

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Havish Koorapaty, et al.
U.S. Patent No.: 10,306,669 Attorney Docket No.: 39843-0100IP1
Issue Date: May 28, 2019
Appl. Serial No.: 16/203,391
Filing Date: November 28, 2018
Title: PHYSICAL UPLINK CONTROL CHANNEL (PUCCH) RE-SOURCE ALLOCATION

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 10,306,669 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

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EXHIBITS

- SAMSUNG-1001 U.S. Patent No. 10,306,669 to Havish Koorapaty, et al. (“the ’669 patent”)
- SAMSUNG-1002 Excerpts from the Prosecution History of the ’669 Patent (“the Prosecution History”)
- SAMSUNG-1003 Declaration of Dr. R. Michael Buehrer
- SAMSUNG-1004 *Curriculum Vitae* of Dr. R. Michael Buehrer
- SAMSUNG-1005 U.S. Patent Publication No. 2013/0208692 (“Seo”)
- SAMSUNG-1006 “NR PUCCH resource allocation,” 3GPP TSG RAN WG1 Meeting NR#3, R1-1715527, September 18-21, 2017 (“ZTE”)
- SAMSUNG-1007 “Resource allocation for NR uplink control channel,” 3GPP TSG RAN WG1 NR Ad-Hoc Meeting, R1-1700369, January 16-20, 2017 (“Intel”)
- SAMSUNG-1008 Declaration of Friedhelm Rodermund
- SAMSUNG-1009 S. Sesia, I. Toufik and M. Baker “LTE: The UMTS Long Term Evolution” (“Sesia”)

Samsung Electronics Co., Ltd. (“Petitioner” or “Samsung”) petitions for *In-ter Partes* Review (“IPR”) of claims 1-3, 6-8, 11-12, and 17-19 (“the Challenged Claims”) of U.S. Patent No. 10,306,669 (“the ’669 patent”). As explained in this petition, there exists a reasonable likelihood that Samsung will prevail with respect to the Challenged Claims.

I. REQUIREMENTS FOR IPR

A. Grounds for Standing

Samsung certifies that the ’669 Patent is available for IPR. Samsung has not been served with a complaint for infringement of the ’669 patent. Samsung is not barred or estopped from requesting this review challenging the Challenged Claims on the below-identified grounds.

B. Challenge and Relief Requested

Petitioner requests IPR and cancellation of the Challenged Claims on the grounds listed below. In support, this Petition includes a declaration from Dr. R. Michael Buehrer (SAMSUNG-1003).

Ground	’669 Patent Claims	Basis for Rejection
1	1-3, 6-8, 11, 12, and 17-19	35 U.S.C. § 103 over Seo (US2013/0208692) and ZTE (R1-1715527)
2	1-3, 6-8, 11, 12, and 17-19	35 U.S.C. § 103 over Seo (US2013/0208692), ZTE (R1-1715527), and Intel (R1-1700369)

The '669 patent issued from U.S. Application No. 16/203,391 filed November 28, 2018 as a continuation of International Patent Application No. PCT/IB2018/058400, filed October 26, 2018, which claims the benefit of Provisional Application No. 62/577,578, filed October 26, 2017. Accordingly, the earliest potential priority date of the '669 patent is October 26, 2017 (the "Critical Date").¹ Each of the references advanced in Grounds 1 and 2 predates October 26, 2017.

Specifically, Seo qualifies as prior art under 35 U.S.C § 102(a)(1) because Seo was published on August 15, 2013, more than a year before the Critical Date. ZTE qualifies as prior art under 35 U.S.C § 102(a)(1) because ZTE was published by September 12, 2017, before the Critical Date. *See generally* SAMSUNG-1008; *see also, e.g.*, [43]-[47]. Intel qualifies as prior art under 35 U.S.C § 102(a)(1) because Intel was published by January 10, 2017, before the Critical Date. *See generally* SAMSUNG-1008; *see also, e.g.*, [38]-[42].

C. Claim Construction under 37 C.F.R. §§ 42.104(b)(3)

Based on the prior art's description of the claimed elements being similar to that of the '669 Patent specification, no formal claim constructions are necessary in this proceeding because "claim terms need only be construed to the extent necessary to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355,

¹ Petitioner does not concede that the '669 patent is entitled to the claimed priority.

1361 (Fed. Cir. 2011).

Petitioner reserves the right to respond to any constructions offered by Patent Owner or adopted by the Board. Furthermore, Petitioner is not conceding that each challenged claim satisfies all statutory requirements, such as 35 U.S.C. § 112. As this is an IPR petition, Petitioner is pursuing prior art-based grounds. Petitioner is not waiving any arguments concerning other grounds that can only be raised in district court.

II. SUMMARY OF THE '669 PATENT

A. Brief Description

The '669 patent describes “[s]ystems and methods for determining an uplink control channel resource to use for transmitting uplink control information to a network node.” SAMSUNG-1001, Abstract. Independent claims 1 and 6 of the '669 patent relate to a first process for determining the uplink control channel resource, and independent claims 11 and 18 of the '669 patent relate to a second, different process for determining the uplink control channel resource.

Specifically, independent claims 1 and 6 of the '669 patent are directed to the description of Fig. 13 and “Embodiment 7.” SAMSUNG-1001, 33:23-40. As shown in Fig. 13 (reproduced below), a user equipment (“UE”) receives, from a network node, two downlink control channel messages that schedule two downlink shared channel transmissions. *Id.*, 33:24-29. The UE then determines one uplink

control channel resource to use for transmitting, to the network node, Hybrid Automatic Repeat Request (“HARQ”) feedback for both downlink shared channel transmissions. *Id.*, 33:30-35. The determination of which uplink control channel resource to use for the HARQ feedback transmission is based on signaling received from the network node and a latest received one of the two downlink control channel messages. *Id.*, 33:35-40. For instance, as explained in “Embodiment 7,” “if a UE receives a [Physical Downlink Control Channel] PDCCH which points to a [Physical Uplink Control Channel] PUCCH resource ... and the UE receives a PDCCH at a later time, this latest scheduled PDCCH can override the PUCCH resource assignment as per the previously received PDCCH, and the HARQ feedback can be sent for both the PDSCHs corresponding to the prior and latest PDCCH using the PUCCH resources determined based on the latest received PDCCH.” *Id.*, 13:10-41; SAMSUNG-1003, [41]-[43].

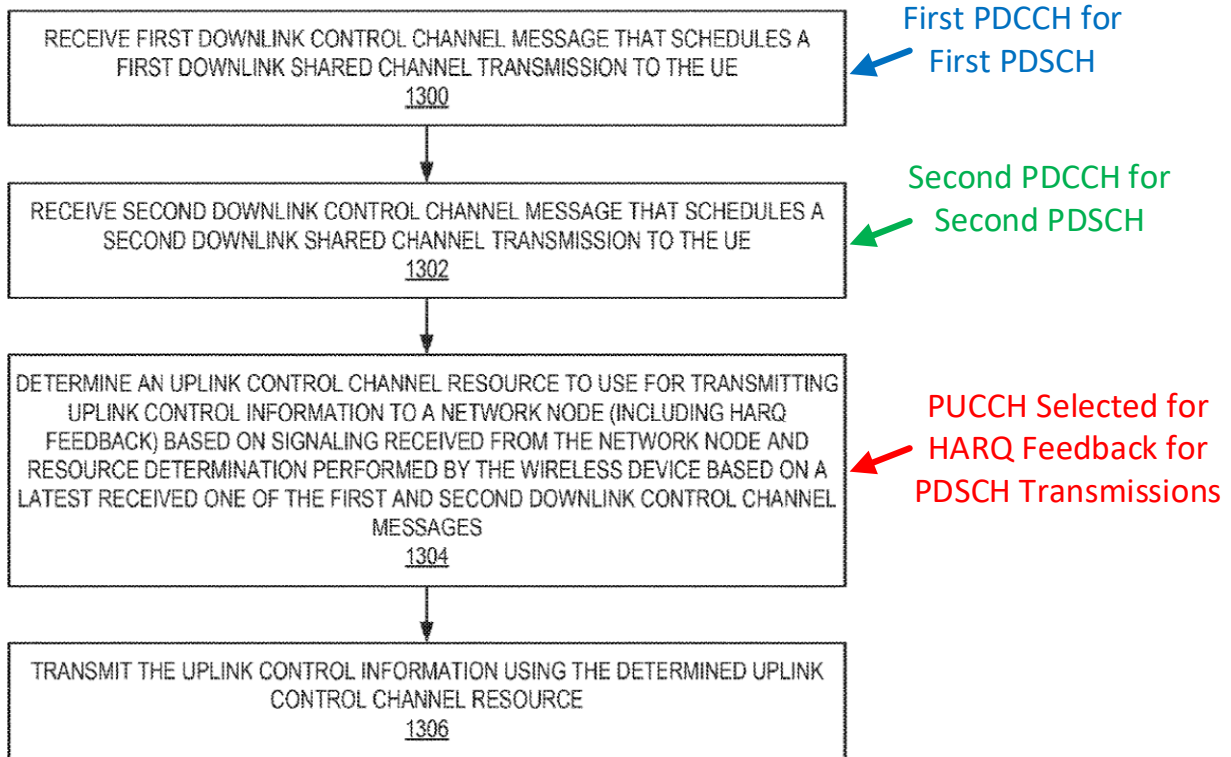
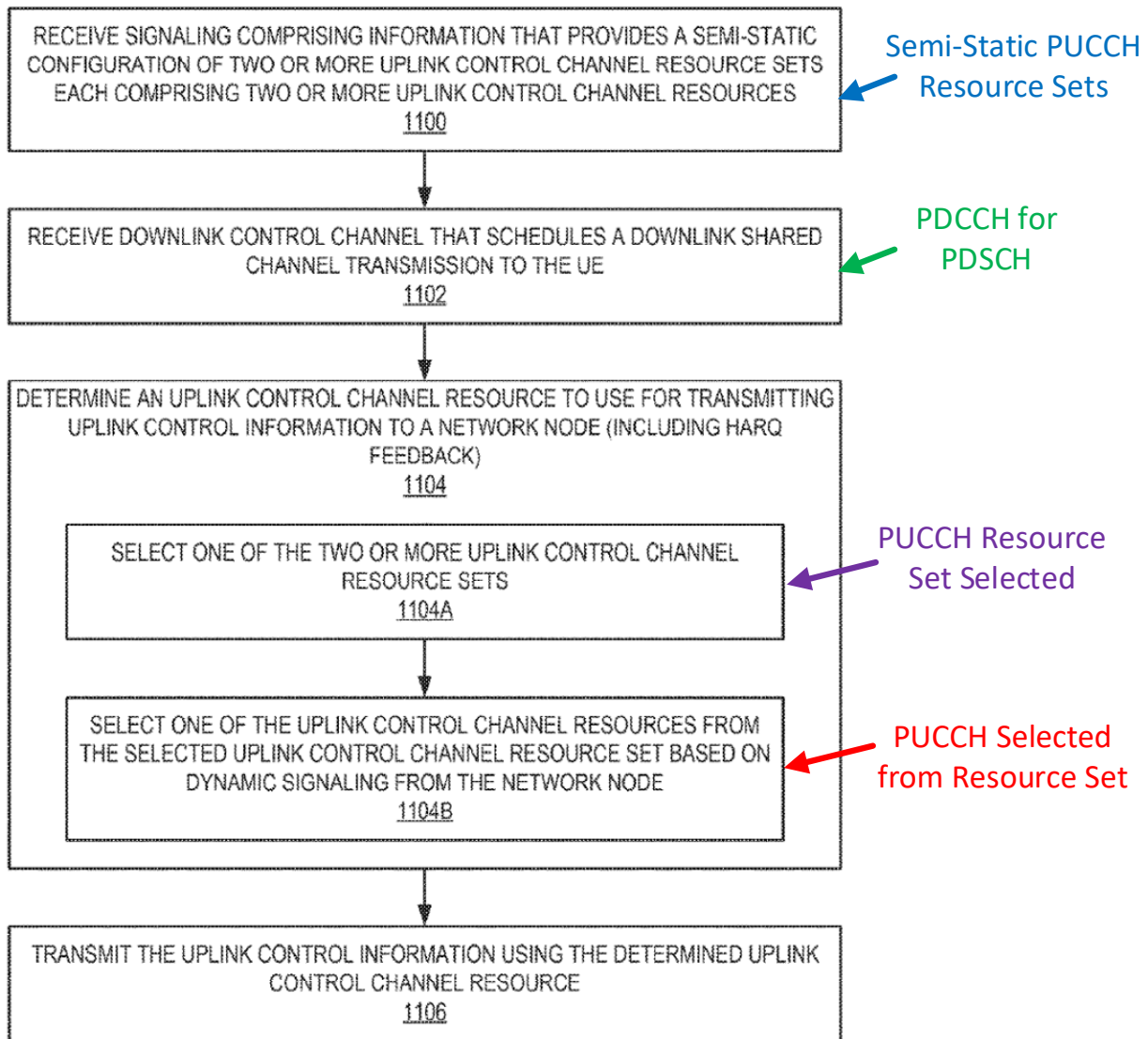


FIG. 13

SAMSUNG-1001, Fig. 13 (annotated)

Independent claims 11 and 18 of the '669 patent are directed to the description of Fig. 11 and “Embodiment 3.” SAMSUNG-1001, 31:36-32:38. As shown in Fig. 11 (reproduced below), a UE receives, from a network node, “a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources” and “a downlink control channel that schedules a downlink shared channel transmission.” *Id.*, 31:37-44. The UE then determines an uplink control channel resource to use for transmitting, to the network node, HARQ feedback for the downlink shared channel transmission. *Id.*,

31:44-49. The UE first selects an uplink control channel resource set based on the HARQ payload size and the starting Control Channel Element (CCE) index of the downlink control channel candidate (*id.*, 31:49-32:24), and then selects, from the selected resource set, an uplink control channel resource based on dynamic scheduling from the network node (*id.*, 32:32-37). For instance, as explained in “Embodiment 3,” “[w]hether a PUCCH format of up to 2 bits or greater than 2 bits is used is determined by the UE implicitly based on the payload size,” “[t]he CCE index ... is then used to determine a single PUCCH resource set within the group of configured PUCCH resource sets corresponding to the chosen PUCCH format,” and “[d]ynamic signaling (2 bits) in the DCI message is used to determine a single PUCCH resource from within the chosen PUCCH resource set.” *Id.*, 10:13-26; 9:45-11:23; SAMSUNG-1003, [44].



SAMSUNG-1001, Fig. 11 (annotated)

B. Summary of the Prosecution History of the '669 Patent

The '669 patent issued on May 28, 2019 from U.S. Patent Application No. 16/203,391 ("the '391 application"), which was filed on November 28, 2018. See SAMSUNG-1002. The '391 application was filed with a Track One Request for

Prioritized Examination and a Request to Participate in the First Action Interview

Pilot Program. *Id.*, 224-319. In a Pre-Interview Communication, the Examiner identified claims 3, 9, and 14 as reciting allowable subject matter. *Id.*, 198-201.

After an interview, the Examiner issued a Notice of Allowance with an Examiner's amendment that amended the independent claims to include the allowable subject matter identified in the Pre-Interview Communication. *Id.*, 164-188. In the Notice of Allowance, the Examiner's statement of reasons for allowance contended that the prior art does not teach:

wherein the signaling received from the network node comprises information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources ... selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node. *Id.*, 170.

C. Level of Ordinary Skill

For purposes of this IPR, Petitioner submits that a person of ordinary skill in the art at the time of the Critical Date (a “POSITA”) would have had at least a Bachelor’s Degree (or higher degree) in an academic area emphasizing telecommunications systems with two or more years of work experience in telecommunications systems. SAMSUNG-1003, [21]. Alternatively, a POSITA would have had a Master of Science Degree in an academic area emphasizing telecommunications systems, or an equivalent field (or a similar technical Master’s Degree, or higher degree) with a concentration in telecommunications systems. *Id.* Additional education in a relevant field, or relevant industry experience may compensate for a deficit in one of the other aspects of the requirements stated above. *Id.*

III. APPLICATION OF PRIOR ART TO THE CHALLENGED CLAIMS

The Challenged Claims are obvious over Grounds 1 and 2 advanced in the present petition. As detailed below, this request shows a reasonable likelihood that claims 1-3, 6-8, 11, 12, and 17-19 of the ’669 patent are unpatentable.

A. [GROUND 1] – Claims 1-3, 6-8, 11, 12, and 17-19 are obvious over Seo and ZTE

1. Overview of Seo²

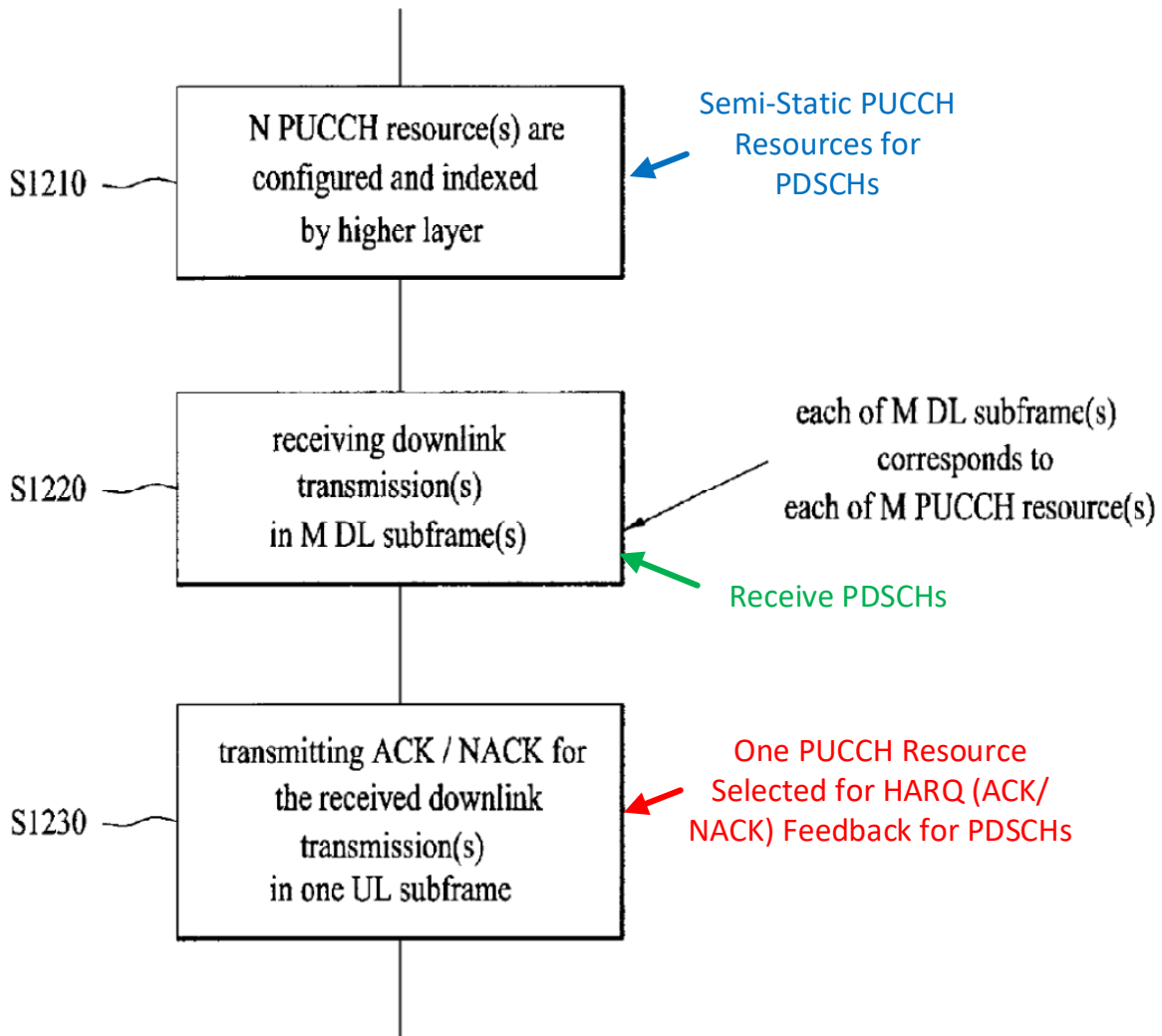
Seo describes “a method and apparatus for transmitting ACK/NACK for downlink transmission in a wireless communication system.” SAMSUNG-1005, [0001]. Seo’s framework uses “a Physical Downlink Control Channel (PDCCH)” to transmit “Downlink Control Information (DCI)” that “includes uplink or downlink scheduling information.” *Id.*, [0051], [0013]-[0014]. Seo’s scheduling information schedules data transmissions on “a Physical Downlink Shared Channel (PDSCH)” and HARQ feedback related to the PDSCH data transmissions. *Id.*, [0051], [0052], [0006], [0011]-[0012].

Starting at paragraph [0133], Seo provides more details on “Determination of Resources Used to Transmit ACK/NACK Information.” *Id.*, [0133]-[0216]. For instance, an eNB sends, to a UE, “control information for downlink data transmission ... via a PDCCH,” the UE “receives data scheduled via the PDCCH to the UE via a PDSCH,” and the UE “transmit[s] ACK/NACK via a PUCCH.” *Id.*,

² General descriptions provided for this and other references and combinations thereof are incorporated into each subsection and mapping of the claims that includes citations to these references. All emphasis is added unless otherwise indicated.

[0138]; *see also* [0134]-[0137]. In some examples, Seo's UE transmits "HARQ ACK/NACK information" for "PDSCH transmission of one or more downlink subframes in one uplink subframe." *Id.*, [0147]; *see also* [0150], [0155].

As shown in Fig. 12 (reproduced below), Seo's UE receives PDCCH transmissions that schedule PDSCH transmissions and "semi-statically configured ... PUCCH resources." *Id.*, [0208]; *see also* [0204] ("semi-statically configuring a plurality of ACK/NACK resource sets"), [0205] ("higher layer signaling (e.g., RRC signaling)"), [0212] ("downlink subframes may be PDSCH transmission(s)"), [0215] ("ACK/NACK feedback for a PDSCH indicated by detection of a corresponding PDCCH"). Seo's UE then receives "downlink subframes" as "PDSCH transmission(s)." *Id.*, [0209]-[0210]; *see also* [0212], [0215]. Seo's UE then uses "one of the M PUCCH resources" to transmit "ACK/NACK information" for the multiple "downlink subframes." *Id.*, [0211] ("ACK/NACK bundling"); SAM-SUNG-1003, [46]-[48].



SAMSUNG-1005, Fig. 12 (annotated)

Seo describes various techniques for selecting the PUCCH resource used to transmit the HARQ ACK/NACK feedback. For example, Seo describes that the “ACK/NACK bundling result may be transmitted via an ACK/NACK resource set *mapped to a last DL subframe* in which the PDSCH is transmitted (*a latest DL subframe*, in which the PDSCH is received, from among m DL subframes).”

SAMSUNG-1005, [0183]; *see also* [0184]-[0188] (“the PUCCH resource set 0

mapped to the last DL subframe (that is, the DL subframe #9) in which the PDSCH is received.”), [0202] (“if ACK/NACK bundling is applied, bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe.”). In this example, dynamic signaling may be used to identify the latest DL subframe and select the PUCCH resource. *Id.*, [0183]. Specifically, the “control channel transmitted from the transmitter may include a control channel number count value,” which “gradually increases for each control channel” and is “similar to a downlink assignment index (DAI) field included in a PDCCH.” *Id.*; *see also* [0187]-[0189], [0196]-[0202] (“bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe”), [0212] (“[t]he control channel may include control channel number count information”). When the control channel number count value is used, Seo’s ACK/NACK resources are “mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe.” *Id.*, [0202].

Seo also describes selecting the PUCCH resource based on control channel elements (CCEs). *Id.*, [0051], [0139]. For instance, “the UE may transmit ACK/NACK via a PUCCH having an index corresponding to an index of a specific

(e.g., first) CCE of the CCEs configuring the PDCCH received by the UE.” *Id.*, [0139]-[0140]. Seo also describes PUCCH resource selection using equations that include the value “ n_{CCE} ,” which “denotes the smallest value of CCE indexes used for PDCCH transmission in a subframe $n-k_m$ (k_m is the smallest value of the set K).” *Id.*, [0142]-[0143], [0150]-[0152]; SAMSUNG-1003, [49]-[50].

Although Seo describes various examples and embodiments for PUCCH resource determination for ACK/NACK information (*id.*, [0133]-[0216]), a POSITA would have viewed the various techniques together and would have found it obvious to apply techniques described in one embodiment to other of the described embodiments. SAMSUNG-1003, [51]. As Dr. Buehrer explains, Seo’s embodiments relate to conventional resource determination and ACK/NACK signaling and a POSITA would have viewed the various techniques together as a collective set of available options for resource determination and ACK/NACK signaling. *Id.* Indeed, Seo itself explains that “two or more embodiments may be simultaneously applicable.” SAMSUNG-1005, [0216]. Through Seo’s suggestion to consider multiple embodiments together and based on the related and well-known techniques described across embodiments, a POSITA would have found it obvious to consider teachings from different embodiments together. SAMSUNG-1003, [51]. Thus, if techniques are described in Seo in different embodiments, a POSITA

nonetheless would have had reason to consider Seo's different embodiments together and would have found it obvious to apply techniques in one embodiment to other of the described embodiments. *Id.*

2. Overview of ZTE

ZTE is a 3GPP contribution directed to "PUCCH resource allocation" in New Radio (NR) and Long-Term Evolution (LTE) systems. SAMSUNG-1006, 1-6. ZTE describes "ARI-based PUCCH resource allocation for HARQ-ACK transmission" where "a PUCCH resource set is configured by high layer signaling, and the physical layer signaling indicates the one PUCCH resource from the set." *Id.*, 2. For example, ZTE proposed "a separate PUCCH resource set for different PUCCH formats." *Id.* Specifically, ZTE proposed "two PUCCH resource sets, one set is for PUCCH format carrying up to 2 bits UCI and another set is for PUCCH format carrying more than 2 bits UCI." *Id.* (emphasis omitted). In ZTE, the "PUCCH resource set is configured by high layer signaling" and "4 bits in DCI is used to indicate one PUCCH resource group index to the UE." *Id.*; SAMSUNG-1003, [52]. As shown in Table 1 (reproduced below), a PUCCH resource set in ZTE includes multiple PUCCH resources. SAMSUNG-1006, 3; SAMSUNG-1003, [52].

PUCCH Resource Set With
Multiple PUCCH Resources

PUCCH Resource Selected
Based On Index in DCI

Table 1– PUCCH resource set for formats carrying up to 2 bits

PUCCH format	PUCCH length	PUCCH resource value	Time domain OCC	Cyclic shift index	PUCCH resource group index
Short Format 0	1	a0	-	CS set #0	0
		a1	-	CS set #1	1
	1	a2	-	CS set #2	2
		a3	-	CS set #3	3
	2	a4	-	CS set #4	4
		a5	-	CS set #5	5
	2	a6	-	CS set #6	6
		a7	-	CS set #7	7
Long Format 0	4	a8	OCC #0	CS set #8	8
		a9	OCC #1	CS set #9	9
	8	a10	OCC #0	CS set #10	10
		a11	OCC #1	CS set #11	11
	8	a12	OCC #0	CS set #12	12
		a13	OCC #1	CS set #13	13
	14	a14	OCC #0	CS set #14	14
		a15	OCC #1	CS set #15	15

SAMSUNG-1006, Table 1 (annotated)

In ZTE, “[f]or PUCCH formats with more than 2 bits, a similar resource set like Table 1 would be introduced.” SAMSUNG-1006, 3. Accordingly, as Dr. Buehrer explains, ZTE describes two PUCCH resource sets: (1) a first resource set with multiple PUCCH resources for 2-bit PUCCH formats (as shown in Table 1) and (2) a second resource set with multiple PUCCH resources for PUCCH formats with more than 2 bits (similar to Table 1, but not shown). *Id.*; SAMSUNG-1003, [53].

ZTE also explains that, “[i]n LTE, a combination of a semi-static configuration and dynamic signalling is used to determine the PUCCH resource for

ACK/NACK in the frequency domain” and “[a] similar concept could be envisioned for NR.” SAMSUNG-1006, 4. In particular, “[a] set containing four PUCCH candidate resources is configured through semi-static signalling, and then the specific PUCCH resources to be used are indicated via the physical layer DCI.” *Id.*, 5. As Dr. Buehrer explains, a POSITA would understand “semi-static signaling” to be equivalent to “higher layer signaling.” SAMSUNG-1003, [54] (citing SAMSUNG-1009, 355, 360, 415).

With this background, ZTE proposed “a new method to achieve semi-static + dynamic PUCCH frequency resource allocation” with “an enhanced ARI mechanism.” *Id.* Specifically, in ZTE’s enhanced ARI mechanism:

The base station always configures 3 *candidate PUCCH resources for the UE through higher layer signalling* and implicitly assumes that 1 candidate PUCCH resource is located within the frequency domain of the PUSCH / PDSCH of the UE. Then, *physical layer signalling is used to indicate the specific PUCCH resource to be used out of the set from the four PUCCH candidate resources.* *Id.*

ZTE describes that this “enhanced ARI mechanism (dynamic + semi-static method) can promptly adjust at least one PUCCH candidate frequency resource to

immediately follow the channel quality” and, therefore, “make full use of channel quality to transmit PUCCH.” *Id.*, 6. And, ZTE confirms that its enhanced ARI mechanism applies to multiple PUCCH sets based on PUCCH format, as “dynamic frequency resource allocation and the enhanced ARI mechanism can be used simultaneously for long/short PUCCHs.” *Id.*; SAMSUNG-1003, [54]-[56].

3. Combination of Seo and ZTE

As Dr. Buehrer explains, a POSITA would have found it obvious to combine teachings of Seo and ZTE. SAMSUNG-1003, [57]-[67]. Specifically, Seo and ZTE are in the same field, each relate to PUCCH resource allocation for ACK/NACK information, and each relate to uplink control resource allocation in 3GPP systems. SAMSUNG-1005, Abstract, [0001], [0133] (“Determination of Resources Used to Transmit ACK/NACK Information”), [0138] (“ACK/NACK via a PUCCH”); SAMSUNG-1006, 2 (“PUCCH resource allocation for HARQ-ACK transmission”); SAMSUNG-1003, [57]. Given this extensive overlap in subject matter, a POSITA would have had reason to consult ZTE when reviewing Seo’s disclosure. SAMSUNG-1003, [57]. Indeed, ZTE was published in 2017, four years after Seo, and a POSITA would have had reason to look to publications, such as ZTE, that discussed advancements to PUCCH resource allocation subsequent to Seo’s writing. *Id.*

Further, a POSITA reviewing Seo’s disclosure would have been motivated

to look to 3GPP technical documents, such as contributions to 3GPP, for technical and implementation details and advancements in cellular communication technology. SAMSUNG-1003, [58]. This is particularly true given that, “[f]or clarity, the [] description [in Seo] focuses on the 3GPP LTE and 3GPP LTE-A system.” SAMSUNG-1005, [0042]. Examples of these contributions include the proposals offered in ZTE’s contribution. SAMSUNG-1003, [58]. A POSITA would have understood that these contributions would provide information about proposals relating to the standard that are being considered by the 3GPP and by wireless companies, prior to adoption by the 3GPP. *Id.*

Notably, regardless of whether information disclosed in contributions are eventually adopted, a POSITA would have been prompted to look to contributions, generally, in order to learn of and understand alternatives or other options being considered. *Id.*, [59]. Indeed, the very format of standards-based deliberation compels participants to consider different documents, not in isolation, but as collections of teachings directed to advancing the field. *Id.*

Although a POSITA would have turned to 3GPP contributions based on the subject matter of Seo’s PUCCH resource allocation for ACK/NACK information, Seo explicitly suggests turning to 3GPP documents, such as ZTE. SAMSUNG-1005, [0041], [0042]. As Seo explains, “[e]xemplary embodiments of the present

invention are supported by standard documents disclosed for at least one of wire-less access systems including ... a 3rd Generation Project Partnership (3GPP) system, a 3GPP Long Term Evolution (LTE) system, and a 3GPP2 system.” *Id.*, [0041]; *see also* [0042] (“the following description focuses on the 3GPP LTE and 3GPP LTE-A system”). “In particular, the steps or parts, which are not described to clearly reveal the technical idea of the present invention, in the embodiments of the present invention may be supported by the above documents.” *Id.*, [0041]. As Dr. Buehrer explains, in evaluating Seo, a POSITA would have been motivated to consider 3GPP contributions, such as ZTE, based on Seo’s explicit indication that its description is supported by 3GPP documents. SAMSUNG-1003, [60].

For these reasons, a POSITA would have been motivated to consult ZTE and would have found it obvious to employ teachings from ZTE’s PUCCH resource allocation in Seo. SAMSUNG-1003, [61]. Specifically, in the combination, a POSITA would have found it obvious to modify Seo to use ZTE’s PUCCH resource sets that are defined for different PUCCH formats. SAMSUNG-1006, 2-3; SAMSUNG-1003, [61]. A POSITA also would have found it obvious to modify Seo to use ZTE’s “dynamic + semi-static” signalling to select a PUCCH resource from the defined PUCCH resource sets. SAMSUNG-1006, 4-6; SAMSUNG-1003, [61].

In fact, combining the teachings of Seo with ZTE would have merely involved combining prior art elements according to known methods to yield predictable results. SAMSUNG-1003, [62]. ZTE, like Seo, discloses selection of a PUCCH resource to use in providing HARQ ACK/NACK feedback. SAMSUNG-1005, Abstract, [0001], [0133], [0138]; SAMSUNG-1006, 2-6. A POSITA would have been motivated to combine the teachings of Seo with the teachings of ZTE to realize, in Seo, the advancements in PUCCH resource allocation described by ZTE in view of development of the same 3GPP standard described in Seo. SAMSUNG-1003, [62]. The combination of Seo and ZTE would have been predictable and foreseeable because 1) Seo and ZTE disclose PUCCH resource allocation, and 2) the combination merely involves incorporating PUCCH resource advancements that are explicitly disclosed by ZTE as part of development of the 3GPP standard upon which Seo is based. SAMSUNG-1003, [62]. The combination is predictable, at least in part, because elements of the combined system would each perform similar functions they had been known to perform prior to the combination. *Id.* For example, Seo's wireless device would still perform the same PUCCH resource allocation as it did prior to the combination with ZTE, but with updates to account for ZTE's different PUCCH resource sets and ZTE's dynamic + semi-static PUCCH resource selection. *Id.*

Additionally, a POSITA would have been motivated to modify Seo's system

to include ZTE's PUCCH resource allocation because the use of ZTE's PUCCH resource allocation technique in Seo's system would have been recognized as simply applying a known technique (e.g., PUCCH resource sets with dynamic + semi-static signalling) to a known system (e.g., Seo's communication system) ready for improvement to yield predictable results (e.g., enable efficient use of different PUCCH formats). *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417, (2007); SAMSUNG-1003, [63]. A POSITA would have recognized that using multiple PUCCH resource sets would have been an obvious design choice selected from among a set of known options (e.g., using individual PUCCH resources versus using sets of PUCCH resources). SAMSUNG-1003, [63].

Further, a POSITA would have been motivated to employ ZTE's different PUCCH resource sets and PUCCH resource selection techniques to gain the benefits of these techniques described by ZTE. SAMSUNG-1003, [64]. As to different PUCCH formats, ZTE explains that:

It can be found that *different PUCCH formats* may require *different resource elements*. For example, cyclic shift index is not applicable to PUCCH format with more than 2 bits. Therefore, *it is reasonable to define a separate PUCCH resource set for different PUCCH formats*.

SAMSUNG-1006, 2.

From this description, a POSITA would have been motivated to use, in Seo, separate PUCCH resource sets to allow for different PUCCH formats that have different resource elements. SAMSUNG-1003, [65]. As Dr. Buehrer explains, tailoring PUCCH formats with different resource elements to different PUCCH resource sets would have led to more efficient PUCCH transmissions because PUCCH resource elements could be tailored to the elements needed for separate PUCCH formats. *Id.* For example, a cyclic shift index element can be included when needed (e.g., for a 2-bit PUCCH format) and can be excluded when it is not applicable (e.g., for a PUCCH format with more than 2 bits). *Id.* Because ZTE's separate PUCCH resource sets enable flexibility in including or excluding particular resource elements and enable tailoring of resource elements to only those resource elements applicable to the PUCCH format associated with the defined resource set, a POSITA would have perceived benefits to ZTE's use of different PUCCH resource sets for different PUCCH formats. *Id.* Indeed, because PUCCH resource elements are tailored to include only those needed for the PUCCH format associated with the PUCCH resource set, a POSITA would have perceived enhanced efficiency in ZTE's solution, recognizing that unnecessary resource elements (e.g., a cyclic shift index for a PUCCH format with more than 2 bits) can be avoided where inapplicable, thereby providing more useful options. *Id.*

Further, as Dr. Buehrer explains, adoption of ZTE's separate PUCCH resource sets in Seo allows for this additional flexibility without significant additional signaling. SAMSUNG-1003, [66]. In Seo, all PUCCH resources are available and signaled whenever PUCCH resources are needed. *Id.* By adopting ZTE's separate resource sets, a POSITA would have understood and found obvious that you can use higher layer signaling to more easily toggle between PUCCH resource sets, thereby offering additional flexibility with reduced signaling overhead. *Id.*

Also, a POSITA would have been motivated to use ZTE's "enhanced ARI mechanism" to take advantage of channel quality in PUCCH transmissions. SAMSUNG-1003, [67]. As ZTE explains, the "enhanced ARI mechanism (dynamic + semi-static method) can promptly adjust at least one PUCCH candidate frequency resource to immediately follow the channel quality" and, therefore, "***make full use of channel quality to transmit PUCCH.***" SAMSUNG-1006, 6. Because ZTE's "enhanced ARI mechanism" takes advantage of channel quality for PUCCH transmission, a POSITA would have perceived benefits to ZTE's "enhanced ARI mechanism" and would have been motivated to achieve these channel quality benefits in Seo. SAMSUNG-1003, [67]. As Dr. Buehrer explains, "[e]xploiting channel quality was a well-known feature in cellular systems for data transmission, and would have provided predictable benefits for control information transmission." *Id.*, (citing SAMSUNG-1009, 215-223).

For at least the reasons discussed above, a POSITA would have found it obvious to combine the teachings of Seo and ZTE. SAMSUNG-1003, [57]-[67].

4. Analysis

The combination of Seo and ZTE renders the Challenged Claims obvious as set forth below. SAMSUNG-1003, [79]-[165].

[1pre] A method performed by a wireless device:

To the extent the preamble is limiting, Seo and ZTE render obvious a method performed by a wireless device. SAMSUNG-1003, [79]. Specifically, Seo describes “a *method* and apparatus *for transmitting ACK/NACK for downlink transmission* in a wireless communication system.” SAMSUNG-1005, [0001]; *see also* [0135], [0148], [0162], [0170], [0173], [0180]-[0181], [0190]-[0191], [0196], [0203], [0207], [0213]; Fig. 12. Seo’s method is performed by a wireless device, such as “a UE.” *Id.*, [0171]; *see also* [0003], [0038], [0223]; SAMSUNG-1003, [79].

[1a] receiving a first downlink control channel message that schedules a first downlink shared channel transmission;

Seo and ZTE render obvious receiving a first downlink control channel message that schedules a first downlink shared channel transmission. SAMSUNG-1003, [80]-[83]; SAMSUNG-1005, [0051], [0138]. Seo’s framework uses “a Physical Downlink Control Channel (PDCCH)” to transmit “Downlink Control Information (DCI)” that “includes uplink or downlink scheduling information.”

SAMSUNG-1005, [0051], [0013]-[0014]. Seo's downlink scheduling information schedules data transmissions on "a Physical Downlink Shared Channel (PDSCH)." *Id.*, [0051], [0052], [0006], [0011]-[0012].

Seo provides more details on "Determination of Resources Used to Transmit ACK/NACK Information." *Id.*, [0133]-[0216]. For instance, an eNB sends, to a UE, "control information for downlink data transmission ... via a PDCCH" and the UE "receives data scheduled via the PDCCH to the UE via a PDSCH." *Id.*, [0138]; *see also* [0134]-[0137]. In some examples, Seo's UE transmits "HARQ ACK/NACK information" for "PDSCH transmission of one or more downlink subframes in one uplink subframe." *Id.*, [0147]; *see also* [0150], [0155].

Seo's UE receives PDCCH transmissions that schedule PDSCH transmissions. *Id.*, [0208]; *see also* [0212] ("downlink subframes may be PDSCH transmission(s)"), [0215] ("a PDSCH indicated by detection of a corresponding PDCCH"), Fig. 12. Seo's UE then receives "downlink subframes" as "PDSCH transmission(s)." *Id.*, [0209]-[0210]; *see also* [0212], [0215].

By receiving PDCCH transmissions that schedule PDSCH transmissions, Seo receives a first downlink control channel message (e.g., first PDCCH) that schedules a first downlink shared channel transmission (e.g., first PDSCH). SAMSUNG-1003, [80]-[83].

[1b] receiving a second downlink control channel message that schedules a second downlink shared channel transmission;

Seo and ZTE render obvious receiving a second downlink control channel message that schedules a second downlink shared channel transmission. SAMSUNG-1003, [84]; SAMSUNG-1005, [0051], [0138], [0147]. As discussed at [1a] (incorporated here), Seo describes multiple PDCCH transmissions that schedule multiple PDSCH transmissions. These multiple PDCCH transmissions include the first PDCCH transmission for scheduling the first PDSCH transmission and a second PDCCH transmission for scheduling a second PDSCH transmission. SAMSUNG-1003, [84].

[1c] determining an uplink control channel resource to use for transmitting uplink control information to a network node on an uplink control channel;

Seo and ZTE render obvious determining an uplink control channel resource to use for transmitting uplink control information to a network node on an uplink control channel. SAMSUNG-1003, [85]-[89]; SAMSUNG-1005, [0148]-[0160]. Seo's uplink scheduling information schedules resources on a "Physical Uplink Control Channel (PUCCH)" for the PDSCH data transmissions. SAMSUNG-1005, [0051], [0052], [0006], [0011]-[0012].

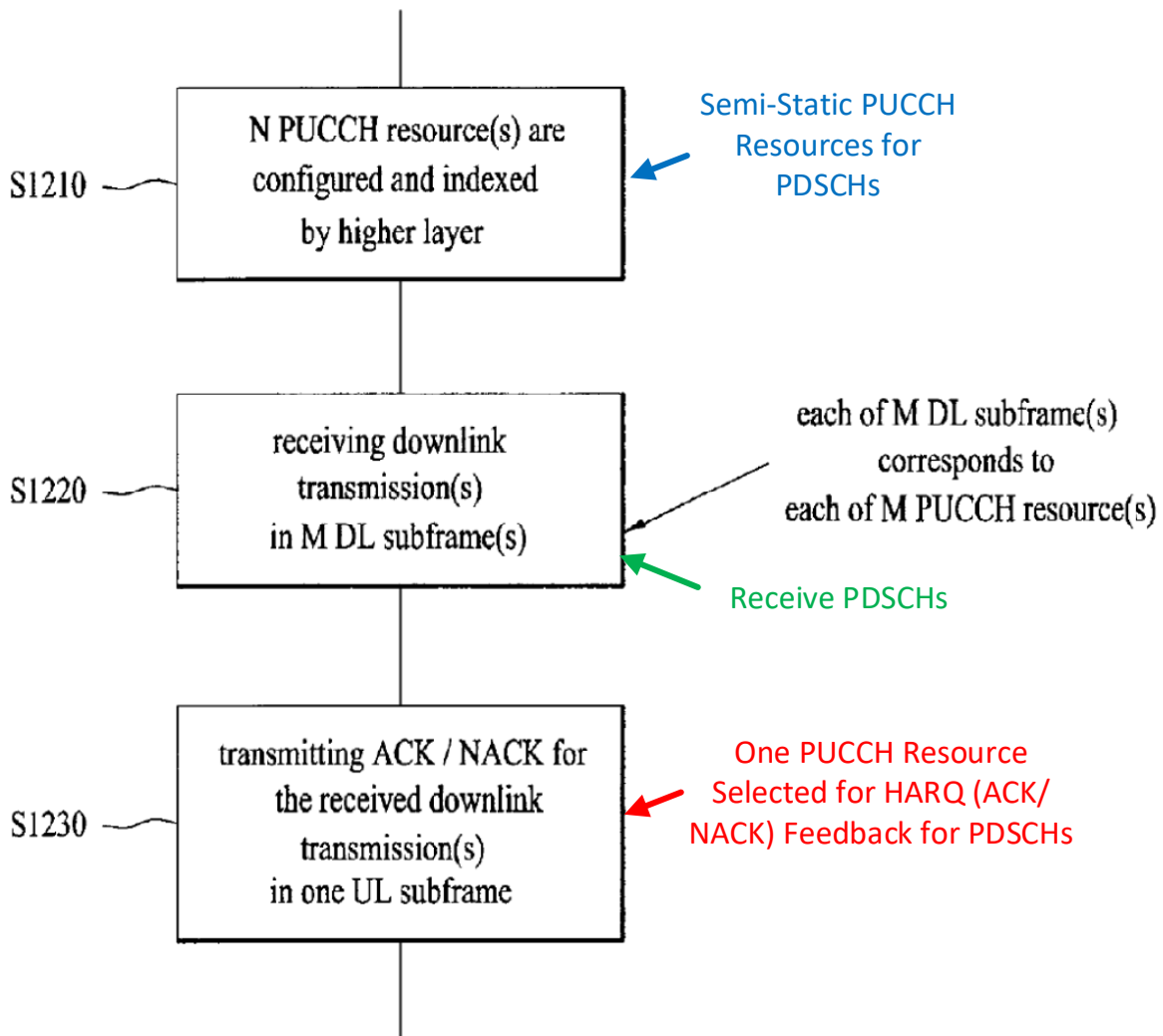
Specifically, Seo provides more details on "Determination of **Resources** Used to Transmit ACK/NACK Information." *Id.*, [0133]-[0216]. For instance, Seo's UE transmits, to a network node, ACK/NACK for the PDSCH transmissions "via a

PUCCH.” *Id.*, [0138]; *see also* [0134]-[0137]. In some examples, Seo’s UE transmits “HARQ ACK/NACK information” for “PDSCH transmission of one or more downlink subframes in one uplink subframe.” *Id.*, [0147]; *see also* [0150], [0155].

As shown in Fig. 12 (reproduced below), Seo’s UE receives “semi-statically configured ... PUCCH resources.” *Id.*, [0208]; *see also* [0204] (“semi-statically configuring a plurality of ACK/NACK resource sets”), [0205] (“higher layer signaling (e.g., RRC signaling)”), [0215] (“ACK/NACK feedback for a PDSCH indicated by detection of a corresponding PDCCH”). As Dr. Buehrer explains, “higher layer signaling” is slower than dynamic (e.g., PHY/MAC layer) signaling and would have been interpreted by a POSITA as “semi-static” signaling. SAMSUNG-1003, [87]; SAMSUNG-1005, [0204]-[0208]; SAMSUNG-1006, 2 (“a PUCCH resource set is configured by high layer signaling”), 5 (“A set containing four PUCCH candidate resources is configured through semi-static signalling, and then the specific PUCCH resources to be used are indicated via the physical layer DCI. ... Since four PUCCH candidate frequency resources are always pre-allocated through higher layer signaling.”)

Seo’s UE then uses “one of the M PUCCH resources” to transmit “ACK/NACK information” for the multiple “downlink subframes.” SAMSUNG-1005, [0211] (“ACK/NACK bundling”); SAMSUNG-1003, [88]. Seo’s ACK/NACK information is uplink control information. SAMSUNG-1005, [0138]

(“transmit *ACK/NACK via a PUCCH* for transmitting *uplink control information*.”), [0052] (“Physical Uplink Control Channel (PUCCH) including uplink control information”); SAMSUNG-1001, 1:24-27 (“Examples of such Uplink Control Information (UCI) are Hybrid Automatic Repeat Request (HARQ) Acknowledgements (ACKs)”), 34:39-44.



SAMSUNG-1005, Fig. 12 (annotated)

By selecting a PUCCH resource (uplink control channel resource) to use for

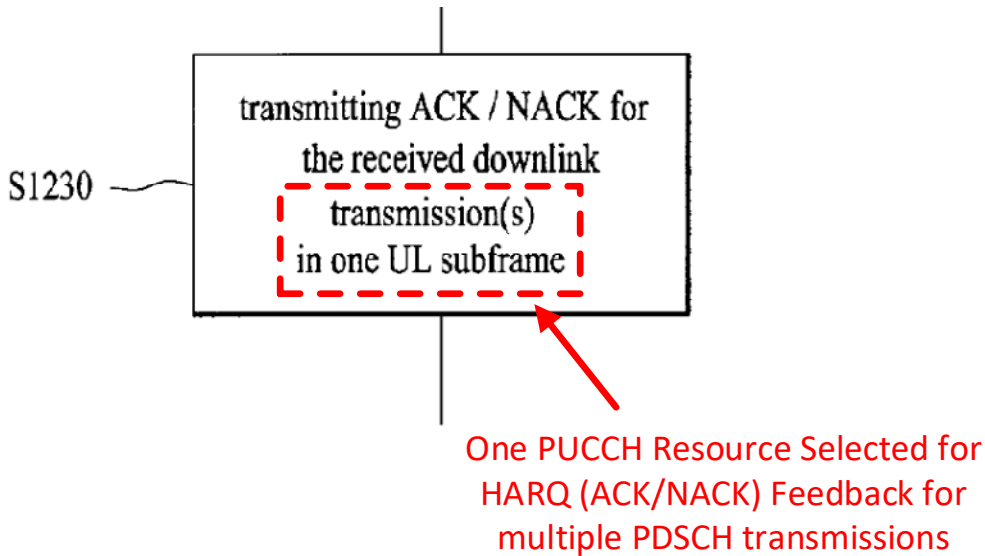
transmitting ACK/NACK information (uplink control information) to a network node on the PUCCH (uplink control channel), Seo determines an uplink control channel resource to use for transmitting uplink control information to a network node on an uplink control channel. SAMSUNG-1003, [89].

[1d] wherein the uplink control information comprises Hybrid Automatic Repeat Request, HARQ, feedback for both the first downlink shared channel transmission and the second downlink shared channel transmission; and

Seo and ZTE render obvious Hybrid Automatic Repeat Request, HARQ, feedback for both the first downlink shared channel transmission and the second downlink shared channel transmission. SAMSUNG-1003, [90]-[91]; SAMSUNG-1005, [0134], [0147]-[0150], [0141], [0160], and [0182]. Seo's UE transmits "HARQ ACK/NACK information" for "PDSCH transmission of one or more downlink subframes in *one uplink subframe*." SAMSUNG-1005, [0147]; *see also* [0150], [0155].

As shown in Fig. 12 (reproduced below), Seo's UE uses "one of the M PUCCH resources" to transmit "ACK/NACK information" for the multiple "downlink subframes." *Id.*, [0211] ("ACK/NACK bundling"); SAMSUNG-1003, [91]. By transmitting ACK/NACK information for multiple PDSCH transmissions in one uplink subframe (one PUCCH resource) and performing ACK/NACK bundling, Seo's uplink control information comprises HARQ feedback for both the first downlink shared channel transmission (first PDSCH) and the second downlink

shared channel transmission (second PDSCH). SAMSUNG-1003, [91].



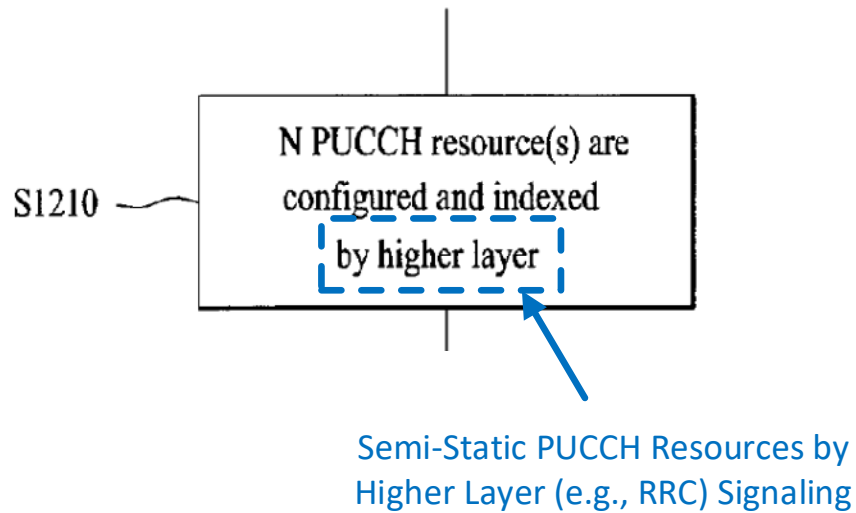
SAMSUNG-1005, Fig. 12 (excerpt; annotated)

[1e] wherein determining the uplink control channel resource to use for transmitting the uplink control information comprises determining the uplink control channel resource based on (a) signaling received from the network node and (b) resource determination performed by the wireless device based on a latest received one of the first downlink control channel message and the second downlink control channel message; and

Seo and ZTE render obvious determining the uplink control channel resource based on (a) signaling received from the network node and (b) resource determination performed by the wireless device based on a latest received one of the first downlink control channel message and the second downlink control channel message. SAMSUNG-1003, [92]-[95]; SAMSUNG-1005, [0052], [0133]-[0134], [0147]-[0152], [0160], and [0169]. Seo's uplink scheduling information schedules

resources on a “Physical Uplink Control Channel (PUCCH)” for the PDSCH data transmissions. SAMSUNG-1005, [0051], [0052], [0006], [0011]-[0012].

Specifically, Seo provides more details on “Determination of *Resources* Used to Transmit ACK/NACK Information.” *Id.*, [0133]-[0216]. As shown in Fig. 12 (reproduced below), Seo’s UE receives “semi-statically configured ... PUCCH resources.” *Id.*, [0208]; *see also* [0204] (“semi-statically configuring a plurality of ACK/NACK resource sets”), [0205] (“higher layer signaling (e.g., RRC signaling)”), [0215] (“ACK/NACK feedback for a PDSCH indicated by detection of a corresponding PDCCH”). Seo’s UE then uses “one of the M PUCCH resources” to transmit “ACK/NACK information” for the multiple “downlink sub-frames.” *Id.*, [0211] (“ACK/NACK bundling”); SAMSUNG-1003, [93]. Because Seo’s PUCCH resources are semi-statically configured by higher layer signaling (e.g., RRC signaling), Seo determines the uplink control channel resource based on signaling received from the network node. *Id.*



SAMSUNG-1005, Fig. 12 (excerpt; annotated)

Seo also describes that the “ACK/NACK bundling result may be transmitted via an ACK/NACK resource set *mapped to a last DL subframe* in which the PDSCH is transmitted (*a latest DL subframe*, in which the PDSCH is received, from among m DL subframes).” SAMSUNG-1005, [0183]; *see also* [0184]-[0188] (“the PUCCH resource set 0 mapped to the last DL subframe (that is, the DL subframe #9) in which the PDSCH is received.”), [0202] (“if ACK/NACK bundling is applied, bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe.”). By mapping the PUCCH resource to the last DL subframe, Seo’s resource determination performed by the wireless device is based on a latest received one of the first downlink control channel message (first PDCCH) and the second downlink control

channel message (second PDCCH). SAMSUNG-1003, [94].

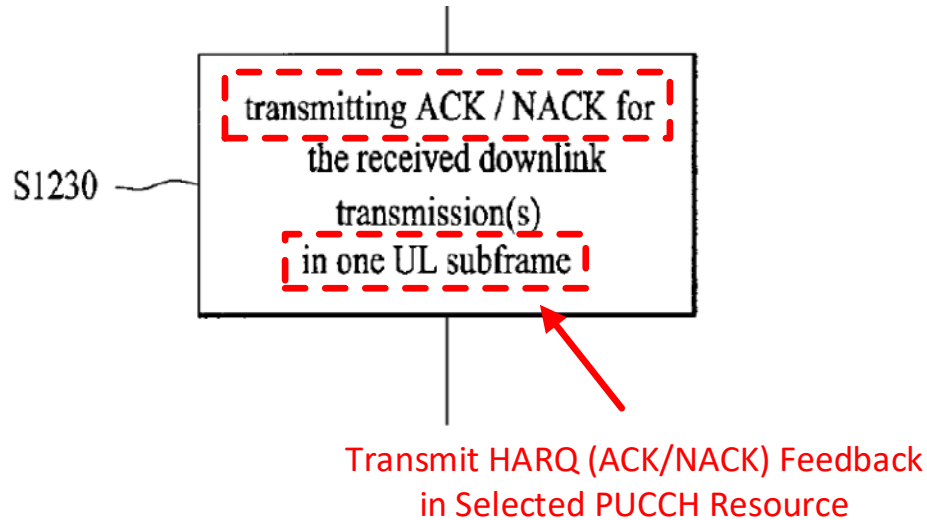
Further, dynamic signaling may be used to identify the latest DL subframe and select the PUCCH resource. SAMSUNG-1005, [0183]. Specifically, the “control channel transmitted from the transmitter may include a control channel number count value,” which “gradually increases for each control channel” and is “similar to a downlink assignment index (DAI) field included in a PDCCH.” *Id.*; *see also* [0187]-[0189], [0196]-[0202] (“bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe”), [0212] (“[t]he control channel may include control channel number count information”). When the control channel number count value is used, Seo’s ACK/NACK resources are “mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe.” *Id.*, [0202]. By using the control channel number count value (e.g., DAI) to select the PUCCH resource associated with the latest received PDCCH, Seo determines the uplink control channel resource based on (a) signaling received from the network node (the higher layer (e.g., RRC) signaling discussed above and/or the signaling of the control channel message with the control channel number count value (e.g., DAI)) and (b) resource determination performed by the wireless device based on a latest received one of the first downlink control channel message (first PDCCH) and the

second downlink control channel message (second PDCCH). SAMSUNG-1003, [95].

[1f] transmitting the uplink control information using the determined uplink control channel resource,

Seo and ZTE render obvious transmitting the uplink control information using the determined uplink control channel resource. SAMSUNG-1003, [96]-[97]; SAMSUNG-1005, [0052], [0133]-[0134], [0141], [0150]-[0152], and [0160]. Seo provides more details on “Determination of Resources Used to ***Transmit ACK/NACK Information.***” SAMSUNG-1005, [0133]-[0216]. For instance, the UE “transmit[s] ACK/NACK via a PUCCH.” *Id.*, [0138]; *see also* [0134]-[0137]. In some examples, Seo’s UE transmits “HARQ ACK/NACK information” for “PDSCH transmission of one or more downlink subframes in one uplink subframe.” *Id.*, [0147]; *see also* [0150], [0155].

As shown in Fig. 12 (reproduced below), Seo’s UE uses “one of the M PUCCH resources” to transmit “ACK/NACK information” for the multiple “downlink subframes.” *Id.*, [0211] (“ACK/NACK bundling”); SAMSUNG-1003, [97]. Seo’s one uplink subframe used to transmit the ACK/NACK information (uplink control information) is the determined uplink control channel resource (PUCCH resource). SAMSUNG-1003, [97].



SAMSUNG-1005, Fig. 12 (excerpt; annotated)

[1g] wherein the signaling received from the network node comprises information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources; and

Seo and ZTE render obvious information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources. SAMSUNG-1003, [98]-[104]. As discussed above at [1c]-[1e] (incorporated here), Seo discloses use of ACK/NACK resource sets and Seo's PUCCH resources are semi-statically configured by higher layer signaling (e.g., RRC signaling). Although Seo discloses PUCCH resource sets with semi-static configuration, Seo does not explicitly disclose a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources. SAMSUNG-1003, [98].

ZTE, however, discloses a semi-static configuration of two or more uplink

control channel resource sets each comprising two or more uplink control channel resources. SAMSUNG-1003, [99]. ZTE describes “ARI-based PUCCH resource allocation for HARQ-ACK transmission” where “a PUCCH resource set is configured by high layer signaling.” SAMSUNG-1006, 2. For example, ZTE proposed “a separate PUCCH resource set for different PUCCH formats.” *Id.* Specifically, ZTE proposed “two PUCCH resource sets, one set is for PUCCH format carrying up to 2 bits UCI and another set is for PUCCH format carrying more than 2 bits UCI.” *Id.* (emphasis omitted). In ZTE, each PUCCH resource set includes multiple PUCCH resources and the “PUCCH resource set is configured by high layer signaling,” which is a semi-static configuration. *Id.*; SAMSUNG-1003, [99]. In fact, as shown in Table 1 (reproduced below), a PUCCH resource set in ZTE includes multiple PUCCH resources. SAMSUNG-1006, 3; SAMSUNG-1003, [99].

PUCCH Resource Set With
Multiple PUCCH Resources

Table 1– PUCCH resource set for formats carrying up to 2 bits

PUCCH format	PUCCH length	PUCCH resource value	Time domain OCC	Cyclic shift index	PUCCH resource group index
Short Format 0	1	a0	-	CS set #0	0
		a1	-	CS set #1	1
	1	a2	-	CS set #2	2
		a3	-	CS set #3	3
	2	a4	-	CS set #4	4
		a5	-	CS set #5	5
	2	a6	-	CS set #6	6
		a7	-	CS set #7	7
Long Format 0	4	a8	OCC #0	CS set #8	8
		a9	OCC #1	CS set #9	9
	8	a10	OCC #0	CS set #10	10
		a11	OCC #1	CS set #11	11
	8	a12	OCC #0	CS set #12	12
		a13	OCC #1	CS set #13	13
	14	a14	OCC #0	CS set #14	14
		a15	OCC #1	CS set #15	15

SAMSUNG-1006, Table 1 (annotated)

In ZTE, “[f]or PUCCH formats with more than 2 bits, a similar resource set like Table 1 would be introduced.” SAMSUNG-1006, 3. Accordingly, as Dr. Buehrer explains, ZTE describes two PUCCH resource sets: (1) a first resource set with multiple PUCCH resources for 2-bit PUCCH formats (as shown in Table 1) and (2) a second resource set with multiple PUCCH resources for PUCCH formats with more than 2 bits (similar to Table 1, but not shown). *Id.*; SAMSUNG-1003, [100].

ZTE also explains that, “[i]n LTE, a combination of a *semi-static configuration* and dynamic signalling is used to determine the PUCCH resource for

ACK/NACK in the frequency domain” and “[a] similar concept could be envisioned for NR.” SAMSUNG-1006, 4. In particular, “[a] set containing four PUCCH candidate resources is configured through *semi-static signalling*.” *Id.*, 5.

With this background, ZTE proposed “a new method to achieve *semi-static* + dynamic PUCCH frequency resource allocation” with “an enhanced ARI mechanism.” *Id.* Specifically, in ZTE’s enhanced ARI mechanism:

The base station always configures 3 *candidate PUCCH resources for the UE through higher layer signalling* and implicitly assumes that 1 candidate PUCCH resource is located within the frequency domain of the PUSCH / PDSCH of the UE. *Id.*

ZTE describes that this “enhanced ARI mechanism (dynamic + *semi-static* method) can promptly adjust at least one PUCCH candidate frequency resource to immediately follow the channel quality” and, therefore, “make full use of channel quality to transmit PUCCH.” *Id.*, 6. And, ZTE confirms that its enhanced ARI mechanism applies to multiple PUCCH sets based on PUCCH format, as “dynamic frequency resource allocation and the enhanced ARI mechanism can be used simultaneously for *long/short PUCCHs*.” *Id.*; SAMSUNG-1003, [101]-[103].

As discussed at Section III.A.3 (incorporated here), a POSITA would have found it obvious to combine teachings of Seo with teachings of ZTE and use, in the

combined system, ZTE's different PUCCH resource sets, each with multiple PUCCH resources, and ZTE's semi-static configuration of the different PUCCH resource sets. SAMSUNG-1003, [104].

[1h] wherein determining the uplink control channel resource based on (a) and (b) comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

Seo and ZTE render obvious selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node. SAMSUNG-1003, [105]-[110]. In ZTE, "the physical layer signaling indicates the one PUCCH resource from the set." SAMSUNG-1006, 2. ZTE proposed "two PUCCH resource sets, one set is for PUCCH format carrying up to 2 bits UCI and another set is for PUCCH format carrying more than 2 bits UCI." *Id.* (emphasis omitted). In this regard, ZTE selects a resource set based on PUCCH format or payload size of the uplink control information (e.g., "2 bits UCI" or "more than 2 bits UCI") and uses "4 bits in DCI ... to indicate one PUCCH resource group index." *Id.*; SAMSUNG-1003, [105]. As shown in Table 1 (reproduced below), a PUCCH resource set in ZTE includes multiple PUCCH resources and a specific resource within a set

(e.g., within Table 1) is selected based on DCI. SAMSUNG-1006, 3; SAMSUNG-1003, [105].

Table 1– PUCCH resource set for formats carrying up to 2 bits

PUCCH Resource Set With
Multiple PUCCH Resources

PUCCH Resource Selected
Based On Index in DCI

PUCCH format	PUCCH length	PUCCH resource value	Time domain OCC	Cyclic shift index	PUCCH resource group index
Short Format 0	1	a0	-	CS set #0	0
		a1	-	CS set #1	1
	1	a2	-	CS set #2	2
		a3	-	CS set #3	3
	2	a4	-	CS set #4	4
		a5	-	CS set #5	5
	2	a6	-	CS set #6	6
		a7	-	CS set #7	7
Long Format 0	4	a8	OCC #0	CS set #8	8
		a9	OCC #1	CS set #9	9
	8	a10	OCC #0	CS set #10	10
		a11	OCC #1	CS set #11	11
	8	a12	OCC #0	CS set #12	12
		a13	OCC #1	CS set #13	13
	14	a14	OCC #0	CS set #14	14
		a15	OCC #1	CS set #15	15

SAMSUNG-1006, Table 1 (annotated)

In ZTE, “[f]or PUCCH formats with more than 2 bits, a similar resource set like Table 1 would be introduced.” SAMSUNG-1006, 3. Accordingly, as Dr. Buehrer explains, ZTE describes two PUCCH resource sets: (1) a first resource set with multiple PUCCH resources for 2-bit PUCCH formats (as shown in Table 1) and (2) a second resource set with multiple PUCCH resources for PUCCH formats with more than 2 bits (similar to Table 1, but not shown). *Id.*; SAMSUNG-1003,

[106]. With this configuration, ZTE selects the resource set (e.g., the 2-bit resource set shown in Table 1 or the more than 2-bit resource set in a table similar to Table 1, but not shown) based on a semi-static configuration through higher layer signaling. SAMSUNG-1006, 2-5; SAMSUNG-1003, [106].

ZTE also explains that, “[i]n LTE, a combination of a semi-static configuration and *dynamic signalling* is used to determine the PUCCH resource for ACK/NACK in the frequency domain” and “[a] similar concept could be envisioned for NR.” SAMSUNG-1006, 4. In particular, “the *specific PUCCH resources* to be used are indicated via the *physical layer DCI*.” *Id.*, 5.

With this background, ZTE proposed “a new method to achieve semi-static + *dynamic* PUCCH frequency resource allocation” with “an enhanced ARI mechanism.” *Id.* Specifically, in ZTE’s enhanced ARI mechanism:

Then, *physical layer signalling is used to indicate the specific PUCCH resource to be used out of the set from the four PUCCH candidate resources.* *Id.*

ZTE describes that this “enhanced ARI mechanism (dynamic + semi-static method) can promptly adjust at least one PUCCH candidate frequency resource to immediately follow the channel quality” and, therefore, “make full use of channel quality to transmit PUCCH.” *Id.*, 6. And, ZTE confirms that its enhanced ARI mechanism applies to multiple PUCCH sets based on PUCCH format, as “dynamic

frequency resource allocation and the enhanced ARI mechanism can be used simultaneously for long/short PUCCHs.” *Id.*; SAMSUNG-1003, [107]-[109].

As discussed at Section III.A.3 (incorporated here), a POSITA would have found it obvious to combine teachings of Seo with teachings of ZTE and use, in the combined system, ZTE’s selection of one of the two or more uplink control channel resource sets based on PUCCH format (e.g., “2 bits UCI” or “more than 2 bits UCI”) and ZTE’s selection of a specific PUCCH resource from the set based on dynamic signaling from the network node (e.g., DCI). SAMSUNG-1003, [110].

[2] The method of claim 1 wherein the uplink control channel is a physical uplink control channel.

Seo and ZTE render obvious a physical uplink control channel. SAMSUNG-1003, [111]. As discussed at [1C] (incorporated here), Seo’s uplink control channel is a “Physical Uplink Control Channel (PUCCH).” SAMSUNG-1005, [0051], [0052], [0006], [0011]-[0012]; SAMSUNG-1003, [111].

[3] The method of claim 1 wherein:

See supra [1pre] (incorporated here). SAMSUNG-1003, [112].

[3.1] each of the first downlink control channel message and the second downlink control channel message comprises bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set;

Seo and ZTE render obvious each of the first downlink control channel message and the second downlink control channel message comprises bits for use to select one of the two or more uplink control channel resources from the selected

uplink control channel resource set. SAMSUNG-1003, [113]. In the combination, Seo's "control channel transmitted from the transmitter may *include a control channel number count value*," which "gradually increases for each control channel" and is "similar to a downlink assignment index (DAI) field included in a PDCCH." SAMSUNG-1005, [0183]; *see also* [0187]-[0189], [0196]-[0202] ("bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe"), [0212] ("[t]he control channel may include control channel number count information"). When the control channel number count value is used, Seo's ACK/NACK resources are "mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe." *Id.*, [0202]. By using the control channel number count value (e.g., DAI) to select the PUCCH resource associated with the latest received PDCCH, Seo's PDCCH transmissions include bits for use to select one of the two or more uplink control channel resources. SAMSUNG-1003, [113].

ZTE also describes bits for use to select one of the two or more uplink control channel resources. SAMSUNG-1003, [116]. For example, ZTE describes "*4 bits* in DCI ... to indicate one PUCCH resource group index." SAMSUNG-1006, 2; SAMSUNG-1003, [116].

[3.2] selecting the one of the two or more uplink control channel resources comprises selecting based on the bits comprised in the latest received one of the first downlink control channel message and the second downlink control channel message.

Seo and ZTE render obvious selecting based on the bits comprised in the latest received one of the first downlink control channel message and the second downlink control channel message. SAMSUNG-1003, [114]-[116]; SAMSUNG-1005, [0052], [0133]-[0134], [0147]-[0152], [0160], and [0169]. As discussed at [1e] and [3.1], Seo and ZTE render obvious determining the uplink control channel resource based on (a) signaling received from the network node and (b) resource determination performed by the wireless device based on a latest received one of the first downlink control channel message and the second downlink control channel message. SAMSUNG-1003, [114]; SAMSUNG-1005, [0052], [0133]-[0134], [0147]-[0152], [0160], and [0169]. Seo's uplink scheduling information schedules resources on a "Physical Uplink Control Channel (PUCCH)" for the PDSCH data transmissions. SAMSUNG-1005, [0051], [0052], [0006], [0011]-[0012].

In the combination, Seo's "control channel transmitted from the transmitter may ***include a control channel number count value,***" which "gradually increases for each control channel" and is "similar to a downlink assignment index (DAI) field included in a PDCCH." SAMSUNG-1005, [0183]; *see also* [0187]-[0189], [0196]-[0202] ("bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number

count value of the DL subframes associated with one UL subframe”), [0212]

(“[t]he control channel may include control channel number count information”).

When the control channel number count value is used, Seo’s ACK/NACK resources are “mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe.” *Id.*, [0202]. By using the control channel number count value (e.g., DAI) to select the PUCCH resource associated with the latest received PDCCH, Seo’s PDCCH transmissions include bits for use to select one of the two or more uplink control channel resources. SAMSUNG-1003, [115].

ZTE also describes bits for use to select one of the two or more uplink control channel resources. SAMSUNG-1003, [116]. For example, ZTE describes “**4 bits** in DCI ... to indicate one PUCCH resource group index.” SAMSUNG-1006, 2; SAMSUNG-1003, [116]. ZTE’s 4 DCI bits are used to select the PUCCH resource from the selected PUCCH resource set. SAMSUNG-1003, [116].

[6pre] A wireless device, comprising:

See supra [1pre] (incorporated here). SAMSUNG-1003, [117]. Seo and ZTE also render obvious a wireless device. SAMSUNG-1005, [0038] (“[t]he term ‘terminal’ may also be replaced with a User Equipment (UE), a Mobile Station

(MS), a Mobile Subscriber Station (MSS) or a Subscriber Station (SS) as necessary.”); *see also* [0007], [0218], [0220], Fig. 13, claim 11; SAMSUNG-1003, [117].

[6a] an interface; and

Seo and ZTE render obvious an interface. SAMSUNG-1003, [118]. Specifically, Seo’s apparatus (e.g., wireless device) includes “a reception (RX) module,” “a transmission (TX) module,” and “antennas 1350,” which serve as an interface for Seo’s wireless device. SAMSUNG-1005, [0007], [0218], [0220], Fig. 13, claim 11; SAMSUNG-1003, [118]. The ’669 patent uses the term interface broadly and provides examples of an air interface similar to Seo’s air interface (e.g., RX module, TX module, and antennas). SAMSUNG-1003, [118]. For example, with reference to Fig. 1, the ’669 patent describes that “interface 114 comprises radio front end circuitry 112 and antenna 111.” SAMSUNG-1001, 19:54-20:11 (“radio front end circuitry and/or antenna 111 may be considered an interface”). Also, with reference to Fig. 2, the ’669 patent describes that “RF interface 209 may be configured to provide a communication interface to RF components such as a transmitter, a receiver, and an antenna.” *Id.*, 23:42-44. Thus, as Dr. Buehrer explains, Seo’s air interface (e.g., RX module, TX module, and antennas) aligns with examples of an interface described in the ’669 patent. SAMSUNG-1005, [0007], [0218], [0220], Fig. 13, claim 11; SAMSUNG-1003, [118].

[6b] processing circuitry configured to cause the wireless device to:

Seo and ZTE render obvious processing circuitry configured to cause the wireless device to perform operations referenced below. SAMSUNG-1003, [119]. Specifically, Seo's apparatus (e.g., wireless device) includes "a processor," which serves processing circuitry for Seo's wireless device that is configured to cause the wireless device to perform the operations referenced below. SAMSUNG-1005, [0007], [0218]-[0226], Fig. 13, claim 11; SAMSUNG-1003, [119].

[6c] receive a first downlink control channel message that schedules a first downlink shared channel transmission;

See supra [1a] (incorporated here). SAMSUNG-1003, [120].

[6d] receive a second downlink control channel message that schedules a second downlink shared channel transmission;

See supra [1b] (incorporated here). SAMSUNG-1003, [121].

[6e] determine an uplink control channel resource to use for transmitting uplink control information to a network node on an uplink control channel;

See supra [1c] (incorporated here). SAMSUNG-1003, [122].

[6f] wherein the uplink control information comprises Hybrid Automatic Repeat Request, HARQ, feedback for both the first downlink shared channel transmission and the second downlink shared channel transmission;

See supra [1d] (incorporated here). SAMSUNG-1003, [123].

[6g] wherein determining the uplink control channel resource to use for transmitting the uplink control information comprises determining the uplink control channel resource based on (a) signaling received from the network node and (b) resource determination performed by the wireless device based on a latest received one of the first downlink control channel message and the second downlink control channel message; and

See supra [1e] (incorporated here). SAMSUNG-1003, [124].

[6h] transmit the uplink control information using the determined uplink control channel resource;

See supra [1f] (incorporated here). SAMSUNG-1003, [125].

[6i] wherein the signaling received from the network node comprises information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources; and

See supra [1g] (incorporated here). SAMSUNG-1003, [126].

[6j] wherein determining the uplink control channel resource based on (a) and (b) comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

See supra [1h] (incorporated here). SAMSUNG-1003, [127].

[7] The wireless device of claim 6 wherein the uplink control channel is a physical uplink control channel.

See supra [2] (incorporated here). SAMSUNG-1003, [128].

[8] The wireless device of claim 6 wherein:

See supra [1pre] and [6pre] (incorporated here). SAMSUNG-1003, [129].

[8a] each of the first downlink control channel message and the second downlink control channel message comprises a downlink control information message comprising bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set;

See supra [3a] (incorporated here). SAMSUNG-1003, [130]. As discussed at [3a], each of Seo and ZTE describe a downlink control information message

comprising bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set. SAMSUNG-1003, [130]. In the combination, Seo's "***control channel number count value***," which "gradually increases for each control channel" and is "similar to a downlink assignment index (DAI) field included in a PDCCH," is a downlink control information message with multiple bits used to select the uplink control channel resource. SAMSUNG-1005, [0183]; *see also* [0187]-[0189], [0196]-[0202] ("bundled ACK/NACK information may be transmitted using ACK/NACK resources mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe"), [0212] ("[t]he control channel may include control channel number count information"). When the downlink control information message with the control channel number count value is used, Seo's ACK/NACK resources are "mapped to the last (or highest) control channel number count value of the DL subframes associated with one UL subframe." *Id.*, [0202]. By using the control channel number count value (e.g., DAI) to select the PUCCH resource associated with the latest received PDCCH, Seo's PDCCH transmissions include a downlink control information message bits for use to select one of the two or more uplink control channel resources. SAMSUNG-1003, [113], [130].

ZTE also describes a downlink control information message with bits for use to select one of the two or more uplink control channel resources. SAMSUNG-

1003, [116], [130]. For example, ZTE describes “**4 bits** in **DCI** ... to indicate one PUCCH resource group index.” SAMSUNG-1006, 2; SAMSUNG-1003, [116], [130]. ZTE’s 4-bit DCI is a downlink control information message with bits for use to select one of the two or more uplink control channel resources. *Id.*

[8b] selecting the one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node comprises selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, the one of the two or more uplink control channel resources from the selected uplink control channel resource set based on the bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set that are comprised in the latest received one of the first downlink control channel message and the second downlink control channel message.

See supra [3b] (incorporated here). SAMSUNG-1003, [131].

[11pre] A wireless device, comprising:

See supra [6pre] (incorporated here). SAMSUNG-1003, [132].

[11a] an interface; and

See supra [6a] (incorporated here). SAMSUNG-1003, [133].

[11b] processing circuitry configured to cause the wireless device to:

See supra [6b] (incorporated here). SAMSUNG-1003, [134].

[11c] receive a downlink control channel that schedules a downlink shared channel transmission to the wireless device;

See supra [1a], [1b], [6c], and [6d] (incorporated here). SAMSUNG-1003, [135].

[11d] receive, from the network node, signaling comprising information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources,

See supra [1g] and [6i] (incorporated here). SAMSUNG-1003, [136].

[11e] determine an uplink control channel resource to use for transmitting uplink control information to a network node,

See supra [1c] and [6e] (incorporated here). SAMSUNG-1003, [137].

[11f] wherein the uplink control information comprises Hybrid Automatic Repeat Request, HARQ, feedback for the downlink shared channel transmission

See supra [1d] and [6f] (incorporated here). SAMSUNG-1003, [138].

[11g] wherein determining the uplink control channel resource comprises selecting the uplink control channel resource from uplink control channel resources in two or more uplink control channel resource sets based on:

See supra [1h] and [6j] (incorporated here). SAMSUNG-1003, [139].

[11h] a payload size of the uplink control information;

Seo and ZTE render obvious selecting the uplink control channel resource from uplink control channel resources in two or more uplink control channel resource sets based on a payload size of the uplink control information. SAMSUNG-1003, [140]. Although Seo does not describe selecting the uplink control channel resource based on a payload size of the uplink control information, ZTE does. ZTE proposed “two PUCCH resource sets, one set is for PUCCH format carrying up to **2 bits UCI** and another set is for PUCCH format carrying **more than 2 bits UCI.**” SAMSUNG-1006, 2-3 (emphasis omitted). In this regard, ZTE selects a resource set based on PUCCH format or payload size of the uplink control

information (e.g., “2 bits UCI” or “more than 2 bits UCI”). *Id.*; SAMSUNG-1003, [140]. Based on this description, a POSITA would have found that selection of ZTE’s PUCCH resource relates to the payload size (e.g., 2 bits or more than 2 bits) of the uplink control information. *Id.*

[11i] a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received; and

Seo and ZTE render obvious selecting the uplink control channel resource from uplink control channel resources in two or more uplink control channel resource sets based on a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received. SAMSUNG-1003, [141]; SAMSUNG-1005, [0150]-[0152]. Seo describes selecting the PUCCH resource based on control channel elements (CCEs). SAMSUNG-1005, [0051], [0139]. For instance, “the UE may transmit ACK/NACK via a PUCCH having an index corresponding to an index of a specific (*e.g., first*) CCE of the CCEs configuring the PDCCH received by the UE.” *Id.*, [0139]-[0140]. Seo also describes PUCCH resource selection using equations that include the value “ n_{CCE} ,” which “denotes the *smallest value of CCE indexes* used for PDCCH transmission.” *Id.*, [0142]-[0143], [0150]-[0152]. From Seo’s disclosure, a POSITA would have found it obvious to select the uplink control channel resource based on a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received. SAMSUNG-1003, [141].

[11j] dynamic signaling received from the network node; and

See supra [1h] and [6j] (incorporated here). SAMSUNG-1003, [142].

[11k] transmit the uplink control information using the determined uplink control channel resource;

See supra [1f] and [6h] (incorporated here). SAMSUNG-1003, [143].

[11l] wherein selecting the uplink control channel resource from the two or more uplink control channel resources in the two or more uplink control channel resource sets comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

See supra [1h] and [6j] (incorporated here). SAMSUNG-1003, [144].

[12] The wireless device of claim 11 wherein:

See supra [1pre] and [6pre] (incorporated here). SAMSUNG-1003, [145].

[12a] the downlink control channel comprises a downlink control information message comprising bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set; and

See supra [3a] and [8a] (incorporated here). SAMSUNG-1003, [146].

[12b] selecting the one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node comprises selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, the one of the two or more uplink control channel resources from the selected uplink control channel resource set based on the bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set that are comprised in the downlink control channel.

See supra [3b] and [8b] (incorporated here). SAMSUNG-1003, [147].

[17pre] The method of claim 1, wherein determining the uplink control channel resource further comprises selecting the uplink control channel resource from uplink control channel resources in two or more uplink control channel resource sets based on:

See supra [1h] and [6j] (incorporated here). SAMSUNG-1003, [148].

[17a] a payload size of the uplink control information;

See supra [11h] (incorporated here). SAMSUNG-1003, [149].

[17b] a starting control channel element index of the latest received one of the first downlink control channel message and the second downlink control channel message downlink control channel; and

See supra [11i] (incorporated here). SAMSUNG-1003, [150].

[17c] dynamic signaling received from the network node.

See supra [1h], [6j], and [11j] (incorporated here). SAMSUNG-1003, [151].

[18pre] A method of operating a wireless device, comprising:

See supra [1pre] (incorporated here). SAMSUNG-1003, [152].

[18a] receiving a downlink control channel that schedules a downlink shared channel transmission to the wireless device;

See supra [1a], [1b], [6c], [6d], and [11c] (incorporated here). SAMSUNG-1003, [153].

[18b] receiving, from the network node, signaling comprising information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources,

See supra [1g], [6i], and [11d] (incorporated here). SAMSUNG-1003, [154].

[18c] determining an uplink control channel resource to use for transmitting uplink control information to a network node,

See supra [1c], [6e], and [11e] (incorporated here). SAMSUNG-1003, [155].

[18d] wherein the uplink control information comprises Hybrid Automatic Repeat Request, HARQ, feedback for the downlink shared channel transmission,

See supra [1d], [6f], and [11f] (incorporated here). SAMSUNG-1003, [156].

[18e] wherein determining the uplink control channel resource comprises selecting the uplink control channel resource from uplink control channel resources in two or more uplink control channel resource sets based on:

See supra [1h], [6j], and [11g] (incorporated here). SAMSUNG-1003, [157].

[18f] a payload size of the uplink control information;

See supra [11h] (incorporated here). SAMSUNG-1003, [158].

[18g] a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received; and

See supra [11i] (incorporated here). SAMSUNG-1003, [159].

[18h] dynamic signaling received from the network node; and

See supra [1h], [6j], and [11j] (incorporated here). SAMSUNG-1003, [160].

[18i] transmitting the uplink control information using the determined uplink control channel resource;

See supra [1f], [6h], and [11k] (incorporated here). SAMSUNG-1003, [161].

[18j] wherein selecting the uplink control channel resource from the two or more uplink control channel resources in the two or more uplink control channel resource sets comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

See supra [1h], [6j], and [11l] (incorporated here). SAMSUNG-1003, [162].

[19] The method of claim 18:

See supra [1pre] and [18pre] (incorporated here). SAMSUNG-1003, [163].

[19a] wherein the downlink control channel comprises a downlink control information message comprising bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set; and

See supra [3a], [8a], and [12a] (incorporated here). SAMSUNG-1003, [164].

[19b] wherein selecting the one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node comprises selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, the one of the two or more uplink control channel resources from the selected uplink control channel resource set based on the bits for use to select one of the two or more uplink control channel resources from the selected uplink control channel resource set that are comprised in the downlink control channel.

See supra [3b], [8b], and [12b] (incorporated here). SAMSUNG-1003, [165].

B. [GROUND 2] – Claims 1-3, 6-8, 11, 12, and 17-19 are obvious over Seo, ZTE, and Intel

1. Overview of Intel

Intel is a 3GPP contribution directed to “Resource allocation for NR uplink control channel.” SAMSUNG-1007, 1. Intel describes that “multiple PUCCH formats are specified to support various UCI payload sizes.” *Id.*

- PUCCH format 1/1a/1b for positive SR, 1 or 2 bit HARQ-ACK or 4 bit HARQ-ACK with channel selection
- PUCCH format 2/2a/2b for CSI report with and without 1 or 2 bit HARQ-ACK.
- PUCCH format 3 for CSI report, 1 bit positive/negative SR and HARQ-ACK.
- PUCCH format 4 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report
- PUCCH format 5 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report

As Intel proposed, “multiple NR PUCCH formats can be supported in order to accommodate various UCI types and payload sizes.” *Id.*, 2.

Intel also suggests that the “resource index for PUCCH format 1a/1b is derived from the first CCE in the PDCCH which is used to schedule the downlink data transmission.” *Id.*

Intel further suggests that “it is more desirable to configure a set of resource indexes from high layer signalling and explicitly signal one resource index from the set of resource indexes in the DCI for HARQ ACK/NACK feedback on UL control channel.” *Id.*, 3. Specifically, a “set of resource indexes for HARQ ACK/NACK feedback on UL control channel are configured via high layer signalling and one resource index among the set of resource indexes is explicitly signaled in the DCI.” *Id.*; SAMSUNG-1003, [68]-[71].

2. Combination of Seo, ZTE, and Intel

As Dr. Buehrer explains, a POSITA would have found it obvious to combine teachings of Seo and ZTE with Intel. SAMSUNG-1003, [72]-[78]. Specifically, Seo, ZTE, and Intel are in the same field and each relate to PUCCH resource allocation for ACK/NACK information in a cellular system. SAMSUNG-1005, Abstract, [0001], [0133] (“Determination of Resources Used to Transmit ACK/NACK Information”), [0138] (“ACK/NACK via a PUCCH”); SAMSUNG-1006, 2 (“PUCCH resource allocation for HARQ-ACK transmission”); SAMSUNG-1007,

1-3. Given this extensive overlap in subject matter, a POSITA would have had reason to consult Intel when reviewing Seo's and ZTE's disclosure. SAMSUNG-1003, [72]. Indeed, Intel was published in 2017, four years after Seo, and a POSITA would have had reason to look to publications, such as Intel, that discussed advancements to PUCCH resource allocation subsequent to Seo's writing. *Id.*

Further, a POSITA reviewing Seo's disclosure would have been motivated to look to 3GPP technical documents, such as contributions to 3GPP, for technical and implementation details and advancements in cellular communication technology. SAMSUNG-1003, [73]. This is particularly true since Seo is described within the context of 3GPP standards LTE and LTE-Advanced. SAMSUNG-1005, [0042]; SAMSUNG-1003, [73]. Examples of these contributions include the proposals offered in Intel's contribution. SAMSUNG-1003, [73]. A POSITA would have understood that these contributions would provide information about proposals relating to the standard that are being considered by the 3GPP and by wireless companies, prior to adoption by the 3GPP. *Id.*

Notably, regardless of whether information disclosed in contributions are eventually adopted, a POSITA would have been prompted to look to contributions, generally, in order to learn of and understand alternatives or other options being considered. *Id.*, [74]. Indeed, the very format of standards-based deliberation

compels participants to consider different documents, not in isolation, but as collections of teachings directed to advancing the field. *Id.*

Although a POSITA would have turned to 3GPP contributions based on the subject matter of Seo's PUCCH resource allocation for ACK/NACK information, Seo explicitly suggests turning to 3GPP documents, such as Intel. SAMSUNG-1005, [0041], [0042]. As Seo explains, "[e]xemplary embodiments of the present invention are supported by standard documents disclosed for at least one of wireless access systems including ... a 3rd Generation Project Partnership (3GPP) system, a 3GPP Long Term Evolution (LTE) system, and a 3GPP2 system." *Id.*, [0041]; *see also* [0042] ("the following description focuses on the 3GPP LTE and 3GPP LTE-A system"). "In particular, the steps or parts, which are not described to clearly reveal the technical idea of the present invention, in the embodiments of the present invention may be supported by the above documents." *Id.*, [0041]. As Dr. Buehrer explains, in evaluating Seo, a POSITA would have been motivated to consider 3GPP contributions, such as Intel, based on Seo's explicit indication that its description is supported by 3GPP documents. SAMSUNG-1003, [75].

For these reasons, a POSITA would have been motivated to consult Intel and would have found it obvious to employ teachings from Intel's resource allocation in Seo and ZTE. SAMSUNG-1003, [76]. Specifically, in the combination, a

POSITA would have found it obvious to modify Seo to use Intel's PUCCH resource formats based on UCI payload size. SAMSUNG-1007, 1-2; SAMSUNG-1003, [76]. A POSITA also would have found it obvious to modify Seo to use Intel's techniques for deriving the resource index for the PUCCH format based on "the first CCE in the PDCCH." SAMSUNG-1007, 2; SAMSUNG-1003, [76]. A POSITA further would have found it obvious to modify Seo to use Intel's techniques where "[a] set of resource indexes for HARQ ACK/NACK feedback on UL control channel are configured via high layer signalling and one resource index among the set of resource indexes is explicitly signaled in the DCI." SAMSUNG-1007, 3; SAMSUNG-1003, [76].

In fact, combining the teachings of Seo and ZTE with Intel would have merely involved combining prior art elements according to known methods to yield predictable results. SAMSUNG-1003, [77]. Intel, like Seo and ZTE, discloses selection of a PUCCH resource to use in providing HARQ ACK/NACK feedback. SAMSUNG-1005, Abstract, [0001], [0133], [0138]; SAMSUNG-1006, 2-6; SAMSUNG-1007, 1-3. A POSITA would have been motivated to combine the teachings of Seo and ZTE with the teachings of Intel to realize, in Seo, the advancements in PUCCH resource allocation described by Intel in view of development of the same 3GPP standard described in Seo. SAMSUNG-1003, [77]. The combination of Seo, ZTE, and Intel would have been predictable and foreseeable

because 1) Seo, ZTE, and Intel disclose PUCCH resource allocation, and 2) the combination merely involves incorporating PUCCH resource advancements that are explicitly disclosed by Intel as part of development of the 3GPP standard upon which Seo is based. SAMSUNG-1003, [77]. The combination is predictable, at least in part, because elements of the combined system would each perform similar functions they had been known to perform prior to the combination. *Id.* For example, the Seo/ZTE wireless device would still perform the same PUCCH resource allocation as it did prior to the combination with Intel, but with updates to account for Intel's PUCCH formats based on UCI payload size, Intel's scheduling based on the first CCE, and Intel's higher layer and DCI signaling. *Id.*

Additionally, a POSITA would have been motivated to modify the Seo/ZTE system to include Intel's PUCCH resource allocation because the use of Intel's PUCCH resource allocation technique in the Seo/ZTE system would have been recognized as simply applying a known technique to a known system ready for improvement to yield predictable results. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417, (2007); SAMSUNG-1003, [78].

3. Analysis

The combination of Seo, ZTE, and Intel renders the Challenged Claims obvious as set forth below. SAMSUNG-1003, [166]. Specifically, Intel offers additional disclosure that corroborates the analysis of Seo and ZTE above and further

supports obviousness of features [1g], [1h], [6i], [6j], [11h], [11i], [11j], [11l], [17a],[17b], [17c],[18f], [18g], [18h], and [18j]. The analysis of other features in Ground 1 apply equally to Ground 2 and the analysis of features [1g], [1h], [6i], [6j], [11h], [11i], [11j], [11l], [17a], [17b],[17c] [18f], [18g], [18h], and [18j] in Ground 1 apply equally to Ground 2, but are supported and supplemented by additional disclosure from Intel as set forth below.

[1g] wherein the signaling received from the network node comprises information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources; and

Intel describes that “multiple PUCCH formats are specified to support various *UCI payload sizes*.” SAMSUNG-1007, 1.

- PUCCH format 1/1a/1b for positive SR, 1 or 2 bit HARQ-ACK or 4 bit HARQ-ACK with channel selection
- PUCCH format 2/2a/2b for CSI report with and without 1 or 2 bit HARQ-ACK.
- PUCCH format 3 for CSI report, 1 bit positive/negative SR and HARQ-ACK.
- PUCCH format 4 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report
- PUCCH format 5 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report

Intel suggests that “it is more desirable to configure a set of resource indexes from high layer signalling and explicitly signal one resource index from the set of

resource indexes in the DCI for HARQ ACK/NACK feedback on UL control channel.” SAMSUNG-1007, 3. Specifically, a “set of resource indexes for HARQ ACK/NACK feedback on UL control channel are configured via high layer signaling and one resource index among the set of resource indexes is explicitly signaled in the DCI.” *Id.* From this disclosure, a POSITA would have found it obvious to use semi-static configuration of two or more uplink control channel resource sets (e.g., different PUCCH formats) each comprising two or more uplink control channel resources. SAMSUNG-1003, [167]-[168].

[1h] wherein determining the uplink control channel resource based on (a) and (b) comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

Intel describes that “multiple PUCCH formats are specified to support various *UCI payload sizes*.” SAMSUNG-1007, 1.

- PUCCH format 1/1a/1b for positive SR, 1 or 2 bit HARQ-ACK or 4 bit HARQ-ACK with channel selection
- PUCCH format 2/2a/2b for CSI report with and without 1 or 2 bit HARQ-ACK.
- PUCCH format 3 for CSI report, 1 bit positive/negative SR and HARQ-ACK.
- PUCCH format 4 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report
- PUCCH format 5 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report

Intel suggests that “it is more desirable to configure a set of resource indexes

from high layer signalling and explicitly signal one resource index from the set of resource indexes in the DCI for HARQ ACK/NACK feedback on UL control channel.” SAMSUNG-1007, 3. Specifically, a “set of resource indexes for HARQ ACK/NACK feedback on UL control channel are configured via high layer signalling and one resource index among the set of resource indexes is explicitly signaled in the DCI.” *Id.* From this disclosure, a POSITA would have found it obvious to select one of the two or more uplink control channel resource sets (e.g., different PUCCH formats), and select one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node (e.g., explicitly signaled in the DCI). SAMSUNG-1003, [169]-[170].

[6i] wherein the signaling received from the network node comprises information that provides a semi-static configuration of two or more uplink control channel resource sets each comprising two or more uplink control channel resources; and

See supra Ground 2 [1g] (incorporated here). SAMSUNG-1003, [171].

[6j] wherein determining the uplink control channel resource based on (a) and (b) comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

See supra Ground 2 [1h] (incorporated here). SAMSUNG-1003, [172].

[11h] a payload size of the uplink control information;

Intel describes that “multiple PUCCH formats are specified to support various

UCI payload sizes.” SAMSUNG-1007, 1.

- PUCCH format 1/1a/1b for positive SR, 1 or 2 bit HARQ-ACK or 4 bit HARQ-ACK with channel selection
- PUCCH format 2/2a/2b for CSI report with and without 1 or 2 bit HARQ-ACK.
- PUCCH format 3 for CSI report, 1 bit positive/negative SR and HARQ-ACK.
- PUCCH format 4 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report
- PUCCH format 5 for more than 22 bits of UCI including HARQ-ACK, SR and CSI report

As Intel proposed, “multiple NR PUCCH formats can be supported in order to accommodate various *UCI types and payload sizes.*” *Id.*, 2. From this disclosure, a POSITA would have found it obvious that PUCCH resource selection is based on a payload size of the uplink control information. SAMSUNG-1003, [173]-[174].

[11i] a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received; and

Intel suggests that the “resource index for PUCCH format 1a/1b is derived from *the first CCE in the PDCCH* which is used to schedule the downlink data transmission.” SAMSUNG-1007, 2. From this disclosure, a POSITA would have found it obvious that PUCCH resource selection is based on a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received. SAMSUNG-1003, [175].

[11j] dynamic signaling received from the network node; and

See supra Ground 2 [1h] and [6j] (incorporated here). SAMSUNG-1003, [176].

[11l] wherein selecting the uplink control channel resource from the two or more uplink control channel resources in the two or more uplink control channel resource sets comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

See supra Ground 2 [1h] and [6j] (incorporated here). SAMSUNG-1003, [177].

[17a] a payload size of the uplink control information;

See supra Ground 2 [11h] (incorporated here). SAMSUNG-1003, [178].

[17b] a starting control channel element index of the latest received one of the first downlink control channel message and the second downlink control channel message downlink control channel; and

See supra Ground 2 [11i] (incorporated here). SAMSUNG-1003, [179].

[17c] dynamic signaling received from the network node.

See supra Ground 2 [1h], [6j], and [11j] (incorporated here). SAMSUNG-1003, [180].

[18f] a payload size of the uplink control information;

See supra Ground 2 [11h] (incorporated here). SAMSUNG-1003, [181].

[18g] a starting control channel element index of a downlink control channel candidate on which the downlink control channel was received; and

See supra Ground 2 [11i] (incorporated here). SAMSUNG-1003, [182].

[18h] dynamic signaling received from the network node; and

See supra Ground 2 [1h], [6j], and [11j] (incorporated here). SAMSUNG-1003, [183].

[18j] wherein selecting the uplink control channel resource from the two or more uplink control channel resources in the two or more uplink control channel resource sets comprises selecting one of the two or more uplink control channel resource sets, and selecting, as the uplink control channel resource to use for transmitting the uplink control information to the network node, one of the two or more uplink control channel resources from the selected uplink control channel resource set based on dynamic signaling from the network node.

See supra Ground 2 [1h], [6j], and [11j] (incorporated here). SAMSUNG-1003, [184].

IV. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

Discretion under 35 U.S.C. 314(a) or 325(d) should not be used to deny this petition. Specifically, no parallel proceeding exists. Seo, ZTE, and Intel have never been considered in a prior review of the '669 patent. Thus, Petitioner's arguments are new.

V. FEES

Samsung authorizes charge of Deposit Account No. 06-1050 for any necessary fees.

VI. CONCLUSION

Petitioner requests cancellation of all Challenged Claims.

VII. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

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

Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., and Samsung Research America (collectively, “Samsung”) are the real parties-in-interest.

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

Samsung is not aware of any disclaimers, reexamination certificates or petitions for *inter partes* review for the '669 Patent. Samsung is not aware of any litigation involving the '669 Patent.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Samsung provides the following designation of counsel.

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D. Service Information

Please address correspondence/service to the above-listed address. Samsung consents to email service at IPR39843-0100IP1@fr.com (referencing No. 39843-0100IP1 and cc'ing PTABInbound@fr.com, axf-ptab@fr.com, and

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Respectfully submitted,

Dated: March 19, 2021

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter partes* Review totals 13,582 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: March 19, 2021

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on March 19, 2021, a complete and entire copy of this Petition for *In-ter partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

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