain that the HARQ-ACK is received by the base station, such that “after the base station received HARQ-ACK information for each CBG, the CBG that is not properly received by the UE may be only retransmitted.” EX-1007, pp. 25. EX-1003, ¶272.

The Wang Foreign Priority Application also contains Figure 5, depicted below, and illustrating a fast HARQ retransmission based upon the affected CBG:

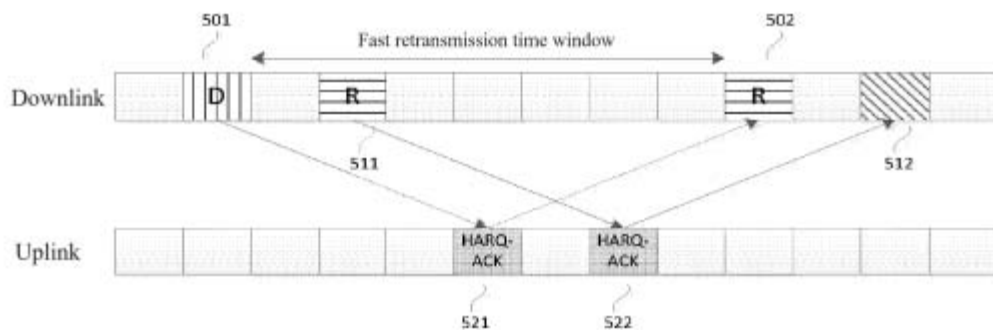


FIG. 5

EX-1007, Fig. 5. EX-1003, ¶273.

Accordingly, a POSITA would understand the Wang Foreign Priority Application to disclose both (1) a BS with receiving circuitry configured to receive CBG based HARQ-ACK; and (2) a UE with transmitting circuitry configured to transmit CBG based HARQ-ACK. EX-1003, ¶275.

Wang thus discloses or render obvious claim element 3.2. EX-1003, ¶276.

[3.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the receiving circuitry is configured to receive one HARQ-ACK bit for the transport block,

Wang discloses this element. EX-1003, ¶277. Wang discloses differentiating between CBG based HARQ-ACK feedback corresponding to the search space (e.g., CSS/USS) that the PDSCH is scheduled in:

[p]referably, the HARQ-ACK information is single bit HARQ-ACK information for one TB or multi-bit HARQ-ACK information for one TB, and ***the HARQ-ACK information is determined to be the single bit HARQ-ACK information or the multi-bit HARQ-ACK information according to one or more of the following parameters:*** business type; DCI format; system parameters; downlink control channel resource set; and ***downlink control channel search space.***

EX-1004, 3:57-65; *see also* EX-1004, 7:57-59. EX-1003, ¶277-78.

More specifically, Wang discloses utilizing one HARQ-ACK bit for the TB when the PDSCH is scheduled in a CSS. EX-1004, 12:50-57 (“In particular, the

single bit HARQ-ACK feedback method is adopted by the DCI in the common search space (CSS) fixedly”); *see also* EX-1004, 12:35-36 (“it is a default operation to feed back single bit HARQ-ACK information for one TB”). EX-1003, ¶279.

The Wang Foreign Priority Application supports this disclosure in Wang. EX-1003, ¶280. Specifically, the Wang Foreign Priority Application explains that “the HARQ-ACK information is divided into two situations of single-bit HARQ-ACK or multi-bit HARQ-ACK information for each transport block.” EX-1007, pp. 13. And that the HARQ-ACK information is generated by the UE “according to the received PDSCH.” EX-1007, pp. 18 (“[g]enerate, by the UE, HARQ-ACK information according to the received PDSCH, and transmit the HARQ-ACK information”). The Wang Foreign Priority Application goes on to explain that one way to determine whether to use single-bit or multi-bit HARQ-ACK feedback is based upon search space configurations, such that “DCI in a common search space (CSS) feeds back one-bit HARQ-ACK information to one TB.” EX-1007, pp. 13. EX-1003, ¶280.

To the extent that Wang does not explicitly disclose element 3.3, it would have been obvious to a POSITA in view of Wang as well as the State of the Art as discussed above. Section, V.F, *supra*; EX-1003, ¶281. As disclosed in Wang and in the prior art discussed in Section V.F, it was well known prior to the Priority Date

that TBs could be further subdivided in CBs or CBGs and that UEs could transmit HARQ-ACK bits on either a TB or CBG basis to improve the efficiency of the system and potentially prevent the need for retransmission of an entire TB whenever a NACK signal is received. Section V.F, *supra*; EX-1003, ¶281.

Moreover, it was known that it may not always be desirable to transmit one HARQ-ACK bit per CBG in all instances, so that it may be desirable to set up a wireless system where one HARQ-ACK bit is transmitted per TB in some instances, and one HARQ-ACK bit is transmitted per CBG in other instances. Section V.F, *supra*; EX-1003, ¶281. To set up such a system, a POSITA would be faced with a limited number of characteristics to use to distinguish between one HARQ-ACK transmission method and another. Accordingly, a POSITA would immediately recognize that one such distinguishing characteristic to devise such a system around is search space configuration, such that one HARQ-ACK bit is transmitted per TB in one search space configuration (*e.g.*, CSS), while one HARQ-ACK bit is transmitted per CBG in another search space configuration (*e.g.*, USS). EX-1003, ¶281;

Accordingly, Wang discloses or render obvious claim element 3.3. EX-1003 ¶282.

[3.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the receiving circuitry is configured to receive HARQ-ACK bits of all CBGs.

Wang discloses this element. EX-1003, ¶283. As detailed and quoted for element 3.3, Wang discloses differentiating between CBG based HARQ-ACK feedback corresponding to the search space that the PDSCH. EX-1004, 3:57-65; *see also* EX-1004, 7:57-59. EX-1003, ¶283-84.

More specifically, Wang discloses utilizing HARQ-ACK bits for all CBGs when the PDSCH is scheduled in a USS. EX-1004, 12:55-57 (“the multi-bit HARQ-ACK feedback method is adopted by the DCI in a user-specific search space (USS) fixedly”); *see also* EX-1004, 12:13-16 (“after receiving HARQ-ACK information of each CBG, the base station may only retransmit CBGs received by the UE incorrectly”); EX-1004, 12:18-19 (“the UE may feed back the HARQ-ACK information for each CBG separately”). EX-1003, ¶285.

The Wang Foreign Priority Application supports this disclosure in Wang. Specifically, the Wang Foreign Priority Application explains that “the HARQ-ACK information is divided into two situations of single-bit HARQ-ACK or multi-bit HARQ-ACK information of each transport block.” EX-1007, pp. 13. *See also* EX-1007, pp. 18 (“[g]enerate, by the UE, HARQ-ACK information according to the received PDSCH, and transmit the HARQ-ACK information”). The Wang Foreign Priority Application teaches that in the multi-bit HARQ-ACK feedback method “the UE may feed back the HARQ-ACK information to each CBG.” EX-1007, pp. 25. One way to determine whether to use single-bit or multi-bit HARQ-

ACK feedback is based upon search space configurations (EX-1007, pp. 13), such that “the DCI in the user specific search space (USS) is fixedly subjected to the multi-bit HARQ-ACK feedback method,” of one bit for each CBG (EX-1007, pp. 26). EX-1003, ¶286.

To the extent that Wang does not explicitly disclose element 3.4, it would have been obvious to a POSITA in view of Wang as well as the state of the art as discussed above. Section, V.F, *supra*; EX-1003, ¶287. As discussed above with respect to element 3.3, it was well known prior to the Priority Date that it may be desirable to device a system that in some instances transmitted one HARQ-ACK bit per TB, but in other instances transmitted one HARQ-ACK bit per CBG. EX-1003, ¶287.

A POSITA looking to device such a system would be faced with a limited number of characteristics to distinguish between the two HARQ-ACK transmission methods, with one obvious distinguishing characteristics to use being search space configuration, such that one HARQ-ACK bit is transmitted per TB in one search space configuration (*e.g.*, CSS), while one HARQ-ACK bit is transmitted per CBG in another search space configuration (*e.g.*, USS). EX-1003, ¶287.

Accordingly, Wang discloses or render obvious claim element 3.4. EX-1003 ¶288.

b. Claim 5

Claim 5 is the method claim that corresponds to the BS operation claimed in claim 3 and effectively has identical limitations. EX-1003 ¶289.

[5.0] A communication method of a base station comprising:

Element [5.0] is substantively identical to element [3.0] and disclosed for the reasons cited therein. EX-1003 ¶290.

[5.1] sending a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Element [5.1] is substantively to element [3.1] and disclosed for the reasons cited therein. EX-1003 ¶291.

[5.2] receiving CBG based HARQ-ACK, wherein

Element [5.2] is substantively to element [3.2] and disclosed for the reasons cited therein. EX-1003 ¶292.

[5.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is received,

Element [5.3] is substantively to element [3.3] and disclosed for the reasons cited therein. EX-1003 ¶293.

[5.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are received.

Element [5.4] is substantively to element [3.4] and disclosed for the reasons cited therein. EX-1003 ¶294.

c. **Claim 1**

Claim 1 is an apparatus claim directed to the UE that communicates with the BS of claim 3. Accordingly, claim 1 is the corollary to claim 3 and effectively has identical limitations except that claim 1 is written from the UE side of the transmissions. EX-1003 ¶295.

[1.0] A user equipment (UE), comprising:

Element [1.0] is written to cover the UE side of the transmission from the BS discussed in element [3.0] and disclosed for the reasons cited therein. EX-1003 ¶296.

[1.1] receiving circuitry configured to receive a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Element [1.1] is written to cover the UE side of the transmission discussed in element [3.1] and disclosed for the reasons cited therein. EX-1003 ¶297.

[1.2] transmitting circuitry configured to transmit CBG based HARQ-ACK, wherein

Element [1.2] is written to cover the UE side of the transmission discussed in element [3.2] and disclosed for the reasons cited therein. EX-1003 ¶298.

[1.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the transmitting circuitry is configured to report one HARQ-ACK bit for the transport block,

Element [1.3] is written to cover the UE side of the transmission discussed

in element [3.3] and disclosed for the reasons cited therein. EX-1003 ¶299.

[1.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the transmitting circuitry is configured to report HARQ-ACK bits of all CBGs.

Element [1.4] is written to cover the UE side of the transmission discussed in element [3.4] and disclosed for the reasons cited therein. EX-1003 ¶300.

d. **Claim 2**

[2.0] The UE of claim 1, wherein determining circuitry configured to determine a physical uplink control channel (PUCCH) resource for transmission of the CBG based HARQ-ACK which PUCCH resource is one of a plurality PUCCH resources defined for different payload sizes.⁵

Wang discloses claim 2. EX-1003, ¶301. More specifically, Wang discloses a UE with a processor that “may detect a PDCCH on a configured control resource set,” “determine a method for dividing CBs and a method for rate matching of a PDSCH according to the PDCCH,” and “generate HARQ-ACK information according to the PDSCH.” EX-1004, 35:48-54. Moreover, “the UE transmits uplink data in a physical uplink shared channel (PUSCH), or transmits uplink

⁵ Claim 2 appears to be indefinite. There is no linkage between the “determining circuitry” and the UE. Recognizing that Section 112 challenges cannot be brought in IPR, Petitioners present an analysis assuming that the determining circuitry is contained within the UE.

control information in a physical uplink control channel (PUCCH).” EX-1004, 6:2-5. Accordingly, Wang’s UE comprises determining circuitry (processor) configured to determine a PUCCH resource for transmission of the CBG based HARQ-ACK which PUCCH is one of a plurality of PUCCH resources defined for different payload sizes. Wang’s Figure 10 and the related components were detailed in element 3.1. EX-1003, ¶301.

The Wang Foreign Priority Application supports this disclosure in Wang. Specifically, the Wang Foreign Priority Application explains that the UE comprises “a PDCCH detecting and analyzing module, a PDSCH receiving module, a HARQ-ACK information generating module and an HARQ-ACK transmitting module.” EX-1007, pp. 60. “The PDCCH detecting and analyzing module is configured to detect a PDCCH of a scheduled PDSCH on a configured control resource set and analyze the detected PDCCH.” EX-1007, pp. 60. “The PDSCH receiving module is configured to determine a method for dividing CBs and a method for rate matching of the PDSCH according to the detected PDCCH and to receive the PDSCH according to the detected PDCCH.” EX-1007, pp. 60. “The HARQ-ACK information generating module is configured to generate HARQ-ACK information according to the detected PDSCH.” EX-1007, pp. 60. Moreover, “the UE transmits uplink data over a physical uplink shared channel (PUSCH), or transmits uplink control information over a physical uplink control

channel (PUCCH).” EX-1007, pp. 9. EX-1003, ¶303.

Accordingly, Wang discloses claim 2. EX-1003 ¶304.

e. **Claim 4**

Claim 4 is the method claim that corresponds to the operation of the UE claimed in claim 1 and effectively has identical limitations. EX-1003 ¶305.

[4.0] A communication method of a user equipment (UE) comprising:

Element [4.0] is substantively identical to element [1.0] and disclosed for the reasons cited therein. EX-1003 ¶306.

[4.1] receiving a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Element [4.1] is substantively identical to element [1.1] and disclosed for the reasons cited therein. EX-1003 ¶307.

[4.2] transmitting CBG based HARQ-ACK, wherein

Element [4.2] is substantively identical to element [1.2] and disclosed for the reasons cited therein. EX-1003 ¶308.

[4.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is transmitted,

Element [4.3] is identical to element [1.3] and disclosed for the reasons cited therein. EX-1003 ¶309.

[4.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are transmitted.

Element [4.4] is substantively identical to element [1.4] and disclosed for the reasons cited therein. EX-1003 ¶310.

B. Ground 2: The Challenged Claims are Unpatentable Over Yang

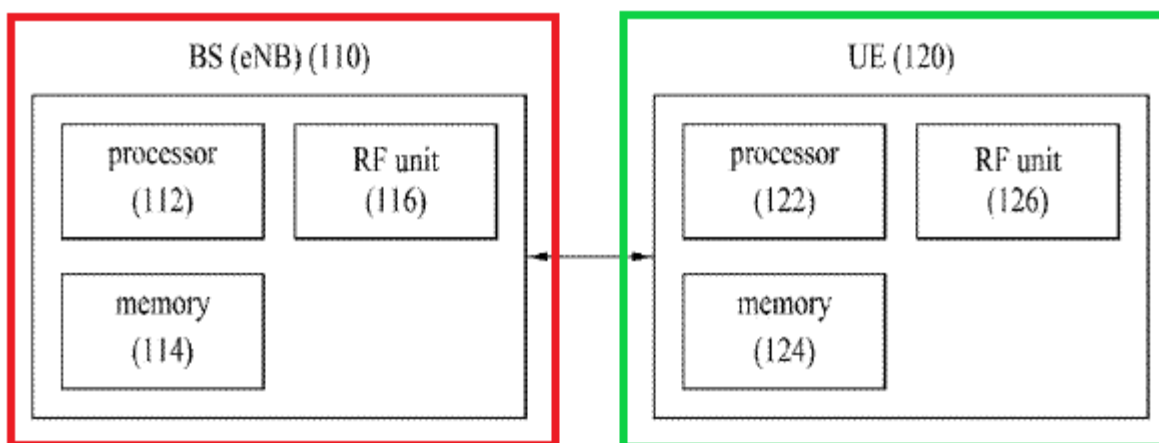
Ground 1 is that Yang renders the identified claims obvious.

1. Overview of Yang

Yang teaches transmitting a TB with multiple CBGs from a BS to a UE and receiving HARQ-ACK information from the UE transmitted back to the BS. EX-1005, Abstract; EX-1003, ¶232. Preferably, the HARQ-ACK payload includes a plurality of HARQ-ACK bits corresponding to CBGs for the TB. EX-1005, Abstract; EX-1003, ¶232.

Yang's Figure 18 (below) shows a BS and a UE. EX-1005, 38:55-56. The BS (outlined in red) includes a processor and an RF unit. EX-1005, 38:61-62. The RF unit is connected to the processor, and transmits and/or receives RF signals from the UE. EX-1005, 38:66-67. The UE (outlined in green) includes a processor connected to an RF unit that transmits and/or receives RF signals from the BS. EX-1005, 38:67-39:7.

【FIG. 18】

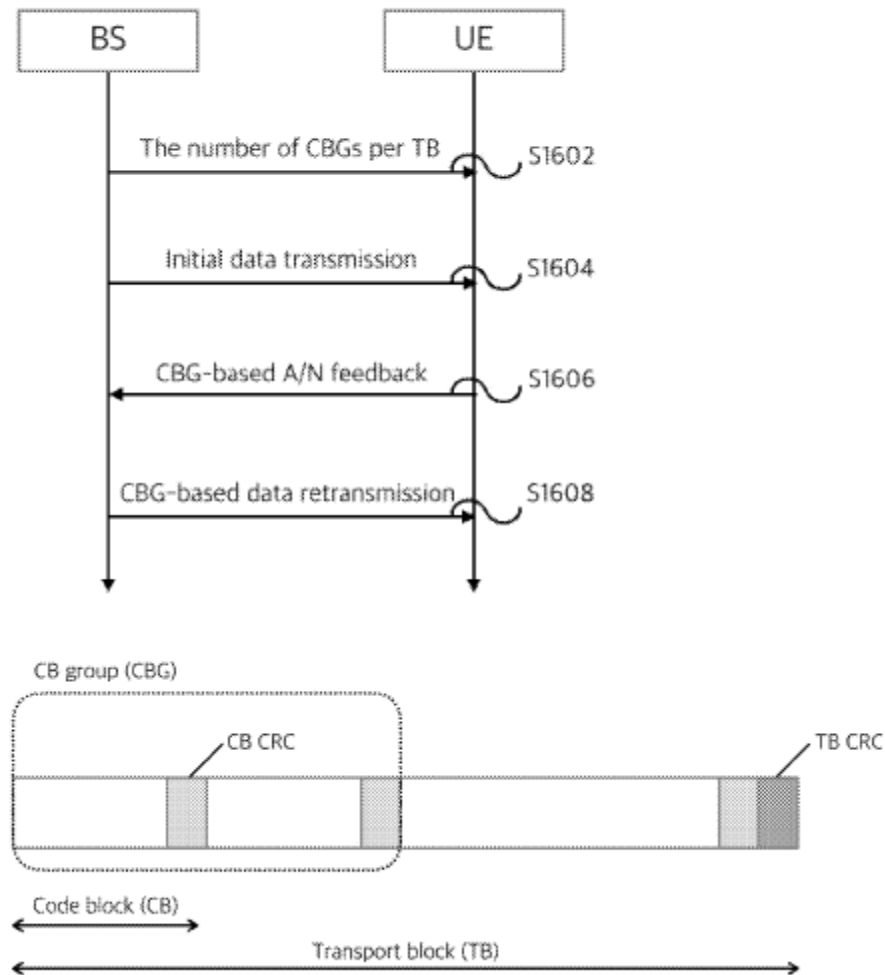


EX-1005, Fig. 18. EX-1003, ¶233.

Yang's Figure 16 (below) illustrates Yang's transmissions. EX-1005, 21:16-17. At S1602, a UE receives information on the plurality of CBGs per TB from a BS. EX-1005, 21:18-21. Thereafter, at S1604, the UE receives the transmission of data, including a TB made up of a plurality of CBs that can be grouped into one or more CBGs, on PDSCH. EX-1005, 21:21-25. Next, at S1606, the UE can feedback CBG-based HARQ-ACK⁶ information on the data to the BS. EX-1005, 21:29-31. Finally, at S1608, based upon the CBG-based HARQ-ACK information received, the BS can perform retransmission to the UE. EX-1005, 21:31-32.

⁶ Yang uses "A/N" to abbreviate "HARQ-ACK." EX-1005, 16:59-61 ("configuring *HARQ-ACK (hereinafter abbreviated A/N) feedback*").

【FIG. 16】



EX-1005, Fig. 16; EX-1003, ¶235.

The '048 Application contains the same disclosure. EX-1003, ¶237.

Specifically, the '048 Application proposes a method “wherein the (retransmission) scheduling is performed in the unit of CB or of CB group (CBG) and the HARQ-ACK feedback is configured/transmitted in the unit of CB/CBG. More specifically, a method for configuring a CBG, a method for configuring HARQ-ACK (that is, A/N) feedback.” EX-1009, pp. 53. The '048 Application

teaches a wireless system, comprising a UE and a BS. EX-1009, pp. 53. EX-1003, ¶237.

Accordingly, Yang and the '048 Application teach all elements found in the Challenged Claims. EX-1003, ¶238.

2. Detailed Application of Yang

a. Claim 3

[3.0] A base station (gNB), comprising:

If the preamble is limiting, Yang discloses this element. EX-1003, ¶311. A POSITA would understand that a base station in a 5G wireless network architecture could be referred to as a gNB. EX-1003, ¶312. Specifically, Yang discloses both (1) a base station and (2) a user equipment for use in a wireless communication system for transmitting and receiving signals to and from the two devices. EX-1005, 2:42-3:8.

user equipment ... including a radio frequency (RF) module and a processor configured to receive information on a number M of code block groups defined for one transport block ***from a base station...***

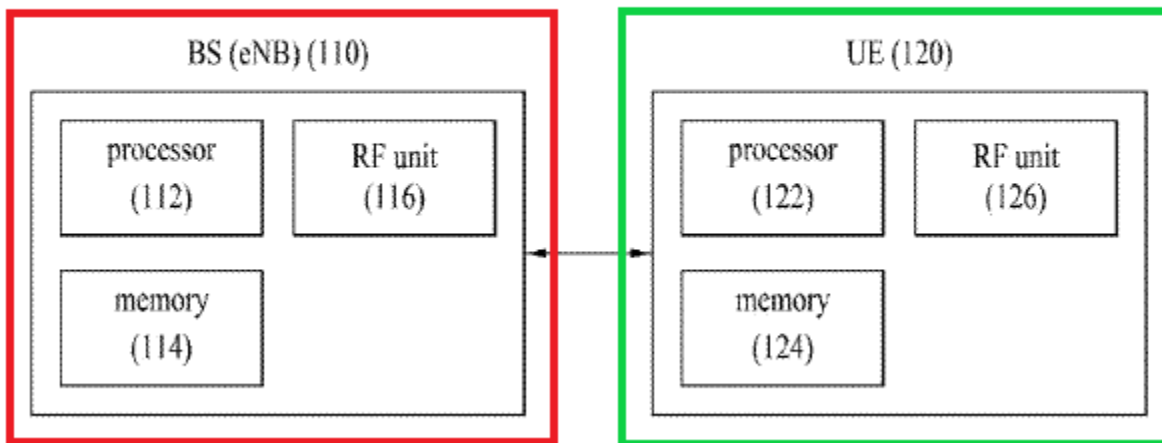
EX-1005, 1:61-66.

the base station including a radio frequency (RF) module and a processor configured to transmit information on a number M of code block groups defined for one transport block to ***a user equipment...***

EX-1005, 2:59-64. EX-1003, ¶¶312-15.

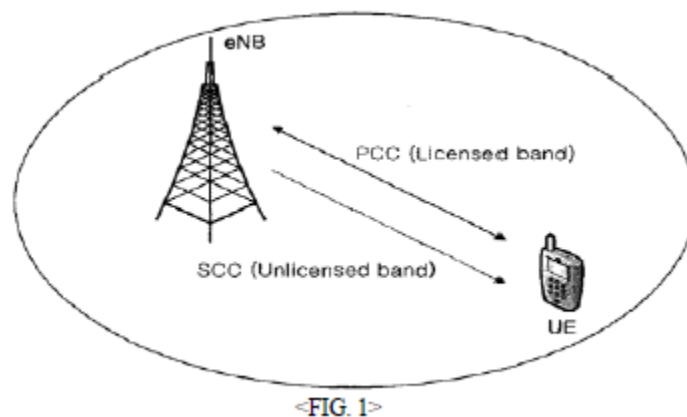
Yang's Figure 18 illustrates a BS (outlined in red) communicating with a UE (outlined in green) in a wireless communication system:

【FIG. 18】



EX-1005, Fig. 18. EX-1003, ¶316.

The '048 Application also discloses this element. EX-1003, ¶318. Similar to Yang, the '048 Application discloses a BS (eNB) may transmit signals to a UE or a UE may transmit signals to a BS as shown in Fig. 1. EX-1009, pp. 38.



EX-1009, pp. 38. EX-1003, ¶318.

Yang thus discloses claim element 3.0. EX-1003, ¶320.

[3.1] sending circuitry configured to send a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Yang discloses this element. EX-1003, ¶321. Yang discloses a BS with sending circuitry configured to send a physical downlink channel that includes CBGs of a TB for receipt by a UE through the UE's receiving circuitry:

the base station including a radio frequency (RF) module and a processor configured to transmit information on a number M of code block groups defined for one transport block to a user equipment through an upper layer signal, ***transmit a first transport block including a plurality of code blocks to the user equipment through a physical layer channel...***

EX-1005, 2:59-67. That physical layer channel may be “a physical downlink shared channel (PDSCH).” EX-1005, 4:45-46; *see also* EX-1005, 21:21-22 (“***the UE can receive initial transmission of data from the BS (on PDSCH)***”). The data transmitted via PDSCH includes a TB comprising CBGs. EX-1005, 21:22-25 (“***the transport block includes a plurality of code blocks, and a plurality of code block groups***”). EX-1003, ¶¶321-22.

Yang's UE receives a PDSCH that includes CBGs of a TB:

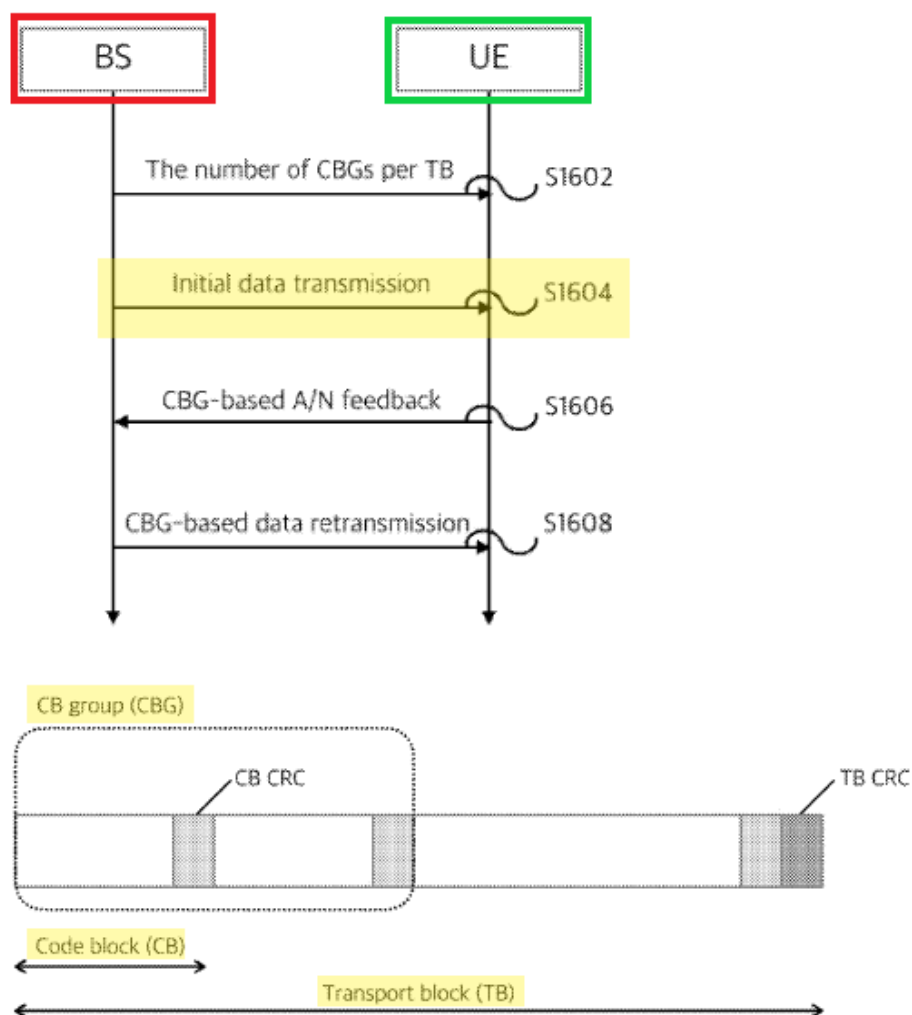
a user equipment ... including a radio frequency (RF) module and a processor configured to receive information on a number M of code block groups defined for one transport block from a base station

through an upper layer signal, receive a first transport block including a plurality of code blocks from the base station through a physical layer channel...

EX-1005, 1:61-2:1. EX-1003, ¶323.

Yang's Figure 16 (below) illustrates the BS (outlined in red) transmitting an "initial data transmission" to the UE (outlined in green) at "S1604" (highlighted yellow). Figure 16 shows that the "data transmission" comprises a transport block, which includes a plurality of CBs and CBGs (both highlighted yellow):

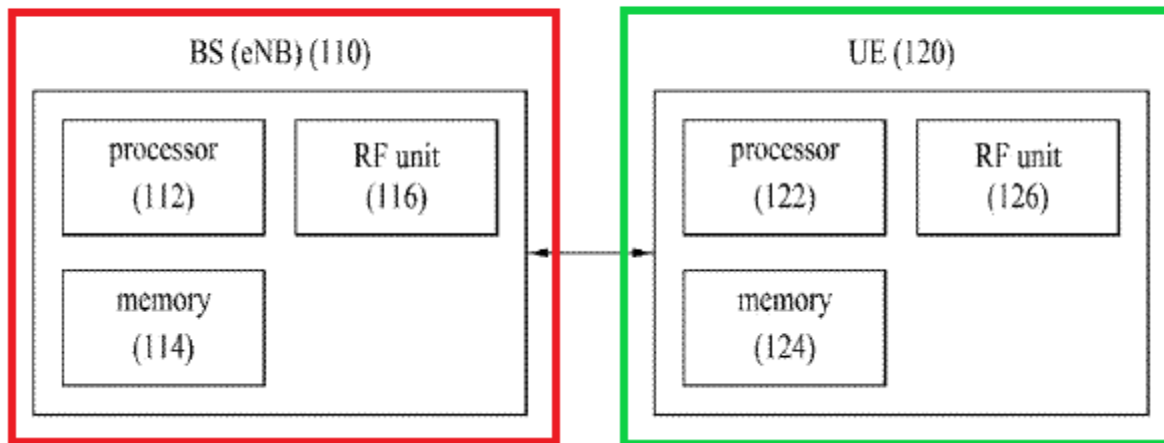
【FIG. 16】



EX-1005, Fig. 16. EX-1003, ¶325.

Yang's Fig. 18 depicts the BS's transmitting circuitry (outlined in red) (*i.e.*, the RF module and processor) and the UE's receiving circuitry (outlined in green) (*i.e.*, the RF module and processor):

【FIG. 18】



EX-1005, Fig. 18. Yang’s invention may be “implemented by various means, for example, hardware, firmware, software, or combinations thereof” including ASICs, DSPs, and various processors. EX-1005, 39:41-51. EX-1003 ¶¶327-28.

Accordingly, a POSITA would understand that Yang discloses both (1) a BS with sending circuitry configured to send a PDSCH that includes CBGs of a TB; and (2) a UE with receiving circuitry to receive a PDSCH that includes CBGs of a TB. EX-1003 ¶321.

The ’048 Application also discloses a BS with sending circuitry configured to send downlink transmissions to a UE with receiving circuitry. EX-1009, pp. 6 (The BS “*RF unit 13 is coupled with the processor 11 and transmits and/or receives a radio signal*”); EX-1009, pp. 6 (The UE’s “*RF unit 23 is coupled with the processor 21 and transmits and/or receives a radio signal*”). Those downlink transmissions may comprise a PDSCH that further comprises CBGs of a TB:

when the size of *DL data (that is, TB size)* becomes a fixed level or more, *the bit stream to be sent via PDSCH is divided into a plurality of CB (Code Block)* and is transmitted in a form in which channel coding and CRC are separately applied for each CB, is applied. *When reception (decoding) of even one of the plurality of CBs included in one PDSCH fails, the UE operates such that HARQ-ACK feedback corresponding to the PDSCH is reported to eNB using NACK.*

EX-1009, pp. 66; *see also* EX-1009, pp. 66 (“[f]or CBG described below, all CBs (constituting a single TB) can be configured as one CBG, or a portion of a plurality of CB is composed of one CBG, or each of one CBs can be configured into one CBG”). A POSITA would understand this passage to disclose the claimed circuitry. EX-1003, ¶¶332-34.

Thus, Yang discloses or renders obvious claim element 3.1. EX-1003 ¶335.

[3.2] receiving circuitry configured to receive CBG based HARQ-ACK, wherein

Yang discloses this element. EX-1003, ¶336. Specifically, Yang discloses a BS with receiving circuitry for HARQ-ACK feedback that is transmitted by a UE through transmitting circuitry:

the base station including a radio frequency (RF) module and a processor configured to... receive Hybrid ARQ Acknowledgement (HARQ-ACK) payload including HARQ-ACK information on the first transport block from the user equipment, ... wherein the HARQ-ACK payload includes a plurality of HARQ-ACK bits corresponding

to M code block groups for the first transport block.

EX-1005, 2:59-3:8. Through the RF module and processor (*i.e.*, the receiving circuitry), Yang's BS receives "CBG-based (code block group-based) A/N information." EX-1005, 21:29-31. EX-1003, ¶¶336-37.

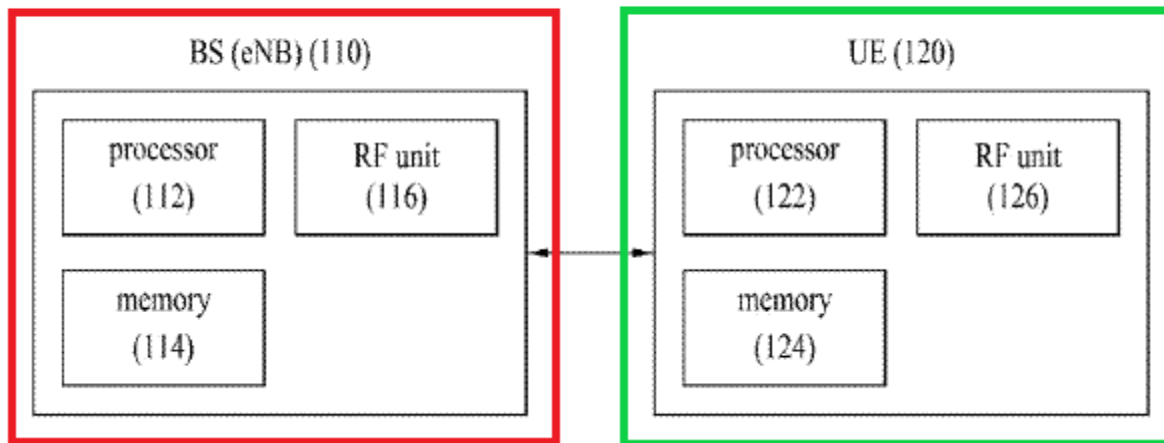
Yang's UE includes transmitting circuitry configured to transmit the CBG-based HARQ-ACK feedback:

a user equipment ... including a radio frequency (RF) module and a processor configured to receive information on a number M of code block groups defined for one transport block from a base station through an upper layer signal, receive a first transport block including a plurality of code blocks from the base station through a physical layer channel, and transmit Hybrid ARQ Acknowledgement (HARQ-ACK) payload including HARQ-ACK information on the first transport block to the base station, ... wherein the HARQ-ACK payload includes a plurality of HARQ-ACK bits corresponding to M code block groups for the first transport block.

EX-1005, 1:61-2:10. Through the RF module and processor (*i.e.*, the transmitting circuitry), Yang's UE may transmit "CBG-based (code block group-based) A/N information." EX-1005, 21:29-31. EX-1003, ¶¶338-39.

The UE's transmitting circuitry (outlined in green) (*i.e.*, the RF module and processor) and the BS's receiving circuitry (outlined in red) (*i.e.*, the RF module and processor) are depicted in Yang's Figure 18:

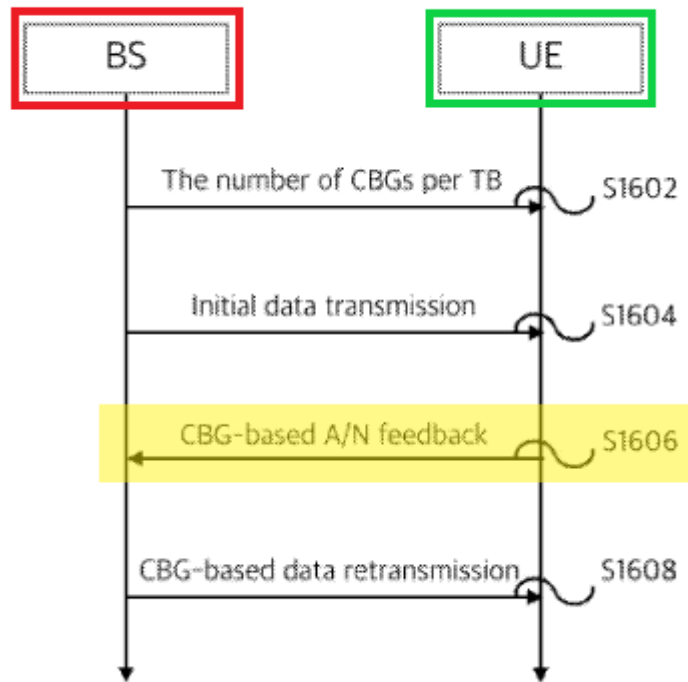
【FIG. 18】



EX-1005, Fig. 18. EX-1003, ¶340.

Yang's Figure 16 below teaches that, following the "initial data transmission" in "S1604", the BS (outlined in red) receives "CBG-based [HARQ-ACK] feedback" at "S1604" (highlighted yellow) via its RF module that is transmitted by the UE (outlined in green):

【FIG. 16】



EX-1005, Fig. 16. As noted in [3.1] above, Yang’s implementations include various forms of circuitry that would implement the receiving circuitry. EX-1005, 39:41-51. EX-1003, ¶¶342-44.

Accordingly, Yang discloses both (1) a BS with receiving circuitry configured to receive CBG based HARQ-ACK; and (2) a UE with transmitting circuitry configured to transmit CBG based HARQ-ACK. EX-1003, ¶347.

The ’048 Application supports this disclosure in Yang, and discloses a BS with receiving circuitry to receive radio signals that are transmitted via transmitting circuitry of a UE. EX-1009, pp. 19 (BS “*RF unit 13 is coupled with the processor 11 and transmits and/or receives a radio signal*”); EX-1009, pp. 19 (UE “*RF unit*

23 is coupled with the processor 21 and transmits and/or receives a radio signal’).

The ’048 Application goes on to explain that the radio signals transmitted from the UE and received by the BS may comprise CBG based HARQ-ACK feedback:

wherein the (retransmission) scheduling is performed in the unit of CB or of CB group (CBG) and the HARQ-ACK feedback is configured/transmitted in the unit of CB/CBG. More specifically, a method for configuring a CBG, ***a method for configuring HARQ-ACK (that is, A/N) feedback....***

EX-1009, pp. 66. EX-1003, ¶348.

Thus, the ’048 Application supports Yang’s disclosure of a BS comprising receiving circuitry configured to receive CBG-based HARQ-ACK feedback transmitted by the transmitting circuitry of a UE. A POSITA would understand this passage to disclose the claimed circuitry. EX-1003, ¶¶349-50.

Yang thus discloses or renders obvious claim element 3.2. EX-1003 ¶351.

[3.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the receiving circuitry is configured to receive one HARQ-ACK bit for the transport block,

Yang discloses this element. EX-1003, ¶352. Yang discloses configuring CBG based HARQ-ACK feedback:

a method of performing (retransmission) scheduling in unit of CB or CBG (CB group) and configuring/transmitting HARQ-ACK feedback in unit of CB/CBG, in consideration of properties of a new RAT

system. ... *a method of configuring HARQ-ACK (hereinafter abbreviated A/N) feedback*

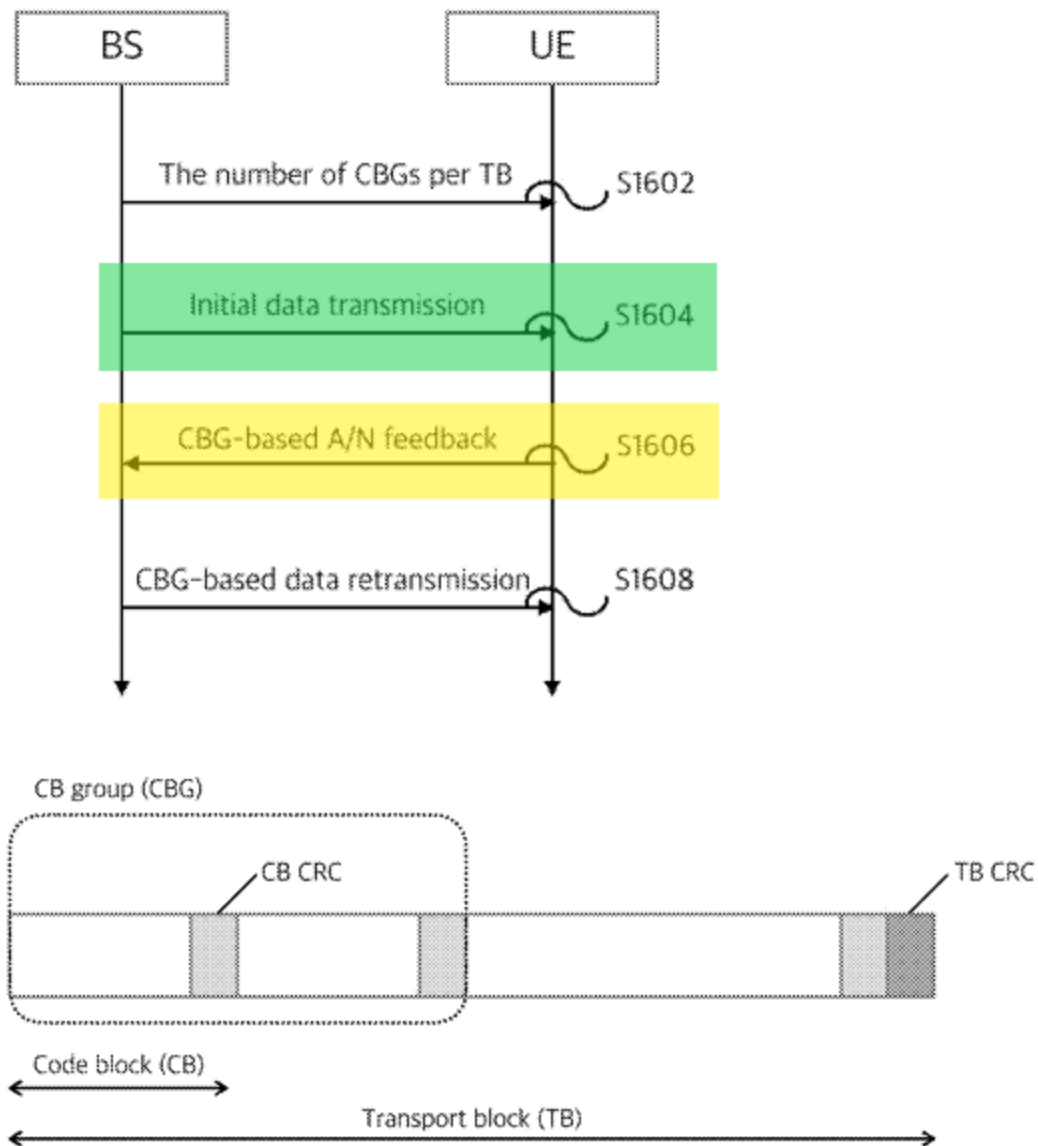
EX-1005, 16:55-64. The CBG based HARQ-ACK feedback received by the BS from the UE corresponds with the PDSCH:

the UE can receive *initial transmission of data from the BS (on PDSCH)* [S1604]...[t]hereafter, the UE can feed back *CBG-based (code block group-based) A/N information on the data to the BS [S1606]*, and the BS can perform data retransmission based on the code block group [S1608].

EX-1005, 21:21-32. EX-1003, ¶¶352-53.

Thus, as seen in Yang's Figure 16 below, the "CBG-based [HARQ-ACK] feedback" in S1606 (highlighted yellow), corresponds directly to the "initial data transmission" in S1604 (highlighted green), which is sent in PDSCH:

【FIG. 16】



EX-1005, Fig. 16. EX-1003, ¶354.

Yang discloses differentiating CBG based HARQ-ACK feedback corresponding to the search space that the PDSCH is scheduled in, such that if scheduled in CSS, a per-TB HARQ-ACK feedback method is configured:

for DL/UL data (and/or Msg3/4) transmission scheduled through

CSS based DCI (or TM-common DCI format) transmission, *a TB-unit retransmission scheduling and per-TB (TB level) A/N feedback operation is applicable/configurable.*

EX-1005, 38:1-6. EX-1003, ¶356.

Thus, Yang discloses utilizing one HARQ-ACK bit for the transport block when the PDSCH is scheduled in a CSS. EX-1003, ¶358.

The '048 Application supports this disclosure in Yang. Specifically, the '048 Application discloses applying specific CBG-based HARQ-ACK feedback configurations based upon search space configurations USS / CSS. EX-1009, pp. 83-84. EX-1003, ¶359.

That HARQ-ACK feedback received by the BS corresponds with the PDSCH sent by the BS. EX-1009, pp. 66 (“[w]hen reception (decoding) of even one of the plurality of CBs included in one PDSCH fails, ***the UE operates such that HARQ-ACK feedback corresponding to the PDSCH is reported to eNB using NACK***”). EX-1003, ¶359.

The '048 Application teaches that “TB-specific” HARQ-ACK feedback can be applied when the transmission is scheduled in a CSS. EX-1009, pp. 84 (“A/N feedback operation on a TB basis may be applied/set for DL/UL data (and/or Msg3/4) transmissions scheduled via CSS-based DCI transmissions”). EX-1003, ¶359.

To the extent that Yang does not explicitly disclose element 3.3, it would have been obvious to a POSITA in view of Yang as well as the state of the art as discussed above. Section, V.F, *supra*. As disclosed in Yang and discussed throughout, it was well known prior to the Priority Date that TBs could be further subdivided in CBs or CBGs and that UEs could transmit HARQ-ACK bits on either a TB or CBG basis to improve the efficiency of the system and potentially prevent the need for retransmission of an entire TB whenever a NACK signal is received. EX-1003, ¶360.

Moreover, it was known that it may not always be desirable to transmit one HARQ-ACK bit per CBG in all instances, so that it may be desirable to set up a wireless system where one HARQ-ACK bit is transmitted per TB in some instances, and one HARQ-ACK bit is transmitted per CBG in other instances. To set up such a system, a POSITA would be faced with a limited number of characteristics to use to distinguish between one HARQ-ACK transmission method and another. EX-1003, ¶360. Accordingly, a POSITA would immediately recognize that one such distinguishing characteristic to devise such a system around is search space configuration, such that one HARQ-ACK bit is transmitted per TB in one search space configuration (*e.g.*, CSS), while one HARQ-ACK bit is transmitted per CBG in another search space configuration (*e.g.*, USS). EX-1003, ¶360.

Accordingly, Yang discloses or renders obvious claim element 3.3. EX-1003

¶361.

[3.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the receiving circuitry is configured to receive HARQ-ACK bits of all CBGs.

Yang discloses this element. EX-1003, ¶362. As discussed above, Yang teaches configuring CBG based HARQ-ACK feedback:

a method of performing (retransmission) scheduling in unit of CB or CBG (CB group) and configuring/transmitting HARQ-ACK feedback in unit of CB/CBG, in consideration of properties of a new RAT system. Particularly, ... a method of configuring CBG, ***a method of configuring HARQ-ACK (hereinafter abbreviated A/N) feedback,***
....

EX-1005, 16:55-64. EX-1003, ¶362.

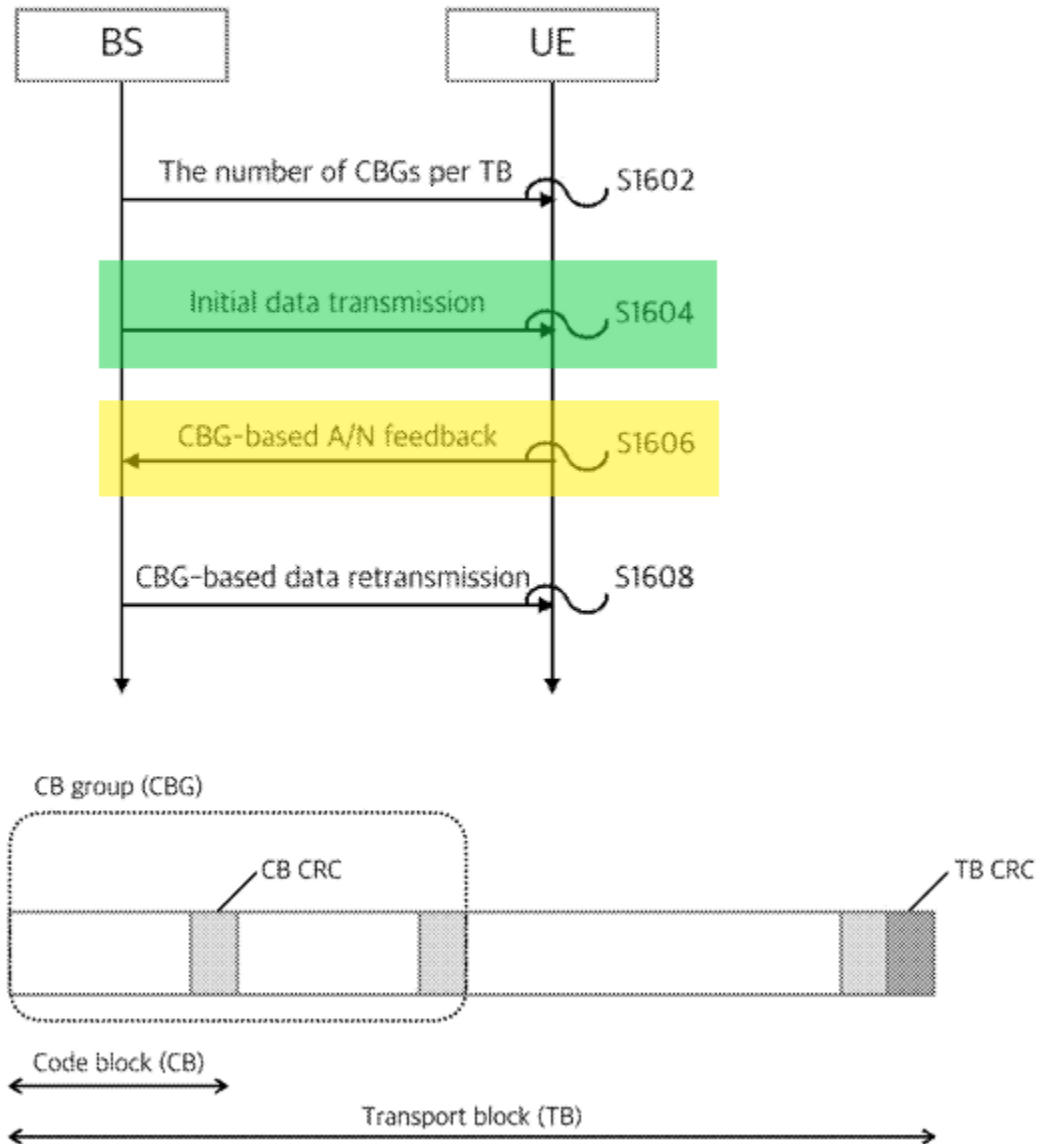
The CBG based HARQ-ACK feedback received by the BS from the UE corresponds with the PDSCH sent by the BS:

the UE can receive ***initial transmission of data from the BS (on PDSCH)*** [S1604]...[t]***hereafter, the UE can feed back CBG-based (code block group-based) A/N information on the data to the BS [S1606],*** and the BS can perform data retransmission based on the code block group [S1608].

EX-1005, 21:21-32. EX-1003, ¶363.

Thus, Yang's Figure 16 depicts that the "CBG-based [HARQ-ACK] feedback" in S1606 (highlighted yellow), corresponds to the "initial data transmission" in S1604 (highlighted green), which is sent in PDSCH:

【FIG. 16】



EX-1005, Fig. 16. EX-1003, ¶364.

More specifically, Yang discloses differentiating CBG based HARQ-ACK

feedback corresponding to the search space that the PDSCH is scheduled in, such that if the PDSCH is scheduled in USS, a per-CBG HARQ-ACK feedback method is configured:

for DL/UL data transmission scheduled through DCI (or TM-dedicated DCI format set/used for specific TM only) transmission based not on CSS but on USS, a CBG-unit retransmission scheduling and per-CBG A/N feedback configuration operation is applicable/configurable.

EX-1005, 37:63-38:1. EX-1003, ¶366.

Thus, Yang discloses utilizing HARQ-ACK bits for all CBGs when the PDSCH is scheduled in a USS. EX-1003, ¶368.

The '048 Application supports this disclosure in Yang. Specifically, the '048 Application discloses applying specific CBG-based HARQ-ACK feedback configurations based upon search space configurations. EX-1009, pp. 83-84. That HARQ-ACK feedback received by the base stations from the UE corresponds directly with the PDSCH sent by the base station to the UE. EX-1009, pp. 66 (“[w]hen reception (decoding) of even one of the plurality of CBs included in one PDSCH fails, *the UE operates such that HARQ-ACK feedback corresponding to the PDSCH is reported to eNB using NACK*”). The '048 Application explains that “CBG-specific” HARQ-ACK feedback can be applied when the transmission is scheduled in a USS. EX-1009, pp. 83-84 (“retransmission scheduling on a CBG

basis and A/N feedback configuration operation on a CBG basis may be applied/set only for DL/UL data transmissions scheduled via USS-based DCI transmissions rather than CSS”). EX-1003, ¶369.

To the extent Yang does not explicitly disclose element 3.4, it would have been obvious to a POSITA in view of Yang as well as the state of the art as discussed above. Section, V.F, *supra*. EX-1003, ¶370. As discussed above with respect to element 3.3, it was well known prior to the Priority Date that it may be desirable to device a system that in some instances transmitted one HARQ-ACK bit per TB, but in other instances transmitted one HARQ-ACK bit per CBG. A POSITA looking to device such a system would be faced with a limited number of characteristics to distinguish between the two HARQ-ACK transmission methods, with one obvious distinguishing characteristics to use being search space configuration, such that one HARQ-ACK bit is transmitted per TB in one search space configuration (*e.g.*, CSS), while one HARQ-ACK bit is transmitted per CBG in another search space configuration (*e.g.*, USS). EX-1003, ¶370.

Accordingly, Yang discloses or renders obvious claim element 3.4. EX-1003 ¶371.

b. Claim 5

Claim 5 is the method claim that corresponds to the operation of the base station claimed in claim 3 and effectively has identical limitations. EX-1003 ¶372.

[5.0] A communication method of a base station comprising:

Element [5.0] is substantively identical to element [3.0] and disclosed for the reasons cited therein. EX-1003 ¶373.

[5.1] sending a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Element [5.1] is substantively identical to element [3.1] and disclosed for the reasons cited therein. EX-1003 ¶374.

[5.2] receiving CBG based HARQ-ACK, wherein

Element [5.2] is substantively identical to element [3.2] and disclosed for the reasons cited therein. EX-1003 ¶375.

[5.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is received,

Element [5.3] is substantively identical to element [3.3] and disclosed for the reasons cited therein. EX-1003 ¶376.

[5.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are received.

Element [5.4] is substantively identical to element [3.4] and disclosed for the reasons cited therein. EX-1003 ¶377.

c. Claim 1

Claim 1 is an apparatus claim directed to the user equipment that communicates with the base station of claim 3. Accordingly, claim 1 is the corollary to claim 3

and effectively has identical limitations. EX-1003 ¶378.

[1.0] A user equipment (UE), comprising:

Element [1.0] is written to cover the UE side of the transmission from the base station discussed in element [3.0] and disclosed for the reasons cited therein. EX-1003 ¶379.

[1.1] receiving circuitry configured to receive a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Element [1.1] is written to cover the UE side of the transmission from the base station discussed in element [3.1] and disclosed for the reasons cited therein. EX-1003 ¶380.

[1.2] transmitting circuitry configured to transmit CBG based HARQ-ACK, wherein

Element [1.2] is written to cover the UE side of the transmission from the base station discussed in element [3.2] and disclosed for the reasons cited therein. EX-1003 ¶381.

[1.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), the transmitting circuitry is configured to report one HARQ-ACK bit for the transport block,

Element [1.3] is written to cover the UE side of the transmission from the base station discussed in element [3.3] and disclosed for the reasons cited therein. EX-1003 ¶382.

[1.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), the transmitting circuitry is configured to report HARQ-ACK bits of all CBGs.

Element [1.4] is written to cover the UE side of the transmission from the base station discussed in element [3.4] and disclosed for the reasons cited therein.

EX-1003 ¶383.

d. Claim 2

[2.0] The UE of claim 1, wherein determining circuitry configured to determine a physical uplink control channel (PUCCH) resource for transmission of the CBG based HARQ-ACK which PUCCH resource is one of a plurality PUCCH resources defined for different payload sizes.

Yang discloses or renders obvious claim 2. EX-1003, ¶384. As discussed above with respect to elements 3.1 and 3.2, and shown in Fig. 18, Yang discloses a UE with a processor and memory (*i.e.*, determining circuitry) to implement the procedures and/or methods proposed in Yang. Yang discloses that “the UE may receive a PDCCH/PDSCH (S107) and transmit a physical uplink shared channel (PUSCH)/physical uplink control channel (PUCCH) (S108), as a general downlink/uplink signal transmission procedure.” EX-1005, 4:58-62. “Here, control information transmitted from the UE to the BS is called uplink control information (UCI).” EX-1005, 4:62-64. “The UCI may include a hybrid automatic repeat and request (HARQ) acknowledgement (ACK)/negative-ACK (HARQ ACK/NACK) signal, a scheduling request (SR), channel state information (CSI), etc.” EX-1005,

5:64-67. “The CSI includes a channel quality indicator (CQI), a precoding matrix index (PMI), a rank indicator (RI), etc.” EX-1005, 6:67-5:2. “While the UCI is transmitted through a PUCCH in general, it may be transmitted through a PUSCH when control information and traffic data need to be simultaneously transmitted.” EX-1005, 5:2-5. EX-1003, ¶384.

Moreover, Yang explains that “based on the CBG number set for TB, an A/N payload size and a corresponding PUCCH format can be set.” EX-1005, 29:26-28. “For example, a PUCCH format used for CBG unit A/N transmission per TBS (total CBG number ‘M’ according to TBS) and a candidate PUCCH resource set can be set independently (differently).” EX-1005, 29:28-31.

Accordingly, the Yang’s UE comprises determining circuitry configured to determine a PUCCH resource for transmission of the CBG based HARQ-ACK which PUCCH is one of a plurality of PUCCH resources defined for different payload sizes. EX-1003, ¶385.

The ’048 Application supports this disclosure in Yang. EX-1003, ¶386. The ’048 Application explains that “the A/N bit configuration of the TB unit and the A/N bit configuration of the CBG unit are configured according to whether A/N feedback is performed by semi-static (e.g., RRC) or dynamic (e.g., DCI) signaling (e.g., (initial) DL data scheduling DCI), and in the case of CBG unit A/N bit configuration, the corresponding A/N payload size (and PUCCH format for the

corresponding A/N transmission) may be set via semi-static (e.g., RRC) signaling.” EX-1009, pp. 77. EX-1003, ¶386.

The '048 Application goes on to state that “for each TB size, the number of CBs comprising the corresponding TB and the CBG configuration based thereon (e.g., the total number of CBs comprising the TB, M, and the number of CBs comprising a single CBG, N) may be determined according to a predetermined rule, and the A/N payload size and the corresponding PUCCH format may be set based on the number of CBGs set in a given TB.” EX-1009, pp. 77. “For example, the PUCCH format and the set of candidate PUCCH resources used for CBG-based A/N transmission may be independently (differently) set for each TB size (and thus the total number of CBGs M).” EX-1009, pp. 77. Accordingly, the '048 Application discloses a UE comprising determining circuitry configured to determine a PUCCH resource for transmission of the CBG based HARQ-ACK which PUCCH is one of a plurality of PUCCH resources defined for different payload sizes. EX-1003, ¶386.

Thus, Yang discloses or renders obvious claim 2. EX-1003, ¶387.

e. **Claim 4**

Claim 4 is the method claim that corresponds to the operation of the user equipment claimed in claim 1 and effectively has identical limitations. EX-1003, ¶388.

[4.0] A communication method of a user equipment (UE) comprising:

Element [4.0] is substantively identical to element [1.0] and disclosed for the reasons cited therein. EX-1003, ¶389.

[4.1] receiving a physical downlink shared channel (PDSCH) that includes code block groups (CBGs) of a transport block; and

Element [4.1] is substantively identical to element [1.1] and disclosed for the reasons cited therein. EX-1003, ¶390.

[4.2] transmitting CBG based HARQ-ACK, wherein

Element [4.2] is substantively identical to element [1.2] and disclosed for the reasons cited therein. EX-1003, ¶391.

[4.3] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a common search space (CSS), one HARQ-ACK bit for the transport block is transmitted,

Element [4.3] is substantively identical to element [1.3] and disclosed for the reasons cited therein. EX-1003, ¶392.

[4.4] for the CBG based HARQ-ACK corresponding to the PDSCH which is scheduled in a UE-specific search space (USS), HARQ-ACK bits of all CBGs are transmitted.

Element [4.4] is substantively identical to element [1.4] and disclosed for the reasons cited therein. EX-1003, ¶393.

VIII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION

A. The Board Should Not Deny Institution Under 35 U.S.C. § 325(d)

Petitioners have not previously challenged by IPR the '443 Patent. Likewise, neither the Examiner nor the Board considered any prior art herein. Moreover, the cited prior art references, Wang and Yang, disclose the exact elements that provided patentability during prosecution.

B. The Board Should Not Deny Institution Under 35 U.S.C. § 314(a)

Related to the Director's June 2022 interim guidance regarding application of the *Fintiv* factors,⁷ (1) the Petition presents compelling merits, and (2) Petitioners will not pursue in the Related Litigation any ground raised in this IPR. Thus, under the Interim Guidance, the Board should not exercise its discretion to deny institution under 35 U.S.C. § 314(a).

The decision in *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (Dec. 1, 2020) instructs that a holistic view of the remaining *Fintiv* factors also weighs in favor of institution.

Factor 1 is neutral because no request for stay has been filed.

⁷ Interim Procedure For Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director's Memorandum (June 21, 2022).

Under factor 2, the earliest scheduled trial date between the two Related Litigations is March 17, 2025. A Final Written Decision is expected in the present matter in November of 2025. Considering the inherent uncertainties of litigation scheduling, this factor is neutral. Because much can change in sixteen months, the current trial date does not support denial. *Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).

Factor 3 heavily favors institution. The *Markman* hearings in the two cases are scheduled for October 1, 2024, and March 11, 2025, which is after the projected institution date. Fact discovery closes on October 11, 2024 and April 18, 2025, respectively, and expert discovery closes on December 4, 2024 and June 10, 2025, respectively. Thus, the Related Litigations are in their early stages, and the investment in them has been minimal at this time. The district court will not invest significant resources or issue substantive orders related to the challenged patent prior to an institution decision. Moreover, Petitioners diligently prepared this Petition and filed in advance of the statutory deadline, which weighs further against denying institution.

Under factor 4, there will not be complete overlap in the issues raised in the IPR and the Related Litigations and this favors institution. As an initial matter, this

Petition challenges all five claims of the '443 Patent, while PO asserted only challenged claims 3 and 5 in the Related Litigations. Furthermore, Petitioners stipulate that they will not pursue invalidity against the Challenged Claims in the district court using the specific combination of prior art references set forth in the grounds herein for establishing invalidity. *See Sand Revolution II LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 11-12 (PTAB June 16, 2020) (holding a similar stipulation weighs against discretionary denial).

Under factor 5, Petitioners are Intervenor / Defendants in the Related Litigations. As such, Petitioners have filed this petition not just to protect their current interests and the interests of the defendants in the Related Litigations, but have also filed this petition to protect their customers more generally, including those that may be subject to claims of infringement by PO with respect to the '443 Patent in the future. Thus, this factor either weighs in favor of institution or at a minimum is neutral as it is “far from an unusual circumstance that a petitioner in inter partes review and a defendant in a parallel district court proceeding are the same.” *Sand*, No. IPR2019-01393, Paper 24, at 12-13.

Under factor 6, other circumstances weigh in favor of institution. Here, the Petition's merits are particularly strong. For example, Wang is directed at the same problem and proposes the same solution as the '443 Patent, and discloses identical

architecture and the identical concepts disclosed in the '443 Patent, demonstrating that the Petition is particularly strong in the underlying merits.

When viewed holistically, the Petition's timing is reasonable, there has been limited investment in the Related Litigation, and there is minimal overlap between the present IPR and the Related Litigation. Coupling these *Fintiv* considerations with the compelling evidence of unpatentability presented herein, the efficiency and integrity of the IPR process is best served by instituting review.

IX. MANDATORY NOTICES UNDER 37 C.F.R. §42.8

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest in this Petition is Ericsson Inc., and corporate parent Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation.⁸ No

⁸ Out of an abundance of caution, Petitioners identify all current defendants in the below identified cases as potential real parties in interest only for the purpose of this proceeding and only to the extent that Patent Owner contends that these separate legal entities should be named real parties in interest in this IPR.

Petitioners do so to avoid the potential expenditure of resources to resolve such a challenge. Petitioners also acknowledge that each petitioner has a number of affiliates. No unnamed entity is funding, controlling, or otherwise has an opportunity to control or direct this Petition or Petitioner's participation in any

other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

To avoid additional issues associated with real parties in interest, Petitioners likewise identify T-Mobile USA, Inc., and Cellco Partnership d/b/a Verizon Wireless because one or both of the Petitioners have intervened in the Related Matters identified below due to their use of Petitioners' products being accused of infringement.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

1. Judicial Matters

As of the filing date of this Petition and to the best knowledge of Petitioners, the '443 Patent is involved in the following litigation:

- *Active Wireless Technologies LLC v. T-Mobile USA, Inc. et al.*, U.S.D.C. EDTX Case No. 2:23-cv-00261-JRG-RSP;
- *Active Wireless Technologies LLC v. Verizon Communications, Inc. et al.*, U.S.D.C. EDTX Case No. 2:23-cv-00620-JRG-RSP.

These are references collectively herein as the "Related Litigation(s)."

resulting IPR. Petitioners are also not aware of any affiliate that would be barred from filing this Petition under 35 U.S.C. § 315(e).

2. Administrative Matters:

As of the filing date of this Petition and to the best knowledge of Petitioners, the '443 Patent was not subject to any administrative matters.

3. Related Patents

Petitioners are unaware of any related United States Patents.

C. Lead/Back-up Counsel (37 C.F.R. § 42.8(b)(3)):

Lead Counsel:

Patrick D. McPherson, USPTO Reg. No. 46,255
DUANE MORRIS LLP, 901 New York Ave. NW, Suite 700 East,
Washington, D.C. 20001
P: (202) 776-5214; PDMcPherson@duanemorris.com

Back-Up Counsel:

Kevin Anderson, USPTO Reg. No. 43,471
DUANE MORRIS LLP, 901 New York Ave. NW, Suite 700 East,
Washington, D.C. 20001
P: (202) 776-5213; KPAnderson@duanemorris.com

D. Notice of Service Information (37 C.F.R. § 42.8(b)(4)):

Please direct all correspondence to lead and back-up counsel at the above addresses. Petitioners consent to electronic service at the email addresses above.

X. CONCLUSION

Petitioners request the Board institute *inter partes* review and cancel all Challenged Claims.

Respectfully submitted,

DUANE MORRIS LLP

BY: /Kevin P. Anderson/
Kevin P. Anderson, Reg. No. 43,471
kpanderson@duanemorris.com
DUANE MORRIS LLP
901 New York Ave NW 700 E
Washington, D.C. 20001

Dated: May 31, 2024

CERTIFICATION OF SERVICE ON PATENT OWNER

Pursuant to 37 C.F.R. §§ 42.6(e), 42.8(b)(4) and 42.105, the undersigned certifies that on the 31st of May, 2024, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 10,531,443 and all supporting exhibits were served via email and/or electronic download by agreement of Patent Owner, to the following address:

Vincent Rubino
vrubino@fabricantllp.com

Julian Pymonto
jpymento@fabricantllp.com

activewireless@fabricantllp.com

Fabricant LLP
411 Theodore Fremd Avenue
Suite 206 South
Rye, NY 10580
UNITED STATES

/Kevin P. Anderson/

Kevin P. Anderson, Reg. No. 43,471
kpanderson@duanemorris.com
DUANE MORRIS LLP
901 New York Ave NW 700 E
Washington, D.C. 20001

ATTORNEY FOR PETITIONERS

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24 *et seq.*, the undersigned certifies that this document complies with the type-volume limitations. This document contains 12,958 words as calculated by the “Word Count” feature of Microsoft Word 2010, the word processing program used to create it.

Dated: May 31, 2024

By: Kevin P. Anderson
Kevin P. Anderson,
Reg. No. 43,471
kpanderson@duanemorris.com
DUANE MORRIS LLP
901 New York Ave NW 700 E
Washington, D.C. 20001
P: (202) 776-7800
F: (202) 776-7801
kpanderson@duanemorris.com