

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ericsson Inc., Nokia of America Corp., AT&T Services, Inc., Cellco Partnership
d/b/a Verizon Wireless, Google LLC, and T-Mobile USA, Inc.,
Petitioners

v.

KT Corporation (Patent Owner) and Pegasus Wireless Innovation LLC (Exclusive
Licensee)
Patent Owner

Case: IPR2025-00083
U.S. Patent No. 10,638,463

**DECLARATION OF DR. SUMIT ROY
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S.
PATENT NO. 10,638,463**

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I, Dr. Sumit Roy, declare that:

I. INTRODUCTION

1. I have been retained by Ericsson Inc., Nokia of America Corp., AT&T Services, Inc., Cellco Partnership d/b/a Verizon Wireless, Google LLC, and T-Mobile USA, Inc., (to whom I will refer to as Petitioners) for this *inter partes* review proceeding (which I may refer to at times as an “IPR”).

2. I have been asked to consider whether certain references disclose, teach, and/or suggest the features recited in Claims 1-9 of U.S. Patent No. 10,638,463 (“the ’463 Patent”).

3. I understand that the ’463 Patent is assigned to KT Corporation, which has given an exclusive license to Pegasus Wireless Innovation LLC.

4. I have been asked to provide an independent analysis of the ’463 Patent in view of the asserted prior art publications cited in the Petition. This Declaration is limited to those issues.

5. I am not, and never have been, an employee of KT Corporation, Pegasus Wireless Innovation LLC, or Petitioners. I am not receiving compensation for this Declaration beyond my normal hourly fees based on my time actually spent analyzing and documenting my opinions herein on the ’463 Patent, the asserted prior art publications cited in this Declaration and in the Petition, and the issues related thereto. My compensation is not related to the outcome of this proceeding,

and I will not receive any additional compensation based on the outcome of any IPR or other proceeding involving the '463 Patent.

6. I have personal knowledge of the facts and opinions stated herein and, if called as a witness, could and would testify competently to them under oath.

II. QUALIFICATIONS

7. All of my opinions stated in this Declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience in the field of wireless networks.

8. I am an expert in the field of wireless networks (both commercial licensed cellular and unlicensed technologies) – having studied, taught, practiced, and researched this field for over thirty years. I summarize in this section my educational background, work experience, and other relevant qualifications. I understand that my curriculum vitae (CV) is being filed as Ex. 1003 in this proceeding. I certify that Ex. 1003 is a true and correct copy and sets forth the details of my educational history, work history, patents, and other related professional experience.

9. I earned my Bachelor of Technology degree in Electrical Engineering from Indian Institute of Technology in Kanpur, India in 1983. Subsequently, I earned my Master of Science and Doctor of Philosophy degrees in Electrical & Computer Engineering from University of California in Santa Barbara – with my

dissertation being on “Estimation Strategies for a Network of Distributed Sensors.”

I also simultaneously was awarded a Master of Arts in Statistics & Applied Probability from University of California in Santa Barbara in 1988.

10. While a graduate student (1983 through 1988), I worked on various projects related to wireless communication and radar systems using a mix of analytical modeling and computer simulation. This initial exposure to 3G cellular systems initiated a career pathway that traversed network evolution through 4G and current 5G systems, giving me a working knowledge of 3GPP technology standards governing these systems. In July 1988, I joined the faculty of the University of Pennsylvania as an Assistant Professor in the Department of Electrical Engineering, where I taught an upper level undergraduate course on “Communication Systems” and graduate level courses on “Advanced Digital Signal Processing” and “Digital Communications,” and conducted research in my specialization.

11. In January 1995, I became a tenured Associate Professor in the Division of Engineering at the University of Texas at San Antonio, in San Antonio, Texas. In April 1998, I transferred to a tenured Associate Professor position in the Department of Electrical Engineering, University of Washington (“UW”) in Seattle, Washington and was promoted to Professor in September 2002. As a faculty member at UW, I have taught courses and directed research in networking

and telecommunications, including 802.11 WLAN and cellular technologies. From September 2014 to September 2019, I was awarded Integrated Systems Term Professorship at UW in recognition of my leadership and national stature in this area.

12. I took full-time leave from UW to serve as a Senior Staff Researcher at Intel Labs, Hillsboro, OR from September 2001 to December 2003. In that role, I served as Wireless Systems Architect researching IEEE 802.15.3a Ultra-Wideband PHY layer for Wireless Personal Area Networks and pre-802.11n (MIMO WiFi). I also represented Intel at IEEE Standards meetings and coordinated with other industry partners. My research resulted in several patents relating to the above, including design implementation of MIMO WiFi transceivers. More recently (July 2020 – August 2022), I served as Program Lead for the U.S. Department of Defense, Office of the Under Secretary of Defense's Innovate Beyond 5G program for research and experimentation within the 5G-to-xG (now renamed FutureG) initiative, where I had responsibility for monitoring commercial 5G evolution via 3GPP standardization.

13. As a result of my academic teaching, research, industry, and federal government experience, I have significant knowledge of wireless networking technologies. Since 1988, I have served as Principal Investigator for multiple competitively-awarded research projects (in excess of \$10M net funding) from

various national organizations (both federal government and private industry sources) to support my research, as listed in my CV. I have authored and co-authored over 200 journal publications, conference proceedings, technical papers, book chapters, and technical presentations in a broad array of communications-related technologies, including networking and wireless communication. My work on Radar-WiFi Spectrum Sharing was recognized with the M. Barry Carlton Award, which recognizes the best paper published in *IEEE Trans. on Aerosp. Elect. Systems* in 2016.

14. My professional affiliation with IEEE includes serving in various professional societies as a reviewer for a number of technical publications, journals, and conferences. I have also received multiple awards and recognitions, most notably, elevation to IEEE Fellow in 2007 for “contributions to multi-user communications theory and cross-layer design of wireless networking standards.” By IEEE bylaws, only 0.1% of IEEE membership is elevated to Fellow annually. See <https://www.ieee.org/membership/fellows/steps.html>. In addition, I was selected as IEEE Communications Society’s Distinguished Lecturer (2014-15, 2017-18), which are listed in my curriculum vitae.

15. In addition to advising and mentoring students at UW, I have served as an external dissertation reviewer for several reputed international universities (e.g., McGill Univ., Montreal, CA; National University of Singapore, and Australia

National University). During my career, I have advised and supervised over 35 Ph.D. students and numerous visiting scholars.

16. I have also served as an expert in certain legal proceedings. A list of cases in which I have testified at trial, hearing, or by deposition is provided. Over the years, I have been retained by both patent owners as well as petitioners.

III. COMPENSATION

17. I am being compensated for my work on this matter at the rate of \$625 per hour, plus expenses. My fees are not contingent upon the outcome of this litigation.

IV. MATERIALS CONSIDERED

18. I have reviewed the materials listed below.

Exhibit	Short Name	Description
Ex. 1001	'463 Patent	U.S. Patent No. 10,638,463
Ex. 1002	Declaration	Declaration of Dr. Sumit Roy
Ex. 1003	CV	<i>Curriculum Vitae</i> of Dr. Sumit Roy
Ex. 1004	'463 File History	File History of U.S. Patent No. 10,638,463
Ex. 1005	'000 File History	File History of U.S. Patent No. 11,219,000
Ex. 1006	Takeda	International Publication No. WO 2019/030929 A1
Ex. 1007	Certified Translation of Takeda	Certified Translation of International Publication No. WO 2019/030929 A1
Ex. 1008	Yan- PCT	International Publication No. WO 2017/024554 A1

Exhibit	Short Name	Description
Ex. 1009	Certified Translation of Yan- PCT	Certified Translation of International Publication No. WO 2017/024554 A1
Ex. 1010	Yan- U.S. Patent	U.S. Patent No. 10,736,085 B2
Ex. 1011	Marinier	U.S. Patent Application Publication No. US 2014/0056278 A1
Ex. 1012	R1-1711853	Activation/deactivation of bandwidth part
Ex. 1013		Reserved
Ex. 1014	Hooli	U.S. Patent Application Publication No. US 2018/0324786 A1
Ex. 1015	Yiu	U.S. Patent Application Publication No. US 2019/0044689 A1
Ex. 1016	Ahn	U.S. Patent Application Publication No. US 2019/0268123 A1
Ex. 1017	Bishop Declaration	Declaration of Craig Bishop
Ex. 1018	21.905 V12.0.0	3GPP Technical Specification 21.905 V12.0.0 (2013-06)
Ex. 1019	21.905 V14.1.1	3GPP Technical Specification 21.905 V.14.1.1 (2017-06)
Ex. 1020	Yang	U.S. Patent Application Publication No. US 2019/239214 A1
Ex. 1021	Takeda '856	U.S. Patent No. 11,265,856
Ex. 1022	Takeda '073	U.S. Patent No. 11,160,073
Ex. 1023	Zhang	International Publication NO. WO 2018/227538 A1
Ex. 1024	Li	U.S. Patent Application Publication NO. US 2016/0338041 A1
Ex. 1025	Ahn '664	U.S. Patent No. 10,305,664
Ex. 1026	Shaheen	U.S. Patent No. 10,805,941

Exhibit	Short Name	Description
Ex. 1027	'463 Claim Chart	U.S. Patent No. 10,638,463 Claim Chart
Ex. 1028	Order modifying deadlines	Order modifying case deadlines for D. Ct. Case Nos. 2:23-cv-00640-JRG, 2:23-cv-00638-JRG, and 2:23-cv-00639-JRG
Ex. 1029	First amended docket control order	First Amended Docket Control Order for D. Ct. Case Nos. 2:23-cv-00640-JRG, 2:23-cv-00638-JRG, and 2:23-cv-00639-JRG
Ex. 1030	Consolidation order	Order consolidating D. Ct. Case Nos. 2:23-cv-00640-JRG, 2:23-cv-00638-JRG, and 2:23-cv-00639-JRG for pretrial issues
Ex. 1031	Andrews	Jeffrey G. Andrews, <i>et al.</i> , "What Will 5G Be?" <i>IEEE Journal on Selected Areas in Communications</i> , Vol. 32, No. 6 (June 2014)
Ex. 1032	Oh	U.S. Patent No. 10,980,007
Ex. 1033	Wilson	U.S. Patent No. 10,588,143
Ex. 1034	Ratasuk	Repeepat Ratasuk, <i>et al.</i> , "Carrier Aggregation and Dual Connectivity," Mobile Radio Research Lab, Nokia Bell Labs (2017)
Ex. 1035	Silva	Icaro Da Silva, <i>et al.</i> , "Tight integration of new 5G air interface and LTE to fulfill 5G requirements" <i>IEEE</i> (2015)
Ex. 1036	Marsch	Patrick Marsch, <i>et al.</i> , "5G Radio Access Network Architecture: Design Guidelines and Key Considerations" <i>IEEE Communications Magazine</i> (November 2016)
Ex. 1037	ATIS	ATIS.3GPP.37.863-01-01.V1540
Ex. 1038	Protective order	<i>Pegasus Wireless Innovation LLC v. Verizon Communications Inc. et al</i> , Nos. 2:23-cv-00640, 2:23-cv-00638, 2:23-cv-00639 (E.D. Tex.) Protective Order from Non-Jurisdictional Discovery

19. I have also relied on my own education, knowledge, and experience in the relevant art.

20. I have also considered the understanding of a person of ordinary skill around the time of the invention of the '463 Patent.

V. LEGAL STANDARDS

21. I am not an attorney and do not offer opinions on the law in this Declaration.

22. In forming my analyses and conclusions expressed here in this Declaration, I have applied the legal principles described in the following paragraphs, which were provided to me by counsel for the Petitioner.

23. I used my understanding of the following legal principles set forth in this section in reaching my opinions.

24. I understand that, in this proceeding, Petitioners have the burden of proving that the challenged claims are invalid by a preponderance of the evidence.

A. Obviousness

25. I have been informed that a claim is invalid as obvious under 35 U.S.C. § 103 (AIA) if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a person of ordinary skill in the art. I have been informed that the following matters are relevant to determining whether the claimed invention would have been obvious: (1) the scope and content of the prior art, (2) the difference or differences between the patent claim and the prior art, (3) the

level of ordinary skill in the art at the time the invention of the patent, and (4) any secondary considerations or objective indicia of non-obviousness.

26. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. When a claim simply arranges prior art elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, then such a combination is obvious. When a patent claims a structure already known in the prior art altered by the mere substitution of one element for another known in the field, the combination is likely to be obvious unless the combination yields an unpredictable result.

27. I have been informed that when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill in the art can implement a predictable variation, such a variation is likely unpatentable. For the same reason, if a technique has been used to improve one device, and one of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. One question to consider is whether the improvement is

more than predictably using prior art elements according to their established functions.

28. I have been informed that it may often be necessary, in a validity analysis, to consider whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. This can be accomplished by looking to interrelated teachings of multiple patents or other publications or pieces of prior art; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by one of ordinary skill in the art.

29. I have been informed that a validity analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim; it is appropriate to take account of the inferences and creative steps that a person of ordinary skill in the art would employ. I have been informed that a person of ordinary skill in the art is a person of ordinary creativity, not an automaton.

30. I have been informed that a claim composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art. I have been informed that it can be important to identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does. I am told that one way that subject matter can be proved obvious is by noting there existed at

the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims. I have been informed that any need or problem known in the field of endeavor at the time of the claimed invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

31. I have been informed that one should not assume that a person of ordinary skill in the art attempting to solve a problem will be led only to those elements of prior art designed to solve the same problem. Instead, I have been informed that since familiar items may have obvious uses beyond their primary purposes, in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple prior art references together like pieces of a puzzle.

32. I have been informed that, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, persons of ordinary skill in the art have good reason to pursue the known options within their technical grasp. If this leads to the anticipated success, the product was likely not accomplished by innovation but by using ordinary skill and common sense. I have been informed that, in such an instance, the fact that the combination was obvious to try may show that the combination was obvious.

33. I have been informed that, when determining whether a claimed combination would have been obvious, the correct analysis is not whether a person

of ordinary skill in the art, writing on a blank slate, would have chosen the particular combination of elements described in the claim. Instead, I have been informed that the correct analysis considers whether one of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to selecting the combination claimed.

34. I have been informed that, when determining whether a claimed invention is obvious, any “secondary considerations” of non-obviousness identified by the patentee should also be considered. These secondary considerations can include:

- commercial success of the invention, causally related to the invention itself rather than to companion factors, such as advertising or attractive packaging;
- the invention taught away from the technical direction followed by those skilled in the art;
- a long-felt but unsatisfied need for the invention while the needed implementing arts and elements had long been available;
- the invention achieves results unexpected to those skilled in the art;
- copying of the invention by competitors as distinguished from their independent development;

- unsuccessful attempts by those skilled in the art to make the invention;
- acquiescence by the industry to the patent's validity by honoring the patent through taking licenses or not infringing the patent, or both; and
- skepticism, disbelief in or incredulity by those skilled in the art that the patentee's approach worked.

35. I have been informed that, for the above information to impact the obviousness of a patent claim, there must be a nexus between the alleged secondary considerations and the claims. In addition, I have been informed that the burden of introducing evidence of secondary considerations generally is on the Patent Owner. If the Patent Owner or its expert should assert secondary considerations of non-obviousness, I reserve the right to provide a Declaration addressing assertions of non-obviousness due to secondary considerations.

B. Claim Construction

36. I have been informed that claim terms are typically given their plain and ordinary meanings, as would have been understood by a person of ordinary skill in the art at the time of the earliest alleged priority date. I have further been informed that when considering the meaning of any terms in the challenged claims of the '463 Patent, I should apply the plain and ordinary meaning of those terms. I have further been informed that in considering the meaning of the claims, one must

consider the language of the claims, the specification, and the prosecution history of record. I have been informed that, in general, a preamble limits the invention if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim. I have further been informed that a preamble is not limiting where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention. I have further been informed that dependence on a particular disputed preamble phrase for antecedent basis may limit claim scope because it indicates a reliance on both the preamble and claim body to define the claimed invention. I have further been informed that clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art transforms the preamble into a claim limitation because such reliance indicates use of the preamble to define, in part, the claimed invention.

37. Claim 7 recites “a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set.” The specification recites that a user equipment includes a controller which “determines one of UL control channel resource sets contained in UL control channel resource set configuration information, and determines one of UL control channel resources

configuring the determined one of UL control channel resource set.” Ex. 1001, 19:46-61. It is my opinion that this is recited at a high level of generality and does not include an algorithm for how the determinations are made. The specification broadly states that “controller” (along with at least seven other terms) “are generally intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution.” Ex. 1001, 20:54-58. The specification further states that “[b]y way of illustration, both an application running on a controller or processor and the controller or processor can be a component.” Ex. 1001, 20:62-64. It is my opinion that the references cited herein describe a controller with at least the same level of specificity performing these same functions. In particular, Takeda discloses a “baseband signal processing unit 204 provided in the user terminal 20 [that] includes a *control unit 401*” Ex. 1007, [0173]. The control unit 401 is described as “control[ing] ... the entire user terminal.” *Id.*, [0174]. Yan discloses that a terminal includes a “first processing unit” which “determine[s] a channel resource set of N channel resource sets as a first channel resource set, where ... the N channel resource sets are preconfigured by the access network device for the terminal device, ... and determine a channel resource that is in the first channel resource set.” Ex. 1010, 26:52-65; Ex. 1009, 36:5-13. Finally, Marinier discloses that the WTRU includes a

“processor” that may perform “any other functionality that enables the WTRU 102 to operate in a wireless environment.” Ex. 1011, [0032]-[0039].

VI. PERSON OF ORDINARY SKILL IN THE ART

38. Assuming that the '463 Patent is entitled to its earliest alleged priority date of September 29, 2017 (*see* Ex. 1001, 1 (“Foreign Application Priority Data” section)), based on my knowledge and experience, I was a person of ordinary skill in the art as of September 29, 2017, and can provide opinions regarding the knowledge of a person of ordinary skill in the art as of that time. My opinions herein are, where appropriate, based on my understandings as to a person of ordinary skill in the art at that time.

39. I understand that factors that are pertinent to a determination of the level of ordinary skill in the art include: (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) the prior art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and (6) and the educational level of workers active in the field.

40. Based on the materials and information I have reviewed and based on my experience in the technical areas relevant to the '463 Patent, a person of ordinary skill in the art at the time of the alleged invention of the '463 Patent would have had a bachelor's degree in electrical engineering, computer engineering, or a related discipline, knowledge of the relevant 3GPP standards as

of this time, and at least 2 years of experience working in a field involving wireless communications. A person with a different degree but with additional relevant experience could still qualify if the additional experience compensates for the different educational background. A person with less than 2 years of experience working in a field involving wireless communications could still qualify if the person has additional education that compensates for their lesser experience.

VII. SUMMARY OF OPINIONS

41. I have been asked to consider whether the claims of the '463 Patent are obvious over certain prior art references. As explained in detail in the following sections, it is my opinion that:

- Ground 1: Claims 1-9 are rendered obvious by International Publication No. WO 2019/030929 A1 (“Takeda”) and U.S. Patent No. 10,736,085 (“Yan”)
- Ground 2: Claims 1-9 are rendered obvious by U.S. Patent Publ. No. 2014/0056278 (“Marinier”), Yan, and 3GPP Submission No. R1-1711853 (“R1-1711853”)

42. The following table is a summary of the above enumerate grounds:

Ground	Prior Art	Claims
1	Takeda and Yan	1-9
2	Marinier, Yan, and R1-1711853	1-9

VIII. TECHNOLOGY BACKGROUND

43. I believe it is helpful to begin my discussion with an overview of the state of the art existing at the time of the alleged invention (September 29, 2017, for the purposes of this Petition) relating to uplink control channel allocation and bandwidth parts generally, as it relates to user equipment communicating with a base station, among other relevant technology.

44. In communications systems such as 4G Long Term Evolution (LTE) and 5G New Radio (NR), a user equipment device (UE) and a base station (BS) communicate via downlink (DL) signals (from the BS to the UE) and uplink (UL) signals (from the UE to the BS). *See* Ex. 1020, [0034]-[0035]; Ex. 1021, 1:12-40. 5G NR builds on 4G LTE with bandwidth parts (BWP) while retaining 4G features including resource allocation processes.

45. In 4G LTE, signals containing data or control information are transmitted from a UE to a BS via uplink signals and from a BS to a UE via downlink signals, using resource grids consisting of slots/OFDM symbols (time) and Resources Blocks of contiguous sub-carriers (frequency). The smallest unit of the resource grid is Resource Element (RE) comprising 1 sub-carrier (frequency) and 1 symbol (time). For example, resources may be mapped to include physical uplink control channel (PUCCH) and physical downlink control channel (PDCCH) for transmitting uplink and downlink control information, respectively. *See* Ex.

1021, 1:12-40; Ex. 1026, 5:37-51. Other types of resources may include physical uplink shared channel (PUSCH) resources and physical downlink shared channel (PDSCH) resources for transmitting uplink and downlink data. *See* Ex. 1021, 1:12-40; Ex. 1026, 5:37-51.

46. The PDCCH and the PUCCH are physical layer channels that are used for transmitting control information and are defined by a set of time and frequency resources used for transmission. The PDCCH is used to transmit downlink control information (DCI) from a BS to a UE, and the PUCCH and/or PUSCH is used to transmit uplink control information (UCI) from a UE to a BS. DCI transmitted on the PDCCH may encompass information relevant for operations to be performed on other downlink channels, i.e. decoding of physical downlink shared channel (PDSCH) and also for scheduling the uplink configuration of resource set indicator in UCI. *See* Ex. 1025, 4:29-36. The UCI may be transmitted in a multiplexed manner via the PUCCH or PUSCH, and may consist of ACKs/NAKs, channel-state feedback, and scheduling requests for uplink data awaiting transmission.

47. The BS controls the resources used for both DL and UL signal transmissions. For the sake of simplicity, I will only discuss the transmission of control information (DCI and UCI), but the same concepts for resource allocation are used for data signals (transmitted on PUSCH resources and PDSCH resources for UL and DL, respectively). In 4G LTE, the DCI is sent within the known

resources allocated to PDCCH, so that the UE knows what PDCCH is used for a DL signal that contains DCI.

48. DCI contains control information used to schedule transmissions of uplink information. For example, DCI may allocate physical resources (e.g., time and/or frequency resources) for uplink data to be transmitted via the PUSCH. The DCI format carries necessary information for scheduling of DL and UL transmissions, inclusive of frequency and time domain resource assignments (resource block locations), the modulation and coding schemes used, antenna ports, precoding matrix information and number of layers, transmit power control, and hybrid automatic repeat request (HARQ)-related aspects of the scheduled transmission.

49. In 4G LTE, the BS controls UL transmissions in one of two ways, depending on the expected characteristics of UL data traffic. For unpredictable UL signals (e.g., when a user is uploading large data files (e.g., images or videos) to a network-based storage environment), the BS may use dynamic scheduling to control UL signal transmissions. In dynamic scheduling, the DCI received by the UE includes uplink channel parameters (e.g., an indication of a set of PUSCH or PUCCH resources available to the UE for transmitting UCI). For dynamic scheduling, the parameters within the DCI are only used for a single UL transmission scheduled by the DCI, after the UE receives and decodes the DCI; a

second set of DCI must be received and decoded by the UE (with new parameters and allocation) before a second UL signal containing UCI is transmitted. The uplink channel parameters and scheduling are used by the UE to determine the UL resource used for UCI signaling. For example, the scheduling information may dictate whether the UCI includes 2 or fewer symbols (e.g., when the UCI only includes HARQ ACK/NACK), or whether the UCI includes greater than two symbols (e.g., when the UCI includes channel quality indicator (CQI)/channel state information (CSI) feedback). Different PUCCH formats are used, depending on the format (size) of the UCI.

50. For more predictable UL signals (e.g., periodic uploads of data over a duration), the BS uses configured grant scheduling for UL signal transmissions. In configured grant scheduling, the parameters for UL transmissions are sent periodically but not necessary before every UL transmission (i.e., the parameters may apply to multiple subsequent UL transmissions). These parameters are sent via Radio Resource Control (RRC) signaling, i.e., a higher-layer logical channel to the UE from the BS. The 3GPP specification has consistently defined RRC as “[a] sublayer of radio interface Layer 3 existing in the control plane only which provides information transfer service to the non-access stratum. RRC is responsible for controlling the configuration of radio interface Layers 1 and 2” since at least 2013, demonstrating that a POSITA recognizes that configuration information,

when sent via higher layer signaling, is sent specifically using RRC signaling. *See* Ex. 1018, 25 (defining RRC in 2013); Ex. 1019, 26 (repeating the same definition in 2017). The content of these parameters is identical to those sent in DCI of the dynamic signaling configuration. In one type of such configured grants, UE waits to receive DCI which schedules transmission of UL PUSCH using parameters configured by RRC. The RRC parameters are relevant for subsequent UL PUSCH transmissions using the ‘periodicity’ parameter set by RRC unless deactivated by a new DCI and re-activated with new RRC provided parameter values, or the device switches to dynamic scheduling. Like the dynamic scheduling configuration discussed above, the UE determines a PUCCH format for the UCI depending on the format (size) of the UCI.

A. Resources

51. Resources for UL and DL transmission encompass time (subframes, made up of slots which include symbols) and frequency (resource block or resource element groups) assigned to a UE for transmission and/or reception. For transmissions between a UE and a BS, resources may be allocated by a time division duplex (TDD) technique, a frequency division duplex (FDD) technique, or a combination of TDD and FDD. *See* Ex. 1024, [0003]-[0004].

52. In TDD, transmissions between a UE and a BS are made based on an allocation of different time resources over the same frequency channel. For

example, the UE may be assigned a first time slot to perform uplink transmission to a BS, and the BS may be assigned a second slot to perform downlink transmission to a UE. A single frequency may be used for both the uplink and downlink transmissions.

53. In FDD, transmissions between a UE and a BS are made based on an allocation of different frequencies for uplink and downlink. For example, the UE may be assigned a first frequency band to perform uplink transmission to a BS, and the BS may be assigned a second frequency band to perform downlink transmission to a UE. Using FDD, uplink and downlink transmissions may be made simultaneously in time between a UE and a BS.

54. In addition to FDD and TDD, UL and DL communications between multiple UEs and a BS may be divided based on time division multiple access (TDMA) and frequency division multiple access (FDMA). Ex. 1023, [0002]. For TDMA, a first UE may be assigned a first time slot for communication with the BS and a second UE may be assigned a second time slot for communication with the BS. Similarly, in FDMA, the first UE may be assigned a first frequency band for communication with the BS and the second UE may be assigned a second frequency band for communication with the BS.

55. Frequency and time division were used in 4G LTE (and before) for uplink and downlink transmissions. Ex. 1023, [0002]; Ex. 1024, [0003]-[0004].

For example, a frequency bandwidth for a UE may be divided into parts for different transmissions. The frequency bandwidth may be divided for uplink transmissions to be performed to different BSs and for downlink transmissions to be received from different BSs. The frequency bandwidth may also be divided for different types of signals to be received or transmitted between a UE and a BS.

B. 5G NR

56. 5G NR introduced more refinements for signaling than 4G LTE, through the introduction of BWPs for UL and DL transmissions. The new degrees of freedom allowed UEs to better manage power usage when communicating with BSs, by allowing UEs to use a portion of a total carrier bandwidth (each portion constituting a single BWP) rather than the entire carrier bandwidth for signaling. However, control over the UL and DL transmissions within any particular BWP is still managed by the BS using control signaling transmitted to the UE through RRC signaling for configuration information in configured grant embodiments and DCI signaling for PUSCH and PUCCH scheduling.

57. In 5G NR, the total carrier bandwidth of a UE device is sub-divided into BWPs – a contiguous set of resource blocks – for transmission and reception. *See Ex. 1022, 1:45-51.* Uplink bandwidth parts are used for transmissions to the BS, and downlink BWPs are used for reception from the BS. Each UE may be assigned up to four uplink/downlink BWPs. However, only one uplink/downlink

BWP may be active at a given time to transmit and receive signals. For a particular UE, different BWPs may be used to support transmissions of different signals or with different BSs. Dividing frequency resources into BWPs reduces UE power consumption since the UE monitors (or transmits using) a narrower bandwidth instead of an entire carrier bandwidth. For UL transmissions from a UE, DCI received from a BS (in the form of a UL grant) schedules the UL transmission within a particular BWP (either using parameters defined within the DCI or within a separate RRC signal, as discussed in reference to 4G LTE UL transmissions), and the UE transmits the UL signal.

58. The way in which UEs receive DCI also differs slightly as compared with 4G. Rather than a PDCCH occupying the entire carrier bandwidth being used for DCI transmission, the BS transmits DCI on a PDCCH within a CORESET – a set of channel resources known to the UE on which DL signals may be transmitted. Since the UE may not know the exact location of PDCCH in a DL transmission a-prior, it searches within the CORESET to detect a DL signal that contains DCI.

IX. OVERVIEW OF THE '463 PATENT

59. The claims of the '463 Patent that are being challenged, and that I have been asked to evaluate, are Claims 1-9. I have reproduced the challenged claims below:

Claim	Recitation
1[pre]	A method of transmitting uplink (UL) control information by a user equipment, the method comprising:
1[a]	receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;
1[b]	determining one of the UL control channel resource sets contained in the UL control channel resource set configuration information;
1[c]	determining one of UL control channel resources contained in the determined UL control channel resource set; and
1[d]	transmitting UL control information through the determined UL control channel resource,
1[e]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and
1[f]	wherein the each UL BWP is activated through downlink (DL) control information.
2	The method according to claim 1, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.
3[pre]	The method according to claim 1, further comprising
3[a]	receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,
3[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.
4[pre]	A method of receiving uplink (UL) control information by a base station, the method comprising:
4[a]	transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment; and
4[b]	receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information,

4[c]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and
4[d]	wherein the each UL BWP is activated through downlink (DL) control information.
5	The method according to claim 4, wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information.
6[pre]	The method according to claim 4, further comprising
6[a]	transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,
6[b]	wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information.
7[pre]	A user equipment for transmitting uplink (UL) control information, comprising:
7[a]	a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;
7[b]	a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and
7[c]	a transmitter configured to transmit the UL control information through the determined UL control channel resource,
7[d]	wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and
7[e]	wherein the each UL BWP is activated through downlink (DL) control information.
8	The user equipment according to claim 7, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.
9[pre]	The user equipment according to claim 7,
9[a]	wherein the receiver receives, from the base station, DL control information containing information that indicates the one of

	the UL control channel resources for the UL control information transmission,
9[b]	wherein the one of the UL control channel resources is indicated from the base station through the DL control information.

A. Prosecution History

60. The '463 Patent was filed as U.S. Patent Application No. 16/147,530 (“the '530 Application”), the claims of which are reproduced below. Ex. 1004, 267-270.

1. A method of transmitting uplink (UL) control information by a user equipment, the method comprising:

Receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;

determining one of UL control channel resource sets contained in the UL control channel resource set configuration information;

determining one of UL control channel resources contained in the determined UL control channel resource set; and

transmitting UL control information through the determined UL control channel resource.

2. The method according to claim 1, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment.

3. The method according to claim 2, wherein the each UL BWP is activated through DL control information.

4. The method according to claim 1, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.

5. The method according to claim 1, further comprising receiving, from the base station, downlink (DL) control information containing information indicating the one of the

UL control channel resources for the UL control information transmission,

wherein the one of the UL control channel resources is indicated from the base station through the DL control information.

6. A method of receiving uplink (UL) control information by a base station, the method comprising:

transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment; and

receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information.

7. The method according to claim 6, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment.

8. The method according to claim 7, wherein the each UL BWP is activated through downlink (DL) control information.

9. The method according to claim 6, wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information.

10. The method according to claim 6, further comprising transmitting, to the user

equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,

wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information.

11. A user equipment for transmitting uplink (UL) control information, comprising:

a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;

a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and

a transmitter configured to transmit the UL control information through the determined UL control channel resource.

12. The user equipment according to claim 11, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment.

13. The user equipment according to claim 12, wherein the each UL BWP is activated through downlink (DL) control information.

14. The user equipment according to claim 11, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.

15. The user equipment according to claim 11, wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,

wherein the one of the UL control channel resources is indicated from the base station through the DL control information.

61. In the first and only Office Action, the Examiner rejected the claims as unpatentable over Hooli (20180324786) (Ex. 1014) in view of Yiu

(20190044689) (Ex. 1015). Ex. 1004, 156-169; *see also* Ex. 1014, FIG. 5, [0006]-[0007], [0028]-[0029], [0036], [0045], [0055], [0057]-[0058]; Ex. 1015, FIGS. 5-6, [0137]-[0152]. In response, the Applicant amended the independent claims to state, “wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,” and “wherein the each UL BWP is activated through downlink (DL) control information.” Ex. 1004, 69-71. The amended claims are reproduced below.

1. **(Currently Amended)** A method of transmitting uplink (UL) control information by a user equipment, the method comprising:
 - receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;
 - determining one of UL control channel resource sets contained in the UL control channel resource set configuration information;
 - determining one of UL control channel resources contained in the determined UL control channel resource set; and
 - transmitting UL control information through the determined UL control channel resource, wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and
wherein the each UL BWP is activated through DL control information.
2. **(Canceled)**
3. **(Canceled)**
4. **(Original)** The method according to claim 1, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.
5. **(Original)** The method according to claim 1, further comprising receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,
 - wherein the one of the UL control channel resources is indicated from the base station through the DL control information.
6. **(Currently Amended)** A method of receiving uplink (UL) control information by a base station, the method comprising:
 - transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment; and
 - receiving the UL control information through one of UL control channel resources

configuring one of UL control channel resource sets contained in UL control channel resource set configuration information,

wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and

wherein the each UL BWP is activated through downlink (DL) control information.

7. **(Canceled)**

8. **(Canceled)**

9. (Original) The method according to claim 6, wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information.

10. (Original) The method according to claim 6, further comprising transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,

wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information.

11. **(Currently Amended)** A user equipment for transmitting uplink (UL) control information, comprising:

a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;

a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set; and

a transmitter configured to transmit the UL control information through the determined UL control channel resource,

wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment, and

wherein the each UL BWP is activated through downlink (DL) control information.

12. (Canceled)

13. (Canceled)

14. (Original) The user equipment according to claim 11, wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.

15. (Original) The user equipment according to claim 11, wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission,
wherein the one of the UL control channel resources is indicated from the base station through the DL control information.

62. The Applicant argued that Yiu failed to disclose these limitations because it fails to teach “receiving any information related to each UL BWP” and “using the BWP to determine one of the UL control channel resource sets of UL control channel resources.” *Id.*, 73. The Applicant stated that the claim is “not directed to the types of BWPs and BWP transitions,” as in Yiu. *Id.*, 73. An Examiner’s amendment was issued to amend “DL control information” to “downlink (DL) control information”, and a Notice of Allowance was then issued. *Id.*, 44-53.

B. Priority Date

63. I understand that the ’463 Patent issued from U.S. Patent Application No. 16/147,530 (“the ’530 Application”) filed September 28, 2018. I understand that the application claims priority to three Korean applications: 10-2018-0077270

(filed July 3, 2018), 10-2017-0162728 (filed November 30, 2017), and 10-2017-0128188 (filed September 29, 2017). For purposes of this Declaration, I have assumed that the earliest priority date of the '463 Patent is not earlier than September 29, 2017.

C. The '463 Patent's Specification

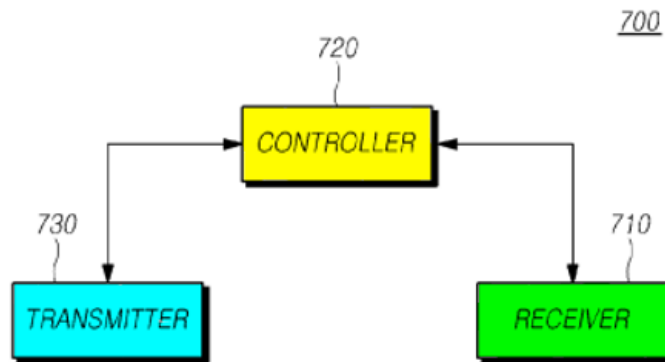
64. The '463 Patent discloses that there is a “need to develop a method for enabling a user device to transmit an uplink channel, such as an uplink control channel and an uplink data channel, to a base station based on a bandwidth part (BWP) when the user device uses various BWPs” in new radio (NR). Ex. 1001, 1:42-46. Accordingly, the '463 Patent discloses “a method of transmitting an UCI in a next-generation/5G radio access network.” Ex. 1001, Abstract. With the method “for an UL transmission and/or reception, the serving cell activates and uses one UL BWP in any UL subframe/slot/mini-slot of one or more UL BWPs configured for the UE.” Ex. 1001, 8:46-49.

1. Hardware

65. FIG. 7 of the '463 Patent, annotated below, describes a user equipment (“UE”). The UE includes a controller, a transmitter, and a receiver. Ex. 1001, 19:44-47. The controller (shown in yellow) controls operations so that separate uplink control channel resource sets are configured for each uplink bandwidth part configured for the UE, determines an uplink control channel

resource set from uplink control channel configuration information based on the size of a UCI, and determines an uplink control channel resource from the uplink control channel resource set. *Id.*, 19:50-54, 19:57-61, 19:66-20:3. The transmitter (shown in blue) transmits UCI and data in messages in a channel resource to a BS, such as UCI through a determined uplink control channel resource. *Id.*, 19:55-56, 20:17-18. The receiver (shown in green) is used to receive downlink control information and data in messages through a channel resource from a BS. For example, the receiver may be used to receive uplink control channel resource set configuration information and/or downlink control information that indicates an uplink control channel resource. *Id.*, 19:48-49, 20:4-16.

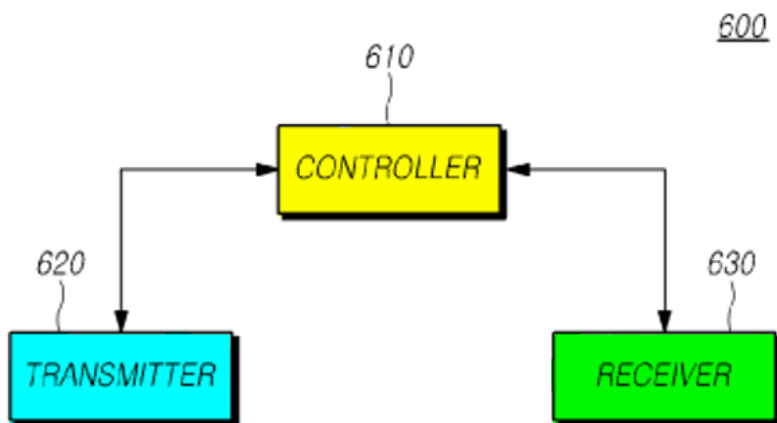
Ex. 1001, FIG. 7



66. A BS described in the '463 Patent is illustrated in annotated FIG. 6 below. The BS includes a controller (shown in yellow), a transmitter (shown in blue), and a receiver (shown in green). *Id.*, 19:10-11. The controller controls operations so that separate uplink control channel resource sets are configured for

each uplink bandwidth part configured for the UE. *Id.*, 19:12-15. The transmitter is used to transmit signals, messages, and data such as uplink control channel resource set configuration information. *Id.*, 19:16-26. The receiver is used to receive signals, messages, and data such as UCI. *Id.*, 19:16-19, 19:27-43.

Ex. 1001, FIG. 6 (annotated)



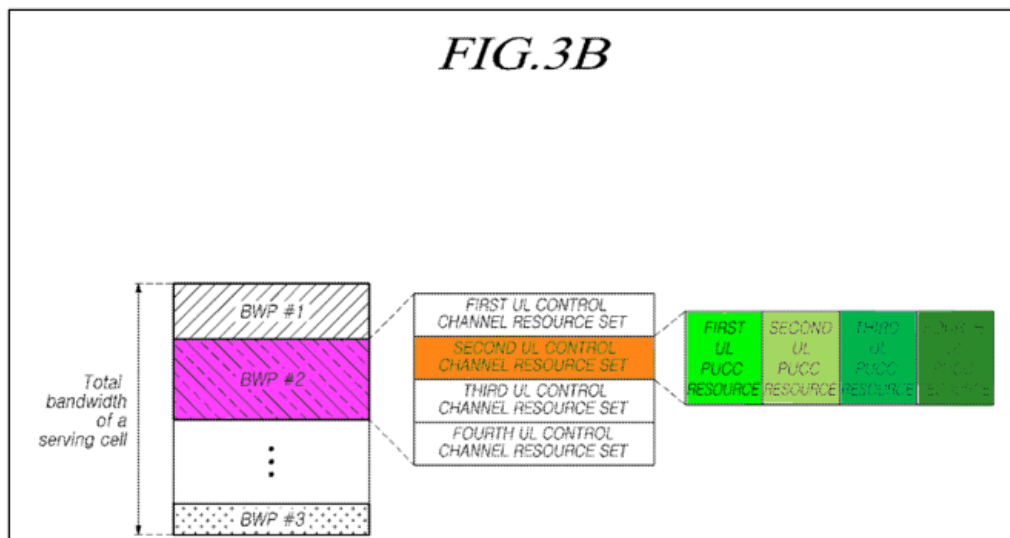
2. Operation

67. The UE communicates UCI “through the determined uplink control channel resource.” *Id.*, Abstract. The ’463 Patent discusses how the UE determines which uplink control channel resource should be used. UL channel resource sets (e.g., PUCCH or PUSCH resource sets), each including a plurality of UL channel resources, are each designated for transmitting UL signals of a different size or type. *Id.*, 2:32-33, 2:57-59, 9:13-20, 10:14-62, 15:1-7. These sets are configured with the included resources through higher layer signaling (RRC signaling) or through DCI. *See, id.* One or more control channel resource sets are associated

with each BWP that a UE may use, as illustrated in annotated FIG. 3B below. *Id.*, 9:61-10:19, FIG. 3B. A single set or multiple sets may be configured for a single UE. *Id.*, 9:12-20, 15:1-7.

68. The UL control channel resource used for UCI (the PUCCH resource) “may be defined as PUCCH format configuration information, time/frequency domain PUCCH resource configuration information (or additionally code domain resource configuration information) in the UL BWP, or the like. For example, as illustrated in FIG. 3B, a specific PUCCH resource set, such as a second PUCCH resource set, may be configured by a first to fourth PUCCH resources.” *Id.* 10:4-13.

Ex. 1007, FIG. 3B (annotated)



69. A BS “may configure a single PUCCH resource set configured by one or more PUCCH resources for HARQ ACK/NACK feedback or a plurality of

PUCCH resource sets, each of which is configured by one or more PUCCH resources, for each UE, and then transmit the configured one or more PUCCH resource sets to each UE through UE-specific higher layer signaling.” *Id.*, 9:13-20. This UL control channel resource set configuration information is configured through RRC signaling, and may configure “a separate PUCCH resource set for each PUCCH format” (*Id.*, 10:40-43) and “one or multiple PUCCH resource sets configure each BWP through the higher layer signaling.” *Id.*, 10:14-16. The ’463 Patent also states that “a separate PUCCH resource set may be configured according to a PUCCH payload size to be transmitted by the UE, i.e., the payload size of UL control information. *Id.*, 10:48-51. As an example, the ’463 Patent states: “the different PUCCH formats are defined as follows: i) PUCCH format 1/1a/1b is used to transmit UL control information of one or two bits (e.g., a scheduling request (SR) and a HARQ ACK); ii) PUCCH format 2a/2b is used to transmit an UL control information having a moderate payload size (e.g., CQI/CSI feedback); and PUCCH format 3 or more is used to transmit the feedback of the UL control information having a large payload size when carrier aggregation (CA) is used.” Ex. 1001, 7:39-47.

70. The UE may determine one of the PUCCH resource sets from DL allocation DL control information (the DL control information is alternatively referred to as “DCI”). For example, “in configuring an area of PUCCH resource

indication information through the DL allocation DL control information, the BS may include explicitly UL BWP indication information for the transmission of a PUCCH” (*Id.*, 10:16-19) and “the PUCCH format indication information for HARQ ACK/NACK feedback of the UE may be transmitted through the DL allocation DL control information, and thus a resource set for PUCCH resource allocation of the UE may be derived.” *Id.*, 10:40-47. If the PUCCH resource sets are configured according to PUCCH payload size, “the PUCCH resource set for the PUCCH resource allocation may be determined according to the UL control information payload size to be transmitted by the UE.” *Id.*, 10:51-54.

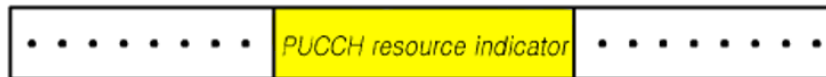
71. The UE additionally determines a specific UL BWP to be activated and used for transmission through DL control information. *Id.*, 8:50-59, 11:1-12, 14:36-38, 14:47-49, 16:58-61, 17:3-12, 19:25-26, 19:64-65. For example, BWP #2 (shown in pink in the annotated FIG. 3B above) may be identified to be activated within DL assignment DL control information or a UL configured grant for transmission. *Id.*, 10:14-19. The UE may determine a second control channel resource set (shown in orange) configured for BWP #2, for example, based on a PUCCH payload size to be transmitted by the UE (*Id.*, 10:48-54) and a second UL PUCCH resource (shown in green) from the determined set for transmission using “DL allocation DL control information [that] may contain PUCCH resource

indication information (PUCCH resource indication or a PUCCH resource indicator).” *Id.*, 11:1-12, FIG. 3C.

72. For example, the DCI may indicate an uplink control channel resource for the transmission of UCI. Ex. 1001, 11:4-6. The DCI may also identify an uplink bandwidth part to be activated so the UE can transmit the UCI. *Id.*, 11:25-30. The indication may activate the indicated bandwidth part. *Id.*, 8:50-59, 11:25-30. The resource allocation information may be a part of a UL grant. *Id.*, 17:9-11. Ex. 1001, FIG. 3B (annotated).

Ex. 1001, FIG. 3C (annotated)

DL CONTROL INFORMATION

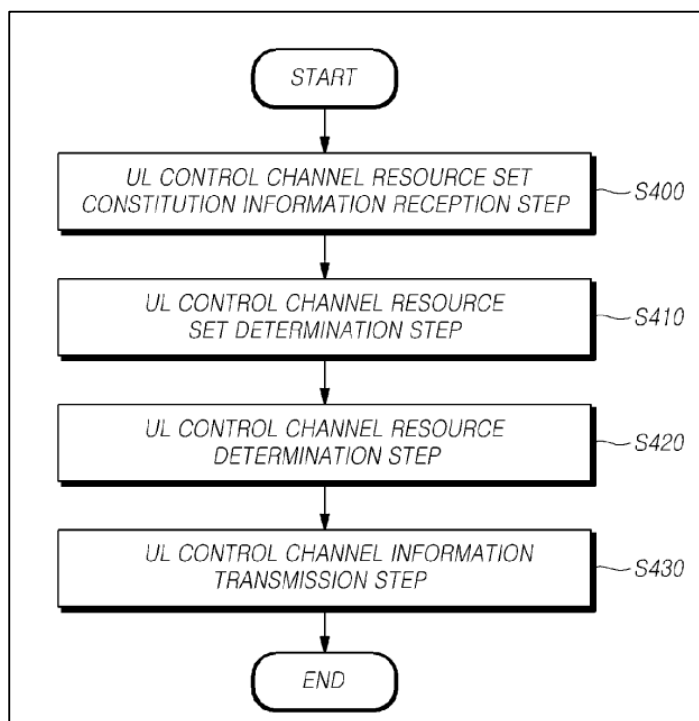


73. FIG. 4 is a “flowchart illustrating a method of a user equipment for transmitting uplink control information.” *Id.* 2:62-63. As shown in step S400 of FIG. 4 (reproduced below), the UE receives configuration information of uplink control channel resource sets. *Id.*, 14:33-35. The uplink control channel resource set configuration information may be received via higher layer signaling including RRC signaling as discussed above. *Id.*, 9:1-3, 10:4-6, 10:14-16, 14:65-67, 17:21-23. The UE may determine the uplink control channel resource set based on the size of the UCI in step S410. *Id.*, 15:20-23. For example, PUCCH formats may be

determined based on whether the UCI payload size exceeds two bits. *Id.*, 7:63-8:8.

In step S420, the UE determines an uplink control channel resource from the determined uplink control channel resource set. *Id.*, 15:24-26. In step S430, the UE transmits the UCI on the determined resource. *Id.*, 16:50-51.

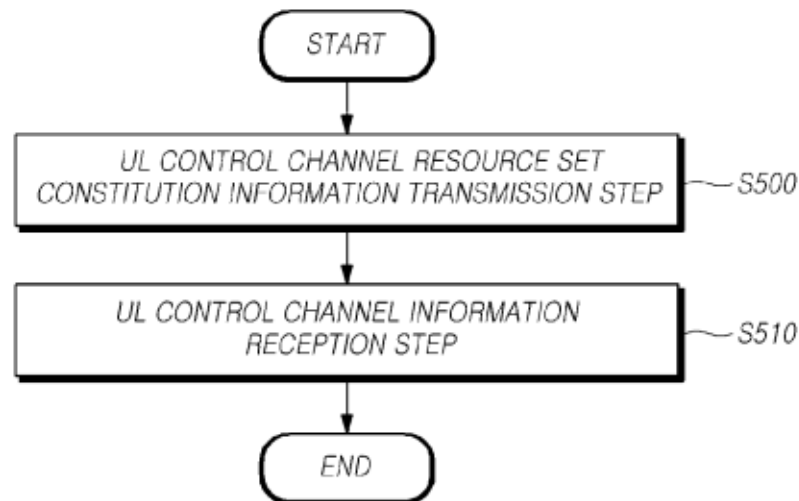
Ex. 1001, FIG. 4



74. FIG. 5 illustrates a “flowchart illustrating a method of a base station for receiving uplink control information.” *Id.* 2:65-67. As shown in step S500 of FIG. 5 below, the ’463 Patent discloses a BS which transmits to a UE, uplink control channel resource set configuration information. *Id.*, 16:55-57, FIG. 5. The uplink control channel resource set configuration information may include one or

more uplink control channel resource sets configured for each uplink bandwidth part configured for a UE. *Id.*, 16:58-60. The uplink bandwidth parts are activated through DCI (e.g., as a part of a UL grant) which are transmitted from the BS. *Id.*, 16:60-61, 17:3-11. At step S510, the BS then receives UCI via an uplink control channel resource configured in the uplink control channel resource set configuration information transmitted at step S500. *Id.*, 17:38-41, FIG. 5.

Ex. 1001, FIG. 5



X. SUMMARY OF THE PRIOR ART

A. International Publication No. WO 2019/030929 to Takeda (Ex. 1006)

75. Takeda is a printed publication of PCT application

PCT/JP2017/029223, filed on August 10, 2017, and designating the United States.

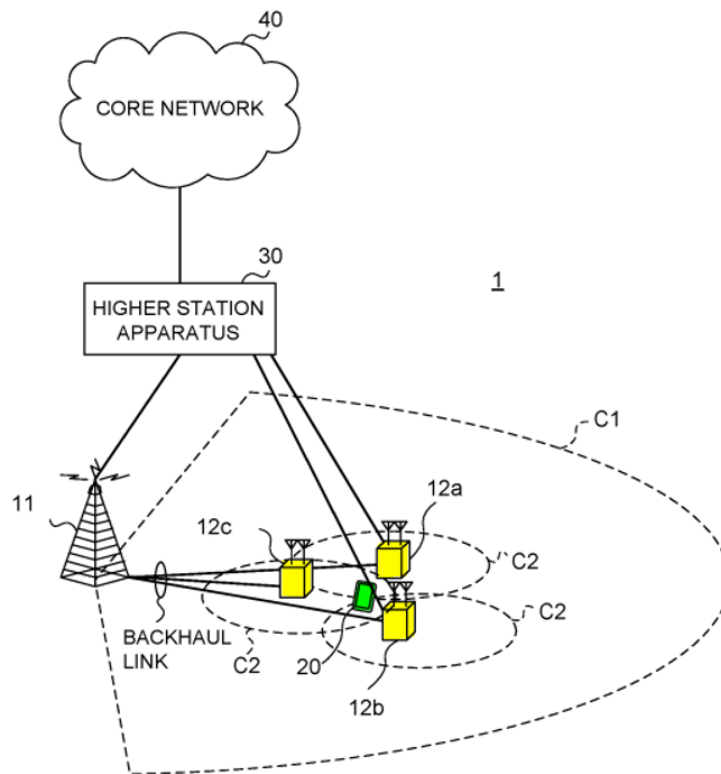
Ex. 1006, 1. I understand that Takeda has been attached as Ex. 1006. *See* Ex. 1006.

I understand that a certified translation of Takeda has been attached as Ex. 1007.

See Ex. 1007. Takeda was not cited and was not considered during prosecution.

76. Takeda is directed to “activation/deactivation of one or more frequency bands (for example, BWPs).” Ex. 1007, Abstract. Takeda describes resource allocation methods for UEs (user terminals) to activate a BWP and transmit UCI to a BS within the activated BWP. As shown in annotated FIG. 12 of Takeda (reproduced below), a user terminal 20 (shown in green) may be connected to several radio base stations 12a-12c (shown in yellow). *Id.*, [0129], FIG. 12. The user terminal 20 may communicate with one or more multiple of radio base stations 12a-12c via downlink and uplink channels on BWPs configured for the user terminal 20 to communicate with the radio base stations 12a-12c. *Id.*, [0015], [0017], [0095]-[0098], [0101], [0103], [0110], [0112], [0115]-[0119], [0120], [0132], [0155], [0179].

Ex. 1007, FIG. 12 (annotated)

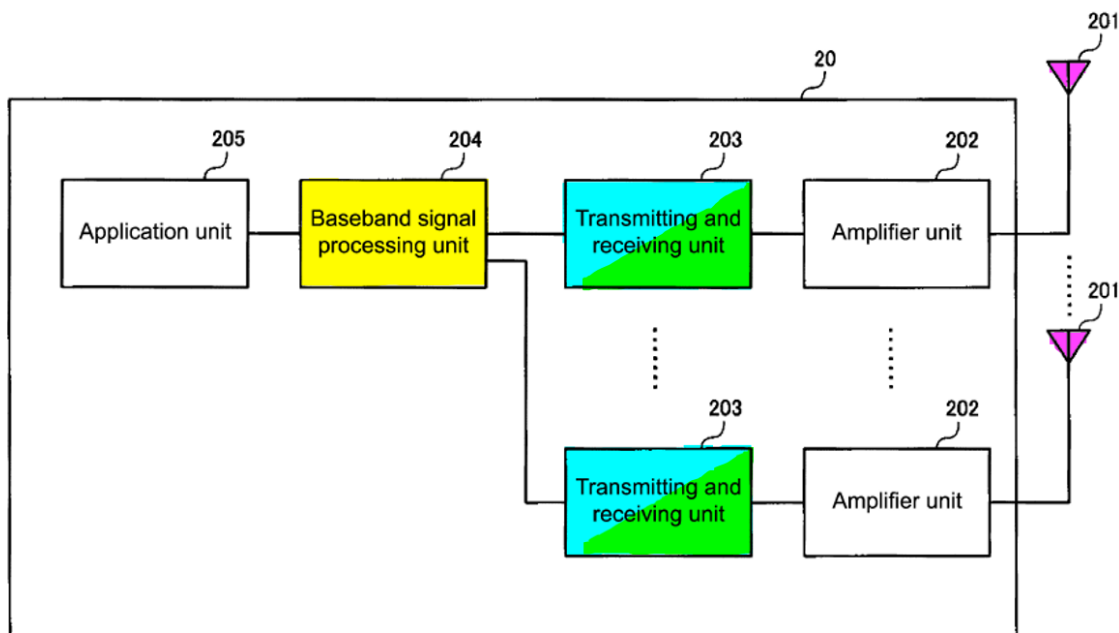


77. Takeda discloses a user terminal which may be used for transmitting uplink transmissions and receiving downlink transmissions in 5G NR. *Id.*, [0001], [0006]-[0010], [0013], [0128]-[0129], [0165]-[0195], FIG. 15.

78. As shown in annotated FIG. 15 of Takeda below, a user terminal 20 includes antennas 201 (shown in pink) for transmitting and receiving signals. *Id.*, [0166], FIG. 15. The user terminal 20 further includes a baseband signal processing unit 204 (shown in yellow) for decoding signals. *Id.*, [0167]-[0168]. Baseband signal processing unit 204 includes a control unit controlling the functionality of the user terminal. *Id.*, [0173]-[0188], FIG. 16. The user terminal 20

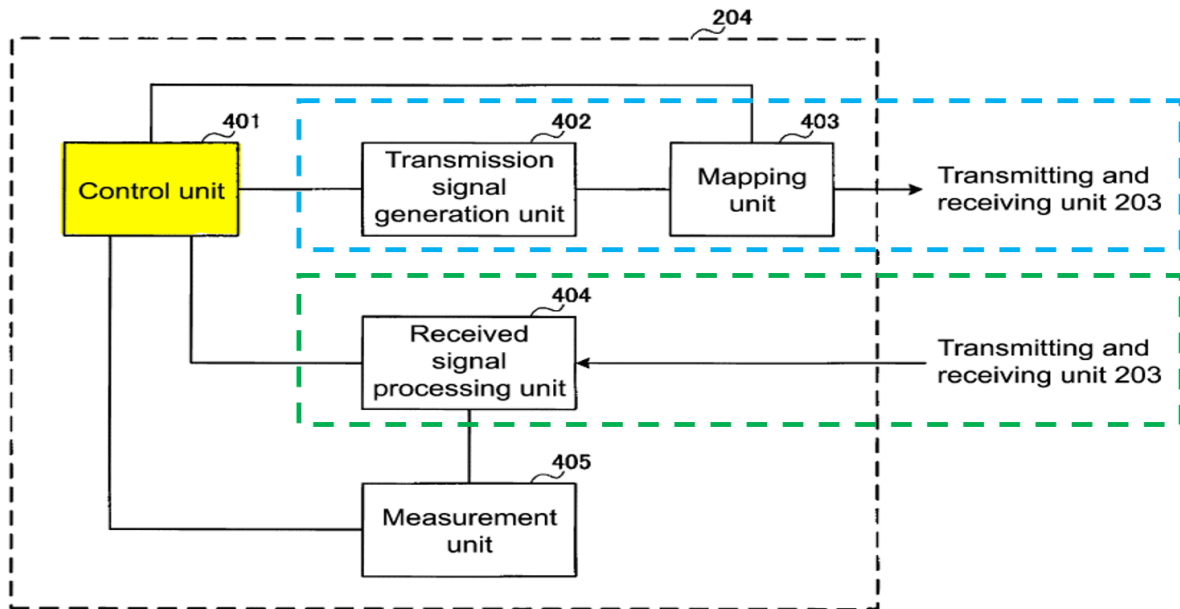
also includes transmitting/receiving units 203 (shown in green/blue) which works with the baseband signal processing unit 204 to convert and transmit signals for transmission and reception. *Id.*, [0169], [0189]-[0191]. For example, the transmitting/receiving units may receive transmit uplink signals and receive downlink signals and higher layer control information. *Id.*, [0170]-[0172]. Takeda states that “[t]he transmitting and receiving unit 203 may be a transmitter/receiver, a transceiver circuit, or a transceiver device ... The transmitting and receiving unit 203 may be configured as an integrated transmitting and receiving unit, or may be configured by a transmission unit and a reception unit.” *Id.*, [0172].

Ex. 1007, FIG. 15



79. FIG. 16, reproduced below with annotations, illustrates the functional structure of the baseband signal processing unit of the user terminal. *Id.*, [0173]. As shown, the baseband signal processing unit includes a control unit 401 (shown in yellow) that controls activation/deactivation of BWPs based on DCI and may control transmission of UL signals. *Id.*, [0174]-[0188]. Other components, including the transmission signal generation unit 402 (boxed in blue), mapping unit 403, received signal processing unit 404 (boxed in green), and measurement unit 405, all function to assist in UL transmission. *Id.*, [0189]-[0196].

Ex. 1007, FIG. 16 (annotated)



80. Takeda’s “Third Aspect,” described beginning at [0102], includes a description of “one or more UL BWPs for the user terminal and control of activation or deactivation of the one or more UL BWPs.” *Id.*, [0102].

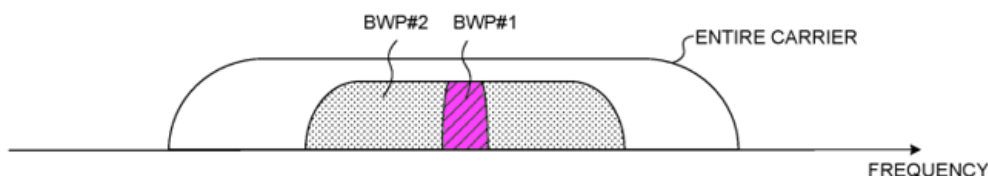
81. For configuring a user terminal for transmitting UCI on a UL BWP, the user terminal of Takeda monitors a control resource region (e.g., a control resource set (CORESET)) which encompasses “a candidate domain to which a DL control channel (for example, PDCCH: Physical Downlink Control Channel) is allocated, and receiving (detect) DCI.” *Id.*, [0006]. The user terminal monitors the CORESET based on “CORESET configuration information” that is provided through higher layer signaling. *Id.*, [0024].

82. The user terminal receives DCI from a radio base station over PDCCH that is within the CORESET. *Id.*, [0004], [0040]-[0042], [0079]-[0082], [0141]-[0143], [0149], [0158]. The user terminal may activate and/or deactivate a UL BWP based on the DCI. As an example, activation of a UL BWP may be explicit – the user terminal can activate a UL BWP “when a UL grant is detected by monitoring the CORESET of the DL BWP.” *Id.*, [0104]. The DCI may include indication information indicating activation or deactivation of the bandwidth part, as well as scheduling information. *Id.*, [0008]-[0011], [0016]-[0030], [0076], [0084], [0104]-[0105], [0107], [0112]-[0113], [0120], [0123]-[0124], [0139], [0177]-[0194]. Activation can alternatively be implicit, such as “when a DW [*sic*] BWP is activated, the UL BWP associated with the DL BWP may also be activated.” *Id.*, [0105].

83. The user terminal may transmit uplink signals in the activated BWP based on the DCI detected in the CORESET. *Id.*, [0183]-[0185]; *see also id.* Abstract, [0010], [0080]. The uplink signals transmitted by the user terminal may include UCI transmitted via a PUCCH resource configured for the UL BWP. *Id.*, [0140], [0224]. The user terminal may determine a PUCCH resource to perform transmission of a UCI based on indication information (or a grant) of a BWP in the DCI. Ex. 1007, [0080], [0140]. A radio base station is configured to receive the UCI from the user terminal. *See* Ex. 1007, [0145]-[0146], [0192]-[0196].

84. Annotated FIG. 1B of Takeda below depicts a plurality of BWPs configured in a single carrier (frequency layer) for a user terminal. *Id.*, [0015]. As can be seen in the Figure, some BWPs in a single carrier may overlap in the frequency band, such as BWP#1 (shown in pink) overlapping BWP#2. *Id.*, [0015], FIG. 1B. A BWP may be activated by the user terminal or based on signaling such as DCI. *Id.*, [0016]-[0019].

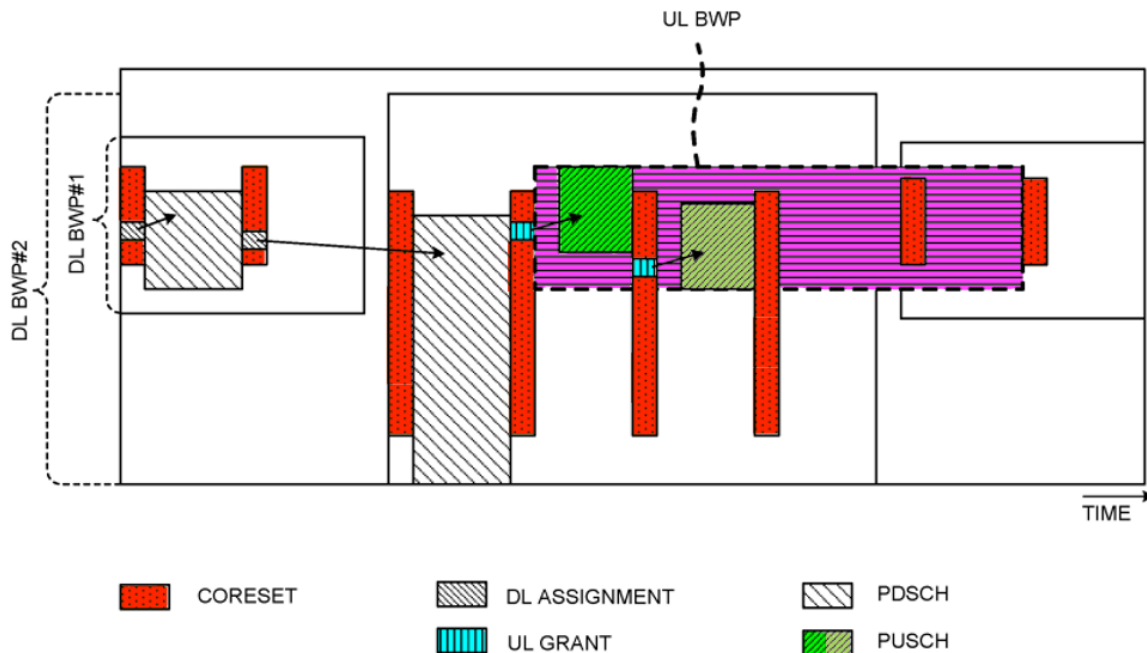
Ex. 1007, FIG. 1B (annotated)



85. FIG. 8 (reproduced with annotations below) illustrates how a user terminal can use DCI to configure a UL BWP. Annotated FIG. 8 is shown with a horizontal axis reflecting elapsed time, and a vertical axis reflecting frequency. Consistent with FIG. 1B, shown above, DL BWP#1 covers a frequency bandwidth that is entirely within the frequency bandwidth of BWP#2. As shown by the vertical positioning of the UL BWP, the UL BWP is also entirely within DL BWP#2. As shown, the user terminal monitors a CORESET (shown in red) configured in the downlink BWPs shown, the CORESET may be provided in multiple BWPs). *Id.*, [0107], FIG. 8. The user terminal receives an uplink grant as a part of the DCI transmitted via a downlink channel within the CORESET (i.e., DCI in a PDCCH resource set) in the CORESET (shown the uplink grant is shown in blue). Based on the grant, the UE determines an uplink BWP (shown in pink) and a scheduled UL resource of a plurality of UL resources that are available for transmission (shown in green). *Id.*, [0107]; *see also id.*, [0120], [0177]. As shown, the UL resources may encompass different time resources and may encompass different resource blocks that may have different frequencies (as reflected by the first UL transmission being higher than the second UL transmission within the UL BWP) and/or different timing (as reflected by the second UL transmission being chronologically after the first UL transmission). Takeda's FIG. 8 illustrates a plurality of PUSCHs within a single BWP, which can be collectively described as

a UL channel set encompassing all of the PUSCHs within the single BWP illustrated in annotated FIG. 8. *See id.*, FIG. 8. Takeda discloses that the illustrated PUSCHs can transmit UCI, or PUCCHs can be used for transmission in the same way as the PUSCHs of FIG. 8. *See e.g., id.*, FIG. 10, [0139]-[0140] (“Uplink control information (UCI) ... is transmitted by the PUSCH or the PUCCH”). The user terminal activates the uplink BWP and transmits the PUSCH scheduled in the uplink BWP based on an uplink grant detected in the CORESET. *Id.*, [0107]; *see also id.*, [0004], [0140].

Ex. 1007, FIG. 8 (annotated)



B. U.S. Patent No. 10,736,085 to Yan (Ex. 1010)

86. Yan is a U.S. Patent issued from application no. 15/890,915, which is a continuation of PCT application no. PCT/CN2015/086763, filed on August 12, 2015. Ex. 1010, 1. The content of Yan is substantially identical to the PCT application, the publication of which I understand is provided as Ex. 1008. *See* Ex. 1008. I understand that a certified translation of the Chinese PCT application has been attached as Ex. 1009. *See* Ex. 1009. Yan was not cited and was not considered during prosecution.

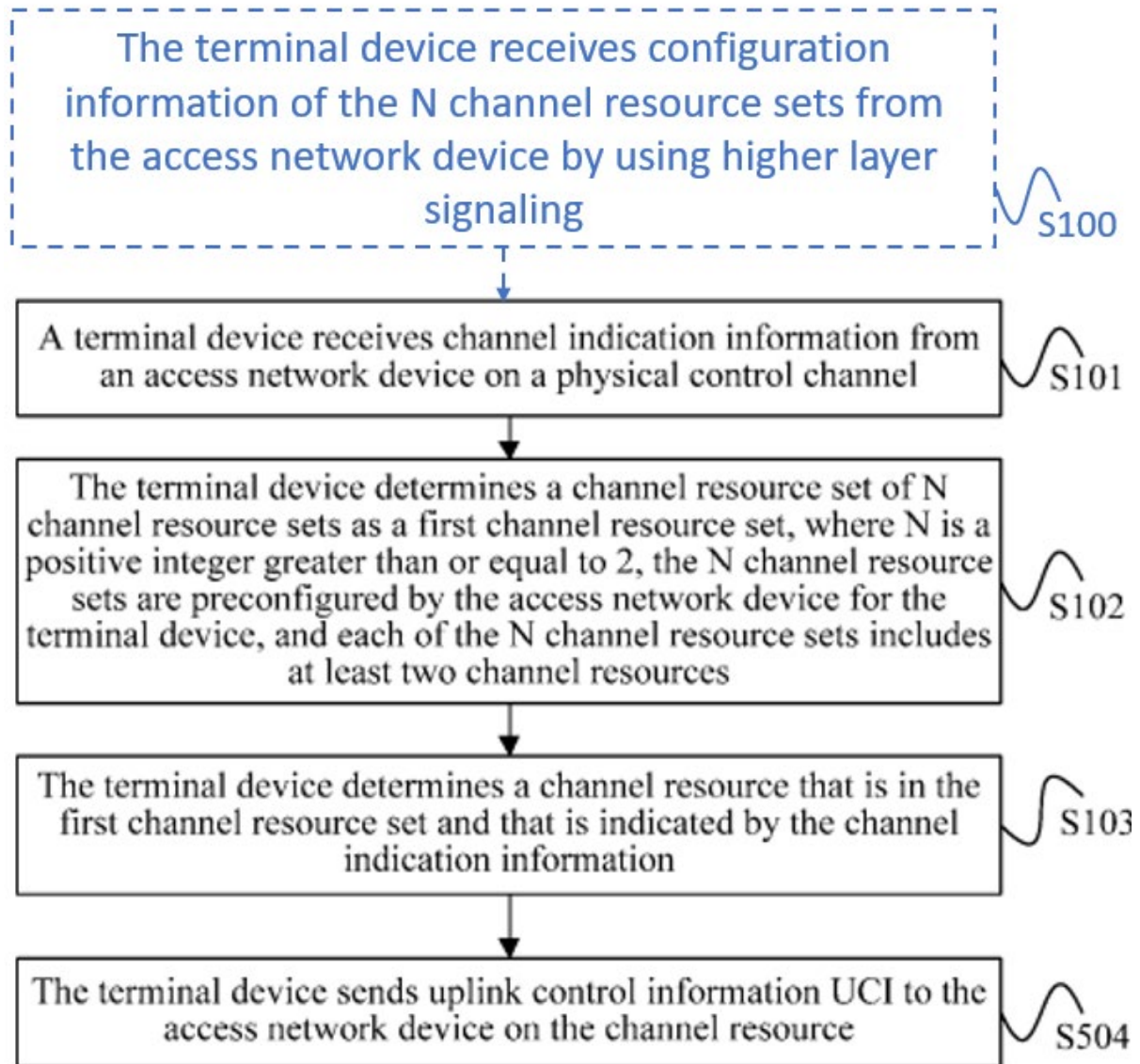
87. Yan is directed to “uplink control information sending” and “uplink control information receiving.” Ex. 1010, Abstract; Ex. 1009, Abstract; *see also id.*, 1:16-19, 2:10-16; Ex. 1009, 1:4-7, 2:13-15. Annotated FIG. 1 of Yan shows an example operation of an uplink control sending method that includes selection of a control channel resource set identified within configuration information and transmitting a UL signal on a determined UL channel within the selected control channel resource set. Ex. 1010, 10:15-17, 11:7-9; Ex. 1009, 13:18-19; 14:30-31. I added the new blue “S100” step in annotated FIG. 1 of Yan, below to reflect Yan’s statement that “[b]efore the receiving, by a terminal device, channel indication information from an access network device on a physical control channel, the method further includes: receiving, by the terminal device, configuration information of the N channel resource sets from the access network device by

using higher layer signaling,” so the user terminal may determine a channel resource set in step S102. Ex. 1010, 3:42-46, 4:16-20, 9:49-55, 12:34-45, 19:5-26, 21:36-48, 24:47-54; Ex. 1009, 4:14-16, 5:9-11, 12:27-31, 16:27-17:2, 25:20-26:1, 28:31-29:8, 33:11-15. I made a similar addition to annotated FIG. 4 (below) to reflect this same disclosure. This information would be sent via RRC signaling – a type of higher level signaling commonly known for configuring UL information. Although this “configuration information” is shown as received “before the receiving, by a terminal device, channel indication information from an access network device,” a POSITA would recognize that this configuration information could be received in RRC signaling simultaneously with the “channel indication information.”

88. As shown in step S101 of annotated Figure 1, the terminal device may receive channel indication information from an access network on a physical control channel, including a PDCCH and an enhanced physical downlink control channel (EPD-CCH). Ex. 1010, 11:17-47; Ex. 1009, 15:5-24. As shown in step S102, the terminal device determines a channel resource set with at least two channel resources. Ex. 1010, 11:48-54, 20:1-47, 22:7-25; Ex. 1009, 15:25-28, 26:28-27:23, 29:24-30:5. As shown in step S103, the terminal device determines a channel resource in the determined channel resource set. Ex. 1010, 2:22-30, 11:48-12:24, 20:1-11, 20:27-42, 22:7-25, 25:17-64, 26:47-67; Ex. 1009, 2:19-24, 15:25-

16:20, 26:28-27:4, 27:13-23, 29:24-30:5, 34:3-35:1, 36:2-14. As shown in step S104, the terminal device transmits UCI on the determined channel resource. Ex. 1010, 2:31-33, 12:25-55, 20:43-50, 22:42-50, 25:65-26:11, 26:65-67; Ex. 1009, 2:25-26, 16:21-17:9, 27:24-28, 30:17-22, 35:2-10, 36:12-14. The channel resource set is determined to match a size of the UCI to be transmitted. Ex. 1010, 3:1-3, 11:64-12:4; Ex. 1009, 3:18-19, 16:3-8.

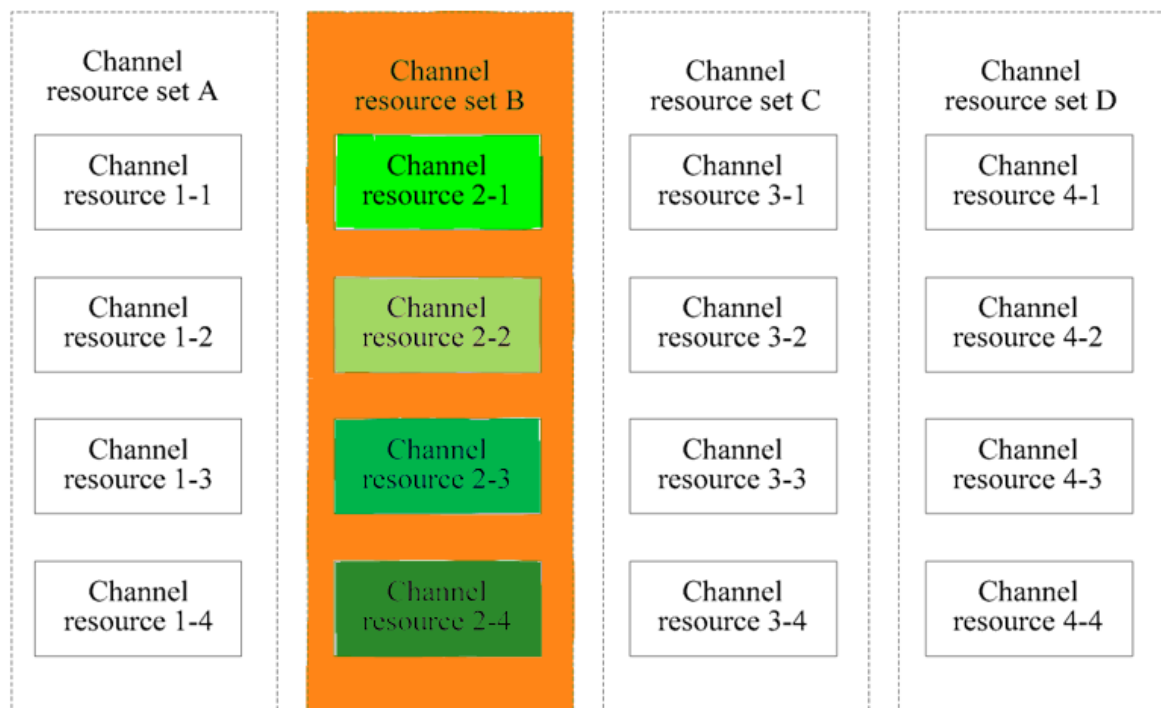
Ex. 1010, FIG. 1 (annotated)



89. Annotated FIG. 3 of Yan illustrates a plurality of channel resource sets and a plurality of channel resources in each set. Ex. 1010, 14:36-46, 15:6-9, 15:60-16:17; Ex. 1009, 19:21-27, 20:14-15, 21:16-31. Yan states that the network device sends configuration information to the terminal device, the configuration

information including capacity ranges corresponding to each of the channel resource sets. Ex. 1010, 15:9-25; Ex. 1009, 20:15-24. Yan explains that a channel resource set may be selected based on a size of the UCI as measured by quantity of bits of the UCI or amount of the UCI. Ex. 1010, 15:25-32; Ex. 1009, 20:20-24. The channel indication information received by the terminal device indicates the channel resources included in the channel resource sets. Ex. 1010, 15:60-16:17; Ex. 1009, 21:16-31. In one example, a terminal device may determine channel resource set B (shown in orange) and channel resource 2-2 (shown in green) of channel resource set B for performing transmission of a UCI. Ex. 1010, 16:18-23; Ex. 1009, 22:1-4.

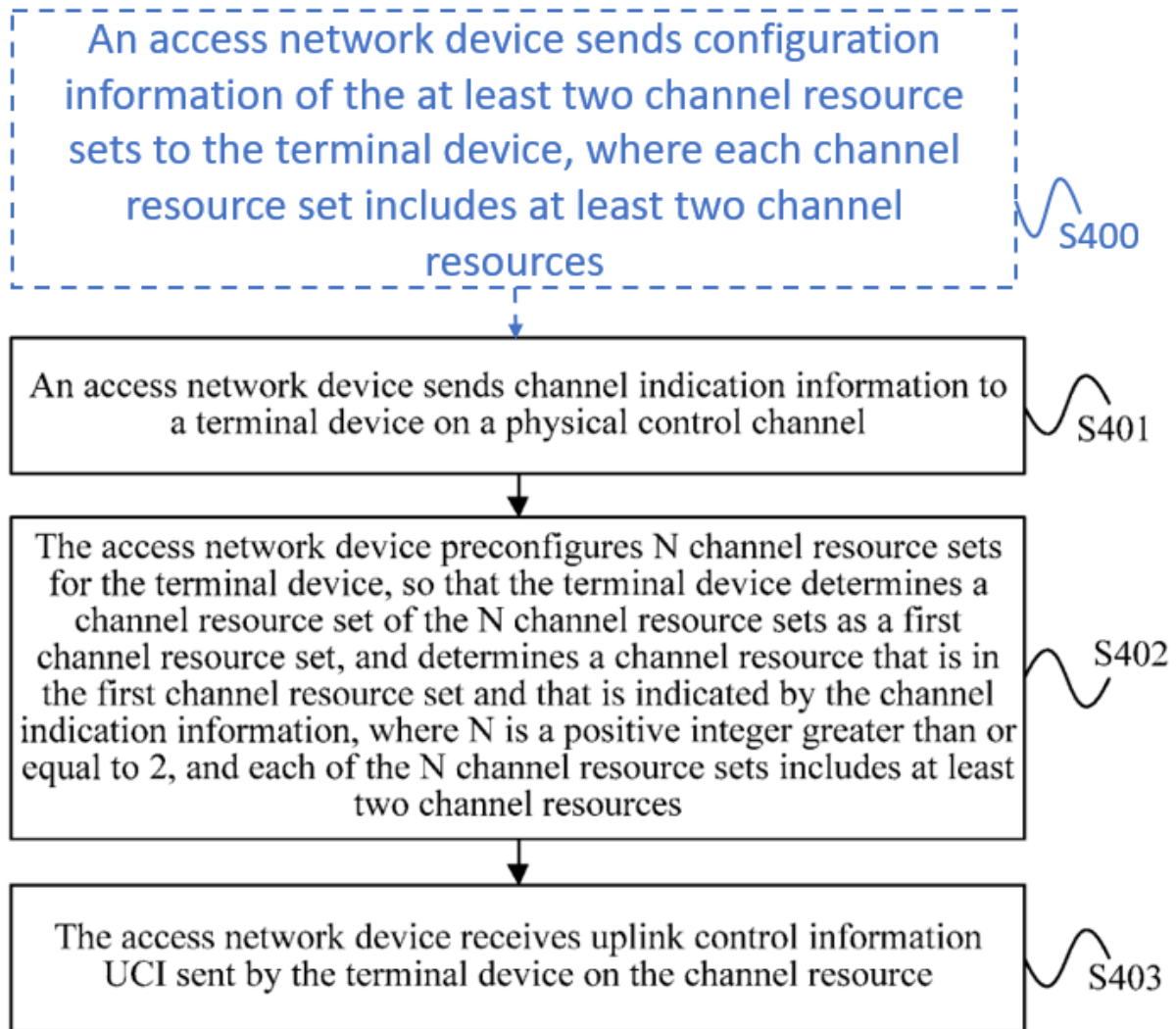
Ex. 1010, FIG. 3 (annotated)



90. FIG. 4 of Yan (reproduced with annotations below) shows an example operation of an access network device providing configuration information to a UE, and receiving UCI transmitted from the UE in accordance with the provided configuration information. Ex. 1010, 10:22-24, 19:27-36; Ex. 1009, 13:24-25, 26:2-7. I annotated FIG. 4 in the same way that I annotated FIG. 1 of Yan, discussed above, to illustrate Yan’s disclosure that “the access network device sends configuration information of the at least two channel resource sets to the terminal device” in the added blue “S400” step, before the access network device sends channel indication information to a terminal device on a physical control

channel, as shown in S401. Ex. 1010, 20:51-55; Ex. 1009, 27:29-31. As shown in step S401 of annotated FIG. 4, the terminal device may receive channel indication information from an access network device on a physical control channel. Ex. 1010, 19:37-39; Ex. 1009, 26:8-9. The access network device of Yan sends configuration information of a plurality of channel resource sets to a user terminal by using higher layer signaling, as shown in step S402 of annotated FIG. 4. Ex. 1010, 20:1-9, 20:51-55; Ex. 1009, 26:28-27:2, 27:29-31. As shown in step S403, the access network device receives UCI from a channel resource determined by the terminal device. Ex. 1010, 20:43-45; Ex. 1009, 27:24-25. The channel resource on which the UCI is received is in the determined channel resource set and indicated by the channel indication information. Ex. 1010, 20:1-42; Ex. 1009, 26:28-27:23.

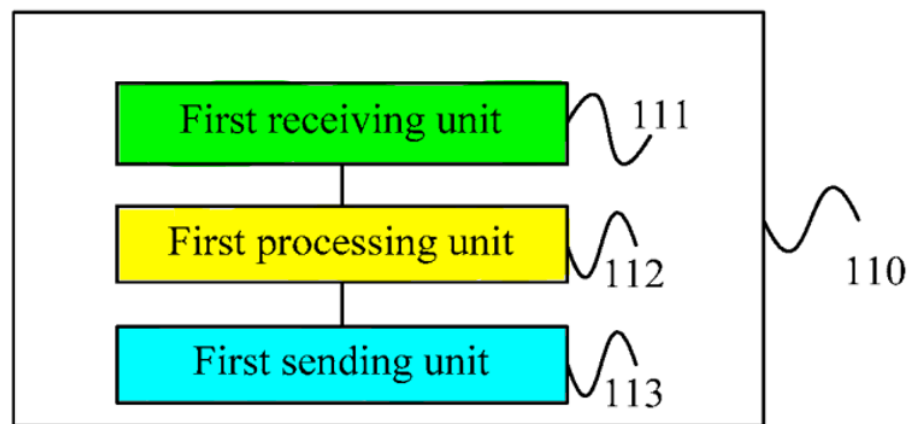
Ex. 1010, FIG. 4 (annotated)



91. Annotated FIG. 11 of Yan illustrates a structural diagram of a terminal device 110. Ex. 1010, 26:47-67; Ex. 1009, 36:2-14. The terminal device 110 includes a first receiving unit 111 (shown in green) which is configured to receive channel indication information from an access network device on a physical control channel. Ex. 1010, 26:52-56; Ex. 1009, 36:5-8. The terminal device 110

further includes a first processing unit 112 (shown in yellow) configured to determine a channel resource set and a channel resource in the determined channel resource set which is indicated by the channel indication information. Ex. 1010, 26:56-65; Ex. 1009, 36:8-13. The first receiving unit 111 is also configured to receive configuration information of a plurality of channel resource sets including the determined channel resource set using higher layer signaling. Ex. 1010, 27:62-67; Ex. 1009, 37:24-27. The first processing unit 112 may determine the channel resource set based on a size of an UCI to be transmitted. Ex. 1010, 27:26-45; Ex. 1009, 36:31-37:12. The terminal device further includes a first sending unit 113 (shown in blue) configured to send UCI to the access network device on the determined channel resource. Ex. 1010, 26:65-67; Ex. 1009, 36:13-14.

Ex. 1010, FIG. 11 (annotated)



C. U.S. Patent Publ. No. 2014/0056278 to Marinier (Ex. 1011)

92. Marinier is pre-issuance publication of U.S. patent application no. 13/974,911 (now U.S. Patent No. 9,699,779), filed August 23, 2013 and published on February 27, 2014. Ex. 1011, Cover. Marinier was not cited and was not considered during prosecution.

93. Marinier discloses “providing physical layer resources to a plurality of medium access control (MAC) instances that are associated with different serving sites that are independently scheduled.” *Id.*, Abstract. A wireless transmit/receive unit (WTRU) of Marinier is a user equipment configured to transmit UCI in UL signals. *Id.*, [0002]-[0008], [0020], [0062]-[0064], [0076], [0078], [0084], [0088], [0093], [0101]-[0105], [0113]-[0117], [0129]-[0144], [0204]-[0215], FIG. 1. The WTRU uses transmission parameters that are provided by a serving site (e.g., via RRC signaling) when transmitting to a serving site. *Id.*, [0084], [0098], [0101], [0103], [0110], [0111], [0134], [0181], [0185]-[0186], [0188]-[0194]. As an example, “the WTRU may receive one or more parameters (e.g., and/or one or more sets of parameters) as semi-static configuration (e.g., for a configured grant such as a semi-persistent scheduling (SPS) grant, a configuration of alternative parameters, an RRC configuration of parameters, etc.).” *Id.*, [0181].

94. Marinier explains that the parameters may include power control parameters, set of virtual cell IDs, dedicated PUCCH resources, etc. *Id.*, [0103].

The WTRU is described as configured to transmit using one of different sets of UL transmission parameters (including dedicated PUCCH resources). *Id.* For example, “the WTRU may be configured to operate using multiple sets of transmission parameters and may select one or more appropriate set(s) of transmission parameters to use in a given subframe based on various criteria.” *Id.*, [0181].

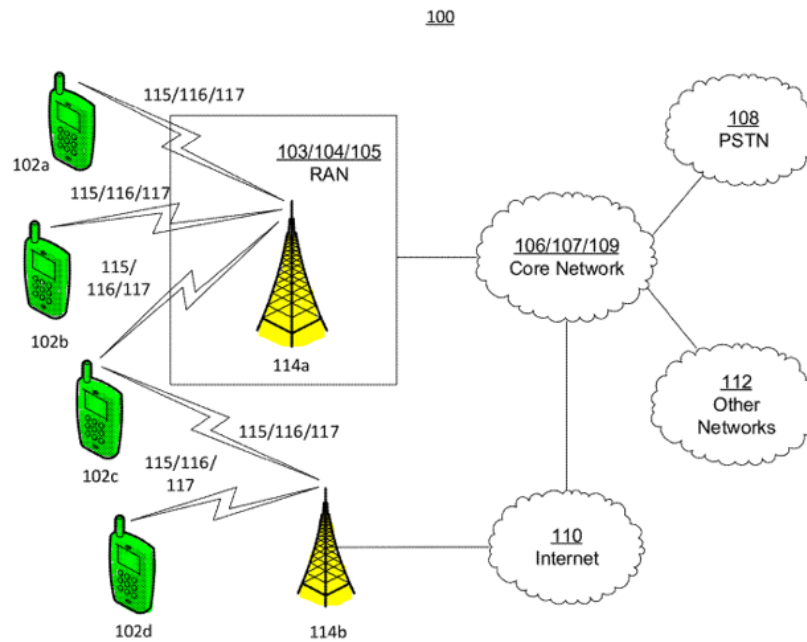
95. The WTRU receives uplink grants (e.g., via DCI) directing the WTRU to transmit over an uplink channel and allocating resources to the WTRU in the frequency and/or time domains. *Id.*, [0062]-[0064], [0070], [0098], [0101], [0103], [0107], [0108], [0171], [0181]-[0190], [0257], [0261]-[0262]. The WTRU determines a set of parameters which are configured by a serving site and are indicated via downlink control signaling (such as a PDCCH transmission with the uplink grant) or RRC signaling. *Id.*, [0062]-[0064], [0070], [0098], [0101], [0103], [0107], [0108], [0171], [0181], [0185]-[0194], [0261]-[0262].

96. A WTRU may begin determining sets of parameters to use for transmission based on DCI contents. *Id.*, [0185], [0189]-[0190], [0261]-[0262]. For example, the “DCI may indicate multiple values for one or more transmission parameters (e.g., an MCS, a redundancy version, a total number of allocated PRBs, a number of coded symbols for control information, a transport block size, etc.), and the WTRU may select which of the values should be applied based on whether the WTRU is concurrently transmitting to another serving site in the same

subframe as the PUSCH transmission.” *Id.*, [0185]. Furthermore, the WTRU is configured with a subset of subframes for each serving site. *Id.*, [0103]. The WTRU may determine which parameters to apply based on the subframe for which the uplink transmission is to occur and perform transmission on the determined subframe. *Id.*, [0097], [0101]-[0107], [0181], [0185]-[0186]. Bandwidth parts may be used for transmissions between the WTRU and the serving site, including WTRU-specific bandwidth parts. *Id.*, [0130], [0147].

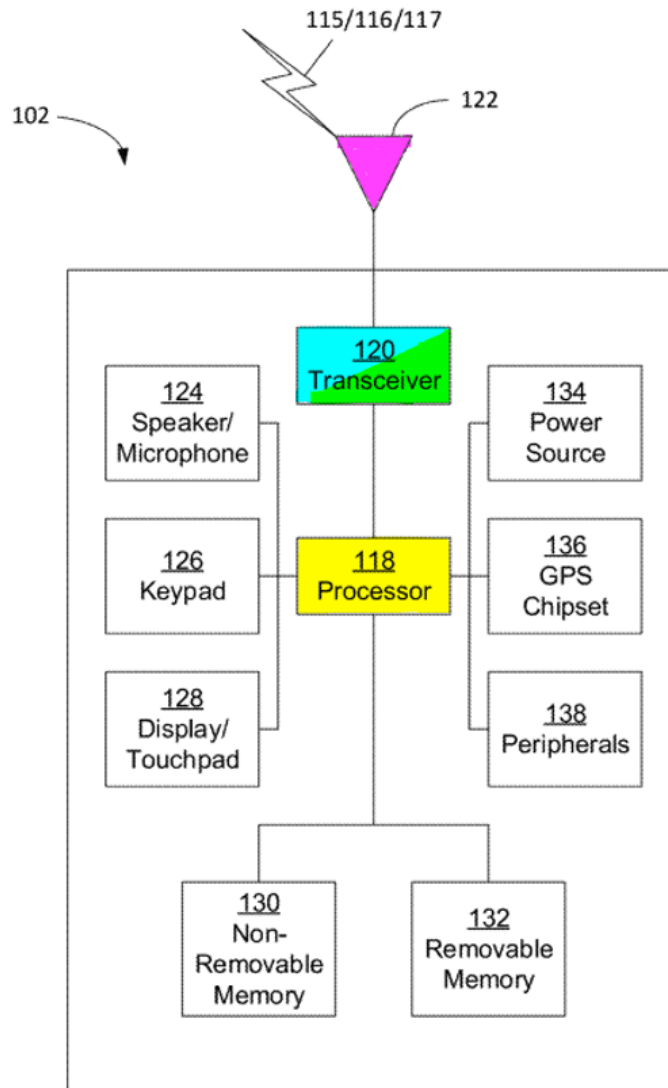
97. As shown in annotated FIG. 1A below, Marinier includes a plurality of WTRUs which each may be a “user equipment (UE)” (shown in green). *Id.*, [0020]. The WTRU may be connected to base station 114a and/or base station 114b (shown in yellow), which is also referred to as a “scheduling site” or “serving site”. *Id.*, [0021], [0031], [0071], [0073].

Ex. 1011, FIG. 1A (annotated)



98. Annotated FIG. 1B of Marinier illustrates a system diagram of a WTRU. *Id.*, [0031]. The WTRU includes a processor (shown in yellow) which may be used to control the functionality of the WTRU *Id.*, [0031]-[0039]. The processor may be coupled to a transceiver 120 (shown in blue/green) which can modulate signals to be transmitted and demodulate signals that are received. *Id.*, [0031]-[0035]. Additionally, the transceiver 120 may be coupled to a transmit/receive element 122 (shown in pink) which transmits signals to and receives signals from a base station. *Id.*

Ex. 1011, FIG. 1B



99. The base stations 114a and 114b are configured to transmit and receive wireless signals. *Id.*, [0022], [0072], [0101]. WTRUs receive UL grants from these base stations as a part of PDCCH and transmit UCI (e.g., HARQ feedback, channel state information (CSI) such as channel quality indicator (CQI), precoding matrix indicator (PMI), rank indicator (RI), Scheduling Request (SR),

etc. (*Id.*, [0078])) to the base stations via PUCCH that are identified from the received grant using assigned transmission parameters. *Id.*, [0062]-[0064], [0070], [0098], [0101]-[0108], [0171], [0181], [0185]-[0186], [0189], [0261]-[0262].

Multiple WTRUs may access the same base station and a WTRU may communicate with more than one base station using, for example, FDMA. *Id.*, [0019], [0023]-[0024].

100. Marinier explains that a WTRU may be configured with multiple frequency subbands, also referred to as “BW parts.” *Id.*, [0130]. “Each serving site may be configured to utilize one or more of the BW parts for communicating with the WTRU” and “each BW part may be treated as a component carrier in carrier aggregation.” *Id.* Marinier explicitly states that “each BW part may include corresponding PUCCH and PUSCH resources.” *Id.* Marinier explains that depending on which BW part is activated (i.e., used for transmission), the power utilized by the WTRU may differ. *Id.*, [0132]. When a WTRU is to transmit multiple PUCCH transmissions simultaneously, the WTRU may rely on priority rankings (e.g., a type of parameter) provided to the WTRU in higher level, Level 3 signaling (e.g., RRC signaling) to determine how to prioritize those PUCCH transmissions, given limited transmission resources of the WTRU. *Id.*, [0169]. So a WTRU of Marinier activates a BW part utilized for transmission depending on

which PUCCH resource is to be used for transmission (based on a UL grant in DCI received from a serving site).

D. R1-1711853 (“R1-1711853”) (Ex. 1012)

101. 3GPP R1-1711853 is a technical contribution submitted to the 3GPP TSG RAN WG1, NR AH 1706 meeting that was held between June 27-30, 2017. Ex. 1017, 30-33. I understand that R1-1711853 was made publicly available on June 29, 2017. *Id.*

102. R1-1711853 discloses that activation and deactivation of DL/UL bandwidth parts may be “by means of DCI (explicitly and/or implicitly).” Ex. 1012. R1-1711853 states that an explicit indication means that the indication in the DCI triggers activation or deactivation of the DL/UL bandwidth part. *Id.* R1-1711853 further states that an implicit indication means that the presence of the DCI in itself triggers activation or deactivation of the DL/UL bandwidth part. *Id.*

XI. OPINIONS

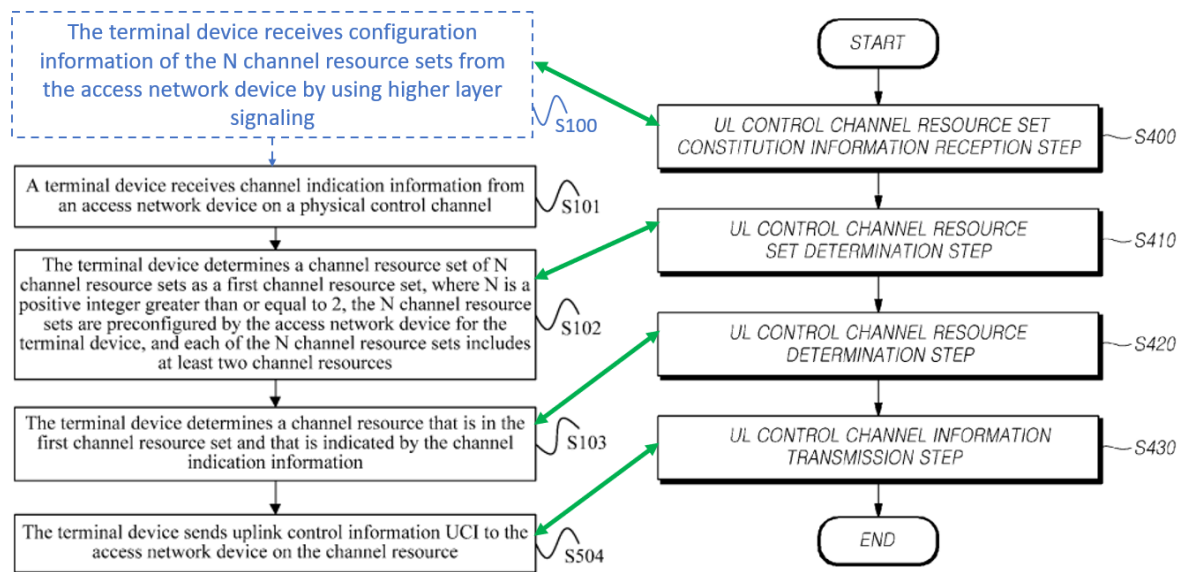
103. The ’463 Patent includes 9 claims, of which Claims 1, 4, and 7 are independent. Claims 1, 4, and 7 are similar – Claim 1 is directed to a method of transmitting uplink (UL) control information by a user equipment and Claim 7 is directed to a user equipment for transmitting UL control information; Claim 4 is directed to a method of receiving UL control information by a base station. The limitations in each of these claims are substantively identical.

A. Ground 1: Claims 1-9 are rendered obvious by Takeda and Yan

104. Takeda and Yan teaches all of the limitations of Claims 1-9. As discussed in the *Prosecution History*, the elements that were indicated as allowable by the Examiner were “wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,” and “wherein the each UL BWP is activated through downlink (DL) control information.” Ex. 1004, 44-53, 69-71; *see supra*, §IX.A. These elements involve 5G BWPs, and the remaining elements of the independent claims were previously well known in 4G. Takeda teaches all of the elements of the independent claims, including allegedly patentable elements related to BWPs. Since Takeda relates to 5G technology, the 4G elements of the claims are also taught by Takeda at least because UL resource allocation methods in 5G incorporate those in 4G. To the extent it is argued that any elements are not explicitly taught by Takeda and/or such elements were not well known to the POSITA, Takeda in view of Yan teaches all of the limitations of Claims 1-9 and, for the reasons outlined below, the POSITA would have combined Takeda and Yan. Limitations 1[a]-1[d] of the ’463 Patent map directly to FIG. 4 of the ’463 Patent. S400 states that “a UE receives, from a BS, UL control channel resource set configuration information;” S410 states that “when the UL control channel resource sets to transmit the UL control information are determined, the UE may determine one of the UL control channel

resource sets according to the size of the UL control information;” S420 states that “the UE determines one of UL control channel resources contained in the determined one UL control channel resource set;” and S430 states that “[t]he UE transmits the UL control information through the determined the [sic] UL control channel resource.” Ex. 1001, 14:33-16:52. I have provided a side-by-side comparison of the annotated version of Yan’s FIG. 1 against FIG. 4 of the ’463 Patent.

Ex. 1001, FIG. 4; Ex. 1010, FIG. 1 (annotated)



1. Motivation to Combine

105. A POSITA would have been motivated to modify Takeda with the teachings of Yan to provide Takeda with backwards network compatibility and to incorporate Yan’s methods for conserving UE power by strategically allocating UL

channel resources into Takeda's methods for transmitting UL signals within BWPs.

106. 5G NR was being implemented prior to priority date of the '463 Patent while 4G LTE remained in use. Because these two networks were in simultaneous use, a POSITA would have recognized benefits for 5G-capable UEs to continue to connect with 4G LTE BSs. In fact, Takeda states that its teachings are applicable to both 4G and 5G. Ex. 1007, [0239]; Ex. 1034, 10; (a "UE may be simultaneously connected to LTE and NR" for non-standalone (NSA) operation); Ex. 1033, 5:23-31 (a wireless communication network may include base stations of different communication technologies including "5G (New Radio or 'NR'), fourth generation (4G)/LTE, 3G, Wi-Fi, Bluetooth, etc."); Ex. 1037, 31 (specifying that a "5G NR UE" should support NSA LTE and NR). A POSITA would know that dual network connectivity requires "increased integration between different RATs, with a typical 5G-enabled device having radios capable of supporting not only a potentially new 5G standard" but also "numerous releases of 4G LTE." Ex. 1031, pg. 3. Furthermore, "[a] common understanding is that the 5G RAN should allow integrating Long Term Evolution-Advanced (LTE-A) evolution and novel 5G radio on the RAN level." Ex. 1035, 1. Likewise, it would have been beneficial to allow a 5G non-standalone operation mode to reuse 4G principles of resource allocation for UL transmission from a UE having 4G LTE, but not 5G NR

capabilities. *See* Ex. 1035, 1 (proposing “a tight integration of LTE and the new 5G air interface to fulfill the 5G requirements, aiming for simultaneous multi-connectivity in order to enable faster mobility and ***common resource management***”), 5. To facilitate such backwards compatibility, a POSITA would recognize efficiencies in designing and implementing Yan’s resource allocation methodology of allocating UL channel resource sets (encompassing the steps discussed in reference to Yan’s FIG. 4) with Takeda’s 5G NR BWPs. By using the same resource allocation methodology in both 4G LTE and 5G NR, UEs and BSs do not need distinct protocols for connecting to each network type. Resource allocation methods can then be used in both 4G LTE and 5G NR, as networks transition from 4G LTE to 5G NR Stand Alone.

107. Moreover, from the UE perspective, a POSITA would have been motivated to modify Takeda’s method for transmitting UL signals to incorporate Yan’s resource allocation method to more efficiently use UE power reserves. Using Yan’s resource allocation method would further Takeda’s stated goal of reducing UE power consumption when transmitting UL signals. Ex. 1007, [0013]. Specifically, Yan discusses that the capacity of UL channels specified by a BS may be underutilized, or UCI bits may be discarded if the size of the UL channel does not match the size of UCI. Ex. 1010, 2:1-6; Ex. 1009, 2:7-10. In other words, some UL transmissions are inefficient and may use more power than necessary (for some

transmissions) to transmit UCI from a UE. This mismatch of UL channel resource allocation and UCI size is a risk in transmissions in BWPs of 5G (as disclosed in Takeda), where UCI is transmitted in resources within individual BWPs. At least in part because Yan and Takeda discuss efficient use of resources for DL and UL transmission, a POSITA would be motivated to utilize the UL resource allocation methods of Yan (including allocating UL channels to UEs for specific BWPs within “sets” that are configured for different sizes or types of UL transmissions and determining an individual resource for UL transmission from downlink control information provided from the BS on PDCCH) with 5G BWP configurations as disclosed in Takeda to efficiently utilize UL resources. Yan’s resource allocation methodologies can be applied to the UL BWPs of Takeda such that UCI bits are not discarded in ULs, and would minimize UL resource consumption by UEs during UL transmission. Ex. 1010, 2:1-6; Ex. 1009, 2:7-10. Yan’s method of allocating UL channel resources into sets would be implemented with Takeda’s configuration of BWPs and activation of BWPs through DCI to take advantage of the power efficiencies provided by Yan.

108. It should be noted that a POSITA would have been equally motivated to modify Yan with Takeda. Specifically, a POSITA would have recognized benefits of incorporating Takeda’s 5G BWP capabilities into Yan’s method for allocating UL resources. Yan’s UL resource allocation method provides flexibility

for UEs to select a UL resource for transmitting UCI based on the predicted size of the UCI. Providing this functionality within BWPs, as disclosed in Takeda, would allow determination of how UEs transmit UL signals to BSs in 5G. Moreover, Takeda discusses that transmitting in BWPs instead of the entire channel provides power use efficiencies. Ex. 1007, [0013]. Because Yan and Takeda both discuss methods for efficient UL transmissions, a POSITA would have been motivated to use the UL resource allocation methods of Yan with 5G BWP configurations (as discussed in Takeda) to further Yan's goal of power-efficient UL signaling.

109. A POSITA would have had a reasonable expectation of success in combining Takeda and Yan because both references discuss UCI transmission and configuring channel resources within the time and frequency domains for UL transmission. *See e.g.*, Ex. 1007, [0001]-[0010], [0102]-[0114], FIG. 8-9; Ex. 1010, 1:16-19, 11:7-16, 12:34-41, 21:43-57; Ex. 1009, 1:5-7, 14:30-15:4, 16:27-31, 29:5-14. Indeed, as evidenced by the secondary considerations outlined below in Section C, others had combined the technologies of Takeda and Yan for the reasons outlined herein confirming that a POSITA would have had a motivation to combine and a reasonable expectation of success in doing so.

110. Yan discusses channel resource configuration for 4G LTE and Takeda discusses channel resource allocation within BWPs of 5G NR and activation of BWPs for UL transmission based on DCI. *See e.g.*, Ex. 1010, 1:23-38; Ex. 1009,

1:10-13; Ex. 1007, [0001]-[0010]. However, a POSITA would recognize that 5G NR BWPs still require resource allocation of PUCCH/PUSCH resources, and that 4G LTE resource allocation processes (as discussed in Yan) would have been a viable method for resource allocation for 5G NR BWPs.

111. Both Yan and Takeda discuss UL transmission in the frequency domain, and allocation of individual UL channel resources. Yan describes that the resources allocated for UL transmission are within individual carriers in the frequency domain. Ex. 1010, 11:20-35, 17:23-46, Ex. 1009, 15:7-16, 23:14-28. Takeda explains that 5G NR allocates a carrier “having a bandwidth [] wider than that of than existing LTE systems” (Ex. 1007, [0013] (parentheticals omitted)) and so Takeda discusses “semi-statically configuring [] one or more frequency bands within the carrier in user terminals” for resource allocation and that “[e]ach frequency band in the carrier is also referred to as a bandwidth part (BWP: Bandwidth Part).” *Id.* A POSITA would recognize that both Takeda’s 5G NR system and Yan’s 4G LTE systems allocate resources on the frequency domain for uplink transmission. While the BWPs of Takeda add another degree of freedom for allocating UL resources as compared to Yan, both systems send the UCI in the frequency domain using the allocated resources.

112. Moreover, Takeda and Yan both disclose that a UE transmits UCI on a channel resource (e.g., PUCCH or PUSCH) that is determined from information

transmitted to the UE from the BS. *See e.g.*, Ex. 1007, [0107] (“the user terminal monitors the CORESET configured in the activated DL BWP at a predetermined period. The user terminal activates the UL BWP, based on the UL grant detected in the CORESET. The user terminal transmits the PUSCH scheduled in the UL BWP based on the UL grant”), [0140], [0220] (UCI is transmitted on either PUSCH or PUCCH and the discussions of PUSCH and/or PUCCH are interchangeable); Ex. 1010, 12:34-55 (“The terminal device first determines the first channel resource set of the multiple channel resource sets, and then determines the channel resource in the first channel resource set according to the channel indication information”); Ex. 1009, 16:27-17:9. Therefore, a POSITA would have recognized that the teachings of Yan and Takeda are relevant to each other and, thus, there would have been a reasonable expectation of success in combining them.

2. Independent Claim 1

a. Element 1[pre]: A method of transmitting uplink (UL) control information by a user equipment, the method comprising:

113. Takeda teaches the preamble of Claim 1, to the extent it is determined to be limiting.

114. Takeda describes its technology as applicable to New Radio (NR) (which is known colloquially as “5G”) for downlink and uplink transmissions. Ex. 1007, [0006]-[0009]. Takeda describes a user terminal that includes, among other

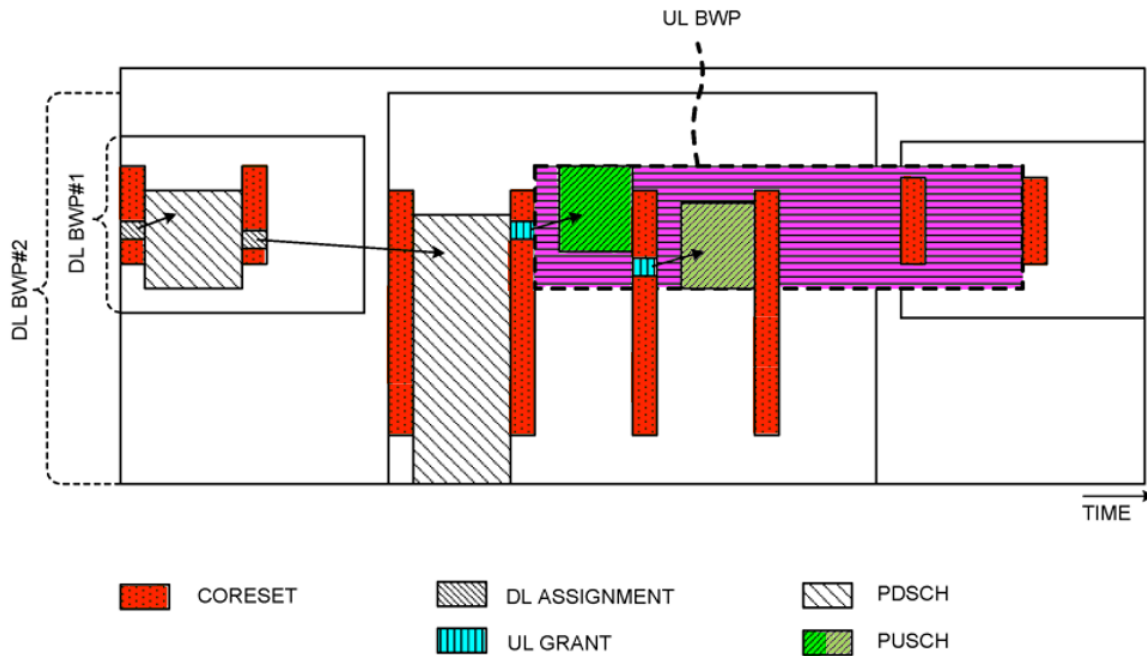
components, “a control unit which controls the transmission of an UL signal in an uplink (UL) frequency band within the carrier, on the basis of the DCI.” *Id.*

Abstract, [0010]. The user terminal with the control unit, “controls transmission of a UL data channel (for example, also referred to as PUSCH: Physical Uplink Shared Channel, UL shared channel, and the like).” *Id.*, [0004], *see also id.*, [0140]

(“***Uplink control information (UCI)*** including at least one of transmission confirmation information (A/N, HARQ-ACK) for the PDSCH, channel state information (CSI), and the like of the PDSCH is ***transmitted on the PUSCH or the PUCCH***); [0149] (“the transmitting and receiving unit 103 receives a UL signal (for example, at least one of a ***UL control signal*** (also referred to as a UL control channel, UCI, or the like), and a reference signal”). As another example, “[w]hen the user terminal succeeds in detecting the DCI for activation, the user terminal may transmit ACK (Acknowledge) to the wireless base station.” *Id.*, [0080].

Takeda’s FIG. 8 illustrates transmission of a PUSCH scheduled in a UL BWP, as shown with annotations highlighting the UL transmissions (in two shades of green) below.

Ex. 1007, FIG. 8 (annotated)

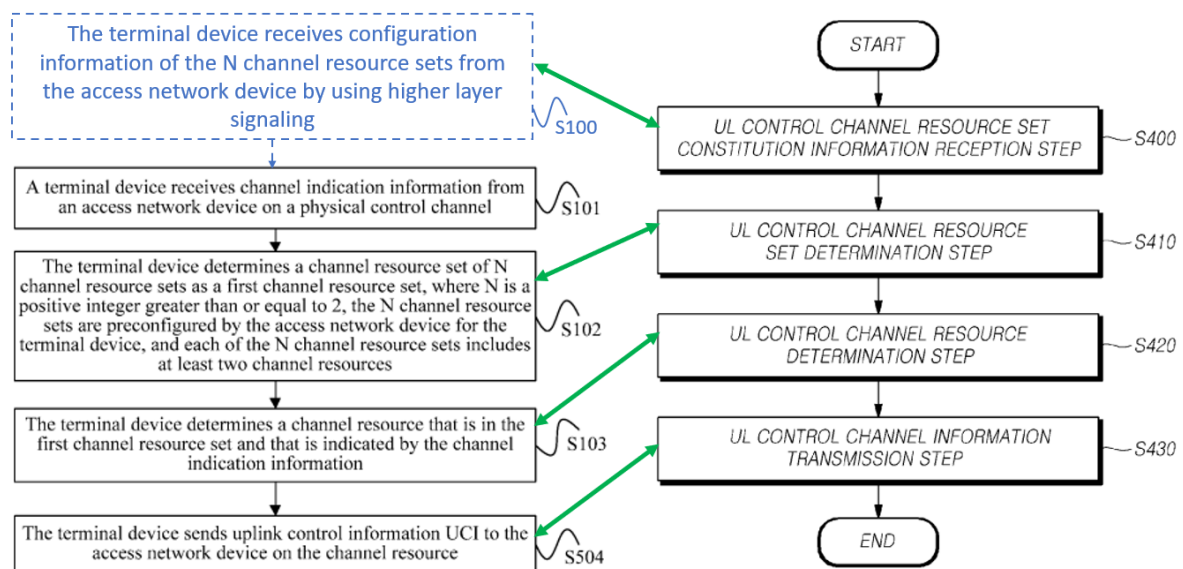


115. Moreover, Yan discloses a method of transmitting UL control information by a UE. For example, “[e]mbodiments of the present invention provide an *uplink control information sending method*.” Ex. 1010, Abstract; Ex. 1009, Abstract; *see also* Ex. 1010, FIG. 1, 1:16-19 (“[a] first aspect provides an *uplink control information sending method*”), 2:10-16; Ex. 1009, FIG. 1, 1:4-7, 2:13-15. For the reasons described above in the section entitled *motivation to combine*, the POSITA would have implemented the resource allocation methods of Yan with the BWP configurations of Takeda.

116. The first four limitations of Claim 1 of the ’463 patent map directly to FIG. 4 of the ’463 patent *and* to annotated FIG. 1 of Yan. S400 states that “a UE

receives, from a BS, UL control channel resource set configuration information;” S410 states that “when the UL control channel resource sets to transmit the UL control information are determined, the UE may determine one of the UL control channel resource sets according to the size of the UL control information;” S420 states that “the UE determines one of UL control channel resources contained in the determined one UL control channel resource set;” and S430 states that as “[t]he UE transmits the UL control information through the determined the [sic] UL control channel resource.” Ex. 1001, 14:40-16:62. I have provided a side-by-side comparison of the annotated version of Yan’s FIG. 1 against FIG. 4 of the ’463 patent.

Ex. 1001, FIG. 4; Ex. 1010, FIG. 1 (annotated)



b. Element 1[a]: receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;

117. Takeda teaches Element 1[a].

118. The '463 Patent provides numerous examples of a BS transmitting “UL control channel resource set configuration information” to a UE. In reference to FIG. 4, the '463 Patent states “a UE receives, from a BS, UL control channel resource set configuration information for transmitting the UL control information S400.” Ex. 1001, 14:33-35. The '463 Patent provides a similar disclosure in reference to FIG. 5, stating “a BS transmits to a UE UL control channel resource set configuration information for the transmission of the UL control information S500.” *Id.*, 16:55-57. The '463 Patent provides a discussion of one example where “one or multiple PUCCH resource sets configure each BWP through the higher layer signaling,” but Claim 1 does not limit the manner in which the claimed UL control channel resource set configuration information is sent to a UE. *See e.g., id.*, 10:40-47.

119. In fact, in the file history of a divisional application (U.S. Patent Application No. 16/826,482, now U.S. Patent No. 11,219,000), the independent claims included an element identical to Element 1[a] and were rejected over Hooli in view of Yiu and further in view of Ahn (20190268123) (Ex. 1016). Ex. 1005, 87-100, 128-135; *see also* Ex. 1014, FIG. 5, [0006]-[0007], [0028]-[0029], [0036],

[0045], [0055], [0057]-[0058]; Ex. 1015, FIGS. 5-6, [0137]-[0152]; Ex. 1016, Abstract, Claim 1, Claim 6. To overcome the rejections, Applicant amended the independent claims to recite “the UL control channel resource set configuration information is received through UE specific radio resource control (RRC) signaling.” Ex. 1005, 74-77. Similar limitations are not present in the claims of the ’463 Patent. *See* Ex. 1001, Ex. 1004.

120. Takeda discloses that BWPs are configured for a UE and for PUSCH/PUCCH UL transmissions. Ex. 1007, [0099]-[0100], [0106]. The BWPs are configured through BWP configuration information received through RRC signals transmitted from a BS. *Id.* Takeda states that the UE controls transmission of a UL data channel based on resource allocation information included in a UL grant that is included in DCI received from a BS. *See id.*, [0107]. Takeda also states that a UL BWP is activated based on the UL grant scheduling a UL transmission on a PUCCH or PUSCH. *Id.* A POSITA would understand that a UL BWP can be activated based on a UL grant of a PUCCH or PUSCH transmission if the PUCCH or PUSCH resource channels are configured for the BWP to be activated, and a POSITA would understand that this configuration would be provided through configuration information for the PUCCH resource or PUSCH resource. Without resource configuration information linking a channel resource with a UL BWP, the UE could not identify the UL BWP for activation based on

the UL grant. For example, Takeda describes that an “index (BWP index) of the UL BWP in which a PUSCH is scheduled may be included in UL grant” (Ex. 1007, [0112]), suggesting that this index encompasses the configuration information necessary to identify a BWP to activate based on the PUSCH or PUCCH scheduled in a UL grant. A POSITA would further recognize that a PUSCH or PUCCH requires further configuration information to enable transmission, including time/frequency scheduling information that defines the time and frequency resources within the BWP encompassed by the PUSCH or PUCCH transmission.

121. While Takeda does not explicitly state how the configuration information is provided to the UE, a POSITA would recognize that PUCCH or PUSCH resources (such as those illustrated in FIG. 8) would be provided to the UE either as a part of allocation information in UL grants of DCI, or with the BWP configuration information provided through RRC. If provided as a part of the allocation information (for dynamic configuration), the resource configuration information would include at least the BWP index mapping a scheduled PUSCH or PUCCH to a BWP, and would further define the time duration and frequency band of the PUCCH or PUSCH. If provided with the BWP configuration information via RRC (for configured grant), the BWP index and the time duration and frequency

band for each PUSCH and PUCCH resource would be defined so that it can be subsequently used in response to a UL grant.

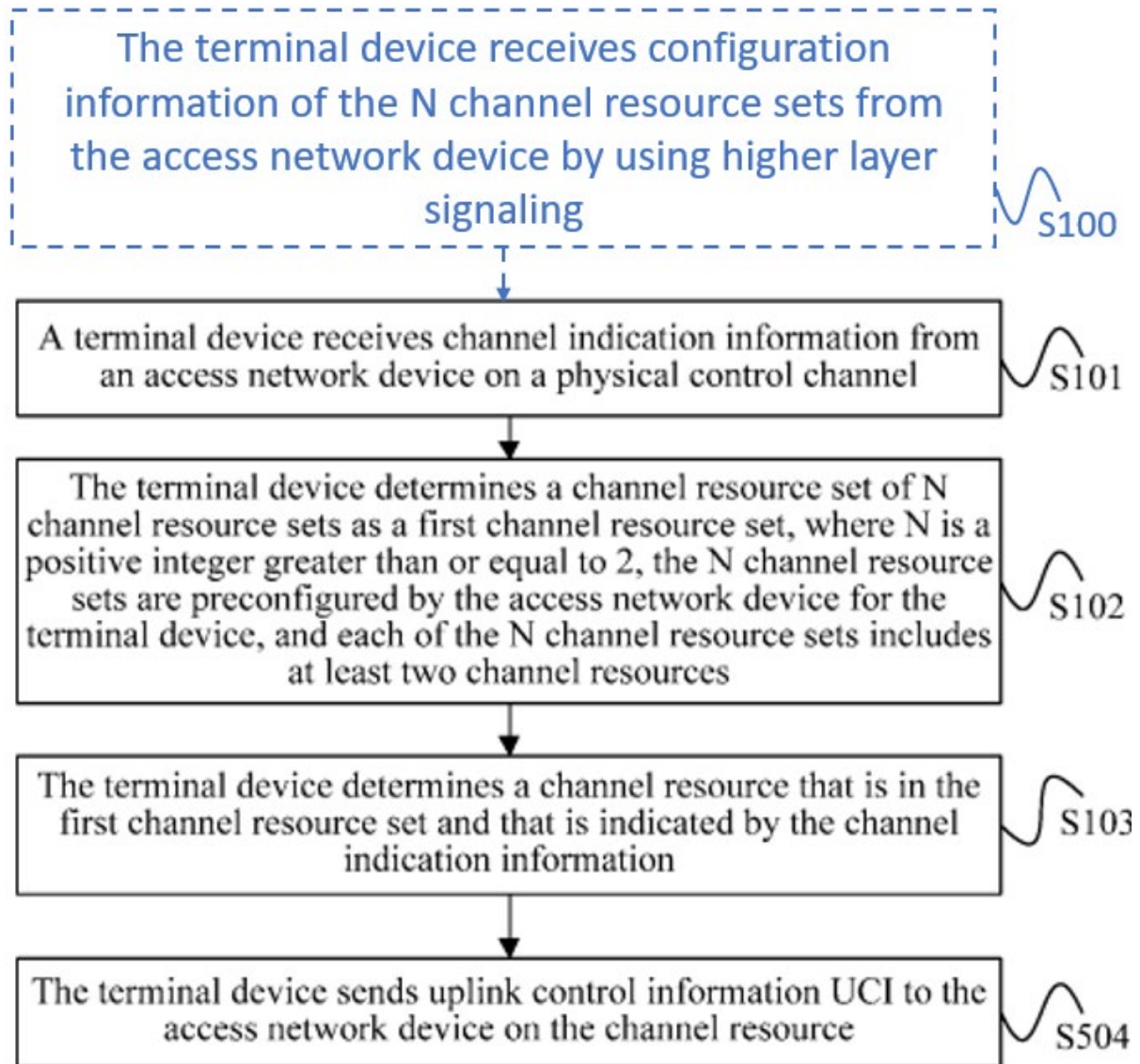
122. Alternatively, a POSITA would have found it obvious to modify Takeda such that resources are configured through configuration information provided by the BS to the UE. Takeda's FIG. 8 illustrates that PUSCH transmissions have defined time durations and frequency bandwidths, and a POSITA would have been motivated to define these characteristics within configuration information provided to the UE from a BS, so that the BS has control over the configuration of UL signals and so that the BS can monitor UL signals within expected frequency bands and time durations. A POSITA would have had a reasonable expectation of success in providing configuration information for resources to a UE based on the disclosure of Takeda, because Takeda discloses that other configuration information may be provided via RRC (BWP configuration information), and/or because Takeda already indicates that UL signals (e.g., PUSCH or PUCCH signals) are configured for transmission within defined frequency bands and time durations within a BWP. *See e.g.*, Ex. 1011, [0098], [0107].

123. Moreover, a POSITA would be motivated to group the UL resources in the UL BWP illustrated in Takeda's FIG 8 into sets and to provide configuration information as UL control channel resource set configuration information in a

convenient and preferred manner for configuring the multiple resources (such as the multiple PUSCH resources shown in Takeda's FIG. 8) and for indicating that multiple resources are available for UL transmission within a BWP. Takeda describes that the PUSCH signals in FIG. 8 are non-limiting examples, and the same principles apply to PUCCH resources for transmitting UCI. Ex. 1007, [0140], [0220]. Thus, a POSITA would find it obvious to group PUCCH resources into sets in the same way as the PUSCH resources shown in FIG. 8. *See* Ex. 1033, 15:37-43 (disclosing that control channel resources are grouped into a "control resource set"). Furthermore, grouping multiple resources into sets would enable a flexible UL channel structure for different UL characteristics (e.g., different UL types and/or different UL sizes), for example, using UL control channel resource set configuration information that applies to the control channel resource set because each control channel resource in the control channel resource set is defined by the DCI. *see* Ex. 1010, 2:1-6; Ex. 1009, 2:7-10. A POSITA would have had a reasonable expectation of success in grouping Takeda's UL resources into sets according to UL control channel resource set configuration information because Takeda already discloses a BWP index that associates UL channel resources with individual BWPs. The functionality of this index could be provided by UL control channel resource set configuration information that defines BWPs associated with each UL resource.

124. In the event that Takeda is found not to teach Element 1[a], Takeda in combination with Yan does. Specifically, Yan describes an “Uplink Control Information Sending Method, Uplink Control Information Receiving Method, Apparatus, and System.” Ex. 1010, 1 (title); Ex. 1009, 1 (title). FIG. 1 (reproduced below) of Yan is described as a “flowchart of an uplink control information sending method according to an embodiment of the present invention.” *Id.*, 10:15-17; Ex. 1009, 13:18-19. FIG. 1 begins with step S101, which is described as a “terminal device receives channel indication information from an access network device on a physical control channel.” *Id.*, 11:17-19; Ex. 1009, 14:30-31. However, the POSITA would understand that this is not the start of the process according to all embodiments of Yan. As illustrated in the annotated version of FIG. 1, below, Yan describes another step that occurs “[b]efore the receiving, by a terminal device channel indication information from an access network device.” *Id.*, 19:5-12; Ex. 1009, 25:20-24. Specifically, Yan describes that “the method further includes: ***“receiving, by the terminal device, configuration information of the N channel resource sets from the access network device*** by using higher layer signaling.” Ex. 1010, 5:41-43; Ex. 1009, 7:8-9; *see also* Ex. 1010, 9:49-55, 19:5-12, 21:6-48; Ex. 1009, 12:27-31, 25:20-24, 28:12-29:8. This is shown as added step S100 in annotated FIG. 1 of Yan.

Ex. 1010, FIG. 1 (annotated)



125. The configuration information in Yan is equivalent to the “UL control channel resource set configuration information” in the ’463 Patent. As discussed above, the ’463 Patent explains that one way of configuring PUCCH resource sets is through higher layer signaling (e.g., RRC signaling). Ex. 1001, 10:4-6.

Moreover, the '463 Patent specifies that the configuration information includes PUCCH format configuration information, which defines PUCCH formats “according to payload sizes of UL control information. *Id.*, 7:37-47.

126. In the same way, Yan explains that the terminal device receives “configuration information of the N channel resource sets from the access network device ***by using higher layer signaling.***” Ex. 1010, 19:5-12; Ex. 1009, 25:20-24.

127. Yan further explains the content of the configuration information includes “the N channel resource sets.” Ex. 1010, 19:18-19; Ex. 1009, 25:27-28. Each channel resource set includes “at least two channel resources.” Ex. 1010, 12:34-38; Ex. 1009, 16:27-29. The configuration information further defines a format and size of UCI that can be sent on a given channel within a channel resource set, as the configuration information includes “a capacity range corresponding to each of the ... channel resource sets.” Ex. 1010, 15:11-13; Ex. 1009, 20:16-17. Yan explains that “the capacity range corresponding to each channel resource set refers to the quantity of bits of UCI that can be sent on channel resources of each channel resource set,” which measures the “size of the UCI.” Ex. 1010, 15:14-32; Ex. 1009, 20:18-29. Yan further states that different channel resources included in the same channel resource set may have different PUCCH or PUSCH formats. Ex. 1010, 16:36-18:62; Ex. 1009, 22:13-25:14. Therefore, Yan’s disclosure of configuration information matches both the content

of UL control channel resource set configuration information of the '463 Patent and the example method for providing configuration information (via RRC signaling) of the '463 Patent.

128. For the reasons described above in the section entitled *motivation to combine*, the POSITA would have implemented the resource allocation methods of Yan with the BWP configurations of Takeda.

c. Element 1[b]: determining one of UL control channel resource sets contained in the UL control channel resource set configuration information;

129. Takeda teaches Element 1[b].

130. Element 1[b] is described with respect to Step S410 of the '463 Patent's FIG. 4. The '463 Patent states "when the UL control channel resource sets to transmit the UL control information are determined, the UE may determine one of the UL control channel resource sets according to the size of the UL control information." Ex. 1001, 15:20-26; 16:14-28 ("a separate PUCCH resource set may be configured according to a PUCCH payload size to be transmitted by the UE, i.e. the payload size of UL control information, and the PUCCH resource set for the PUCCH resource allocation may be determined according to the UL control information payload size to be transmitted by the UE").

131. Takeda teaches the use of "DCI for scheduling (DL assignment or UL grant)." Ex. 1007, [0076], [0084], [0104], [0107], [0112]-[0113], [0123]. As

discussed above in reference to Element 1[a], a POSITA would have understood that at least some portion of the DCI used for resource allocation or the BWP configuration would have included “UL control channel resource set configuration information,” or a POSITA would have found it obvious to include UL control channel resource set configuration information. *See supra*, §XI.A.2.b. And a POSITA would have understood that Takeda’s UE would have determined one of those UL control channel resource sets when transmitting the ***multiple uplink signals transmitted within the UL BWP*** of Takeda’s FIG. 8 (as shown in multiple shades of green within the pink UL BWP). For example, the determined UL control channel resource set may encompass all of the UL signals within the UL BWP illustrated in Takeda’s FIG. 8. The UL control channel resource set would be determined from the UL grant in the DCI of the CORESET to enable the user terminal to activate the UL BWP associated with the UL channel resource set and to transmit the multiple uplink signals of the UL channel resource set. For example, Takeda determines the multiple resources for transmitting uplink signals as illustrated in FIG. 8, which a POSITA would recognize would be grouped according to UL control channel resource set configuration information as discussed in reference to Element 1[a]. To achieve the benefits of the UL control channel resource set configuration information discussed in Element 1[a], a POSITA would recognize that the UE would determine a UL control channel

resource set, for example as a part of Takeda's allocation information sent in DCI when determining a resource for UL transmission.

132. Moreover, Takeda describes that the PUSCH signals in FIGS. 8-9 are non-limiting examples, and the same principles apply to PUCCH resources for transmitting UCI. Alternatively, Takeda states that UCI is transmitted on a PUSCH (as illustrated in FIG. 8). Ex. 1007, [0115] (“The UL signal is, for example, at least one of a UL data channel (for example, PUSCH), *a UL control channel (for example, PUCCH),...*”), [0140] (“*Uplink control information (UCI)* including at least one of acknowledgment information (A/N, HARQ-ACK), channel state information (CSI), and the like of the PDSCH is *transmitted by the PUSCH or the PUCCH*”), [0220].

133. If Takeda is interpreted as failing to explicitly disclose Element 1[b], a POSITA would have found that adding a step for “determining one of UL control channel resource sets contained in the UL control channel resource set configuration information” would have been an obvious addition to the teachings of Takeda. As discussed above, Takeda teaches that DCI received by the UE may include a UL grant that schedules a single UL transmission (e.g., a single PUSCH or PUCCH) within a BWP. *Id.*, [0076], [0084], [0104], [0107], [0112]-[0113], [0123], FIGS. 8-9. The UE's control unit “control[s] transmission of a uplink (UL) signal in a frequency band for UL in the carrier based on the DCI.” *Id.*, [0010]. A

POSITA reviewing Takeda would have been motivated to determine a UL control channel resource set prior to determining an individual UL control channel resource to provide more flexibility for identifying an appropriate UL channel resource based on characteristics of the UCI (e.g., based on a size of the UCI). A POSITA would recognize that this flexibility would provide power conservation to the UE, which would determine a UL control channel resource set with lower power requirements when transmitting small UCI signals. For example, each available “set” of UL channel resources may be configured for signaling UCI with certain characteristics (e.g., certain ranges of UCI size), and so a UL control channel resource set would be determined before determining an individual UL control channel resource for signaling. As discussed above, Takeda discloses that multiple UL channels may be provided within a single BWP, and a POSITA would understand that grouping multiple UL channels into resource sets would enable the flexible UL channel structure that provides different channel resources for different types of UCI. Moreover, a POSITA would have had a reasonable expectation of success in implementing multiple channel sets with Takeda’s system, at least because Takeda discloses that multiple UL channel resources can be used within a single BWP, and the UE determines a UL channel resource based on UL grants in DCI, which can include configuration information such as resource set configuration information applicable to a plurality of UL channel resources.

134. In the event that Takeda is found not to teach Element 1[b], Yan does. *See supra*, §XI.A.2.a. For the reasons described above in the section entitled *motivation to combine*, the POSITA would have implemented the resource allocation methods of Yan with the BWP configurations of Takeda. Step S102 of Yan’s FIG. 1 (shown above) maps directly to Element 1[b]. Step S102 states: “[t]he ***terminal device determines a channel resource set*** of N channel resource sets as a first channel resource set, where N is a positive integer greater than or equal to 2, the N channel resource sets are preconfigured by the access network device for the terminal device, and each of the N channel resource sets includes at least two channel resources.” Ex. 1010, 11:48-54, 20:1-42, 22:7-25; Ex. 1009, 15:29-16:8, 26:28-27:23, 29:24-30:5. The channel resource sets each correspond to a capacity range for transmitting UCI (i.e., a size of UCI that can be transmitted using the channel resource sets). Ex. 1010, 15:11-13; Ex. 1009, 20:16-17. Yan further explains that the “terminal device ***determines a channel resource set of the N channel resource sets as the first channel resource set***. Specifically, determining the channel resource set of the N channel resource sets may be according to a type or size of the UCI fed back by the terminal device to the access network device. Ex. 1010, 11:62-12:4; Ex. 1009, 15:29-16:8. This matches the ‘463 Patent’s description of the process for determining a UL control channel resource set. Yan provides an example with reference to FIG. 2, stating “the configuration

information in the foregoing embodiment includes two channel resource sets.” Ex. 1010, 13:46-14:35; Ex. 1009, 18:15-19:20. This embodiment is described as “specifically provid[ing] the method for determining, by the terminal device according to the type of the UCI, the channel resource set matching the type of the UCI of the two channel resource sets as the first channel resource set.” Ex. 1010, 14:31-35; Ex. 1009, 19:18-20.

135. Yan continues by explaining an example in which the terminal device determines a channel resource set based on a size of the UCI. As discussed in Yan, the size of the UCI can be determined “using configuration information that is for periodic CSI on each downlink carrier and that is configured by the base station, a quantity of bits for reporting the periodic CSI on each carrier in a current uplink subframe and reported content, so as to determine a size K of UCI that needs to be fed back in the current uplink subframe.” Ex. 1010, 14:36-60; Ex. 1009, 19:21-20:4.

136. To determine the channel resource set of the N channel resource sets and “that matches the size K of the UCI as the first channel resource set,” Yan explains that the terminal device determines “a capacity range corresponding to each of the N channel resource sets” and determines “a channel resource set of the N channel resource sets as the first channel resource set” that satisfies size criteria based on the determined size K of the UCI. Ex. 1010, 14:61-15:5; Ex. 1009, 20:5-

12. Specifically, the criteria is that “the size K of the UCI meets $R_{min} \leq K \leq R_{max}$, where a capacity range of the channel resource set is $[R_{min}, R_{max}]$, R_{min} is a minimum value of a capacity of the channel resource set, and R_{max} is a maximum value of the capacity of the channel resource set.” Ex. 1010, 14:61-15:5; Ex. 1009, 20:5-12.

137. As discussed above, the “ N channel resource sets” are contained in “configuration information” sent from the access network device. Ex. 1010, 9:49-59 (“the access network device sends the configuration information of the at least two channel resource sets to the terminal device.... *The terminal device first determines the first channel resource set of the multiple channel resource sets.*”), 12:34-45, 19:5-26, 21:36-48, 24:47-54; Ex. 1009, 12:27-13:1, 16:27-17:2, 25:20-26:1, 28:31-29:8, 33:11-15.

d. Element 1[c]: determining one of UL control channel resources contained in the determined UL control channel resource set;

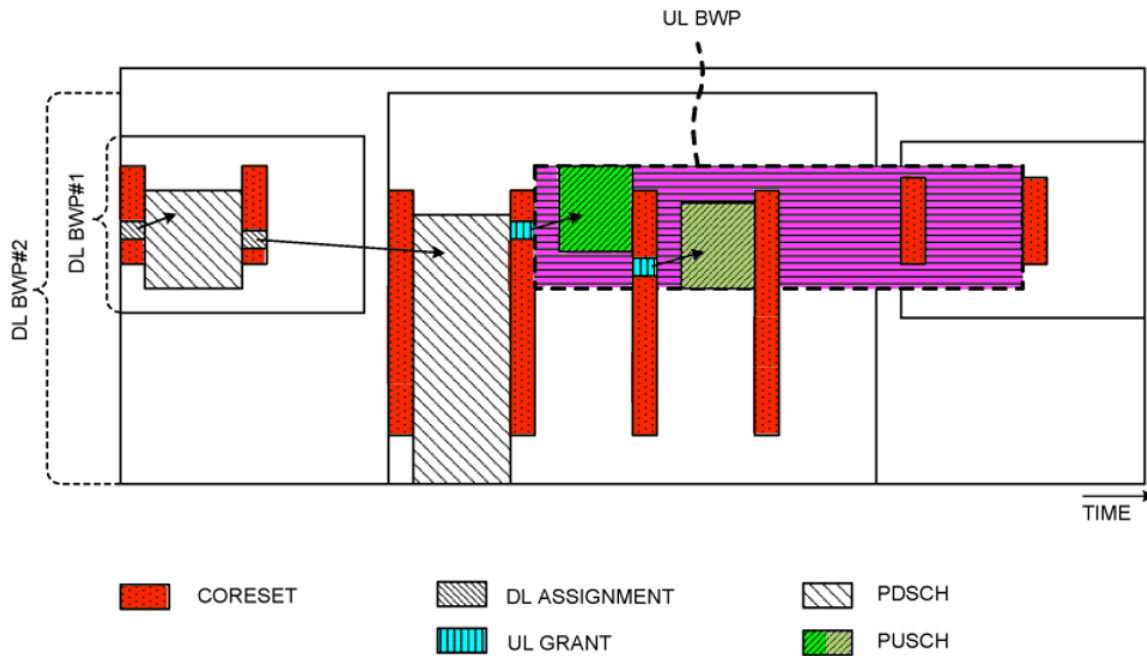
138. Takeda teaches Element 1[c].

139. The '463 Patent describes Element 1[c] with respect to step S420 in FIG. 4 of the '463 Patent. Ex. 1001, 15:24-26 (“the UE determines one of UL control channel resources contained in the determined one UL control channel resource set S420”). The '463 Patent further explains that DCI (or “DL control information”) can be used to determine a UL control channel resource. *Id.* 15:27-

31 (“the UE may receive from the BS DL control information containing information indicating one, for the transmission of the UL control information, of UL control channel resources”).

140. As discussed above, Takeda teaches that DCI received by the UE may include a UL grant that schedules a single UL transmission (e.g., a single PUSCH or PUCCH) within a set of UL transmissions (e.g., multiple PUSCHs or PUCCHs) on a single BWP. Ex. 1007, [0076], [0084], [0104], [0107], [0112]-[0113], [0123], FIGS. 8-9. The UE’s control unit “control[s] transmission of a uplink (UL) signal in a frequency band for UL in the carrier based on the DCI.” *Id.*, [0010]. FIGS. 8-9, annotated FIG. 8 reproduced below, ***each demonstrate that the UE determines a UL control channel resource based on a UL grant***, as demonstrated by the arrow connecting the UL grant (shown in blue) with a PUSCH (shown in green). The arrow represents that the UL grant, which is received in the CORESET (shown in red) of DL BWP#2 schedules the PUSCHs (or PUCCHs) for UL transmission in the UL BWP. *Id.*, [0107]. To the extent that a POSITA would recognize that the UE would determine a control channel resource set (*see supra*, §XI.A.2.b-c), the UL resource scheduled in the DCI would be contained within the determined control channel resource set.

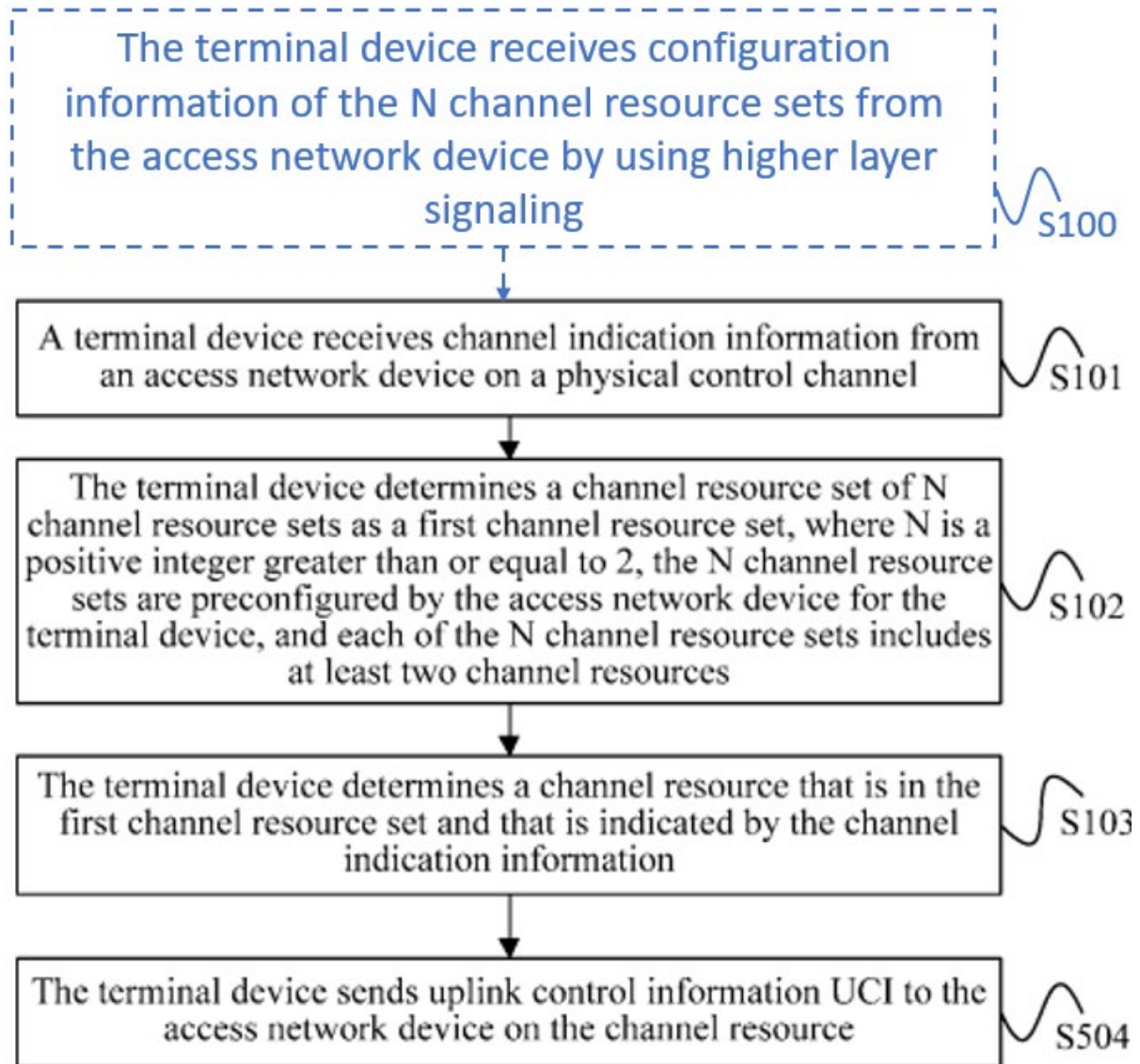
Ex. 1007, FIG. 8 (annotated)



141. As pointed out previously, a PUSCH and a PUCCH may be configured in the same way according to Takeda, and/or a PUSCH may be used to convey UCI. *See supra*, §XI.A.2.c. Therefore, Takeda confirms that a PUSCH is a UL control channel resource. *Id.*, [0115] (“The UL signal is, for example, at least one of a UL data channel (for example, PUSCH), *a UL control channel (for example, PUCCH),...*”), [0140] (“*Uplink control information (UCI)* including at least one of acknowledgment information (A/N, HARQ-ACK), channel state information (CSI), and the like of the PDSCH is *transmitted on the PUSCH or the PUCCH*”), [0220].

142. In the event that Takeda is found not to teach Element 1[c], Yan does. *See supra*, §XI.A.2.a. For the reasons described above in the section entitled *motivation to combine*, the POSITA would have implemented the resource allocation methods of Yan with the BWP configurations of Takeda. Step S103 of Yan’s FIG. 1 (reproduced below) maps directly to Element 1[c]. Step S103 states “[t]he terminal device **determines a channel resource** that is **in the first channel resource set** and that is indicated by the channel indication information.” Ex. 1010, 12:5-7, 20:1-11, 20:27-42 (“[a]fter the first channel resource set is determined, the terminal device **determines the channel resource that is in the first channel resource set ...**”), 22:7-25, 25:17-64, 26:47-67; Ex. 1009, 16:9-10, 26:28-27:4, 27:13-23, 29:24-30:5, 34:3-35:1, 36:2-14. As shown in step S101 of annotated FIG. 1, below, the channel indication information is received on a physical control channel, separately from the channel configuration information. Yan explains that “[d]ifferent channel resources may be determined at different times in a subframe according to same channel indication information.” Ex. 1010, 11:17-47, 12:45-50; Ex. 1009, 15:5-24, 17:3-5.

Ex. 1010, FIG. 1 (annotated)



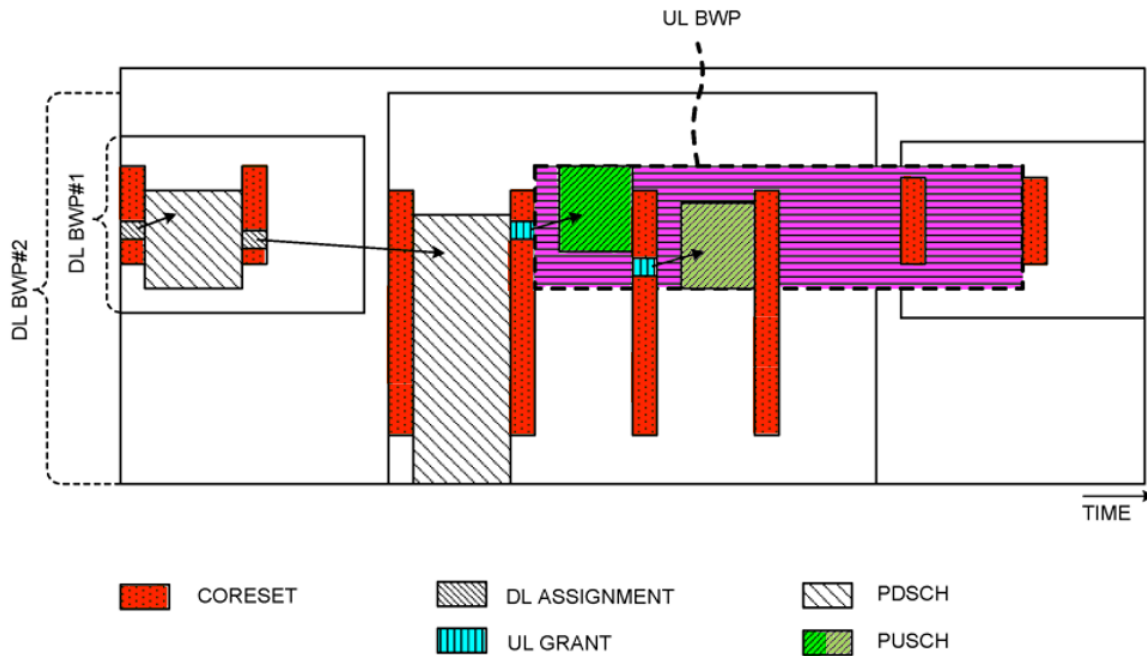
e. Element 1[d]: transmitting UL control information through the determined UL control channel resource,

143. Takeda teaches Element 1[d].

144. In reference to Step S430 of FIG. 4, the '463 Patent states the “UE transmits the UL control information through the determined the [*sic*] UL control channel resource S430.” Ex. 1001, 16:50-51.

145. Each of Takeda’s FIGS. 8-9 (FIG. 8 reproduced below) demonstrate transmission of UL information via a PUSCH (shown in green). According to Takeda, a PUCCH is configured in the same way as a PUCCH, and/or the PUSCH is used to convey UCI. This confirms that the PUSCH is a UL control channel resource. Ex. 1007, [0115] (“The UL signal(s) is, for example, at least one of a UL data channel (for example, a PUSCH), *a UL control channel (for example, a PUCCH),...*”), [0140] (“*Uplink control information (UCI)* including at least one of acknowledgment information (A/N, HARQ-ACK), channel state information (CSI), and the like of the PDSCH is *transmitted on the PUSCH or the PUCCH*”), [0220]. *See also, id.*, [0080], [0091]-[0092], [0107], [0113], [0115]-[0119], [0139]-[0140].

Ex. 1007, FIG. 8 (annotated)



146. In the event that Takeda is found not to teach Element 1[d], Yan does. *See supra*, §XI.A.2.a. For the reasons described above in the section entitled *motivation to combine*, the POSITA would have implemented the resource allocation methods of Yan with the BWP configurations of Takeda. Step S104 of Yan’s FIG. 1 maps directly to Element 1[d]. Step S104 states “[t]he terminal device *sends uplink control information UCI* to the access network device *on the channel resource.*” Ex. 1010, 12:25-33, 20:43-50, 22:42-50, 25:65-26:11, 26:47-67; Ex. 1009, 16:21-26, 27:24-28, 30:17-22, 35:2-10, 36:2-14. The channel resource is “used as an uplink channel to *bear* the uplink control information UCI,

and *is used to send the UCI* to the access network device.” Ex. 1010, 12:28-33;
Ex. 1009, 16:23-26.

f. Element 1[e]: wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,

147. Takeda teaches Element 1[e].

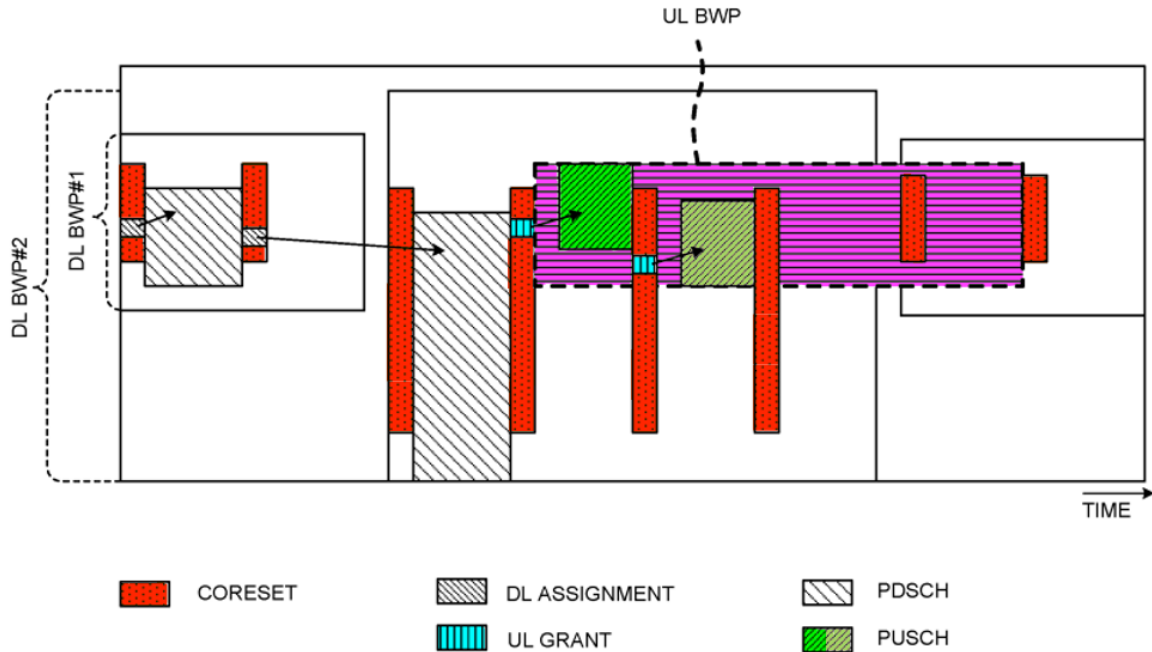
148. As described above in my discussion of Element 1[b], the ’463 Patent explains that channel resource sets include multiple UL channel resources within a single BWP. *See supra*, §XI.A.2.c. “For example, as illustrated in FIG. 3B, *in a case where the UL control channel resource set is formed of the first to fourth PUCCH resources, PUCCH resource indication information illustrated in FIG. 3C may indicate one of the four PUCCH resources.*” Ex. 1001, 11:8-12.

149. Takeda teaches that PUSCH and/or PUCCH can be scheduled for transmission within a particular UL BWP. Ex. 1007, [0080] (“For example, the user terminal may transmit the ACK by using *a UL control channel (for example, PUCCH) or a UL data channel (for example, PUSCH) of the UL BWP.*”), [0107] (“The user terminal transmits *the PUSCH scheduled in a UL BWP* based on the UL grant.”), [0112], [0117] (“UL BWP #1 includes *configuration information of the PRACH and/or the PUCCH*”), [0123].

150. FIGS. 8-9 of Takeda show that multiple UL resources are configured for a single UL BWP. As shown, *multiple uplink resources are used to transmit*

UL signals (PUSCHs) within a single UL BWP. Therefore, Takeda discloses that a set (encompassing multiple UL resources) are configured for a BWP.

Ex. 1007, FIG. 8 (annotated)



151. Moreover, Takeda describes that the resources used to transmit the UL signals illustrated in FIGS. 8-9 are UL control channel resources. Ex. 1007, [0115] (“The UL signal is, for example, at least one of a UL data channel (for example, PUSCH), *a UL control channel (for example, PUCCH),...*”), [0140] (“*Uplink control information (UCI)* including at least one of acknowledgment information (A/N, HARQ-ACK), channel state information (CSI), and the like of the PDSCH is *transmitted by the PUSCH or the PUCCH*”), [0220].

152. Takeda describes that ***BWPs are configured for the user terminal***. *Id.*, [0015], [0017], [0095]-[0098] (describing “maximum bandwidth” and “minimum bandwidth” for “one or more BWPs ***configured for the user terminal***”), [0101], [0103] (UL BWP), [0110], [0112] (plural UL BWPs), [0115]-[0119], [0120], [0132], [0155], [0179].

153. In addition, as discussed above with respect to Element 1[b], Yan teaches UL control channel resource sets configured within a carrier. *See supra*, §XI.A.2.c. When incorporating Yan’s teachings for allocating UL resources, including the inclusion of UL control channel resource sets, with Takeda’s BWP-based UL transmission method, the resulting UL resources and the UL control channel resource sets that include those resources would have been configured for BWPs that are configured for the UE. As discussed above, Takeda explicitly discloses that UL resources are configured for BWPs, and Yan’s resource allocation method would be used for selecting among the UL resources that are configured for each BWP to save power by avoiding discarding of UCI bits. *See supra*, §XI.A.1. Thus, Takeda in view of Yan teaches Element 1[e].

g. Element 1[f]: wherein the each UL BWP is activated through downlink (DL) control information.

154. Takeda teaches Element 1[f].

155. The ’463 Patent explains that “when one or more BWPs are configured in an serving cell of an UE, the UE can activate and use one BWP at

any time.” Ex. 1001, 8:40-42. The “[a]ctivation/deactivation indications of the DL BWP and the UL BWP to an UE may be performed through DL control information (DCI) transmitted through a PDCCH.” *Id.*, 8:50-52. Activation is performed through DCI when the UE receives, from the BS, “DL control information containing information that indicates one of one or more BWPs contained in the one or more BWP sets configured by the BWP configuration information. The UE may receive the PDSCH or transmit the PUSCH or PUCCH through the one BWP indicated in the DL control information.” *Id.*, 8:59-67.

156. Takeda explicitly states “[t]he user terminal may control activation and/or deactivation of one or more UL BWPs configured for the user terminal based on the explicit or implicit indication information. The explicit indication information may be, for example, DCI (UL grant).” Ex. 1007, [0120]; *see also id.*, [0008]-[0011], [0016]-[0020], [0104]-[0105], [0112], [0123]-[0124], [0177]-[0184].

3. Dependent Claim 2

157. Dependent Claim 2 recites: the method according to Claim 1, “wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.”

158. As discussed above in reference to Element 1[b], the '463 Patent explains that a UL control channel resource set is determined according to the size of the UL control information. Ex. 1001, 15:19-22; 16:14-28.

159. Although Takeda does not discuss determining a UL control channel resource set based on a size of the UL control information, Yan does. Yan provides detail about the execution of its step S102, which is similarly performed by determining a size of UCI to be transmitted (“[t]he terminal device determines a channel resource set of N channel resource sets as a first channel resource set, where N is a positive integer greater than or equal to 2, the N channel resource sets are preconfigured by the access network device for the terminal device, and each of the N channel resource sets includes at least two channel resources”). Ex. 1010, 11:48-54; Ex. 1009, 15:25-28. Yan states “***determining the channel resource set of the N channel resource sets as the first channel resource set may be according to a type or size of the UCI fed back by the terminal device to the access network device.***” Ex. 1010, 11:64-12:4; Ex. 1009, 16:3-8. Yan explains that “the size of the UCI may be specifically measured by using a quantity of bits of the UCI or an amount of UCI.” Ex. 1010, 11:64-12:4; Ex. 1009, 16:3-8. As described above with respect to Element 1[a], the channel resource sets each correspond to a capacity range for transmitting UCI of different bit quantities, and the channel resource set is determined so that the size of the UCI falls within a minimum and maximum

capacity of the resource set. *See supra*, §XI.A.2.b; Ex. 1010, 14:61-15:32; Ex. 1009, 20:5-29.

4. Dependent Claim 3

160. Takeda and Yan teach Claim 3.

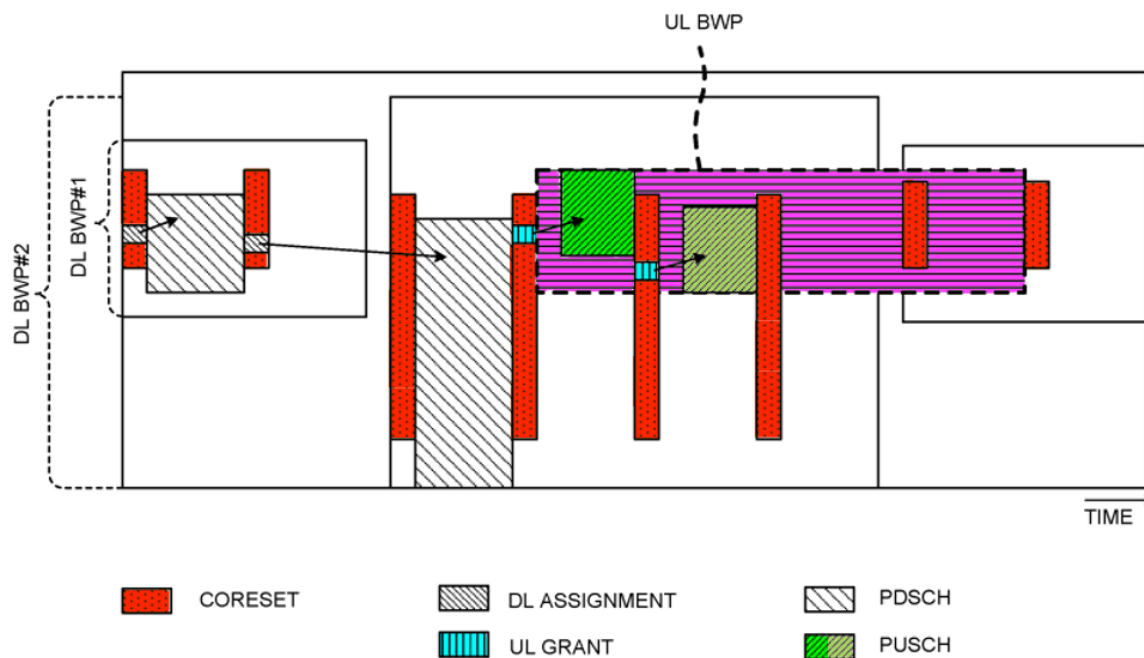
a. Element 3[pre]: The method according to claim 1, further comprising

161. Takeda and Yan teach Element 3[pre] for at least the reasons discussed for claim 1. *See supra*, §XI.A.2.a-g.

b. Element 3[a]: receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,

162. Takeda teaches Element 3[a]. As discussed herein, Takeda states that a UL grant is provided to the user terminal from the base station, and the UL grant identifies the PUCCH channel to be utilized for transmission of UCI. FIG. 8 (below) illustrates this: arrows connect ***UL grants (blue) in the CORESET (red) to UL transmissions (green) in the UL BWP (pink)***. *Id.* FIG. 8. Therefore, Takeda discloses that DCI (UL grant) contains information indicating a UL control channel resource for UL control information transmission.

Ex. 1007, FIG. 8 (annotated)



163. Furthermore, Step S101 of Yan discloses “[a] terminal device receives channel indication information *from an access network device on a physical control channel*,” which Yan explains is a *physical downlink control* channel (PDCCH). Ex. 1010, 11:17-47, 19:37-67; Ex. 1009, 15:5-24, 26:8-9. Because the channel *indication information* is transmitted via a physical *downlink control* channel—the channel indication information constitutes downlink (DL) control information, as the term is used in the claim. Ex. 1010, 11:17-47, 19:37-67; Ex. 1009, 15:5-24, 26:8-9. Yan further explains that “the terminal device determines the channel resource that is in the first channel resource set *and that is indicated by the channel indication information*.” Ex. 1010, 12:5-24; Ex. 1009, 16:9-20. For

the reasons described above in the section entitled *motivation to combine*, the POSITA would have implemented the resource allocation methods of Yan with the BWP configurations of Takeda. *See supra*, §XI.A.4.b.

c. Element 3[b]: wherein the one of the UL control channel resources is indicated from the base station through the DL control information.

164. Takeda and Yan teach Element 3[b]. As discussed above, a UL grant *provided by the BS to the user terminal identifies the UL channel resource* to be used for UL signal transmission. *Id.*, [0080], [0091]-[0092], [0107], [0113]-[0120], [0139]-[0140], [0177], [0220], FIG. 8-9. The UL grant is provided within PDCCH as a part of DCI. *Id.* Furthermore, Yan's access network device (BS) provides the channel indication information through the PDCCH (as DCI), and the channel indication information indicates one of UL control channel resources. Ex. 1010, 11:17-47, 12:5-24; 19:37-67; Ex. 1009, 15:5-24, 16:9-20, 26:8-9.

5. Independent Claim 4

165. Independent Claim 4 recites all of the same elements as Claim 1, but these elements are recited from the perspective of the base station in Claim 4, instead of from the perspective of the user equipment, as recited in Claim 1.

166. The following subsections explain the similarity between the elements of Claim 4 and the elements of Claim 1, described above.

a. Element 4[pre]: A method of receiving uplink (UL) control information by a base station, the method comprising:

167. UCI transmitted by a UE (as recited in Claim 1) is received by a BS (as recited in Claim 4).

168. Takeda and Yan both teach Element 4[pre] for at least the reasons discussed with respect to Element 1[pre]. *See supra*, §XI.A.2.a.

169. Moreover, Takeda explicitly discusses that radio base stations are configured to receive UL control information. *See e.g., id.*, [0145]-[0146], [0192]-[0196]. Yan also discloses a method of receiving UL control information by a BS. For example, “[e]mbodiments of the present invention provide ... ***an uplink control information receiving method.***” Ex. 1010, Abstract; Ex. 1009, Abstract; *see also* Ex. 1010, FIG. 4, 1:16-19, 2:10-16; Ex. 1009, FIG. 4, 1:4-7, 2:13-15.

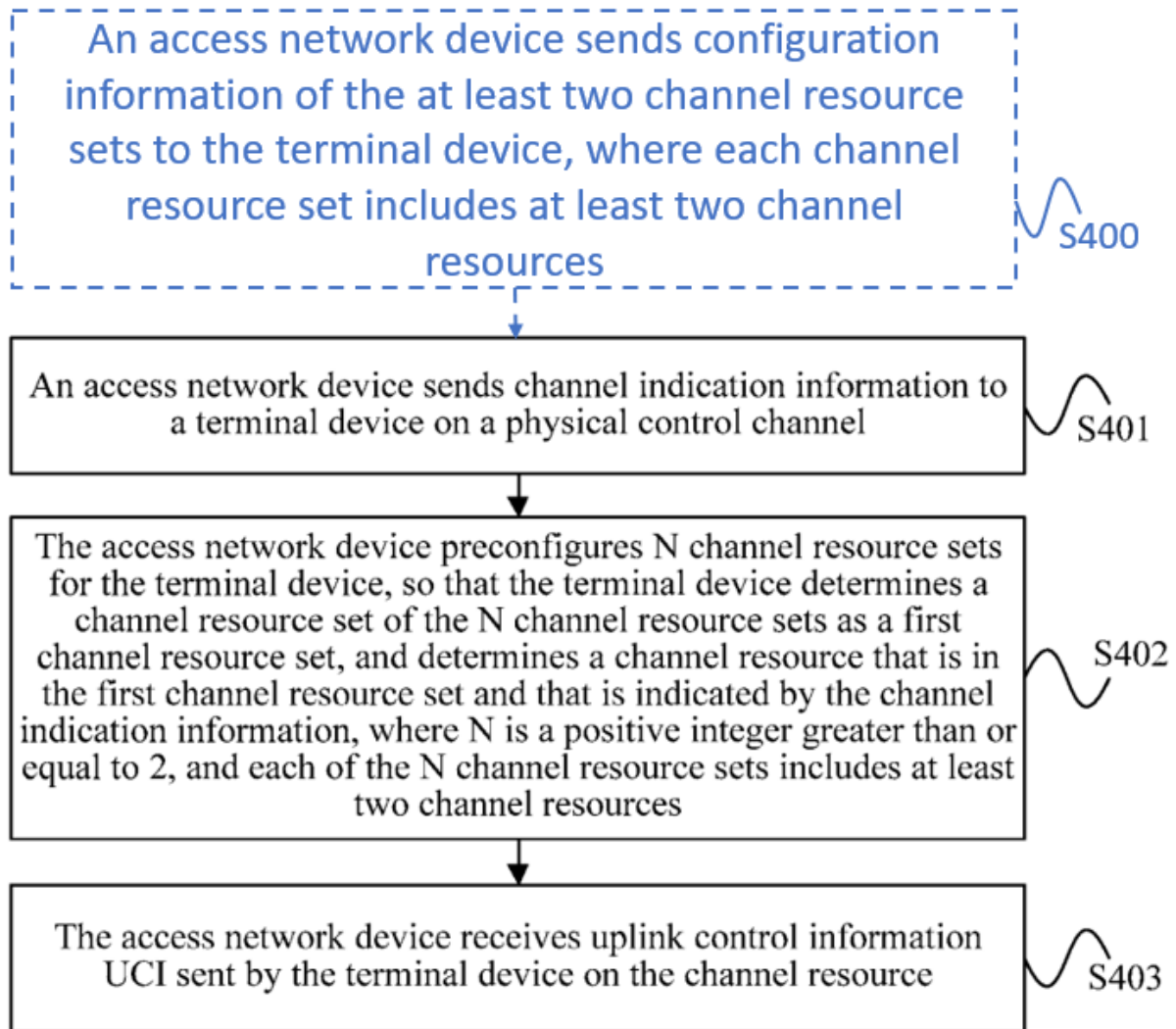
b. Element 4[a]: transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment;

170. Element 4[a] is substantively identical to Element 1[a] discussed above, but states that the UL control channel resource set configuration information is “transmitted”—reflecting that Claim 4 is directed to the operation of the base station, whereas Claim 1 is directed to the operation of the user equipment.

171. Takeda and Yan teach Element 4[a] for at least the reasons discussed with respect to Element 1[a]. *See supra*, §XI.A.2.b.

172. Moreover, Yan describes an “Uplink Control Information Sending Method, Uplink Control Information Receiving Method, Apparatus, and System. Ex. 1010, 1 (title). FIG. 4 of Yan is described as a “flowchart of an uplink control information receiving method according to another embodiment of the present invention.” Ex. 1010, 10:22-24; Ex. 1009, 13:24-25. Yan’s FIG. 4 shows the access network device’s steps while the user terminal is performing the steps of FIG. 1 (discussed above). Ex. 1010, 19:27-36; Ex. 1009, 26:2-7. Step S402 of Yan’s FIG. 4 illustrates the access network device preconfiguring the channel resource sets for the terminal device. Ex. 1010, 20:1-9; Ex. 1009, 26:28-27:2. Specifically, “the access network device sends configuration information of the at least two channel resource sets to the terminal device, where each channel resource set includes at least two channel resources.” Ex. 1010, 20:51-55; Ex. 1009, 27:29-31. As reflected by added step S400 in the annotated version of FIG. 4, reproduced below, “step S402 may be performed first and then step S401 may be performed.” Ex. 1010, 20:10-13; Ex. 1009, 27:3-4. The configuration information may also be sent in the same signal as the channel indication information.

Ex. 1010, FIG. 4 (annotated)



c. Element 4[b]: receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information,

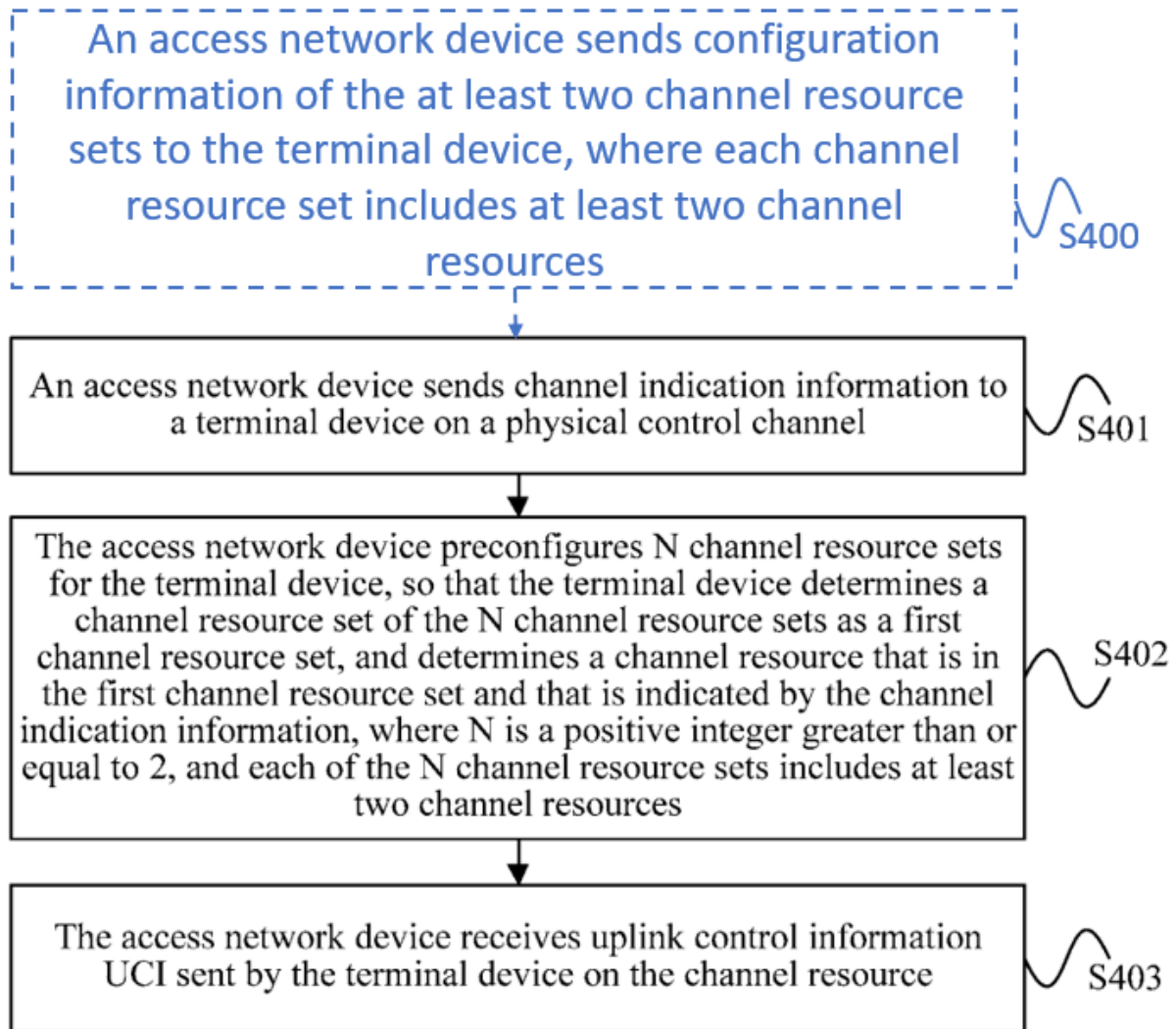
173. Element 4[b] is equivalent to Element 1[d] and references the UL control channel resources determined by the UE as reflected in Elements 1[b] and 1[c]. As recited in Element 4[b], the UL control information is received through

one of UL control channel resources (which is transmitted from the UE, as reflected in Element 1[d] – the UL control channel resource that is “determined” by the UE as reflected in Elements 1[b]-1[c]).

174. Takeda and Yan teach Element 4[b] for at least the reasons discussed with respect to Elements 1[b]-1[d]. *See supra*, §XI.A.2.c-e.

175. Moreover, Step S403 of Yan’s FIG. 4 (reproduced below) recites “[t]he access network device *receives uplink control information UCI sent by the terminal device on the channel resource.*” Ex. 1010, 20:43-45, Ex. 1009, 27:24-25. Yan’s reference to “the channel resource” in S403 is the channel resource “that is in the first channel resource set and that is indicated by the channel indication information” provided to the terminal device. Ex. 1010, 20:1-42; Ex. 1009, 26:28-27:23.

Ex. 1010, FIG. 4 (annotated)



d. Element 4[c]: wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,

176. Element 4[c] is identical to Element 1[e]. Takeda teaches Element 4[c] for at least the reasons discussed with respect to Element 1[e]. *See supra*, §XI.A.2.f.

e. Element 4[d]: wherein the each UL BWP is activated through downlink (DL) control information.

177. Element 4[d] is identical to Element 1[f]. Takeda teaches Element 4[d] for at least the reasons discussed with respect to Element 1[f]. *See supra*, §XI.A.2.g.

6. Dependent Claim 5

178. Dependent Claim 5 recites: the method according to Claim 4, “wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information.”

179. Takeda and Yan teach Claim 5 for at least the reasons discussed with respect to Claim 2. *See supra*, §XI.A.3.

7. Dependent Claim 6

180. Dependent Claim 6 recites: the method according to Claim 4, “further comprising transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission, wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information.”

181. Takeda teaches Claim 6 for at least the reasons discussed with respect to Claim 3. *See supra*, §XI.A.4. As discussed in reference to Claim 3, the UL grant including the DCI is transmitted from the BS to the user terminal for the user

terminal to identify the UL channel resource to transmit UCI to the BS. *Id.* FIG. 10, [0080], [0091]-[0092], [0107], [0113], [0115]-[0120], [0139]-[0140], [0177], [0220], [0120], FIG. 8-9.

8. Independent Claim 7

182. Independent Claim 7 recites all of the same elements as Claim 1, phrased as components of a user equipment for transmitting uplink (UL) control information.

183. The following subsections explain the similarity between the elements of Claim 7 and the elements of Claim 1, described above.

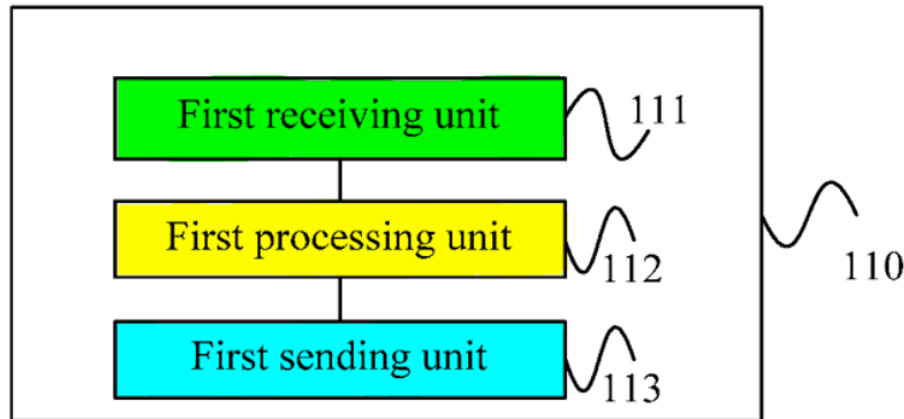
a. Element 7[pre]: A user equipment for transmitting uplink (UL) control information, comprising:

184. Takeda teaches the preamble of Claim 7, to the extent it is determined to be limiting.

185. Takeda is entitled “*User Terminal* and Wireless Communication Method.” Ex. 1007, 1. The Abstract, Technical Field, and Solution to Problem subsections also describe User Terminals. *Id.*, Abstract, [0001], [0010]; *see also* [0013], [0128]-[0129], [0165]-[0195], FIG. 12, FIG. 15, FIG. 16. The User Terminal (described as a hardware device identical to a user equipment as described in the ’463 Patent) is described for *transmitting UL control information (UCI)* throughout Takeda. *Id.*, [0165], [0170], [0183]-[0185]. Yan also discloses a user equipment, described as a “terminal device.” *See* Ex. 1010, 26:47-67; Ex.

1009, 36:2-14. FIG. 11 of Yan, reproduced below with annotations, illustrates the disclosed user terminal.

Ex. 1010, FIG. 11 (annotated)

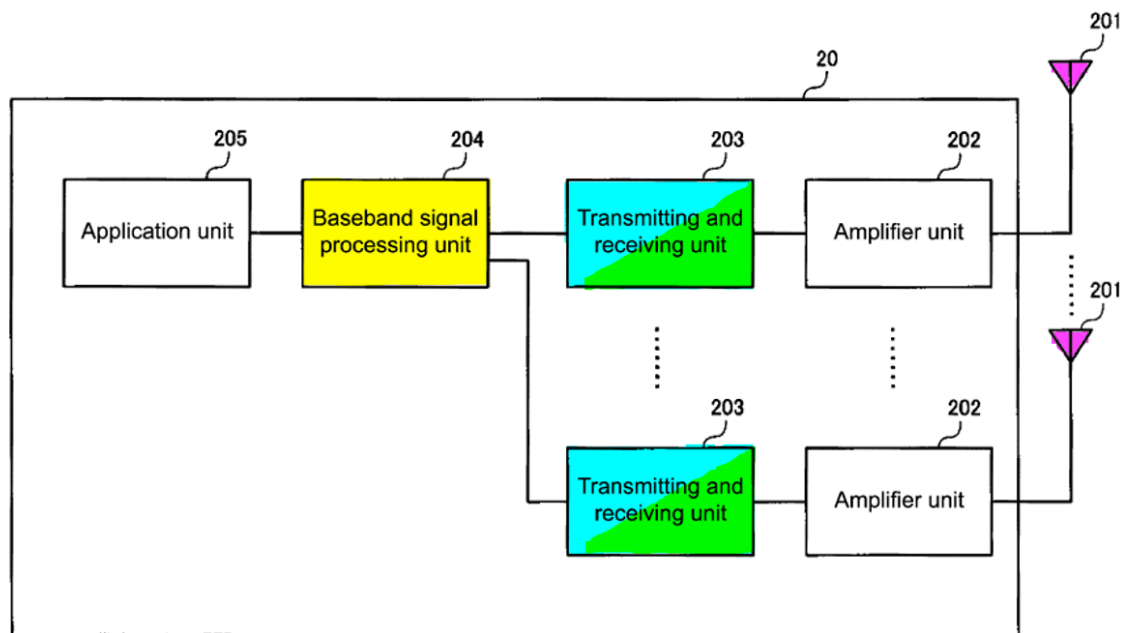


b. Element 7[a]: a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;

186. Takeda teaches Element 7[a] for at least the reasons discussed with respect to Element 1[a]. *See supra*, §XI.A.2.b. Moreover, Takeda’s discussion of user terminal hardware explicitly describes “transmitting and receiving units 203 [that] may be a transmitter/**receiver**, a transceiver circuit, or a transceiver device described based on common understanding in the technical field to which the present invention pertains.” Ex. 1007, [0172]. The transmitting and receiving unit 203 “receives a DL signal (for example, at least one of a DL control signal (also referred to as a DL control channel, DCI, or the like)).” *Id.*, [0170]. As discussed in reference to Claim 1 above, the received DL signals encompass UL control

channel resource set configuration information for UL control information transmission. In the below annotated FIG. 15 of Takeda, the Transmitting/Receiving Units (shown in blue) illustrate the transmitters/receivers (which may be embodied as a single entity or with “a transmission unit and a reception unit”). *Id.*, [0172].

Ex. 1007, FIG. 15 (annotated)



187. Moreover, Yan discloses that the terminal device includes “a first receiving unit 111, a first processing unit 112, and a first sending unit 113.” Ex. 1010, 26:52-55; Ex. 1009, 36:5-8.

c. Element 7[b]: a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set,

188. Takeda teaches Element 7[b] for at least the reasons discussed with respect to Element 1[b] and Element 1[c]. *See supra*, §XI.A.2.c-d.

189. Moreover, Takeda discloses a “baseband signal processing unit 204 provided in the user terminal 20 [that] includes a **control unit 401**.” Ex. 1007, [0173]. The baseband signal processing unit is shown in yellow in the reproduced FIG. 14 of Takeda above. The control unit 401 “may control ... detection of DCI for the user terminal 20 (at least one of DL assignment, UL grant, group DCI, common DCI, activation DCI, and deactivation DCI).” *Id.*, [0177]. The control unit 401 is also described as “**control[ling] the entire user terminal 20**” (*Id.*, [0174]), “control[ling] configuration of one or more BWPs (one or more DL BWPs and/or one or more UL BWPs)” (*Id.*, [0175]), “**control[ling] the transmission direction for each symbol in a time unit**” (*Id.*, [0178]), “control[ling] activation or deactivation of one or more UL BWPs (frequency bands for UL)” (*Id.*, [0184]), “control[ling] transmission of a random access channel and/or a **UL control channel** in UL BWP #1” (*Id.*, [0185]), and “**control[ling] activation of a UL BWP** (frequency band for DL) based on any one of DCI, a MAC (Medium Access Control) control element, a random access response, and a message for collision

resolution, or a DL BWP (frequency band for DL) associated with the UL BWP (frequency band for UL) (*third aspect*)” (*Id.*, [0186]). This control element thereby performs the steps discussed above in Elements 1[b] and 1[c]. Moreover, as discussed above, Yan discloses that the terminal device includes a “first processing unit,” which is equivalent to a “controller” as recited in Claim 7. Ex. 1010, 26:47-28:14; Ex. 1009, 36:2-38:5.

d. Element 7[c]: a transmitter configured to transmit the UL control information through the determined UL control channel resource,

190. Takeda teaches Element 7[c] for at least the reasons discussed with respect to Element 1[d]. *See supra*, §XI.A.2.e.

191. As discussed above and as shown in the illustrated FIG. 15, Takeda’s discussion of user terminal hardware explicitly describes “transmitting and receiving units 203 [that] may be a *transmitter*/receiver, a transceiver circuit, or a transceiver device described based on common understanding in the technical field to which the present invention pertains.” Ex. 1007, [0172]. The transmitting/receiving units may be constituted with “a transmission unit and a reception unit.” *Id.*

192. The transmitting/receiving units 203 work together with the baseband signal processing unit 204 for generating and transmitting UL control information. *See id.*, [0168]-[0169]. The UL data “is input from the application unit 205 to the

baseband signal processing unit 204.” *Id.* “The transmitting and receiving unit 203 converts the baseband signal output from the baseband signal processing unit 204 into a radio frequency band and ***transmits the radio frequency band.***” *Id.* Takeda describes that the UL transmission is sent via the determined control channel resource using the control unit 401 and mapping unit 403 of the baseband signal processing unit 204. *Id.*, [0189]-[0190] (“The mapping unit 403 maps the retransmission control information of the UL signal and the DL signal generated in the transmission signal generation unit 402 to a radio resource based on an indication from the control unit 401”).

193. Moreover, as discussed above, Yan discloses that the terminal device includes a “first sending unit,” which is equivalent to a “transmitter” as recited in Claim 7. Ex. 1010, 26:47-67; Ex. 1009, 36:2-14.

e. Element 7[d]: wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,

194. Takeda teaches Element 7[d] for at least the reasons discussed with respect to Element 1[e]. *See supra*, §XI.A.2.f.

f. Element 7[e]: wherein the each UL BWP is activated through downlink (DL) control information.

195. Takeda teaches Element 7[e] for at least the reasons discussed with respect to Element 1[f]. *See supra*, §XI.A.2.g.

9. Dependent Claim 8

196. Dependent Claim 8 recites: the user equipment according to Claim 7, “wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.”

197. Takeda and Yan teach Claim 8 for at least the reasons discussed with respect to Claim 2. *See supra*, §XI.A.3.

10. Dependent Claim 9

198. Dependent Claim 9 recites: the user equipment according to Claim 7, “wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission, wherein the one of the UL control channel resources is indicated from the base station through the DL control information.”

199. Takeda teaches Claim 9 for at least the reasons discussed with respect to Claim 3. *See supra*, §XI.A.4.

B. Ground 2: Claims 1-9 are rendered obvious by Marinier, Yan, and R1-1711853

200. Marinier, Yan, and R1-1711853 teach all of the limitations of Claims 1-9.

1. Motivation to Combine

201. A POSITA would have been motivated to combine the teachings of Marinier, Yan, and R1-1711853. Specifically, a POSITA would have been motivated to modify Marinier's methods for transmitting UL signals to incorporate Yan's methods for allocating UL channel resources to determine and use the most efficient UL channel resource based on a size of the UCI. Yan explains that the capacity of UL channel resources specified by a BS may be underutilized, or UCI bits may be discarded if the size of the UL channel does not meet the size of UCI. Ex. 1010, 2:1-6, Ex. 1009, 2:7-10. This mismatch of UL channel resource size and UCI size is applicable for any UL signaling methods, including Marinier's BWP-based UL signaling configuration. Therefore, a POSITA would have incorporated Yan's resource allocation methodology of determining a UL channel resource set based on UCI size to efficiently utilize Marinier's UL channel resources and to conserve UE power during UL signaling. Using Yan's resource allocation methodology within UL BWPs of Marinier would ensure that UCI bits are not discarded in ULs, and minimizes UL resource consumption by UEs during UL transmission. Ex. 1010, 2:1-6; Ex. 1009, 2:7-10.

202. A POSITA would have had a reasonable expectation of successfully combining the teachings of Marinier and Yan. Marinier and Yan both discuss UCI transmission and resource allocation for transmitting UCI. *See e.g.*, Ex. 1011,

[0064] (“[T]he WTRU may be configured to transmit uplink control information (UCI) in a given subframe based on a Physical Downlink Shared Channel (PDSCH) transmission received from a first serving site”); Ex. 1010, 1:16-19, 11:7-16, 12:34-41, 21:42-67; 21:43-57; Ex. 1009, 1:5-7, 14:30-15:4, 16:27-31, 29:5-14. These references also discuss that parameters provided by the BS control UL transmissions. In particular, Marinier discusses that PUCCH parameters received from the BS, including “preconfigured set[s] of parameters” that define dedicated PUCCH resources control UL transmissions. Ex. 1011, [0101], [0181]. These parameters are usable for UL transmissions in individual BWPs. *Id.*, [0130]. Yan discloses analogous features for determining a channel resource for UL signaling from resource sets included in configuration information from a BS. *See e.g.*, Ex. 1010, 12:34-55; Ex. 1009, 16:27-17:9. Therefore, a POSITA would have recognized that Marinier’s methods for selecting a “preconfigured set of parameters” for UL transmission would be adaptable to utilize Yan’s methods for determining UL resources within configuration information received from the BS, for example so that the UE can determine a UL resource using the configuration received from the BS.

203. Marinier discusses BWPs, but not in the context of 5G NR (which did not exist at the time of Marinier’s publication). A POSITA would have been motivated to modify the UL signaling method as taught by Marinier and Yan with

the teachings of R1-1711853 to incorporate 5G NR BWPs (and specifically the BWP activation protocol proposed in R1-1711853) to achieve improved power efficiency when transmitting UL signals from a UE using 5G NR. Marinier explains that its resource allocation methods provide power efficiency by selecting optimal UL resources for UCI. Incorporating 5G NR's effective use of BWPs and methods of activating those BWPs would further support Marinier's stated goal of conserving UE power because 5G NR BWPs allow UEs to transmit only a portion of the carrier frequency band, instead of the entire carrier frequency band.

204. A POSITA would have a reasonable expectation of success of combining Marinier's and Yan's teachings with R1-1711853's 5G NR BWPs and methods of activating those BWPs. Ex. Marinier discusses that UL signals can be transmitted on BWPs based on UL grants received as a part of DCI, which would be relevant for selecting UL resources in accordance with the combined teachings of Marinier and Yan. R1-1711853 explains that BWPs can be activated explicitly or implicitly using DCI, and so a POSITA would understand that R1-1711853's discussion would be usable with DCI activation of BWPs as discussed in Marinier. Thus, a POSITA would have had a reasonable expectation of success in combining the teachings of Marinier, Yan, and R1-1711853.

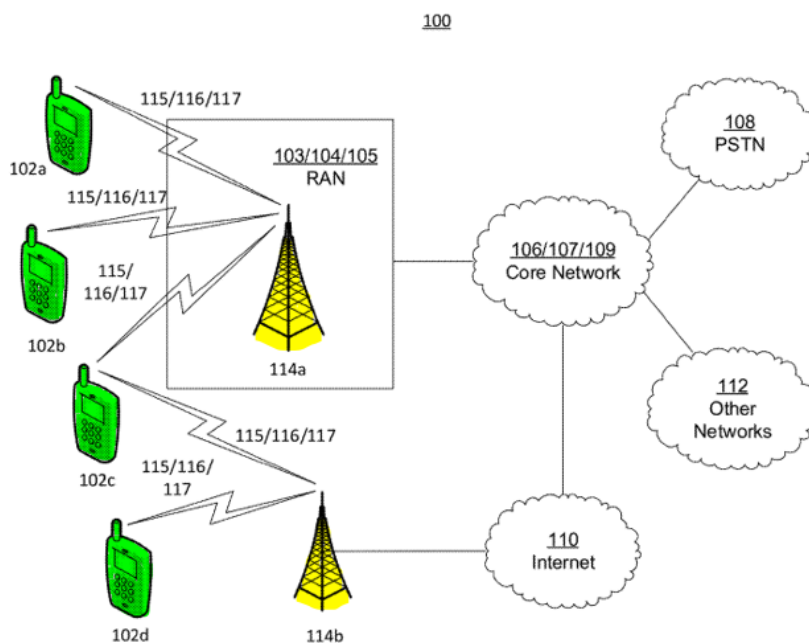
2. Independent Claim 1

a. Element 1[pre]: A method of transmitting uplink (UL) control information by a user equipment, the method comprising:

205. Marinier teaches the preamble of Claim 1, to the extent it is determined to be limiting.

206. Marinier discusses the “operation of a *wireless transmit/receive unit (WTRU)* in a network in which the scheduling functionality for the downlink and/or *the uplink transmissions* is distributed in more than one physical location and/or node may present some challenges.” Ex. 1011, [0003]. Paragraph [0020] states that *a WTRU “may include user equipment (UE).” See also id.*, FIG. 1A. The WTRU is “configured to transmit *uplink control information (UCI)*.” Ex. 1011, [0064].

Ex. 1011, FIG. 1A (annotated)



b. Element 1[a]: receiving, from a base station, UL control channel resource set configuration information for UL control information transmission;

207. Marinier teaches Element 1[a].

208. Marinier explains that the WTRU transmits UL signals using *transmission parameters that are provided by a serving site (e.g., via RRC signaling)* when transmitting to a serving site. *Id.*, [0084], [0098], [0101], [0103], [0110], [0111], [0134], [0181], [0185]-[0186], [0188]-[0194]. Marinier uses the term “scheduling site” or “serving site” interchangeably with eNodeB or Base Station. *See e.g., id.*, [0031]. As an example, *the WTRU may receive one or more sets of parameters as “an RRC configuration of parameters.” Id.*, [0181]. For

example, “*the WTRU may be configured to operate using multiple sets of transmission parameters and may select one or more appropriate set(s) of transmission parameters to use in a given subframe based on various criteria.*” *Id.*, [0181].

209. When received from a BS, Marinier’s RRC configuration of parameters that include the transmission parameters (e.g., multiple sets of transmission parameters) are equivalent to the “UL control channel resource set configuration information” in the ’463 Patent. As discussed in Ground 1, the ’463 Patent describes an example in which PUCCH resource sets are configured through higher layer signaling and contain information defining characteristics of a UL transmission and UL resources. Ex. 1001, 13:24-32. Specifically, the ’463 Patent describes the example in which PUCCH resource sets are configured through higher layer signaling to specify UL BWP configuration information. Ex. 1001, 13:24-32 (“Additionally, when configuration information on PUCCH resources configuring ***PUCCH resource sets configured through higher layer signaling*** contains UL BWP configuration information, according to PUCCH resource allocation indicated by PUCCH resource indication information of DL allocation DL control information, as in the case of the explicit UL BWP indication, the UE may perform an UL BWP activation or an UL BWP switching operation to an UL BWP configured by the one or more PUCCH resources”); *see also id.*, 12:46-53 (“***[O]ne***

or multiple PUCCH resource sets configured through the higher layer signaling may be defined as PUCCH format configuration information, UL BWP configuration information, and time/frequency domain PUCCH resource configuration information in the UL BWP (or additionally code-domain resource configuration information), or the like.”). Marinier similarly describes transmission parameters as defining characteristics of a UL transmission, including “a resource block assignment, a modulation and coding scheme (MCS), a demodulation reference signal (DM-RS) characteristic, transmission of aperiodic CSI, a HARQ characteristic, an SRS transmission” (Ex. 1011, [0084]), “power control parameters, set of virtual cell IDs, [and/or] dedicated PUCCH resources.” *Id.*, [0103]. Notably, Marinier’s explanation that the transmission parameters include “dedicated PUCCH resources” matches the ’463 Patent’s indication that “UL control channel resources” are contained in a UL control channel resource set that is “contained in the received UL control channel resource set configuration information.” Ex. 1001, Claim 1.

210. In the event that Marinier is found not to teach Element 1[a], Yan does, as discussed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.2.b, §XI.B.1.

c. Element 1[b]: determining one of UL control channel resource sets contained in the UL control channel resource set configuration information;

211. Marinier teaches Element 1[b].

212. As discussed above, Marinier explains that “the WTRU may be configured to operate using multiple sets of transmission parameters and may select one or more appropriate set(s) of transmission parameters to use in a given subframe based on various criteria.” Ex. 1011, [0181]. ***Those sets of parameters may include “dedicated PUCCH resources,” so that selecting a set of parameters includes selecting a set of dedicated PUCCH resources. Id., [0103].*** As discussed above, the sets of transmission parameters are a part of the RRC configuration of parameters received from the BS. *Id.*, [0181].

213. In the event that Marinier is found not to teach Element 1[b], Yan does, as discussed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.2.c, §XI.B.1.

d. Element 1[c]: determining one of UL control channel resources contained in the determined UL control channel resource set;

214. Marinier teaches Element 1[c].

215. Marinier states that “[t]he grants may direct the WTRU to transmit over on [sic] an uplink (UL) channel (e.g., Physical Uplink Control Channel

(PUCCH), Physical Uplink Shared Channel (PUSCH)).” *Id.*, [0062]. ***The WTRU therefore determines one of UL control channel resources according to the UL grant.*** As discussed above, the UL control channel resources (including “dedicated PUCCH resources”) are within sets of parameters that may be used by the WTRU to transmit to a serving site. *Id.*, [0062]-[0064], [0107], [0185], [0189], [0261]-[0262].

216. In the event that Marinier is found not to teach Element 1[c], Yan does, as discussed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.2.d, §XI.B.1.

e. Element 1[d]: transmitting UL control information through the determined UL control channel resource,

217. Marinier teaches Element 1[d].

218. Marinier provides several examples of transmitting UL control information through the determined UL control channel resource. *Id.*, [0062], [0098], [0101]-[0107], [0181], [0185]-[0186]. As a specific example, Marinier states “***a WTRU may be configured to transmit a PUCCH transmission to a first serving site and a PUSCH transmission to a second serving site in the same subframe. As an example, the WTRU may receive an UL grant for transmission to a first serving site in subframe(n), and the WTRU may also be configured to transmit HARQ feedback via the PUCCH to a second serving site in the same***

subframe(n). *Id.*, [0105]. As discussed above, the UL grant determines the channel resource for transmitting UL control information, and so the subsequent transmission is performed on the determined channel resource of the UL grant.

219. Moreover, Yan additionally teaches Element 1[d], as discussed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.2.e, §XI.B.1.

f. Element 1[e]: wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,

220. Marinier teaches Element 1[e].

221. Marinier explicitly discusses the use of BWPs for communicating between a WTRU and a serving site. In relevant part, paragraph [0130] states:

For example, a WTRU may be configured with one or more frequency subband subsets for one or more serving sites. For example, if *[sic]* first cell of a first serving site operates in the same frequency band and/or component carrier of a second cell of a second serving site, the MAC instances associated with the different serving sites may be configured to use different subband subsets within the frequency band/component carrier. In an example, ***the bandwidth (BW) utilized by the different serving sites may be divided into a plurality of BW parts. Each serving site may be configured to utilize one or more of the BW parts for communicating with the WTRU.*** For example, each BW part may be treated as a component carrier in carrier aggregation. For example, ***each BW part may include corresponding PUCCH and PUSCH resources.*** Some bandwidth parts may include PUCCH without a PUSCH (e.g., for CSI reporting to a serving site) and/or PUSCH without PUCCH.

222. The BWPs may be specifically configured for each WTRU. Marinier states “if frequency segregation is used, a serving site may segregate one or more specific control channel elements (CCEs), for example CCEs included in **WTRU-specific BW parts**, to WTRUs who may be configured with frequency segregation. Such frequency segregation may affect the search-space to be used by a transmission point for a given WTRU.” *Id.*, [0147].

223. Although Marinier is explicit about PUCCH resource sets being configured for each UL BWP configured for the WTRU (so that the combined teachings of Marinier and Yan teach Element 1[e]), Marinier’s disclosure and Yan’s disclosure focus on 4G uses. *See id.*, [0002].

224. Nevertheless, to the extent the combined teachings of Marinier and Yan are insufficient to render obvious Claim 1 of the ’463 Patent, the R1-1711853 disclosure explicitly discusses activation of BWPs by means of RRC signaling or DCI signaling, including based on grants included in DCI signaling. Ex. 1012, 2. R1-1711853 would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.B.1.

g. Element 1[f]: wherein the each UL BWP is activated through downlink (DL) control information.

225. Marinier and Yan in view of R1-1711853 teaches Element 1[f].

226. Marinier discusses UL grants within DCI that “direct the WTRU to transmit over on [sic] an uplink (UL) channel (e.g., Physical Uplink Control

Channel (PUCCH), Physical Uplink Shared Channel (PUSCH)).” *Id.*, [0062], [0103]. The WTRU uses the UL grant in the DCI to select the PUCCH resource from “dedicated PUCCH resources” within sets of parameters provided to the WTRU. *Id.*, [0103], [0185].

227. Upon receipt of a UL grant within DCI, the WTRU transmits a PUCCH transmission to a serving site. *Id.*, [0105]. A POSITA would understand that in order to transmit on a PUCCH, the frequency band including the PUCCH must be activated. As Marinier discloses that a BW parts (containing PUCCH resources) are used for communication between serving sites and WTRUs (*Id.*, [0130], [0147]), a POSITA would further recognize that a bandwidth part “containing” the PUCCH used for UL transmission would need to be activated to perform the UL transmission. *Id.* Consequently, where a UL grant included within DCI is used to select a PUCCH included in an inactive BW part for UCI transmission, a POSITA would understand that Marinier’s disclosure teaches that the UE activates the necessary BW part through the DL control information that contains the UL grant, so that the UE can transmit UCI on the PUCCH that is included in the BW part.

228. In the event that Marinier is found not to teach Element 1[f], R1-1711853 does and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.B.1. Ex. 1012. R1-1711853

explicitly states that activation of DL or UL bandwidth parts is performed “by means of DCI (explicitly or implicitly).” *Id.* Therefore, Marinier, Yan, and R1-1711853, considered collectively, teaches Element 1[f]. A POSITA would understand that UL BWPs (such as those described in Marinier) can be activated by means of DCI, such as Marinier’s DCI that contains a UL grant.

3. Dependent Claim 2

229. Dependent Claim 2 recites: the method according to Claim 1, “wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.”

230. Marinier teaches Claim 2.

231. Marinier states that the *selection of transmission parameters (which includes dedicated PUCCH resources) may be performed by the WTRU “based on DCI contents received for one or more of the serving sites.”* Ex. 1011, [0103], [0185]. *The “DCI may indicate multiple values for one or more transmission parameters” such as “a number of coded symbols for control information [or] a transport block size.”* *Id.* By selecting transmission parameters (including dedicated PUCCH resources) on the basis of DCI contents that may indicate a number of coded symbols for control information, Marinier’s WTRU is configured to determine a set of dedicate PUCCH resources based on the size (number of coded symbols) of the control information for upload. The ’463 Patent similarly

distinguishes between PUCCH resources for “i) short duration PUCCH transmitted using one to two symbols and ii) a long duration PUCCH transmitted using four to fourteen symbols in a single slot.” Ex. 1001, 7:48-62.

232. In the event that Marinier is found not to teach Claim 2, Yan does for the reasons listed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.3, §XI.B.1.

4. Dependent Claim 3

233. Marinier teaches Claim 3.

a. Element 3[pre]: The method according to claim 1, further comprising

234. Marinier, Yan, and R1-1711853 teach Element 3[pre] for at least the reasons discussed for Element 1[pre]. *See supra*, §XI.B.2.a.

b. Element 3[a]: receiving, from the base station, downlink (DL) control information containing information indicating the one of the UL control channel resources for the UL control information transmission,

235. Marinier teaches Element 3[a]. As discussed in reference to Element 1[a], Marinier states that “the WTRU may *receive grants (e.g., dynamic grants via a Physical Downlink Control Channel (PDCCH), semi-persistent scheduling (SPS) grants, other uplink grants, etc.) from each of the two scheduling sites. The grants may direct the WTRU to transmit over on an uplink (UL) channel*

(e.g., *Physical Uplink Control Channel (PUCCH)*, Physical Uplink Shared Channel (PUSCH)), and two or more grants may allocate resources to the WTRU that overlap in the frequency and/or time domain(s).” Ex. 1011, [0062]-[0064], [0070], [0098], [0101], [0103], [0107], [0108], [0171], [0181], [0185]-[0186], [0189]. Marinier explains that the UL grants or other information may be a part of downlink control information (DCI) transmitted on a PDCCH and/or E-PDCCH used for indicating appropriate resources to use in UL transmissions to the serving site. *Id.*, [0081], [0147]-[0148]. Marinier further explains that “sets of transmission parameters that may be used by the WTRU may be obtained by the WTRU in a number of ways” including “via downlink control signaling such as a PDCCH transmission” or RRC signaling. *Id.*, [0181], [0185]-[0189], [0194], [0261]-[0262].

236. In the event that Marinier is found not to teach Element 3[a], Yan does for at least the reasons discussed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.4.b, §XI.B.1.

c. Element 3[b]: wherein the one of the UL control channel resources is indicated from the base station through the DL control information.

237. Marinier teaches Element 3[b]. As discussed in reference to Element 3[a], Marinier discloses that the UL grants indicate a PUCCH resource to be used for UL transmissions, and those UL grants may be a part of DCI. *Id.*, [0062]-

[0064], [0070], [0098], [0101], [0103], [0107], [0108], [0171], [0181], [0185]-
[0186], [0189].

238. In the event that Marinier is found not to teach Element 3[b], Yan does for at least the reasons discussed in Ground 1 and would be used to modify Marinier for the reasons explained in the motivation to combine section. *See supra*, §XI.A.4.c, §XI.B.1.

5. Independent Claim 4

239. Independent Claim 4 recites all of the same elements as Claim 1, but these elements are recited from the perspective of the base station in Claim 4, instead of from the perspective of the user equipment, as recited in Claim 1.

240. The following subsections explain the similarity between the elements of Claim 4 and the elements of Claim 1, described above.

a. Element 4[pre]: A method of receiving uplink (UL) control information by a base station, the method comprising:

241. UCI transmitted by a UE (as recited in Claim 1) is received by a BS (as recited in Claim 4).

242. Marinier and Yan teach Element 4[pre] for at least the reasons discussed with respect to Element 1[pre]. *See supra*, §XI.B.2.a. Moreover, the summary section explicitly states that a “WTRU is configured to transmit to a plurality of serving sites.” Ex. 1011, [0004]. Moreover, Marinier explains that base

stations “may be configured to transmit and/or *receive wireless signals* within a particular geographic region.” *Id.*, [0022], [0072], [0101].

b. Element 4[a]: transmitting UL control channel resource set configuration information for transmitting UL control information to a user equipment;

243. Marinier teaches Element 4[a] for at least the reasons discussed with respect to Element 1[a]. *See supra*, §XI.B.2.b. As discussed therein, the grants received by the WTRU are *from scheduling sites*. Ex. 1011, [0062]-[0064], [0070], [0098], [0101], [0103], [0107], [0108], [0171], [0181], [0185]-[0186], [0189].

244. If Marinier is found not to teach Element 4[a], Yan does, as discussed in Ground 1 above, and in the above discussion of Claim 1 in Ground 2. The discussion of Claim 1 above, provides a discussion of motivation to combine Marinier, Yan, and R1-1711853 for analogous limitations.

c. Element 4[b]: receiving the UL control information through one of UL control channel resources configuring one of UL control channel resource sets contained in UL control channel resource set configuration information,

245. Marinier teaches Element 4[b] for at least the reasons discussed with respect to Elements 1[c] and 1[d]. *See supra*, §XI.B.2.d-e. As discussed therein, the WTRU transmits UL control information *to serving sites* based on UL grants provided by the serving sites. Ex. 1011, [0062]-[0064], [0098], [0101]-[0107], [0181], [0185]-[0186], [0189], [0261]-[0262].

246. If Marinier is found not to teach Element 4[a], Yan does, as discussed in Ground 1 above, and in the above discussion of Claim 1 in Ground 2. The discussion of Claim 1 above, provides a discussion of motivation to combine Marinier, Yan, and R1-1711853 for analogous limitations.

d. Element 4[c]: wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,

247. Marinier and R1-1711853 teach Element 4[c] for at least the reasons discussed with respect to Element 1[e]. *See supra*, §XI.B.2.f.

e. Element 4[d]: wherein the each UL BWP is activated through downlink (DL) control information.

248. Marinier and R1-1711853 teach Element 4[d] for at least the reasons discussed with respect to Element 1[f]. *See supra*, §XI.B.2.g.

6. Dependent Claim 5

249. Dependent Claim 5 recites: the method according to Claim 4, “wherein the one of the UL control channel resource sets for the UL control information transmission is determined based on a size of the UL control information.”

250. Marinier, Yan, and R1-1711853 teaches Claim 5 for at least the reasons discussed with respect to Claim 2. *See supra*, §XI.B.3.

7. Dependent Claim 6

251. Dependent Claim 6 recites: the method according to Claim 4, “further comprising transmitting, to the user equipment, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission, wherein the one of the UL control channel resources is indicated to the user equipment through the DL control information.”

252. Marinier teaches Claim 6 for at least the reasons discussed with respect to Claim 3. *See supra*, §XI.B.4.

8. Independent Claim 7

253. Independent Claim 7 recites all of the same elements as Claim 1, phrased as components of a user equipment for transmitting uplink (UL) control information.

254. The following subsections explain the similarity between the elements of Claim 7 and the elements of Claim 1, described above.

a. Element 7[pre]: A user equipment for transmitting uplink (UL) control information, comprising:

255. Marinier and Yan teach Element 7[pre] for at least the reasons discussed with respect to Element 1[pre]. *See supra*, §XI.B.2.a. Marinier also describes WTRUs “may be configured to transmit and/or receive wireless signals and may include user equipment (UE).” Ex. 1011, [0020].

b. Element 7[a]: a receiver configured to receive, from a base station, UL control channel resource set configuration information for UL control information transmission;

256. Marinier and Yan teach Element 7[a] for at least the reasons discussed with respect to Element 1[a]. *See supra*, §XI.B.2.b.

257. Moreover, Marinier describes that the WTRU may include “a transceiver 120, [and] a transmit/receive element 122.” Ex. 1011, [0032]-[0036]. The transmit/receive element 122 is described as being “configured to transmit signals to, or receive signals from, a base station.” *Id.*, [0034]. The transmit/receive element 122 may be a single element or multiple elements (e.g., a receiver and a transmitter). Ex. 1011, [0034]. These elements perform the transmission and reception steps discussed in Claim 1.

c. Element 7[b]: a controller configured to determine one of UL control channel resource sets contained in the UL control channel resource set configuration information, and determine one of UL control channel resources configuring the determined one UL control channel resource set,

258. Marinier and Yan teach Element 7[b] for at least the reasons discussed with respect to Element 1[b] and Element 1[c]. *See supra*, §XI.B.2.c-d. Mariner’s discussion also states that the WTRU includes a “processor” that may perform “any other functionality that enables the WTRU 102 to operate in a wireless environment.” Ex. 1011, [0032]-[0039]. This functionality includes the steps discussed in Claim 1.

d. Element 7[c]: a transmitter configured to transmit the UL control information through the determined UL control channel resource,

259. Marinier and Yan teach Element 7[c] for at least the reasons discussed with respect to Element 1[d]. *See supra*, §XI.B.2.e. As discussed above, Marinier describes a “transmit/receive element 122” that may be embodied as a single component or multiple components (e.g., a transmitter and a receiver). Ex. 1011, [0033]-[0034].

e. Element 7[d]: wherein the UL control channel resource sets are configured for each UL bandwidth part (BWP) configured for the user equipment,

260. Marinier and R1-1711853 teach Element 7[d] for at least the reasons discussed with respect to Element 1[e]. *See supra*, §XI.B.2.f.

f. Element 7[e]: wherein the each UL BWP is activated through downlink (DL) control information.

261. Marinier and R1-1711853 teach Element 7[e] for at least the reasons discussed with respect to Element 1[f]. *See supra*, §XI.B.2.g.

9. Dependent Claim 8

262. Dependent Claim 8 recites: the user equipment according to Claim 7, “wherein the determining of the one of the UL control channel resource sets is performed based on a size of the UL control information.”

263. Marinier, Yan, and R1-1711853 teach Claim 8 for at least the reasons discussed with respect to Claim 2. *See supra*, §XI.B.3.

10. Dependent Claim 9

264. Dependent Claim 9 recites: the user equipment according to Claim 7, “wherein the receiver receives, from the base station, DL control information containing information that indicates the one of the UL control channel resources for the UL control information transmission, wherein the one of the UL control channel resources is indicated from the base station through the DL control information.”

265. Marinier teaches Claim 9 for at least the reasons discussed with respect to Claim 3. *See supra*, §XI.B.4.

C. Secondary Considerations

266. U.S. Patent Number 10,980,007 to Oh (“Oh”) was filed the same day as the ’463 Patent and claims priority to a provisional application filed on the same priority date as is alleged for the ’463 Patent (September 29, 2017). Oh discloses the elements claimed by the ’463 Patent. For example, regarding 1[pre], Oh teaches “a method for transmitting uplink control information in a wireless communication system.” Ex. 1032, Abstract. Regarding element 1[a], Oh teaches a terminal (UE) which receives “configuration information on a plurality of bandwidth parts (BWPs).” Ex. 1032, 2:58-3:4. The configuration information includes “a configuration on one or more uplink control channel resource for each of the plurality of BWPs.” Ex. 1032, Claim 1, 15:48-59 (“PUCCH configuration

information”). Regarding elements 1[b]-1[d], Oh teaches that the terminal then “identif[ies] an uplink control channel resource for transmitting acknowledgment information” (which a POSITA would understand is a type of UL control information) and “transmit[s] the acknowledgment information on the identified uplink control channel resource.” Ex. 1032, 2:58-3:4. Regarding element 1[e], Oh teaches that “PUCCH transmission resources may be configured for ... BWPs.” Ex. 1032, 15:48-59. As discussed with regards to 1[a] of Ground 1, a POSITA would further understand it to be obvious to group multiple PUCCH transmission resources into a “set.” *See supra*, §VII.A.2.b. Regarding element 1[f], Oh teaches that a “**BWP may be activated** or deactivated via at least one of higher layer signaling, **DCI conveyed in a DL control channel**, MAC CE, and BWP activation/deactivation timer.” Ex. 1032, 15:44-47.

267. The above teachings of Oh provide additional corroboration for each of the combinations, evidencing that there was not only a rationale to combine but others did in fact combine these references. It further evidences the reasonable expectation of success and that the claims of the '463 Patent are obvious in light of the above Grounds. These two alleged inventions were independently made and filed on the same day, demonstrating that a POSITA would have been motivated by the advancements from 4G to 5G occurring at the time. The mutual teachings of Oh and the '463 Patents demonstrate that it would have been obvious to a POSITA

at priority date of the '463 Patent to apply resource allocation methods known in 4G to the context of 5G BWPs.

XII. CONCLUSION

The opinions and conclusions expressed in this Declaration represent my current opinions and conclusions, and the bases thereof. They may be revised and/or supplemented should additional information or insights become available to me.

As discussed above, it is my opinion that Claims 1-9 of the '463 Patent are obvious and should be canceled as unpatentable over the prior art.

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code.

Executed November 13, 2024.

A handwritten signature in black ink, appearing to be "Ericsson", written over a horizontal line.