

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner

v.

ASUS TECHNOLOGY LICENSING INC.,
Patent Owner.

Patent No. 10,187,878 to Lin et al.
IPR2024-00614

**DECLARATION OF HARRY V. BIMS, Ph.D. IN SUPPORT
OF PETITION FOR *INTER PARTS* REVIEW**

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1001	U.S. Patent No. 10,187,878 (“the ’878 patent”)
1002	File history of U.S. Patent No. 10,187,878 (“’878FH”)
1003	Declaration of Harry V. Bims, Ph. D. (“Bims”)
1004	U.S. Patent No. 9,762,372 to Ekpenyong et al. (“Ekpenyong”)
1005	R2-153374, <i>Uplink latency reduction for synchronized UEs</i> (Aug. 14, 2015) (“Huawei-374”) Agenda Item: 7.11 Source: Huawei, HiSilicon 3GPP TSG-RAN WG2 Meeting #91 Beijing, China, Aug 24-28, 2015
1006	R2-154192, <i>Further analysis on uplink transmission skipping</i> (Sept. 26, 2015) (“Huawei-192”) Agenda Item: 7.10.1 Source: Huawei, HiSilicon 3GPP TSG-RAN WG2 Meeting #91bis Malmo, Sweden, 05 – 09 October 2015
1007	R2-153332, <i>Skipping uplink transmission with no data to transmit</i> (Aug. 14, 2015) (“Samsung-332”) Agenda Item: 7.11 Source: Samsung 3GPP TSG-RAN WG2 Meeting #91 Beijing, China, Aug 24-28, 2015
1008	R2-153333 (Change Request for 36.321), <i>Skipping uplink transmission with no data to transmit</i> (Aug. 14, 2015) (“Samsung-333”) Source: Samsung

Exhibit	Description
	3GPP TSG-RAN WG2 Meeting #91 Beijing, China, Aug 24-28, 2015
1009	3GPP TS 36.212 V13.0.0 (2015-12) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 13) (January 5, 2016) (“3GPP-36.212”)
1010	3GPP TS 36.213 V12.5.0 (2015-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 12) (March 25, 2015) (“3GPP-36.213”)
1011	U.S. Patent No. 10,129,782 to Novlan et al. (“Novlan”)
1012	Stefania Sesia, Issam Toufik, and Matthew Baker (eds.), <i>LTE—The UMTS Long Term Evolution : from theory to practice</i> , 2d ed., John Wiley & Sons Ltd. (2011) (“LTE-UMTS”) TK5103.4883.S47 2011 621.3845’6-dc22 2010039466 Print ISBN: 978040660256 (H/B) ePDF ISBN: 9780470978511 oBook ISBN: 9780470978504 epub ISBN: 9780470978641
1013	R1-073322, <i>UL physical channel for CQI report</i> (Aug. 15, 2007) Agenda Item: 7.2.4 Source: Sharp 3GPP TSG RAN WG1 Meeting #50 Athens, Greece, August 20-24, 2007
1014	R1-073858, <i>Way forward for CQI reporting</i> (Aug. 29, 2007) Agenda Item: 7.2.4

Exhibit	Description
	Source: Ericsson et al. 3GPP TSG-RAN WG1 Meeting #50 Athens, Greece, Aug 20 – 24, 2007
1015	R1-074383, <i>Proposed way forward for CQI reporting</i> (Oct. 3, 2007) Agenda Item: 7.2.4 Source: Nokia Siemens Networks et al. 3GPP TSG-RAN WG1 Meeting #50bis Shanghai, China, Oct 8 – 12, 2007
1016	RP-150465, <i>New SI proposal: Study on Latency reduction techniques for LTE</i> (March 12, 2015) Agenda Item: 13.1.2 Source: Ericsson, Huawei 3GPP TSG RAN Meeting #67 Shanghai, China, Mar 9-12, 2015
1017	RP-150310, <i>Motivation for new SI: Study on Latency reduction techniques for LTE</i> (March 3, 2015) Agenda Item: 13.1.2 Source: Ericsson 3GPP TSG RAN Meeting #67 Shanghai, China, Mar 9-12, 2015
1018	3GPP TS 36.321 V12.5.0 (2015-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification (Release 12) (March 25, 2015)

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1019	3GPP TS 36.331 V12.5.0 (2015-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (Release 12) (March 27, 2015)
1020	3GPP TR 36.881 V0.6.0 [R2-161964] (2016-02) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Study on latency reduction techniques for LTE (Release 13) (Feb. 19, 2016)
1021	3GPP TS 36.212 V13.6.0 (2017-06) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 13) (June 23, 2017)
1022	3GPP TS 36.213 V13.6.0 (2017-06) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 13) (June 23, 2017)
1023	3GPP TS 36.321 V12.6.0 (2015-06) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification (Release 12) (June 30, 2015)
1024	Declaration of Craig Bishop (“Bishop”)
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I, Harry V. Bims, Ph.D., declare as follows:

I. Introduction and Qualifications

1. I am over the age of 21 and am competent to make this declaration.
2. I have been retained on behalf of Petitioner Samsung Electronics Co., Ltd. (“Samsung”) to provide my opinions regarding the validity of claims 1-28 of U.S. Patent No. 10,187,878 (Ex-1001, the “’878 patent”). I submit this declaration based on my personal knowledge and in support of Samsung’s *inter partes* review Petition (the “Petition”) against the ’878 patent.
3. I have been asked to provide my independent analysis of the ’878 patent in light of the materials cited below and my knowledge and experience in this field during the relevant period. I have been asked to consider whether the references cited in the Petition render obvious the invention described by claims 1-28.
4. I am being compensated at my normal hourly rate for my time. My compensation is not contingent in any way on the content of my analysis or the outcome of this proceeding. I am not and never have been an employee or agent of Samsung.
5. My opinions are based on my study, experience, and background discussed below, informed by my extensive experience regarding the subject matter of the ’878 patent and the related prior art. For more than 30 years, since approximately 1981, I have studied, designed, and worked in the field of

telecommunications, including wireless communications. During this period, I have designed and implemented various products involving cellular communication technology.

A. Education Background

6. My findings are also based on my education as an electrical engineer. I received a B.S. in Computer and Systems Engineering from Rensselaer Polytechnic Institute in 1985.

7. I received an M.S. in Electrical Engineering in 1988 and a Ph.D. in Electrical Engineering in 1993, both from Stanford University. As a graduate student, I studied the principle of Digital Communications theory, including data modulation and demodulation, signal constellations and lattices, channel estimation, equalization, filtering, precoding, synchronization, and trellis coding.

8. My Ph.D. thesis addressed the application of trellis coding and precoding to a digital modulation system, and was titled “Trellis Coding for Multi-Level, Partial Response Continuous Phase Modulation with Precoding.”

B. Professional Experience

9. After receiving my Ph.D. in 1993, I worked for Glenayre Technologies – Wireless Access Group, where I worked on applications for wireless communication, including inventing, designing, and building a patented two-way pager test system and co-developing a wireless application protocol.

10. In January of 1999, I launched a technology consulting company, Protocomm Systems Inc., which focuses on the development of advanced wireless communications protocols and related software implementations for wireless product companies.

11. From 1999 to 2001, I was also the Director of Software Architecture for Symmetry Communications System. In this position, I was responsible for the software architecture for core SGSN (Serving GPRS Support Node) and GGSN (Gateway GPRS Support Node) products for the GPRS (Generic Packet Radio Services) market. I also held management responsibility for the Firmware, Hardware, Performance, and Systems Engineering Groups.

12. In 2001, I developed a business plan for building network infrastructure for Institute of Electrical and Electronics Engineers (“IEEE”) 802.11 standard (“Wi-Fi”) enterprise networks, and then later that year founded AirFlow Networks, Inc. where I invented and received eleven patents on a distributed antenna system design for wireless networks, based on the 802.11 wireless local area network specification.

13. I am currently the President of Protocomm Systems, LLC and Bims Laboratories, LLC, both of which I founded. As the President of Bims Laboratories, I perform technical research in wireless technology standards, such as UMTS, LTE/4G, 5G, Wi-Fi, Bluetooth, and other network communication protocols. I am named as an inventor of twenty-three telecommunications related patents.

14. In addition, I am a named Technical Expert and former Vice-Chair and Secretary of the IEEE 802.16 Working Group, which develops technical standards for the wireless protocol commonly known as WiMax. I am also a voting member of the IEEE 802.11 Working Group (which develops technical standards for WiFi), and the IEEE 802.15 Working Group (which develops standards for a variety of specialty wireless networks). Within the IEEE 802.15 Working Group, I am the technical editor for IEEE 802.16t, an amendment to the WiMAX standard that supports long-range wireless networks for the railroad industry. Within the IEEE 802.11 Working Group, I routinely participate and vote on discussions relating to the design of wireless communications, including packet prioritization, transmission, acknowledgment, and retransmission.

15. Attached as Appendix A is my curriculum vitae, which includes a more detailed statement of my professional qualifications, including education, publications, honors and awards, professional activities, consulting engagements, and other relevant experience.

II. Methodology and Materials Considered

16. As described in more detail below, based on my experiences, I understand and know the capabilities of a person of ordinary skill in the art of the '878 patent in 2016, when the application to which the '878 patent claims priority was filed. I have relevant personal knowledge and experience, in addition to working

directly with many such persons in these fields during that time frame.

17. I have also relied on my review and analysis of the prior art cited in the Petition, information provided to me in connection with this case, and information I have independently reviewed.

18. In forming my opinions, I have been asked to review the '878 patent including the specification and claims 1-28 (the "Challenged Claims"). I have also considered the materials cited herein, including those itemized in the Table of Exhibits that precedes this declaration.

19. My opinions are based on the materials I reviewed and my knowledge and professional judgment. My opinions have also been guided by my understanding of how a person of ordinary skill in the art would have understood the claims of the '878 patent in the relevant time frame.

20. I also understand from counsel that the prior art references cited herein (e.g., Ex-1004 through Ex-1020 and Ex-1023) qualify as prior art under U.S. law.

21. In my analysis below, emphasis in my citations has been added unless otherwise noted. Likewise, annotations to images and figures (typically yellow highlighting) has been added unless otherwise noted.

22. I reserve the right to supplement and amend any of my opinions in this declaration based on documents, testimony, and other information that becomes available to me after the date of this declaration.

III. Legal Standards

23. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the challenged claims.

24. I have been informed that there are two ways in which prior art may render a patent claim unpatentable. First, I have been informed that the prior art can “anticipate” a claim. Second, I have been informed that the prior art can render a claim “obvious” to a person of ordinary skill in the art. I understand that a claim is patentable if it was not anticipated and would not have been obvious by the prior art at the effective filing date of the patent. In this declaration, I only address obviousness.

25. I have been informed that a dependent claim is a patent claim that refers back to another patent claim. I have been informed that a dependent claim includes all of the limitations of the claim to which it refers.

26. I have been asked to provide my opinions as to whether the cited prior art renders obvious claims 1-28 of the '878 patent from the perspective of a person of ordinary skill in the art at the '878 patent's earliest possible effective filing date

in 2016, as described in more detail below.

27. I have been informed that in *inter partes* review proceedings, such as this one, the party challenging the patent bears the burden of proving unpatentability by a preponderance of the evidence. I understand that a preponderance of the evidence means “more likely than not.”

28. For purposes of this declaration, I have been asked to provide my opinions on issues regarding unpatentability. I have been informed of the following legal standards, which I have applied in forming my opinions.

A. Level of Ordinary Skill

29. I understand that my assessment of the claims of the '878 patent must be undertaken from the perspective of what would have been known or understood by a person having ordinary skill in the art, reading the '878 patent on its priority date and in light of the specification and file history of the '878 patent. I will refer to such a person as a “POSITA.”

30. I understand that my analysis and opinions expressed in this declaration must be rendered based on the perspective of a POSITA as of the priority date of the '878 patent. I also understand that a POSITA is a hypothetical person who is presumed to know the relevant art at the time of the alleged invention claimed in the '878 patent.

31. I further understand that in determining the level of ordinary skill in the

art, I am to consider factors including:

- the type of problems encountered in the art or field of invention,
- prior art solutions to those problems,
- the rapidity with which innovations are made,
- sophistication of the technology, and
- the educational level of active workers in the field.

32. I have been instructed to assume a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors discussed above.

33. I understand that a POSITA is a person of ordinary creativity, but not an automaton, and that a POSITA can often fit multiple patents or prior art references together like pieces of a puzzle as a result of this ordinary creativity. I also understand that I may consider the inferences and creative steps that a POSITA would employ. In addition, I understand that a POSITA would necessarily have been capable of understanding the scientific and engineering principles applicable to the pertinent art. I also understand that when I consider what would have been obvious to a POSITA, I am not considering what would have been obvious to me at the time, nor to the inventors, judges, laymen, those skilled in other arts, or to geniuses in the art.

B. Prior Art

34. I have been advised and understand that the information used to

evaluate whether an invention was new and not obvious when made is generally referred to as “prior art.” I understand that prior art includes patents and printed publications that existed before the earliest claimed priority date or the earliest filing date of the patent (which I have been informed is also called the “effective filing date”).

35. I have been informed and understand that a patent or published patent application is prior art if it was filed before the effective filing date of the claimed invention.

36. I have also been informed and understand that a printed publication is prior art if it was publicly available before the earliest filing date and could be located by a POSITA exercising reasonable diligence.

C. Obviousness

37. I understand that a claim may be invalid if the subject matter described by the claim as a whole would have been obvious to a POSITA in view of a prior art reference, or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a POSITA, and that the asserted claims of the patent should be read from the point of view of such a person at the time the claimed invention was made. I further understand that a POSITA is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit and all analogous prior art. I

understand that obviousness in an *inter partes* review proceeding is evaluated using a preponderance of the evidence standard, which means that the claims must be more likely obvious than nonobvious.

38. I also understand that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention, and the level of ordinary skill in the pertinent art involved. I understand as well that a prior art reference should be viewed as a whole. I understand that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSITA. I also understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or in a different one, so that if a POSITA can implement a predictable variation, the variation is likely obvious;
- If a technique has been used to improve one device, and a POSITA would have recognized 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;

- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;
- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;
- "Common sense" teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSITA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSITA is also a person of ordinary creativity, not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was "obvious to try," particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSITA would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

39. I have been informed that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For my obviousness analysis, counsel for Petitioner instructed me to assume that the effective filing date is April 1, 2016, and that I should assume this is the date of invention for the Challenged Claims. My opinions would not change

if I assumed a later date of invention.

IV. Claim Construction

40. I understand that claim terms in an IPR are generally interpreted according to their ordinary and customary meaning. I further understand that the claims are read in light of the patent's specification and that claims themselves often provide significant guidance as to the meaning of a particular term. I also understand that extrinsic evidence may be helpful when construing a claim term, but that it is less relevant than the intrinsic evidence and is often unreliable.

41. The Challenged Claims use terms and phrases that would have been easily understood by a POSITA, and the prior art discussed herein would disclose the Challenged Claims under any reasonable constructions. Thus, I believe no formal claim constructions are required.

V. 3GPP Overview

42. The 3rd Generation Partnership Project ("3GPP") is a well-known consortium of partnership organizations that develop standards for mobile telecommunications. 3GPP has developed standards for the GSM ("2G"), UMTS ("3G"), LTE ("4G"), and 5G NR ("5G") cellular standards.

43. Generally, the 3GPP holds technical standards group meetings several times a year to propose and discuss new standards and/or changes to existing standards. 3GPP materials are made available to the public on the 3GPP website.

44. 3GPP is organized into several Technical Specification Groups (“TSGs”), which “prepare, approve and maintain the 3GPP Technical Specifications and Technical Reports, under the chair-ship of an elected leadership.” *See* 3GPP website at <https://www.3gpp.org/3gpp-groups>. Each TSG consists of several “Working Groups” (“WGs”). For example, the Radio Access Network TSG includes the RAN WG1, “Radio Layer 1” working group, referred to as either TSG RAN WG1 or sometimes simply as RAN1.

45. 3GPP organizes its published standards documents into “Releases.” Each “Release” is associated with a defined set of technical features that are updated and refined over time in successive document versions within the release. A new Release is introduced when a new set of technical features are added to the cellular standard, and this can occur at any time. As a result, multiple releases of the same cellular standard are often maintained and developed in parallel. A table of Releases dating back to 1998 is provided below:

Name	Status	Start Date	End Date (Meeting #)	Closure Date (Meeting #)
Release 19	Open	2021-06-18		
Release 18	Open	2019-09-16		
Release 17	Open	2018-06-15	2022-06-10 (SA#96)	
Release 16	Frozen	2017-03-22	2020-07-03 (SA#88-e)	
Release 15	Frozen	2016-06-01	2019-06-07 (SA#84)	
Release 14	Frozen	2014-09-17	2017-06-09 (SA#76)	
Release 13	Frozen	2012-09-30	2016-03-11 (SA#71)	
Release 12	Frozen	2011-06-26	2015-03-13 (SA#67)	
Release 11	Frozen	2010-01-22	2013-03-06 (SA#59)	
Release 10	Frozen	2009-01-20	2011-06-08 (SA#52)	
Release 9	Frozen	2008-03-06	2010-03-25 (SA#47)	

Release 8	Frozen	2006-01-23	2009-03-12 (SA#43)	
Release 7	Closed	2003-10-06	2008-03-13 (SA#39)	2014-09-17 (SA#65)
Release 6	Closed	2000-03-28	2005-09-28 (SA#29)	2014-09-17 (SA#65)
Release 5	Closed	2000-05-01	2002-09-12 (SA-#17)	2014-09-17 (SA#65)
Release 4	Closed	1998-08-01	2001-06-21 (SA-#12)	2014-09-17 (SA#65)

46. A “Frozen” Release is one that can have no further functionality changes, other than to align earlier stages with later stages. The “end date” is indicative only, since for each Release, a considerable number of refinements and corrections can be expected for at least two years following this date.

47. To provide additional context for the meaning of a release and the frequency with which they occur, the first release of the 3GPP standards that was marketed as the LTE standard was Release 8. The ’878 patent cites various Release 12 and Release 13 specifications. These were still part of the LTE standard. There are multiple releases between each major upgrade in cellular operator equipment.

48. Each version of each release is documented in technical specifications (“TSs”) covering the functionality of the cellular network (including cellular end-user devices), spanning the management functionality of the core network, to the functionality of the air interface transmission and reception, to interoperability with other networks, or network security.

VI. The ’878 Patent

A. General Overview

49. The ’878 patent concerns a standard wireless network having user

equipment (“UE,” e.g., a wireless communication device) and base stations (“BSs”).
(Ex-1001 at 3:53-60.)

50. UEs are devices such as smart phones that may support “the standard offered by a consortium named ‘3rd Generation Partnership Project’ referred to herein as 3GPP.” (Ex-1001 at 3:1-18, 3:57-60.) 3GPP was (and still is) a well-known consortium that specifies the details of well-known communications networks, including the networks that are marketed as LTE and 5G.

51. The ’878 patent is primarily concerned with UE uplink (“UL”) transmissions. Typically, a UE would receive a UL grant to send data or control information to a BS in a given transmission time interval (“TTI”). (Ex-1001 at 6:30-34.) The 3GPP standard traditionally required the UE to send padding transmissions to the BS pursuant to its UL grant even when it had no data or other useful information to send. (*Id.*)

52. Shorter TTIs and pre-scheduled UL grants were later standardized to reduce latency and improve performance, but these changes made empty padding transmissions more wasteful. (*Id.* at 5:37-6:41.)

53. To address these problems, the ’878 patent suggests that a UE should transmit data and/or control information on a data channel called “PUSCH” (Physical Uplink Shared Channel) pursuant to a UL grant, and skip the UL grant (rather than send empty padding) otherwise. (*Id.* at 1:41-54, claims 1-28.)

54. This was not new or inventive when it was claimed in the '878 patent.

My analysis in §§VIII-IX shows this to be the case in view of various prior art references. The specification of the '878 patent also shows this was the case. In exhibit 1026, for example, one can see large portions of the '878 patent are copied and pasted from prior-art 3GPP documents. I highlight some of those disclosures in the next few paragraphs.

55. As a first example, the '878 patent quotes 3GPP TR 36.881 v0.6.0, which discloses that UEs should be allowed to skip UL grants when they have nothing to send:

8.2 UL Grant reception

In current specifications, the UE sends a MAC PDU containing a MAC CE for padding BSR and optionally padding bits in response to an allocated UL dynamic or configured grant even if no data is available for transmission in the UE buffer and no other regular MAC CE is needed to be sent. It is beneficial to allow UEs to skip (most) dynamic and configured uplink grants if no data is available for transmission. With frequent UL grants, allowing skipping UL grants may decrease UL interference and improve UE battery efficiency. The UE will continue to send one or more regular MAC CE(s), if any. The eNB may enable skipping UL grants by RRC dedicated signalling.

(Ex-1020-36.881 at §8.2; *see* Ex-1001 at 6:30-39 (“Detailed result of the study can be found in 3GPP TR 36.881 v0.6.0 as quoted below.”))

56. As a second example, the '878 patent quotes 3GPP TS 36.212 v13.0.0, which discloses transmitting physical control information on a data channel (PUSCH) when there was no UL data to transmit:

5.2.4 Uplink control information on PUSCH without UL-SCH data

When control data are sent via PUSCH without UL-SCH data, the following coding steps can be identified:

- Channel coding of control information
- Control information mapping
- Channel interleaver

(Ex-1009-3GPP-36.212 at §5.2.4; *see* Ex-1001 at 34:26-32 (copying the same); *see also* Ex-1009-3GPP-36.212 at §5.2.4.1 (referencing the same type of physical control information ultimately claimed in the '878 patent).)

57. As yet another example, the '878 patent refers to “traditional” UE behavior that included transmitting physical control information (“PCI”) on PUSCH when the UE had a UL grant. (Ex-1001 at 36:8-16 (citing 3GPP TS 36.213 v12.5.0).) Section 7.2 of 3GPP-36.213 discloses that periodic CSI reporting is transmitted on PUCCH when a UE does not have an uplink grant (“no PUSCH allocation,” blue highlighting), on PUSCH when a UE has an uplink grant (“with a PUSCH allocation,” green highlighting), and on PUSCH for aperiodic reporting under conditions specified in 3GPP-36.213 (yellow highlighting):

CSI reporting is periodic or aperiodic.

If the UE is configured with more than one serving cell, it transmits CSI for activated serving cell(s) only.

If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUCCH as defined hereafter in subframes with no PUSCH allocation.

If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUSCH of the serving cell with smallest *ServCellIndex* as defined hereafter in subframes with a PUSCH allocation, where the UE shall use the same PUCCH-based periodic CSI reporting format on PUSCH.

A UE shall transmit aperiodic CSI reporting on PUSCH if the conditions specified hereafter are met. For aperiodic CQI/PMI reporting, RI reporting is transmitted only if the configured CSI feedback type supports RI reporting.

58. Notably, this was not new behavior—it had long been the case that PUSCH was used for transmitting UCI when the UE had a UL grant. (Ex-1012-LTE-UMTS at 366; Ex-1013-R1-073322 at §§3-4; Ex-1014-R1-073858 at §2; Ex-1015-R1-074383 at §1.)

B. Effective Filing Date

59. I have been instructed to assume that the effective filing date of the '878 patent is April 1, 2016.

C. Prosecution History

60. I understand that an overview of the prosecution history is provided in the Petition. I have reviewed the prosecution history at a high level, but I am not a lawyer as stated above and thus do not offer opinions on the overall process. Instead, I highlight below several issues that arose during prosecution that relate to my technical analysis.

61. First, the examiner noted the following:

Examiner will interpret[] the limitation ‘UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not’ as follows:

If the UE has physical control information to transmit, the UE will transmit said control information. If on the other hand, the UE does

not have physical control information to send, it will skip the uplink grant (i.e. the UE does not perform transmission (as clarified in claim 3)).

(Ex-1002-'878FH at 185.)

62. I believe the examiner's interpretation was correct and apply it herein; in other words, when a UE does not transmit pursuant to a UL grant it has skipped that UL grant.

63. Next, I note that the examiner rejected various claims based on references that I have not considered or reviewed in forming my opinions, including Kim (US2011/0205991), Ratilainen (US2018/0091269), Pelletier (US2017/0013565), and Sun (US2016.0242176). (*Id.* at 187-200.)

64. Finally, I note that the examiner seems to have relied on PUCCH as a data channel. PUCCH is a control channel, not a data channel. The examiner was incorrect to view it otherwise, and I do not make that same error in this declaration.

D. The Challenged Claims

65. The Challenged Claims are claims 1-28. Claims 1, 6, 11, 16 are independent.

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

66. Based on my review and analysis of the '878 patent, the prior art cited herein, and the ordinary skill factors described in this section, a POSITA in the field of the '878 patent at the time of the earliest effective filing date (April 1, 2016) would

have had at least a bachelor's degree in electrical engineering, familiarity with the relevant 3GPP standards as of this time, and two years of experience working in a field involving wireless communications. Additional education may serve as a substitute for a lack of experience and vice versa.

67. My opinion relies on various factors. For example, the “Field” of the ’878 patent indicates that the patent “generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving a transmission using a configured resource in a wireless communication system.” (Ex-1001 at 1:14-19.) Wireless communication networks of the type discussed in the ’878 patent were generally standardized by 3GPP, including LTE and 5G. The people working in this field usually had an electrical engineering degree, as I note below, and ordinary skill would require a couple of years of experience and familiarity with the 3GPP standards as well.

68. Likewise, the “Background” section describes a rising demand for data-intensive communications to and from mobile devices. (*Id.* at 1:23-30.) The “Background” states:

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the

3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

(Ex-1001 at 1:31-39.) E-UTRAN is often referred to as LTE and encompasses the LTE air interface as well as UEs, and BSs operating on the network. A POSITA would have been familiar with this background information, including the ongoing 3GPP standardization efforts as 3GPP standards evolved from LTE to 5G.

69. As I noted above in §VI.A, large portions of the '878 patent were also copied from 3GPP technical specifications and proposals. This is shown, for example, in Ex-1026, which identifies the portions of 3GPP proposals and specifications that are cited/quoted in the '878 patent.

70. In my own experience working in this field, experience with reviewing 3GPP standards including technical specifications and proposals was important for individuals working in the field. Such materials informed those working in the field how 3GPP standard networks functioned, including for well-known networks like LTE.

71. The educational level of active workers in the field of the invention also informs my opinion. Such individuals usually had at least a bachelor's degree in electrical engineering or a related discipline and at least two years of experience working in the field of wireless communications networks or in academic research

72. As of April 1, 2016, I had more than ordinary skill in the art. I am, however, familiar with the skills and knowledge possessed by those I would have considered to be of ordinary skill in the art as of that date. When I refer to the understanding of a POSITA, I am referring to the understanding of such a person as of April 1, 2016.

VII. Overview of the Prior Art

73. I understand that the Petition addresses three obviousness grounds:

Ground	'878 Patent Claim	Basis
Ground 1	1-28	Ekpenyong (Ex-1004) in view of Huawei-374 (Ex-1005) and Huawei-192 (Ex-1006)
Ground 2	1-28	Novlan (Ex-1011) in view of 3GPP TS 36.212 v13.0.0 (Ex-1009), 3GPP TS 36.213 v12.5.0 (Ex-1010), Samsung-332 (Ex-1007), and Samsung-333 (Ex-1008)

74. I provide a brief overview of the prior art references identified in Petitioner's grounds below.

A. Ekpenyong (Ex-1004, US9,762,372)

75. Ekpenyong is U.S. Patent No. 9,762,372. Ekpenyong was filed June 15, 2011. I have been informed that Ekpenyong qualifies as prior art.

76. Ekpenyong “generally relates to wireless cellular communication” and as such is in the same field as the ’878 patent (wireless communication networks). (Ex-1004-Ekpenyong at 1:31-32.)

77. Ekpenyong discloses a UE that transmits physical control information (“PCI”) on a data channel to a UE pursuant to an uplink grant. In particular, Ekpenyong’s UE transmits Channel State Information (“CSI”), which comprises various types of PCI. This transmission of control information is on the Physical Uplink Shared Channel (“PUSCH”), and may occur even when the UE does not have data to transmit. I discuss Ekpenyong’s CSI transmissions on PUSCH in more detail below with respect to claim 1. (Ex-1004-Ekpenyong at 5:23-31, 5:44-57, 8:54-62, 13:10-35, FIG. 7.)

B. Huawei-374 (Ex-1005, R2-153374)

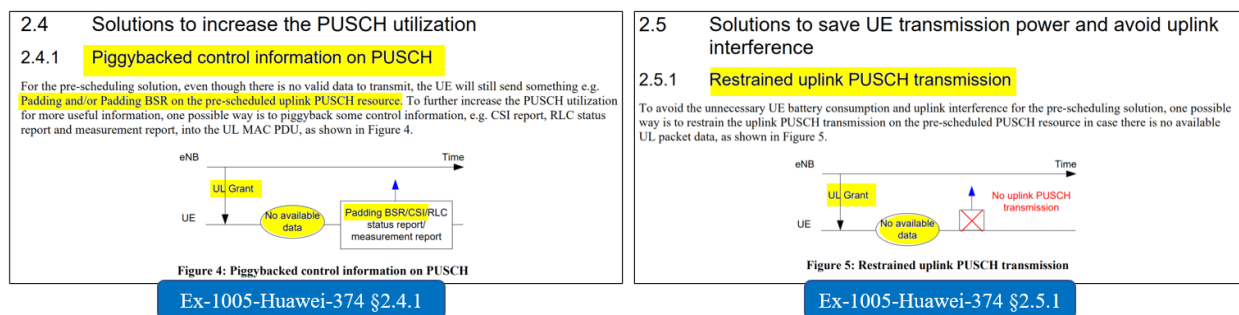
78. Huawei-374 is a proposal titled “Uplink latency reduction for synchronized UEs.” I have been informed that Huawei-374 qualifies as prior art.

79. Huawei-374 is a technical discussion document for a 3GPP standards development meeting and as such is in the same field as the ’878 patent (wireless communication networks).

80. Huawei-374 identifies a problem with the “pre-scheduling” feature. “Pre-scheduling” refers to a semi-persistent scheduling (“SPS”) grant that allocates uplink resources implicitly on a periodic basis going forward, without the need to

precede each allocation of uplink resources with a separate grant. The time interval between periodic implicit allocations of uplink resources is configurable. An SPS grant need only be transmitted by the base station once for the UE to understand it has been allocated repeated uplink resources into the future. This is useful, for example, for voice calls, where the UE uploads voice information on a regular basis for the duration of the call. Only one SPS grant needs to be allocated at the beginning of the call, rather than repetitive grants throughout the call. However, the 3GPP standard required a UE to send empty padding transmissions pursuant to a pre-scheduled UL grant even if it had nothing useful to send. This naturally caused “[u]nnecessary uplink PUSCH resource waste,” “[u]nnecessary uplink interference,” and “[u]nnecessary UE battery consumption,” as Huawei-374 recognized. (Ex-1005-Huawei-374 at §§2.1, 2.4, 2.5.)

81. Huawei-374 offered two pertinent solutions to the problems identified above:



(Ex-1005-Huawei-374 at §§2.4-2.5.)

82. Figure 4 illustrates a “piggybacking” solution where the UE sends

physical control information (i.e., “CSI report”) into the UL MAC PDU in order to increase PUSCH utilization by transmitting “more useful information.” (Ex-1005-Huawei-374 at §2.4.1.) Figure 5 illustrates a “skipping” solution where the UE skips the UL grant when it has no useful information to send. (*Id.* at §2.5.1.)

C. Huawei-192 (Ex-1006, R2-154192)

83. Huawei-192 is a proposal titled “Further analysis on uplink transmission skipping.” I have been informed that Huawei-192 qualifies as prior art.

84. Huawei-192 is a technical discussion document for a 3GPP standards development meeting and as such is in the same field as the ’878 patent (wireless communication networks).

85. Like Huawei-374, Huawei-192 identifies “skipping” as a solution to the aforementioned problems associated with pre-scheduling. (Ex-1006-Huawei-192 at §§1, 2.) Huawei-192 also notes that “skipping” may be used in the context of different types of UL grants, namely dynamic and periodic UL grants. (*Id.*)

D. 3GPP TS 36.212 v13.0.0 (Ex-1009) and 36.213 v12.5.0 (Ex-1010)

86. 3GPP TS 36.212 v13.0.0 (“3GPP-36.212”) and 3GPP TS 36.213 v12.5.0 (“3GPP-36.213”) are technical specifications that both include disclosures relating to physical channel information reports that are transmitted by a UE on PUSCH.

87. 3GPP-36.212 is a technical specification titled “Evolved Universal

Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding.” I have been informed that 3GPP-36.212 qualifies as prior art.

88. 3GPP-36.212 is part of a collection of technical documents produced by 3GPP to describe the requirements for signaling formats, processing functions, and protocol layer procedures related to the operation of a cellular wireless network and as such is in the same field as the ’878 patent (wireless communication networks).

89. 3GPP-36.212 generally discloses transport channel and control channel data processing, including multiplexing, channel coding and interleaving. 3GPP-36.212 discloses sending CQI, rank indication, and HARQ-ACK feedback via PUSCH without UL data. (Ex-1009-3GPP-36.212 at §§5.2.4-5.2.4.3.)

90. 3GPP-36.213 is a technical specification titled “Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures.” I have been informed that 3GPP-36.213 qualifies as prior art.

91. 3GPP-36.213 is part of a collection of technical documents produced by 3GPP to describe the requirements for signaling formats, processing functions, and protocol layer procedures related to the operation of a cellular wireless network and as such is in the same field as the ’878 patent (wireless communication networks).

92. 3GPP-36.213 discloses characteristics of physical layer procedures

including UE procedures for reporting CSI using PUSCH. (Ex-1010-3GPP-36.213 at §§7.2-7.2.4.)

E. Samsung-332 (Ex-1007, R2-153332) and Samsung-333 (Ex-1008, R2-153333)

93. Samsung-332 and Samsung-333 are related 3GPP contributions submitted by Samsung. Samsung-332 is a discussion document titled “Skipping uplink transmission with no data to transmit.” Samsung-333 is a corresponding change request (proposing a change to 3GPP TS 36.321 v12.6.0 for a future Release 13 version of the technical specification).

94. Samsung-332 is a technical discussion document for a 3GPP standards development meeting and as such is in the same field as the ’878 patent (wireless communication networks). I have been informed that Samsung-332 qualifies as prior art.

95. Samsung-332 discloses a battery-consumption problem associated with pre-scheduling and a “[s]traightforward solution [that allows a] UE to skip [an] uplink transmission if no data is available for transmission.” (Ex-1007-Samsung-332 at §§1, 2.1.)

96. Samsung-333 is a technical discussion document for a 3GPP standards development meeting and as such is also in the same field as the ’878 patent (wireless communication networks). I have been informed that Samsung-333 qualifies as prior

97. Samsung-333 is a “change request” that discloses a battery-drain issue associated with pre-scheduling and proposes adding a skipping feature to 3GPP TS 36.321. (Ex-1008-Samsung-333 at §§1-2.)

F. Novlan (Ex-1011, US10,129,782)

98. Novlan is U.S. Patent 10,129,782. Novlan was filed January 25, 2016. I have been informed that Novlan qualifies as prior art.

99. Novlan is a Samsung patent that “relates generally to wireless communication systems” and a “method and apparatus for CSI measurement configuration and reporting on unlicensed spectrum” and as such is in the same field as the ’878 patent (wireless communication networks). (Ex-1011-Novlan at 1-26-29.)

100. Novlan discloses a UE having a processor, memory, and circuitry connecting these elements with transmit and receive functionality. (Ex-1011-Novlan at FIG. 3, 7:60-8:67.)

G. Publication and Public Accessibility of Prior Art

101. Huawei-374, Huawei-192, 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 were all publicly accessible documents available from the 3GPP website. In general, 3GPP member organizations contribute proposals, change requests, and the like on a regular basis, and these documents are made available on

the 3GPP website through simple navigation steps. *See* <https://www.3gpp.org/specifications-technologies/specifications-by-series/change-requests-for-change-request-instructions>; *See* <https://www.3gpp.org/3gpp-groups/radio-access-networks-ran/ran-wg2> and https://www.3gpp.org/ftp/tsg_ran/WG2_RL2 for meeting documents that include proposal contributions for the RAN2 technical area, which includes MAC and RLC layer specifications for LTE and 5G.

102. As I noted above in my discussion of the level of ordinary skill in the art, a POSITA in the field of the '878 patent would be familiar with 3GPP proposals and technical specifications, including how to find and locate documents of particular interest. 3GPP organizes documents by working groups and meetings, provides reports and summaries for these meetings, and makes all of this information publicly available via the 3GPP website. *See, e.g.,* <https://www.3gpp.org/3gpp-groups/radio-access-networks-ran/ran-wg2>.

103. Moreover, the nature of the '878 patent and the prior art patents (Ex-1004-Ekpenyong and Ex-1011-Novlan) in this proceeding confirms my understanding. All three of these patents repeatedly refer to 3GPP contributions including proposals and technical specifications. (*See, e.g.,* Ex-1001 at 1-2 (Other Publications), 3:1-15; Ex-1004-Ekpenyong at 1-2 (Other Publications), 1:62-2:18, 4:33-54, 8:7-13, 12:60-65; Ex-1011-Novlan at 4:21-35 (referencing and

incorporating-by-reference 3GPP “documents and standards descriptions” including “3GPP TS 36.212 v12.2.0” and “3GPP TS 36.213 v12.2.0”).)

104. For example, Novlan at 4:21-35 refers to two Release 12 specifications that are slightly earlier versions of 3GPP-36.212 (Ex-1009) and 3GPP-36.213 (Ex-1010) in this proceeding. It was trivial for a POSITA to find each successive release of these technical specifications, as they were well organized on the 3GPP website. *See* <https://www.3gpp.org/specifications-technologies/releases>.

105. It is trivial to find summary information about the technology in each release at a high level. The specification documents for each release are primarily organized by technical area (called a “series”), within which each specification document in the series is organized by version within each release.

106. Thus, to find 3GPP TS 36.212 v12.2.0, one would start at the following link: <https://www.3gpp.org/specifications-technologies/specifications-by-series>. Then click on “36 series”, which takes you to the following link: <https://portal.3gpp.org/Specifications.aspx?q=1&series=30&releases=all&draft=False&underCC=False&withACC=False&withBCC=False&numberNYA=False>. By clicking on the 36.212 link, a window is presented with all the release versions of the 36.212 document, including v12.2.0.

VIII. GROUND 1: Ekpenyong in view of Huawei-374 and Huawei-192

A. Reasons for Combining Prior Art

107. In Ground 1, I describe why a POSITA would have combined Ekpenyong, Huawei-374, and Huawei-192.

108. Ekpenyong is a patent relating to a wireless cellular communications network titled “CSI reporting on PUSCH for carrier aggregation.” (Ex-1004-Ekpenyong at 1:29-34.)

109. Ekpenyong discloses a network that has base stations (“BSs”) and mobile devices (“UEs”):

Wireless cellular communication networks incorporate a number of mobile UEs and a number of NodeBs. A NodeB is generally a fixed station, and may also be called a base transceiver system (BTS), an access point (AP), a base station (BS), or some other equivalent terminology. ... [A] NodeB is sometimes also referred to as an evolved NodeB (eNB). ...

User equipment (UE), also commonly referred to as a terminal or a mobile station, may be a fixed or mobile device and may be a wireless device, a cellular phone, a personal digital assistant (PDA), a wireless modem card, and so on. Uplink communication (UL) refers to a communication from the UE to the NodeB, whereas downlink (DL) refers to communication from the NodeB to the UE.

(*Id.* at 1:36-61.)

110. In Ekpenyong (e.g., FIG. 7 below), a UE communicates with a base

station over various channels including a data channel called PUSCH and a control channel called PUCCH. (*Id.* at 5:9-11.)

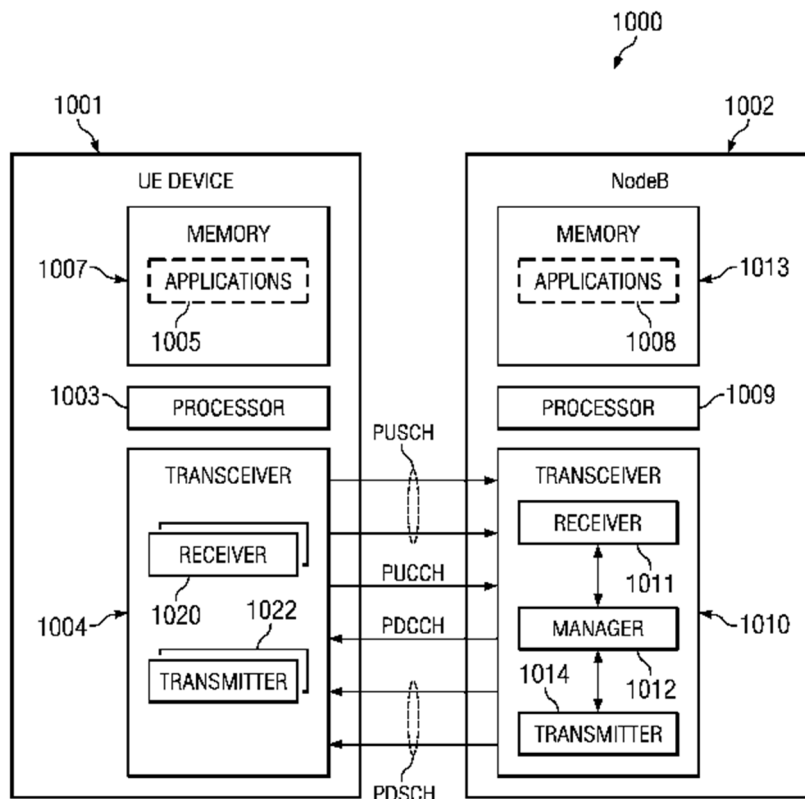


FIG. 7

111. The specification also discloses that 3GPP working groups were in the process of standardizing LTE networks, which were also called “E-UTRA:”

Long Term Evolution (LTE) wireless networks, also known as Evolved Universal Terrestrial Radio Access (E-UTRA), are being standardized by the 3GPP working groups (WG).

(*Id.* at 1:62-65.)

112. Ekpenyong also discloses that “TSG RAN” refers to “Technical Standards Group Radio Access Network.” TSG RAN is a common acronym seen on

113. Ekpenyong further describes the importance of transmitting physical control information reports from a UE to a BS, particularly as 3GPP standards development continues to increase data rates through various mechanisms. At a high level, these reports could be periodic or aperiodic, and could be transmitted on PUCCH or PUSCH:

Carrier aggregation allows concurrent transmission on multiple component carriers (CC) to increase the data rate. ... UE feedback is important to report downlink channel state information (CSI) to the eNB to enable closed-loop MIMO beamforming and frequency-selective scheduling. For Rel-8/9 systems CSI feedback can be periodic on PUCCH and aperiodic on PUSCH. To maintain the single carrier property, periodic CSI is transmitted on the PUSCH when an UL grant coincides in the same subframe with a periodic CSI report. On the other hand, aperiodic CSI feedback on PUSCH is triggered by setting the (1-bit) CQI request field to “1” in the UL grant. Furthermore, aperiodic CSI can be transmitted on the PUSCH with or without UL-SCH data.

(*Id.* at 5:16-31.)

114. Ekpenyong also disclosed that PCI feedback was provided as “channel state information (CSI) feedback” made up of CQI, PMI, and RI as defined in the excerpt below:

[A] transmitter must have knowledge of the channel, which is provided by the UE on the uplink control channel. This process is generally referred to as channel state information (CSI) feedback. This knowledge may include a channel quality index (CQI), a precoding matrix Indicator (PMI), and a rank indication (RI). CSI feedback (RI/PMI/CQI) are recommended MIMO transmission properties derived at the UE based on the channel estimation.

(*Id.* at 5:44-52; *see id.* at 5:52-67 (further describing RI/PMI/CQI).)

115. Providing CSI feedback on PUCCH was one conventional option, but it was well known to those of ordinary skill in the art that PUCCH was also insufficient to support larger-sized CQI reports. (*See, e.g.*, Ex-1013-R1-073322 at §1.)

116. Ekpenyong also recognized that larger CSI payloads in subsequent 3GPP standard releases (e.g., Release 10 and higher) were making this problem even worse:

In general, Rel-10 systems require higher CSI feedback accuracy, and larger CSI feedback payload to accommodate CSI reporting for multiple DL CCs. Therefore, aperiodic CSI transmission is considered important in Rel-10 to fully reap the performance gain promised by Rel-10 features including carrier aggregation and enhanced DL MIMO (8Tx SU-MIMO and MU-MIMO).

(*Id.* at 5:31-38.)

117. Thus, Ekpenyong proposes “[s]everal embodiments for improved CSI

feedback on the PUSCH.” (*Id.* at 5:39-43.)

118. Ekpenyong also discloses providing (1) aperiodic CSI feedback on PUSCH without uplink data and (2) periodic CSI feedback on PUSCH when the periodic feedback coincides with a UL grant. (*Id.* at 13:10-35 (describing “Aperiodic CSI Transmission Without UL-SCH Data”), 8:56-58 (“[P]eriodic CSI is transmitted on the PUSCH when an UL grant coincides in the same subframe with a periodic CSI report.”).)

119. Accordingly, Ekpenyong’s network discloses UEs that receive UL grants from a BS and transmit (1) aperiodic CSI feedback on PUSCH in some circumstances and (2) periodic CSI feedback on PUSCH when the periodic CSI feedback coincides with a UE’s uplink grant.

120. In August 2015, Huawei-374 submitted a contribution for that month’s working group meeting that proposed several ways to improve a 3GPP standard network such as the LTE network described in Ekpenyong. In particular, Huawei-374 explains:

[F]or active UEs and UEs that have been inactive a longer time, but are kept in RRC Connected, focus should be on reducing user plane latency for the scheduled UL transmission and getting a more resource efficient solution with protocol and signaling enhancements, compared to the pre-scheduling solutions allowed by the standard today.

121. Huawei-374 also states that “in order to achieve the latency reduction gain, the pre-scheduling period should be less than 10ms for the pre-scheduling solution.” (*Id.* at §2.1.) These short pre-scheduling periods caused unnecessary UE battery consumption and uplink interference:

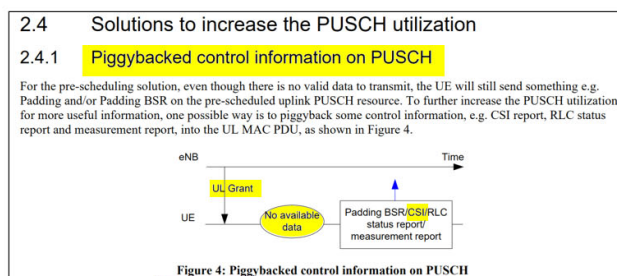
For the pre-scheduling solution, according to the current specification, the UE will anyway send something e.g. Padding and/or Padding BSR on the pre-scheduled uplink resources even though there is no valid data to transmit. This will cause unnecessary UE battery consumption as well as unnecessary uplink interference.

Observation: The pre-scheduling solution with small period has the following problems:

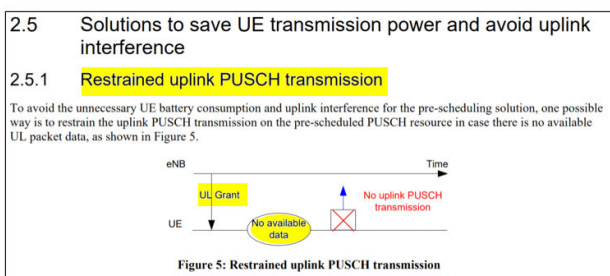
- Significant PDCCH overhead
- Unnecessary uplink PUSCH resource waste
- Unnecessary uplink interference
- Unnecessary UE battery consumption

(Ex-1005-Huawei-374 at §2.1.)

122. Huawei-374 discloses two complementary solutions to address the pre-scheduling problems: (1) “Piggybacked control information on PUSCH” to “increase the PUSCH utilization,” and (2) “Restrained uplink PUSCH transmission” to “save UE transmission power and avoid uplink interference.” Figures 4 and 5 illustrate these solutions:



Ex-1005-Huawei-374 §2.4.1



Ex-1005-Huawei-374 §2.5.1

123. Figure 4 shows a “piggybacking” solution. This involves piggybacking control information (PCI feedback and the like) on PUSCH. As Huawei-374 discloses in §2.4.1, piggybacking was performed when there was no data to send.

124. Figure 5 shows a “skipping” solution, which involves skipping the uplink transmission entirely (e.g., when there is neither data nor PCI feedback to send).

125. Like Petitioner, I will refer to these two solutions in Huawei-374 as “piggybacking” and “skipping” respectively.

126. At the next working group meeting in October 2015, Huawei-192 submitted a follow-up contribution confirming the benefits of using the skipping solution:

1 Introduction In the context of the Rel-13 Study Item “Study on Latency reduction techniques for LTE”, RAN2#91 discussed the uplink transmission skipping when no available data to transmit [1, 2], and the following agreements were made: <table border="1"><tr><td> Agreements 1 It is beneficial to allow UEs to skip (most) dynamic and configured uplink transmissions if no data is available for transmission (the UE still sends the regular MAC CE, if any). 2 The eNB may enable this by RRC dedicated signalling. </td></tr></table> In this contribution, we will provide further analysis on uplink transmission skipping if the UE has no available data to transmit, for both dynamic scheduling and SPS.	Agreements 1 It is beneficial to allow UEs to skip (most) dynamic and configured uplink transmissions if no data is available for transmission (the UE still sends the regular MAC CE, if any). 2 The eNB may enable this by RRC dedicated signalling.
Agreements 1 It is beneficial to allow UEs to skip (most) dynamic and configured uplink transmissions if no data is available for transmission (the UE still sends the regular MAC CE, if any). 2 The eNB may enable this by RRC dedicated signalling.	

(Ex-1006-Huawei-192 at §1.) As the excerpt above discloses, the working group had agreed that skipping *most* UL grants was beneficial.

127. Huawei-192 also discloses that the skipping solution “[a]ccording to

the RAN2 agreement” should be used for dynamic scheduling UL grants and SPS (semi-persistent scheduling) UL grants. (*Id.* at §2.)

128. Huawei-192 also discloses that skipping should be used even though the BS would not know whether it failed to receive a UL transmission due to transmission errors. (*Id.*) This was the case because “for both dynamic scheduling and SPS activation, it is not necessary for the UE to provide any feedback if there is no available data to transmit” and “‘no feedback’ will not cause more serious PUSCH resource waste” as compared to empty padding transmissions. (*Id.*)

129. In my opinion, a POSITA would have been motivated and found it obvious to improve Ekpenyong in view of Huawei-374 and Huawei-192 to ensure that Ekpenyong’s UEs (1) transmit CSI via PUSCH even when they have no data to transmit and (2) skip uplink grants when there was neither data nor CSI to send.

130. As I detailed above, Ekpenyong discloses transmitting CSI via PUSCH without data (in the aperiodic CSI feedback scenario). Huawei-374 and Huawei-192 disclose piggybacking and skipping solutions that would further enhance Ekpenyong. (Ex-1005-Huawei-374 at §§2.4-2.5; Ex-1006-Huawei-192 at §§1-2.) Specifically, Huawei-374 discloses well-understood problems with PUSCH utilization, uplink interference, and unnecessary UE battery consumption. Piggybacking (for PUSCH utilization) and skipping (for uplink interference and UE battery consumption) were solutions to those problems. (Ex-1005-Huawei-374 at

131. Huawei-192 also advocates skipping both dynamic UL grants and periodic (“SPS”) UL grants:

3 Conclusion

In this contribution, we provided some further analysis on uplink transmission skipping if the UE has no available data to transmit, and we have the following proposal:

Proposal: For both dynamic scheduling and SPS activation, the UE doesn’t provide any feedback (e.g. empty MAC PDU or PUCCH ACK) if there is no available data to transmit.

(Ex-1006-Huawei-192 at §3 (emphasis in original).)

132. Accordingly, a POSITA would have been motivated and found it obvious to implement both piggybacking and skipping with Ekpenyong’s system as taught in Huawei-374 and further supported in Huawei-192. A POSITA would have implemented these solutions to increase PUSCH utilization, improve battery consumption, and reduce uplink interference. (Ex-1005-Huawei-374 at §§2.4-2.5).)

133. More specifically, the piggybacking and skipping solutions would have been implemented together and in a complementary way so that piggybacked control information was not skipped, thereby lowering the number of UE transmissions in response to a pre-scheduled grant. A POSITA would have known to implement these solutions in that way because Ekpenyong disclosed the growing importance of transmitting control information (and needing to do so on PUSCH in some circumstances) that accompanied the increased data rates in the 3GPP standards.

(Ex-1004-Ekpenyong at 5:31-38; *see also* Ex-1013-R1-073322 at §1 (disclosing that even as early as 2007 it was known that some control information had to be transmitted on PUSCH due to its size).)

134. Moreover, the Huawei references disclose that pre-scheduling led to a battery drain problem because UEs had to transmit empty padding transmissions every time the UE had a UL grant with nothing to send. Pre-scheduling involved shorter transmission time intervals and more unneeded UL grants, so UEs would often need to send useless padding transmissions thereby wasting battery. (Ex-1005-Huawei-374 at §§2.1, 2.5; Ex-1006-Huawei-192 at §1.)

135. Separately, the piggybacking solution addressed wasted UL resources by “increas[ing] the PUSCH utilization for more useful information.” (Ex-1005-Huawei-374 at §2.4.) Thus, a POSITA would have used Huawei-374’s two solutions simultaneously and in complementary ways to skip only the useless padding transmissions that caused rapid battery drain while continuing to utilize UL grants for useful information including CSI reports. A POSITA would have considered this at least obvious to try because there were two choices: a POSITA could design the UE’s in Ekpenyong’s system to (1) skip UL grants that would result in transmitting anything other than data or (2) skip UL grants that would result in transmitting only empty padding.

136. Option (2) would have been the clear choice for a POSITA. In part, this

was because option (1) failed to address the increasing importance of CSI feedback.

Ekpenyong noted, for example that CSI feedback was growing in importance, which means it would not make sense to skip CSI feedback any time there was no corresponding data to send. (Ex-1004-Ekpenyong at 5:31-38.) As I noted above, I understand that a POSITA is not an automaton, can often fit multiple disclosures together like a puzzle, and can make reasonable inferences and take reasonable creative steps when considering the prior art. Here, a POSITA would not blindly skip useful PCI transmissions when Huawei-374 discloses both piggybacking and skipping solutions. The preferable, logical, and most reasonable way to use both solutions would result in skipping UL grants if there was no data and no PCI to transmit.

137. Likewise, Huawei-192 discloses that skipping was only appropriate for “most” UL transmission that had no data to transmit, and expressly discloses that skipping would not impact some non-data transmissions: “the UE still sends the regular MAC CE [control element], if any[.]” (Ex-1006-Huawei-192 at §1.) Although MAC CEs are different than physical control information (e.g., Ekpenyong and Huawei’s CSI reports comprising CQI, PMI, and/or RI), the rationale is the same: this was useful information that should be transmitted pursuant to a UL grant when necessary rather than skipped.

138. A POSITA would have succeeded in implementing Huawei-374’s

piggybacking and skipping solutions with Ekpenyong's system. Ekpenyong taught transmitting CSI on PUSCH without data for aperiodic transmissions, so a POSITA would easily implement Huawei-374's piggybacking technique to transmit CSI on PUSCH without data when the UE had a UL grant.

139. A POSITA would have had no difficulty modifying Ekpenyong's system to skip UL grants when the UE had neither data nor CSI to send. Simple programming to remove the UE's mandate for sending empty padding transmissions whenever it had an unneeded UL grant was all that would have been required.

140. Mere ordinary skill was also all that was needed to add Huawei's piggybacking and skipping solutions to the Ekpenyong system. Transmitting CSI feedback via PUSCH without data and skipping UL grants when there was nothing to send were known solutions to known problems related to unnecessary uplink interference and unnecessary UE battery consumption. There was nothing unpredictable about the resulting system, either, as it would simply result in a network where UEs transmit CSI feedback via PUSCH in response to pre-scheduled uplink grants even when there is no data to send and skip transmitting altogether when there is no data or control feedback to transmit.

141. A POSITA would have recognized that the downsides of implementing Huawei's proposed solutions were also minimal. For example, Huawei-192 disclosed:

For both dynamic scheduling and SPS activation, “no feedback” [i.e., skipping] will not cause more serious PUSCH resource waste compared to “feedback with empty MAC PDU or PUCCH ACK”.

(Ex-1006-Huawei-192 at §2; *see id.* (noting the low rate of PDCCH loss).)

B. Challenged Claims

142. Claims 1-28 are not arranged in a typical order. For example, claims 21 and 25 depend from claim 1, and claims 22 and 26 depend from claim 6. Thus, like Petitioner, I have grouped my analysis below by claim sets in view of the discontinuous dependencies in the claims:

- Claim Set A: 1-5, 21, 25;
- Claim Set B: 6-10, 22, 26;
- Claim Set C: 11-15, 23, 27;
- Claim Set D: 16-20, 24, 28.

1. Claim Set A

[1.0] “A method of a UE (User Equipment), comprising:”¹

143. Ekpenyong in view of Huawei-374 and Huawei-192 teaches the preamble.

144. Ekpenyong discloses “[w]ireless cellular communication networks”

¹ Claim limitations are italicized and quoted in these headings.

that “incorporate a number of mobile UEs and a number of NodeBs.”² (Ex-1004-Ekpenyong, 1:36-39.)

145. A UE, for example, was “a terminal or a mobile station...and may be a wireless device, a cellular phone, a personal digital assistant (PDA), a wireless modem card, and so on.” (*Id.* at 1:48-51.)

146. Conventional UEs had transmitters and receivers to communicate directly with a NodeB, rather than directly with other UEs. (*Id.* at 1:57-61.)

147. As I explain in § VIII.A, Huawei-374 and Huawei-192 also disclose this limitation by proposing UE modifications. In particular, the Huawei references teach the use of piggybacking and skipping. (Ex-1005-Huawei-374 at §§2.4-2.5; Ex-1006-Huawei-192 at §§1-2).)

[1.1] “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;”

148. Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation.

149. Ekpenyong discloses a UE that receives an uplink grant from a base

² NodeBs are also referred to eNBs, base stations, and access points in Ekpenyong; for ease of reference, these elements are referred to as “base stations” or “BSs” herein. (*See, e.g.*, Ex-1004-Ekpenyong, 1:38-47.)

When UE 109 is not up-link synchronized with eNB 101, non-synchronized UE 109 employs non-synchronous random access (NSRA) to request allocation of up-link 112 time or frequency or code resources. If UE 109 has data ready for transmission, for example, traffic data, measurements report, tracking area update, etc., UE 109 can transmit a random access signal on up-link 112 to eNB 101. The random access signal notifies eNB 101 that UE 109 requires up-link resources to transmit the UE's data. eNB 101 responds by transmitting to UE 109, via down-link 110, a message containing the parameters of the resources allocated for UE 109 up-link transmission along with a possible timing error correction. After receiving the resource allocation and a possible timing adjustment message transmitted on down-link 110 by eNB 101, UE 109 may adjust its transmit timing, to bring the UE 109 into synchronization with eNB 101, and transmit the data on up-link 112 employing the allotted resources during the prescribed time interval.

(Ex-1004-Ekpenyong at 6:43-61.)

150. In accordance with the disclosure above, Ekpenyong discloses a Base Station (“BS”) that allocates a UL grant to a UE (“the parameters of the resources allocated for UE 109 uplink transmission”). The UE can transmit data in a TTI (“transmit the data on up-link 112 employing the allotted resources during the prescribed time interval”). (*Id.*)

151. Where Ekpenyong indicates that the UE has received allocated

resources for transmitting back to the BS in a prescribed time interval, it is referring to a UL grant that is available for the UE in a TTI—UL grants are provided for a given TTI and expressed in such terms. (Ex-1018-36.321 at §5.4.1 (“The period of configured uplink grants is expressed in TTIs”); Ex-1020-36.881 at §5.1.1 (“Transmission Time Interval (TTI) The transmission of a request, grant, or data is done in subframe chunks with a fixed duration (1 ms)”).)

152. A UE may also have no data to send pursuant to its UL grant:

For Rel-8/9 systems CSI feedback can be periodic on PUCCH and aperiodic on PUSCH. To maintain the single carrier property, periodic CSI is transmitted on the PUSCH when an UL grant coincides in the same subframe with a periodic CSI report. On the other hand, aperiodic CSI feedback on PUSCH is triggered by setting the (1-bit) CQI request field to “1” in the *UL grant*. Furthermore, aperiodic CSI can be transmitted on the PUSCH with *or without UL-SCH data*.

(Ex-1004-Ekpenyong at 5:23-31; *see id.* at 8:54-62.)

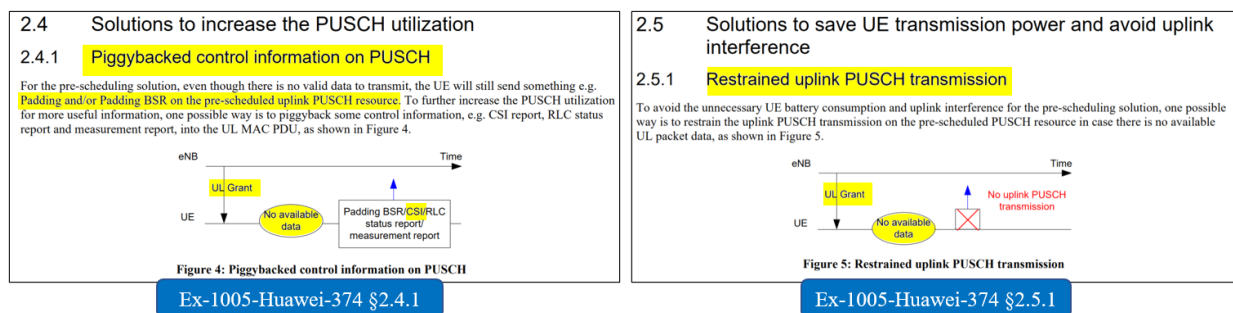
153. A POSITA would have understood that Ekpenyong’s statement that CSI may be transmitted on PUSCH “without UL-SCH data” discloses the claimed “an uplink grant is available for the UE . . . wherein the UE does not have data available for transmission,” because the CSI was sent on PUSCH even when there was no UL-SCH data to send. (*Id.*)

154. Ekpenyong also discloses aperiodic CSI transmission pursuant to a UL

grant in the case where the UE does not also have data for transmission. (*Id.* at 13:10-35 (“One scheme for aperiodic CSI transmission without UL-SCH data for CSI feedback . . . is to set CQI request bit to trigger CSI reports”; “[a] second scheme is to restrict aperiodic CQI request without UL-SCH data to the Rel-8/9 procedure.”).)

155. Ekpenyong’s two schemes disclose that an uplink grant is available for the UE in a TTI even though the UE does not have data available for transmission.

156. Huawei-374 and Huawei-192 disclose two proposed modifications to a UE’s functionality when it has no data to send. As shown in the figures below, those modifications are piggybacking and skipping:



(Ex-1005-Huawei-374 at §§2.4-2.5; *see also* Ex-1006-Huawei-192 at §§1-2.) As previously explained, piggybacking refers to sending control information including PCI (e.g., a CSI report) “into the UL MAC PDU,” and skipping (the “restrained uplink PUSCH transmission” shown in Figure 5 above) means the UE would not transmit when it has “no available UL packet data” to transmit. (*Id.*)

[1.2] “the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not; and”

157. Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation.

158. This limitation uses the term “physical control information” (“PCI”). PCI includes at least CQI, PMI, and RI. (See claim 21.)

159. PCI transmissions were important:

CQI feedback is important for informing the DL channel status to the eNB in order to perform accurate DL link adaptation (e.g. rank, precoding matrices, modulation and coding schemes, frequency-selective scheduling) and UE scheduling.

(Ex-1004-Ekpenyong at 4:40-48.)

160. A UE also provides channel information in the form of “channel state information (CSI) feedback” to “have knowledge of the channel.” (*Id.* at 5:44-47.)

161. In Ekpenyong, “CSI” feedback includes CQI, RI, PMI, all of which are expressly identified in the ’878 patent as examples of PCI:

For best operation, a transmitter must have knowledge of the channel, which is provided by the UE on the uplink control channel. This process is generally referred to as channel state information (CSI) feedback. This knowledge may include a channel quality index (CQI), a precoding matrix Indicator (PMI), and a rank indication (RI). CSI feedback (RI/PMI/CQI) are recommended MIMO

transmission properties derived at the UE based on the channel estimation. For example, RI is the recommended number of transmission layers (rank). PMI reflects the recommended precoding matrices within the recommended rank (RI). CQI is the observed channel quality indicator (e.g. recommended modulate and coding scheme) assuming that the RI/PMI feedback are used for MIMO precoding.

(*Id.* at 5:44-57.)

162. Ekpenyong also discloses that transmitting PCI was important, though it does not expressly state that a UE should determine whether to skip a UL grant based on whether PCI is available for transmission.

163. However, as I explain above in §VIII.A, a POSITA would have been motivated and found obvious to employ the piggybacking and skipping approaches of Huawei-374 with the Ekpenyong system in a complementary manner.

164. More particularly, Huawei-374 explains that a UE had to send padding even when it had no data to transmit. (Ex-1005-Huawei-374 at § 2.4.1.) Huawei-374 discloses a way to enhance PUSCH resource utilization by “piggybacking” PCI into a UL MAC PDU:

2.4 Solutions to increase the PUSCH utilization

2.4.1 Piggybacked control information on PUSCH

For the pre-scheduling solution, even though there is no valid data to transmit, the UE will still send something e.g. Padding and/or Padding BSR on the pre-scheduled uplink PUSCH resource. To further increase the PUSCH utilization for more useful information, one possible way is to piggyback some control information, e.g. CSI report, RLC status report and measurement report, into the UL MAC PDU, as shown in Figure 4.

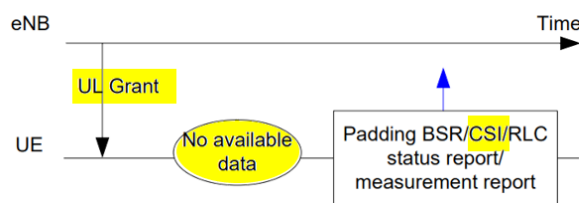


Figure 4: Piggybacked control information on PUSCH

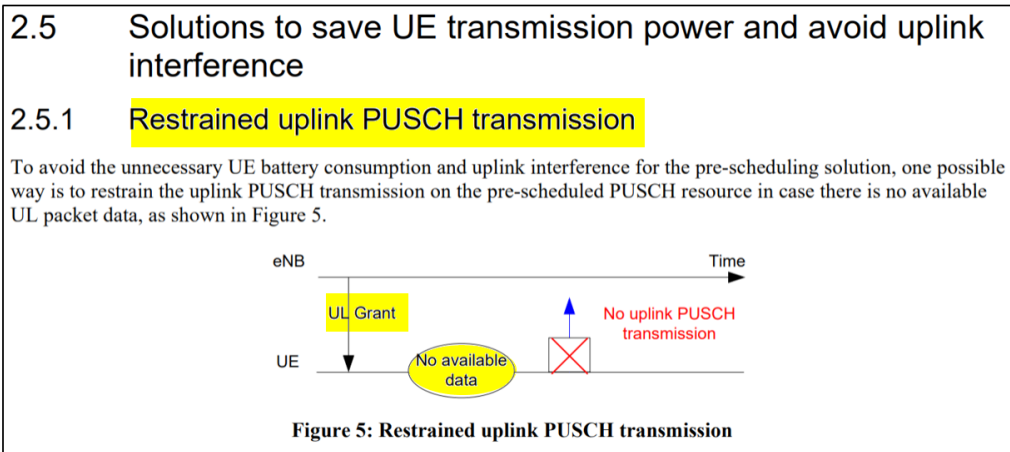
Ex-1005-Huawei-374 §2.4.1

(*Id.*)

165. Thus, Huawei-374 teaches sending control information on PUSCH. In particular, this would have been when the UE had “no valid data to send,” in order to increase “PUSCH utilization.” (*Id.*)

166. Figure 4 illustrates this improvement. As shown above, Figure 4 illustrates a UE sending PCI on PUSCH pursuant to a UL grant even when the UE has “no available data.” (*Id.*)

167. Huawei-374 also teaches “sav[ing] UE transmission power” by sending control information on PUSCH when there is “no available UL packet data:”



Ex-1005-Huawei-374 §2.5.1

(Ex-1005-Huawei-374 at §2.5.1, Figure 5.)

168. Huawei-192 also discloses skipping and indicates that skipping would be used for dynamic and SPS UL grants:

2 Discussion

According to the RAN2 agreement, even if the UE has already been provided with UL Grant (i.e. by either dynamic scheduling or SPS), the UE will still skip the UL PUSCH transmission in case there is no available data to transmit, as shown in Figure 1. Such an optimization can avoid the unnecessary UE battery consumption as well as uplink interference for the pre-scheduling scheme which is allowed by the standard today, for which the UE will anyway send something (e.g. Padding and/or Padding BSR) with the UL Grant.

(Ex-1006-Huawei-192 at §2.)

169. Huawei’s “skipping” improved performance by avoiding “unnecessary UE battery consumption as well as uplink interference for the pre-scheduling scheme which is allowed by the standard today, for which the UE will anyway send something (e.g. Padding and/or Padding BSR) with the UL Grant.” (Ex-1005-Huawei-374 at §2.5.1.)

170. A POSITA would have been motivated to improve Ekpenyong’s

system by adding piggybacking and skipping in view of the Huawei references. (*See* §VIII.A.) As further explained above, a POSITA would have found it obvious to implement these two features together, and to do so such that the UE would not skip piggybacked PCI because such PCI transmissions were important and distinct from the type of empty padding transmission that motivated the skipping functionality. (*Id.*)

171. Thus, Ekpenyong in view of Huawei-374 and Huawei-192 teaches a system that (a) transmits data pursuant to a UL grant when the UE has data to send, (b) transmits physical control information pursuant to the UL grant when the UE has no data to send, and (c) skips the UL grant otherwise. (*See* §VIII.A.)

[1.3] “the UE transmits the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.”

172. Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation.

173. “PUSCH” is a “data channel” for uplink transmissions from the UE. (*See* claim 25.)

174. As shown above, Ekpenyong discloses transmitting PCI (CQI, PMI, and RI in particular) on PUSCH. (*See* limitations 1.1-1.2; Ex-1004-Ekpenyong at 5:23-31 (“CSI feedback can be periodic on PUCCH and aperiodic on PUSCH. To maintain the single carrier property, periodic CSI is transmitted on the PUSCH when

a UL grant coincides in the same subframe with a periodic CSI report. On the other hand, aperiodic CSI feedback on PUSCH is triggered by setting the (1-bit) CQI request field to ‘1’ in the UL grant. Furthermore, aperiodic CSI can be transmitted on the PUSCH with or without UL-SCH data.”); *see id.* at 5:44-57, 8:54-62, 13:10-35.)

175. Huawei-374’s piggybacking solution also discloses the transmitting of PCI on PUSCH. The purpose was to increase PUSCH utilization for transmission of useful information, as I also explained above in §VIII.A. (Ex-1005-Huawei-374 at §2.4.1 (“To further increase the PUSCH utilization for more useful information, one possible way is to piggyback some control information, e.g. CSI report...into the UL MAC PDU”).)

176. Thus, Ground 1 renders obvious claim 1.

[Claim 2] “The method of claim 1, wherein the uplink grant is a configured uplink grant that is periodically available.”

[Claim 3] “The method of claim 1, wherein the uplink grant is a dynamic grant specific for the TTI.”

177. Ekpenyong in view of Huawei-374 and Huawei-192 teaches claims 2-3.

178. Claim 2 uses the phrase “configured uplink grant that is periodically available.” “Semi-persistent scheduling” or “SPS” UL grants are periodically available:

Semi-persistent scheduling enables a UE to consider a configured uplink grant occurs periodically after it is initiated. It may be initiated by receiving a network signaling to initiate SPS (Semi-Persistent Scheduling).

(Ex-1001 at 35:44-47.)

179. Huawei-192 discloses that the UE may skip a UL grant that was provided “by either dynamic scheduling or SPS.” (Ex-1006-Huawei-192 at §2.)

180. A UL grant provided by “dynamic scheduling” is one that “is a dynamic grant specific for the TTI” (claim 3), and a UL grant provided by SPS is one that “is a configured uplink grant that is periodically available” (claim 2).

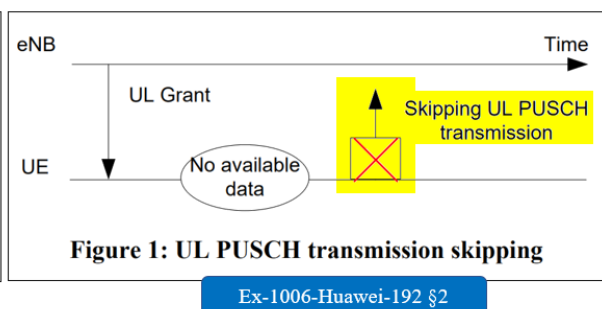
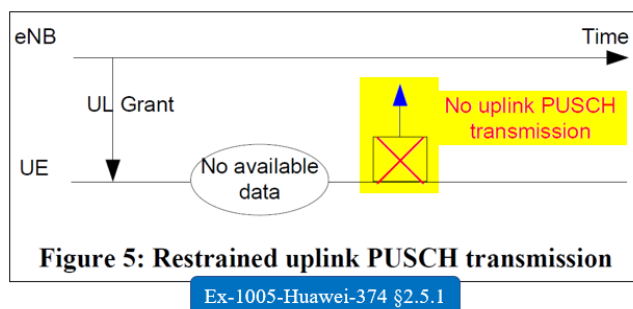
181. “Dynamic scheduling” UL grants and SPS UL grants were common UL grant types. (Ex-1006-Huawei-192 at §2.) Huawei-192 teaches that Ekpenyong’s UEs should be designed to skip either type of UL grant when the UE had nothing useful to send. (See §VIII.A.)

182. Thus, Ground 1 renders obvious claims 2-3.

[Claim 4] “The method of claim 1, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.”

183. The Huawei references teach this limitation. (See Claim 1.)

184. In particular, Huawei-374 and Huawei-192 disclose and teach that UL transmission would not occur when the UL grant is skipped:



(Ex-1005-Huawei-374 at Figure 5; 1006-Huawei-192 at Figure 1.)

185. As shown in Huawei-374’s Figure 5, there would be “No uplink PUSCH transmission” in the event of a skip. (Ex-1005-Huawei-374 at Figure 5; *see also* §VIII.A.)

186. Thus, Ground 1 renders obvious claim 4.

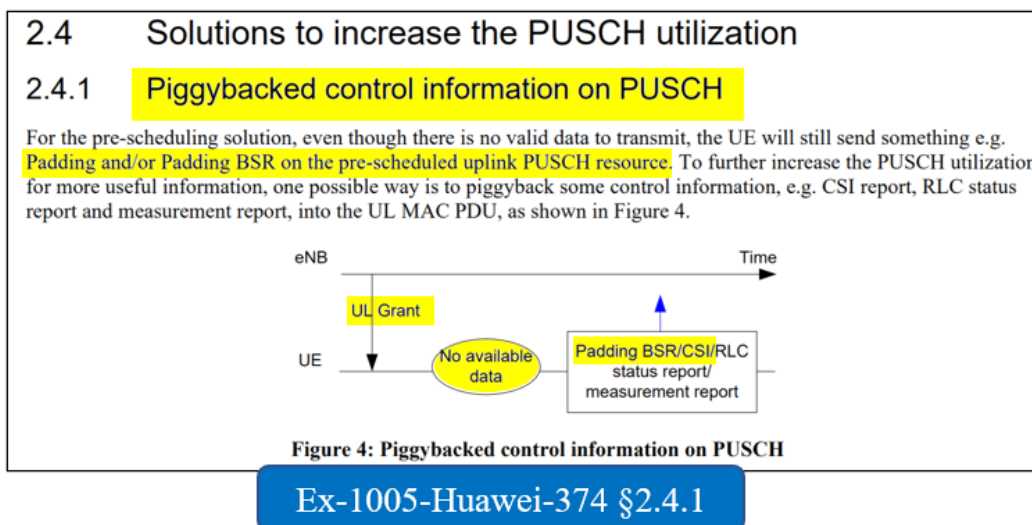
[Claim 5] “The method of claim 1, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.”

187. Huawei-374 teaches this limitation.

188. In my opinion, “comprise” means “comprising” in this claim and corresponding dependent claims 10, 15, and 20.

189. Specifically, Huawei-374 discloses piggybacking CSI into a UL MAC PDU that contains “padding and/or padding BSR.” (Ex-1005-Huawei-374 at §2.4.1.)

Figure 4 shows the same:



(Ex-1005-Huawei-374 at Figure 4.)

190. A POSITA would have understood from at least the '878 patent that padding BSR is a MAC control element. (Ex-1001 at 6:30-31 (“In current specifications, the UE sends a MAC PDU containing a MAC CE for padding BSR”), 42:2-3 (“a MAC control element corresponding to a Padding BSR”), 41:62-63 (“The UE could receive the signalling before transmitting a BSR control element.”).)

191. Thus, Ground 1 renders obvious claim 5.

[Claim 21] “The method of claim 1, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.”

192. Ekpenyong and Huawei-374 teach this limitation for the reasons described above regarding claim 1.

193. In particular, Ekpenyong and Huawei-374 disclose transmitting PCI via

PUSCH. Both references use the term “CSI,” which includes at least one of CQI, PMI, and/or RI. (Ex-1004-Ekpenyong at 5:23-31, 5:44-57, 8:54-62, 13:10-35; Ex-1005-Huawei-374 at §2.4.1.)

194. Accordingly, Ground 1 renders obvious claim 21.

[Claim 25] “The method of claim 1, wherein the data channel is Physical Uplink Shared Channel (PUSCH).”

195. Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation for the reasons described above regarding limitation 1.3, and Ground 1 renders obvious claim 25.

2. Claim Set B

[6.0] “A User Equipment (UE),”

196. Ekpenyong, Huawei-374, and Huawei-192 all teach this limitation.

197. Huawei-374 and Huawei-192 disclose a UE that receives a UL grant from a BS and propose modifying how a UE utilizes such a grant. (See Claim 1; Ex-1005-Huawei-374 at §§2.4-2.5; Ex-1006-Huawei-192 at §2.)

198. Ekpenyong explains in more detail that its UE may be a mobile device, like a phone. (Ex-1004-Ekpenyong at 1:48-61.)

199. Ekpenyong also discloses basic UE components, as discussed further below. (See limitations 6.1.1-6.1.3.)

[6.1] “wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission comprising:”

200. This limitation is obvious for the reasons provided above regarding limitation 1.1.

[6.1.1] “a control circuit;”

[6.1.2] “a processor installed in the control circuit; and”

[6.1.3] “a memory installed in the control circuit and operatively coupled to the processor;”

201. Ekpenyong teaches these limitations.

202. In particular, Ekpenyong’s UE has a control circuit that includes a processor and a memory operatively coupled together:

An embodiment of the invention may include a system with a processor coupled to a computer readable medium in which a software program is stored that contains instructions that when executed by the processor perform the functions of modules and circuits described herein. The computer readable medium may be memory storage such as dynamic random access memory (DRAM), static RAM (SRAM), read only memory (ROM), Programmable ROM (PROM), erasable PROM (EPROM) or other similar types of memory.

(Ex-1004-Ekpenyong at 16:4-20.)

UE device 1001 includes a processor 1003 coupled to a memory 1007 and a Transceiver 1004. The memory 1007 stores (software) applications 1005 for execution by the processor 1003. ...

Transceiver 1004 includes uplink logic which may be implemented by execution of instructions that control the operation of the transceiver. Some of these instructions may be stored in memory 1007 and executed when needed. As would be understood by one of skill in the art, the components of the uplink and downlink logic may involve the physical (PHY) layer and/or the Media Access Control (MAC) layer of the transceiver 1004.

(*Id.* at 14:9-31.)

203. A POSITA would have understood that any practical UE discloses these limitations. Ekpenyong's UEs were devices like mobile phones, which would conventionally have a processor and memory operatively coupled together to perform the functionality described in Ekpenyong (and, similarly, that would be expected by users of their mobile devices).

[6.2] "wherein the processor is configured to execute a program code stored in the memory to:"

204. Ekpenyong teaches this limitation.

205. Ekpenyong discloses a UE having a processor and memory. "The memory 1007 stores (software) applications 1005 for execution by the processor 1003." (*See* limitations 6.1.1-6.1.3; Ex-1004-Ekpenyong at 14:9-12.)

206. In Ekpenyong, "at least some of the applications" were used for transmitting and receiving between a UE and BS. The memory likewise stored instructions for uplink and downlink operations involving the physical and MAC

layer of the UE's transceiver. (*Id.* at 14:24-34.)

[6.2.1] “determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not; and”

207. This limitation is obvious for the reasons provided above regarding limitation 1.2.

[6.2.2] “transmit the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.”

208. This limitation is obvious for the reasons provided above regarding limitation 1.3 and Ground 1 renders obvious claim 6.

[Claim 7] “The UE of claim 6, wherein the uplink grant is a configured uplink grant that is periodically available.”

[Claim 8] “The UE of claim 6, wherein the uplink grant is a dynamic grant specific for the TTI.”

209. Claims 7-8 are obvious for the reasons provided above for claims 2-3.

[Claim 9] “The UE of claim 6, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.”

210. Claim 9 is obvious for the reasons provided above for claim 4.

[Claim 10] “The UE of claim 6, wherein the processor is further configured to execute a program code stored in the memory to: transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.”

211. Ekpenyong teaches a “processor is further configured to execute a program code stored in the memory” for the reasons described above relative to limitations 6.1-6.2.

212. Huawei-374 teaches transmitting “the physical control information on the data channel with a transport block [comprising] a padding or a padding MAC (Medium Access Control) control element” for the reasons described above relative to claim 5. A POSITA would have been motivated to use Huawei’s piggybacking functionality with the Ekpenyong system as I explain in §VIII.A.

213. Accordingly, Ground 1 renders obvious claim 10.

[Claim 22] “The UE of claim 6, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARO) feedback.”

214. Claim 22 is obvious for the reasons provided above for claim 21.

[Claim 26] “The UE of claim 6, wherein the data channel is Physical Uplink Shared Channel (PUSCH).”

215. Claim 26 is obvious based on Ekpenyong plus Huawei-374/192 for the same reasons provided above for claim 25.

3. Claim Set C

[11.0] “A method of a UE (User Equipment), comprising:”

216. This preamble is obvious for the reasons provided above regarding preamble 1.0.

[11.1] “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;”

217. This limitation is obvious for the reasons provided above regarding limitation 1.1.

[11.2] “the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI; and”

218. This limitation is obvious for the reasons provided above regarding limitation 1.2.

[11.3] “the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI.”

219. This limitation is obvious for the reasons provided above regarding limitation 1.3 and Ground 1 renders obvious claim 11.

[Claim 12] “The method of claim 11, wherein the uplink grant is a configured uplink grant that is periodically available.”

[Claim 13] “The method of claim 11, wherein the uplink grant is a dynamic grant specific for the TTI.”

220. Claims 12-13 are obvious for the same reasons provided above regarding claims 2-3.

[Claim 14] “The method of claim 11, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.”

221. Claim 14 is obvious for the reasons provided above regarding claim 4.

[Claim 15] “The method of claim 11, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.”

222. Claim 15 is obvious for the reasons provided above regarding claim 5.

[Claim 23] “The method of claim 11, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.”

223. Claim 23 is obvious for the reasons provided above regarding claim 21.

[Claim 27] “The method of claim 11, wherein the data channel is Physical Uplink Shared Channel (PUSCH).”

224. Claim 27 is obvious for the reasons provided above regarding claim 25.

4. Claim Set D

[16.0] “A User Equipment (UE),”

225. This preamble is obvious for the reasons described above regarding preamble 1.0 and 6.0.

[16.1] “wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission comprising:”

226. This limitation is obvious for the reasons provided above regarding limitation 1.1 and 6.1.

[16.1.1] “a control circuit;”

[16.1.2] “a processor installed in the control circuit; and”

[16.1.3] “a memory installed in the control circuit and operatively coupled to the processor;”

[16.2] “wherein the processor is configured to execute a program code stored in the memory to:”

227. These limitations are obvious for the reasons provided above regarding limitations 6.1.1-6.1.3 and 6.2.

[16.2.1] “transmit a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI; and”

228. This limitation is obvious for the reasons provided above regarding limitation 1.3.

[16.2.2] “skip the uplink grant if the physical control information does not need to be transmitted in the TTI.”

229. This limitation is obvious for the reasons provided above regarding limitation 1.2 and Ground 1 renders obvious claim 16.

[Claim 17] “The UE of claim 16, wherein the uplink grant is a configured uplink grant that is periodically available.”

[Claim 18] “The UE of claim 16, wherein the uplink grant is a dynamic grant specific for the TTI.”

230. Claims 17-18 are obvious for the reasons provided above for claims 2-3.

[Claim 19] “The UE of claim 16, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.”

231. Claim 19 is obvious for the reasons provided above for claim 4.

[Claim 20] “The UE of claim 16, wherein the processor is further configured to execute a program code stored in the memory to: transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.”

232. Claim 20 is obvious for the reasons provided above for claims 5 and 10.

[Claim 24] “The UE of claim 16, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.”

233. Claim 24 is obvious for the reasons provided above for claim 21.

[Claim 28] “The UE of claim 16, wherein the data channel is Physical Uplink Shared Channel (PUSCH).”

234. Claim 28 is obvious for the reasons provided above for claim 25.

IX. GROUND 2: Novlan in view of 3GPP-36.212 v13.0.0, 3GPP-36.213 v12.5.0, Samsung-332, and Samsung-333

A. Reasons for Combining Prior Art

235. Novlan incorporates by reference 3GPP documents and standards descriptions for “E-UTRA” (which refers to an LTE radio access network) in the 36-series of technical specifications. This series of specifications discloses technical requirements for a UE, including 3GPP-36.212 (Ex-1009) and 3GPP-36.213 (Ex-1010). (Ex-1011-Novlan at 4:21-35; 4:58-5:8, 7:60-9:13.)

236. Novlan further discloses an exemplary wireless network according to its embodiments that includes a UE 116 that “may be a mobile device (M), such as a cell phone, a wireless laptop, a wireless PDA, or the like.” (Ex-1011-Novlan at FIG. 1; *Id.*, at 4:46-67.) As an example, Novlan teaches that this UE has conventional elements, that may include a control circuitry comprising a processor, memory, and corresponding reception/transmission circuitry, as shown in FIG. 3:

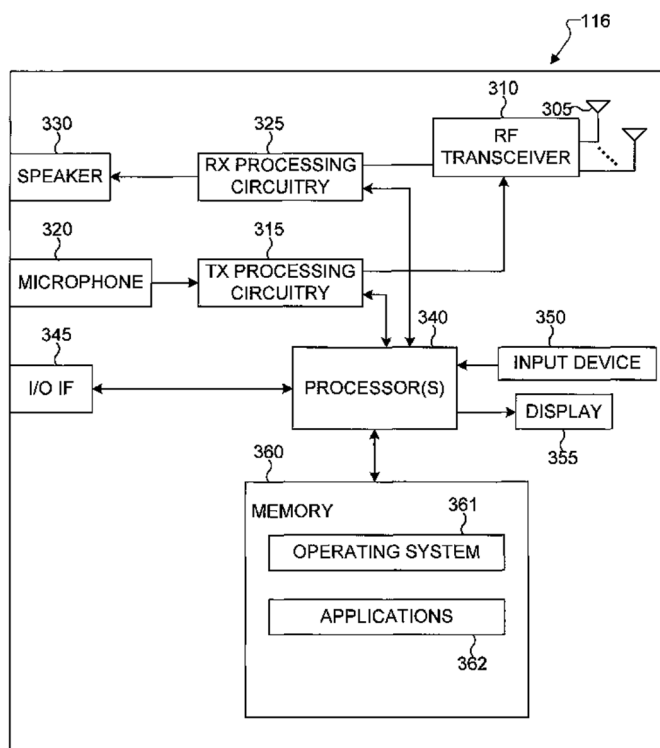


FIGURE 3

(Ex-1011-Novlan at FIG. 3; *see id.* at 7:60-9:13 (describing UE 116).)

237. Novlan also describes how its UE's processor and memory elements worked together to implement the device's functionality. (Ex-1011-Novlan at 4:21-35, 7:60-9:13.)

238. 3GPP-36.212 and 3GPP-36.213 provided details for transmitting PCI from a UE to a BS. Both of these technical specifications were part of the 3GPP standard for LTE networks. 3GPP-36.212 is a "Release 13" 3GPP technical specification from January 2016. (Ex-1009-3GPP-36.212 at 1.) This specification discloses conventional PCI reporting behavior for a UE in §5.2.4 (titled "Uplink

control information on PUSCH without UL-SCH data”).

239. 3GPP-36.213 is a “Release 12” 3GPP technical specification from 2015. (Ex-1010-3GPP-36.213 at 1.) This specification specifies “UE procedure[s] for reporting Channel State Information (CSI).” §7.2 describes that a UE transmits PCI on PUSCH when the UE has an uplink grant. (Ex-1010-3GPP-36.213 at §7.2.)

240. I note that this version of 3GPP-36.213 (i.e., version 12.5.0) is quoted and incorporated-by-reference in the ’878 patent. (*E.g.*, Ex-1001 at 3:1-17.) Later “Release 13” iterations disclosed the same functionality. (*See, e.g.*, Ex-1022 (3GPP TS 36.213 V13.6.0) at 1 (identifying Release 13), §7.2 (disclosing CSI reporting procedures).)

241. A POSITA would have been familiar with conventional UE behavior. Specifically, a UE would typically transmit PCI reports (CQI, PMI, and RI, in particular) on PUSCH—even when the UE did not have data to transmit—if the UE had an uplink grant. (Ex-1009-3GPP-36.212 at §5.2.4.1; Ex-1010-3GPP-36.213 at §7.2.) This had been the convention for many years. (Ex-1012-LTE-UMTS at 366; Ex-1013-R1-073322 at §§3-4; Ex-1014-R1-073858 at §2; Ex-1015-R1-074383 at §1.)

242. In 2015 and early 2016, 3GPP members were working on updates to Release 12 of the 3GPP standard for Release 13. In August 2015, Samsung submitted two related contributions to the appropriate 3GPP working group—these

contributions are Samsung-332 and Samsung-333. (Exs-1007-08.) These contributions related to a proposed “skipping” enhancement to 3GPP TS 36.321 V12.6.0 (a Release 12 technical specification):

This contribution discusses the problem of the pre-scheduling in terms of battery consumption, and proposes to enhance the UE behaviour to mitigate the problem.

(Ex-1007-Samsung-332 at §1; *see id.* at §§2.3-2.4.)

243. Samsung-332 described the root of the problem and disclosed a “straightforward” solution—skipping UL grants rather than transmitting empty padding transmissions:

In pre-scheduling solution, ENB [BS] schedules uplink resource for a UE without knowing the buffer status of the UE, which leads to allocating uplink resource to a UE without data to transmit. Current specification mandates UE to produce and transmit a padding MAC PDU even in such case.

In terms of latency reduction, for pre-scheduling scheme to be effective, uplink resource should be granted with very short interval. On the other hands, if UE runs TCP applications or web applications, uplink data will occur infrequently. All these just suggest that there will be continuous padding MAC PDUs which would drain UE battery quickly. Straightforward solution would be to allow UE to skip uplink transmission if no data is available for transmission.

(*Id.* at §2.1.)

244. A change request (Samsung-333) for modifying 3GPP TS 36.321 V12.6.0 for Release 13 accompanied Samsung-332. (Ex-1008-Samsung-333 at cover page (indicating that the current version of 36.321 was 12.6.0 and the proposed change would relate to Release 13 (“Rel-13”)).) Samsung-332 was a discussion document and Samsung-333 was the formal CR.

245. Samsung-332 is a document authored by Samsung titled “Skipping uplink transmission with no data to transmit” that was submitted to the 3GPP TSG-RAN WG2 for discussion during their Meeting #91, which was held from August 24-28, 2015. The document discusses “pre-scheduling” as a technique that promises to reduce latency, but proposes an enhancement to mitigate a battery consumption problem in the UE. Samsung-333 is a Change Request document authored by Samsung and approved as a Work Item to the TSG. It is titled “Skipping uplink transmission with no data to transmit,” and is a formal request for correction to the radio access network and UE behavior of the E-UTRA. The reason stated for making this change is to address the battery drain problem when using “pre-scheduling” to reduce uplink latency. The document further states that if the requested change is not made, “pre-scheduling remains impractical solution due to excessive UE battery waste.”

246. Indeed, Samsung-332 refers to Samsung-333 as one of Samsung’s drafts CRs for the skipping functionality. (Ex-1007-Samsung-332 at §2.3, 3,

247. Thus, Samsung-332 and Samsung-333 were related documents and would have been considered together. They were also directed to solving the same well-understood problem with pre-scheduling grants. In particular, short-interval UL grants were allocated in such a way that UEs often had nothing useful to transmit, but the 3GPP standard nonetheless required the UE to send empty padding transmissions pursuant to those grants. Doing so was a waste of transmission resources and UE battery. (Ex-1007-Samsung-332 at §2.1.)

248. A POSITA would have been motivated and found it obvious to enhance the UEs disclosed in Novlan (a patent filed by Samsung) and its associated 3GPP standard functionality (including PCI reporting functionality) in combination with Samsung's proposed skipping functionality.

249. Samsung-332 and Samsung-333 disclosed that skipping empty padding transmissions was a straightforward fix for the UL resource waste and battery drain problems identified above. (Ex-1007-Samsung-332 at §2.1; Ex-1008-Samsung-333 at cover page.) Thus, a POSITA would have been motivated to improve Novlan's UEs by implementing Samsung's skipping functionality—by allowing Novlan's UE to skip unnecessary UL grants and avoid the battery-draining empty padding transmissions, Novlan's UE would preserve battery life and avoid wasting UL resources.

250. A POSITA implementing Samsung's skipping functionality would have had to make one additional choice between two known options: (1) skip the uplink grant entirely, even if Novlan's the UE needed to transmit control information on PUSCH; or (2) skip the uplink grant if there was no data and no control information to transmit on PUSCH.

251. Samsung-333 discloses and teaches option (2) by proposing the following change to subclause §5.4.1 of 38.331: "the MAC entity considers itself having a valid uplink grant only if there is data available for transmission." (Ex-1008-Samsung-333 at §5.4.1; *id.* at cover page.) The text in this subclause is written in the context of subclause §5.4, titled "UL-SCH data transfer." Thus, the requirement allowing a MAC entity process to skip an uplink grant when there is no uplink data available for transmission is in the context of UL-SCH data transfer, and does not apply to the process within the UE for transmitting PCI. Thus, Samsung-333 discloses and teaches that Samsung's proposed skipping functionality would be implemented by having the UE's MAC entity skip the step of generating empty padding for transmission when skipping was enabled. This would not have impacted the UE's PCI reporting—the UE would still transmit PCI on PUSCH pursuant to the UL grant when necessary (as was conventional). A POSITA would have been motivated and found it obvious to modify Novlan's UE in view of Samsung-332 and Samsung-333 to skip a UL grant when the UE did not have data and/or PCI to

transmit. That would have been the clear choice to a POSITA because the intent of Samsung's skipping proposals was to skip the empty padding transmissions that did not communicate useful information and instead rapidly drained UE battery. A POSITA would have had no inclination to skip PCI transmissions on PUSCH—those were known to be important and useful transmissions. Indeed, PCI transmissions grew in importance with each 3GPP standard release for LTE networks as data rates increased, and it was often the case that PCI had to be transmitted on PUSCH due to size constraints. (*E.g.*, Ex-1013-R1-073322 at §1.) Thus, Novlan's UE would transmit data and/or PCI pursuant to a UL grant and skip the uplink grant if the UE did not have either type of information to transmit.

252. This simple combination of Samsung's skipping solution with conventional PCI reporting was also predictable. In particular, it predictably maintains the 3GPP standard's existing PCI reporting scheme while merely adding the ability to skip uplink grants when there was nothing useful to transmit. At the very least, it was obvious to try skipping only the empty padding transmissions while still transmitting data or PCI in view of Samsung-332 and Samsung-333, because these references identified the padding transmissions as the cause of the UL resource waste and UE battery drain problem. It would not have made sense to further modify the 3GPP standard to skip useful PCI transmissions on PUSCH when the root cause of the problem that motivated the skipping solution was the transmission of useless

empty padding transmissions. Indeed, as I noted in my analysis with respect to Ground 1, I understand that a POSITA is not an automaton, can often fit multiple disclosures together like a puzzle, and can make reasonable inferences and take reasonable creative steps when considering the prior art. Here, a POSITA would not blindly redesign a UE to skip PCI transmissions when Samsung-332 and Samsung-333 disclose skipping as a way to avoid useless, battery-draining empty padding transmissions. The preferable, logical, and most reasonable way to use Samsung's skipping teachings was to skip UL grants if there was no data and no PCI to transmit.

253. A POSITA also would have expected to succeed using a simple implementation change to Novlan's UEs. This change simply involved refraining from sending useless empty padding transmissions, with no effect on how Novlan's UE transmitted useful information (i.e., data or PCI). This change was a simple implementation choice—a "straightforward solution" as stated in Samsung-332 and Samsung-333—wherein a UE would be programmed in a conventional manner to transmit data and/or PCI on PUSCH pursuant to a UL grant and skip the UL grant otherwise.

254. A POSITA also would have had no difficulty enhancing Novlan in view of 3GPP-36.212 and 3GPP-36.213 with Samsung's skipping teachings, because doing so merely required skipping unnecessary affirmative steps (preparing and transmitting empty padding transmissions).

B. Challenged Claims

1. Claim Set A

[1.0] “A method of a UE (User Equipment), comprising:”

255. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach the preamble.

256. I explain in §IX.A that Novlan discloses a UE that would operate on a 3GPP standard network and send PCI reporting in a conventional way as detailed in 3GPP-36.212 and 3GPP-36.213. (Ex-1009-3GPP-36.212 at §5.2.4 (describing coding steps for UE uplink control data transmissions on PUSCH without UL data); Ex-1010-3GPP-36.213 at §7.2 (indicating that a UE transmits CSI on PUSCH when it has a UL grant).)

257. Novlan’s UE operation would also include UL grant skipping in view of Samsung-332 and Samsung-333. (See §IX.A; Ex-1007-Samsung-332 at §1; Ex-1008-Samsung-333 at cover page.)

[1.1] “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;”

258. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation.

259. In general, a UE would need a UL grant in a TTI in order to transmit on PUSCH. This was well known, including as reflected in Samsung-333. (Ex-1008-Samsung-333 at §5.4.1 (“In order to transmit on the UL-SCH the MAC entity must

have a valid uplink grant...” and “for each grant received for this TTI...”), (“NOTE: The period of configured uplink grants is expressed in TTIs”), “Summary of change” [cover page] (“UE initiates UL-SCH transmission only when it has a valid uplink grant”).)

260. 3GPP-36.212 §5.2.4 discloses coding steps for transmitting “control data...via PUSCH without UL-SCH data” in §5.2.4 (“Uplink control information on PUSCH without UL-SCH data”). This shows that Novlan’s UE would conventionally transmit PCI on PUSCH without data.

261. Samsung’s proposals also disclose that the UE would occasionally need to send PCI on PUSCH without data:

2.1 The problem of pre-scheduling in the current specification

In pre-scheduling solution, ENB schedules uplink resource for a UE without knowing the buffer status of the UE, which leads to allocating uplink resource to a UE without data to transmit. Current specification mandates UE to produce and transmit a padding MAC PDU even in such case.

(Ex-1007-Samsung-332 at §2.1.)

262. Samsung-332 further notes that sending padding MAC PDUs will needlessly drain a UE’s battery, but a “[s]traightforward solution would be to allow UE to skip uplink transmission if no data is available for transmission.” (*Id.*)

[1.2] “the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not; and”

263. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation.

264. Novlan’s UE conventional behavior would include transmitting PCI on PUSCH without accompanying data. This is set forth in the 3GPP standard, as discussed above. (See Ground 2, limitation 1.1; Ex-1009-3GPP-36.212 at §5.2.4 (“Uplink control information on PUSCH without UL-SCH data”).)

265. 3GPP-36.213 §7.2 discloses that Novlan’s UE would report periodic PCI on PUSCH when a UE had a UL grant (“with a PUSCH allocation,” highlighted green) and for aperiodic PCI reporting under various other conditions (highlighted yellow):

CSI reporting is periodic or aperiodic.
If the UE is configured with more than one serving cell, it transmits CSI for activated serving cell(s) only.
If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUCCH as defined hereafter in subframes with no PUSCH allocation.
If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUSCH of the serving cell with smallest <i>ServCellIndex</i> as defined hereafter in subframes with a PUSCH allocation, where the UE shall use the same PUCCH-based periodic CSI reporting format on PUSCH.
A UE shall transmit aperiodic CSI reporting on PUSCH if the conditions specified hereafter are met. For aperiodic CQI/PMI reporting, RI reporting is transmitted only if the configured CSI feedback type supports RI reporting.

(Ex-1010-3GPP-36.213 at §7.2.)

266. As I explain in detail above in §IX.A, it was obvious in view of Samsung-332 and Samsung-333 to allow the UE to skip a UL grant when a UE had

neither data nor PCI to send. A POSITA would have found this obvious because Samsung-332 identified a problem with pre-scheduling and provided a “[s]traightforward solution” of allowing “UE to skip uplink transmission if no data is available for transmission.” (Ex-1007-Samsung-332 at §2.1; *see also* Ground 2, limitation 1.1.)

267. It was obvious for Novlan’s UE to determine that it should skip a UL grant when it had no data to transmit based on whether it had PCI to send pursuant to a UL grant given the importance of transmitting PCI on PUSCH. In particular, PCI conveyed useful information and was not the type of empty padding transmission that had to be repeatedly sent under the existing 3GPP standard, thereby wasted UL resources and draining UE battery. (*See* §IX.A.) Samsung’s skipping functionality would be implemented by having the “MAC entity” (which is part of layer 2 of the UE and not the UE as a whole) behave as though it did not have a UL grant when it did not have data. (Ex-1008-Samsung-333 at §5.4.1, cover page.) This teaches a POSITA that the MAC entity would not generate empty padding for transmission, thereby skipping empty padding transmissions, without simultaneously requiring the UE’s physical layer (layer 1) to skip useful PCI transmissions. (*Id.*)

268. Thus, it was obvious for Novlan’s UE to skip the UL grant when it did not have data and did not have PCI to send. Samsung’s skipping functionality

disclosed and taught skipping wasteful padding transmissions that did not convey useful information by modifying “MAC entity” functionality. PCI transmissions are controlled by a different part of the UE and, like data, represent useful information that should not be skipped. (Ex-1009-3GPP-36.212 at §5.2.4.1; Ex-1010-3GPP-36.213 at §7.2; *see* §IX.A.)

[1.3] “the UE transmits the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.”

269. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation.

270. As I explain above in §X.A, 3GPP-36.212 and 3GPP-36.213 disclose that Novlan’s UE would conventionally transmit PCI reports on PUSCH, including CQI, PMI, and RI reporting. (Ex-1009-3GPP-36.212 at §5.2.4–5.2.4.1; Ex-1010-3GPP-36.213 at §7.2.)

271. Section 7.2 of 3GPP-36.213 shows this to be the case for periodic PCI reports, for example. Such reports were conventionally transmitted on PUSCH pursuant to a UL grant even when there was no data to transmit: “[A UE] shall transmit periodic CSI reporting on PUSCH...in subframes with a PUSCH allocation.” (Ex-1010-3GPP-36.213 at §7.2.) The “PUSCH allocation” in §7.2 is a reference to a UL grant. (*See also* Ex-1008-Samsung-333 at §5.4.1 (“In order to transmit on the UL-SCH the MAC entity must have a valid uplink grant...” and “for

each grant received for this TTI”).)

272. Novlan’s UE would have maintained this functionality when combined with the skipping functionality of Samsung-332 and Samsung-333 because UE transmissions of PCI on PUSCH conveyed important information to a BS. For example, Samsung-333 discloses and teaches that skipping would be implemented by modifying the UE’s MAC entity (part of the UE’s layer 2) to act as if it had no UL grant when it has no data to transmit—without disclosing or teaching modifications to layer 1, where PCI is coded and added to a UE’s UL transmission. Thus, unlike empty padding transmissions, a POSITA would not want the UE to skip UL grants that would be used to transmit PCI on PUSCH. (*See* §IX.A.)

273. Thus, Ground 2 renders obvious claim 1.

[Claim 2] “The method of claim 1, wherein the uplink grant is a configured uplink grant that is periodically available.”

[Claim 3] “The method of claim 1, wherein the uplink grant is a dynamic grant specific for the TTI.”

274. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach claims 2-3.

275. Samsung-332 discloses skipping a UL grant whether it is a dynamic grant or a configured uplink grant that is periodically available:

Proposal 3: To not enhance implicit release mechanism for pre-scheduling scenario (i.e. if ‘skipping uplink transmission’ is configured, UE without data to transmit skips uplink transmission

regardless of whether it is by the dynamic grant or by the configured grant).

(Ex-1007-Samsung-332 at §2.2 (original bold/italic emphasis removed, underlining added)).

276. Samsung-333 also discloses that skipping will be used for both dynamic and configured uplink grants. (Ex-1008-Samsung-333 at §5.4.1.)

277. A UL grant provided by “dynamic grant” is one that “is a dynamic grant specific for the TTI” (claim 3), and a UL grant provided by “the configured grant” is one that “is a configured uplink grant that is periodically available” (claim 2). Thus, Samsung-332 and Samsung-333 disclose that either type of UL grant may be skipped, and Ground 2 renders obvious claims 2-3.

[Claim 4] “The method of claim 1, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.”

278. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation.

279. Samsung-332 states that a UE should “skip uplink transmission if no data is available for transmission” instead of sending empty padding transmissions on PUSCH. (Ex-1007-Samsung-332 at §2.1.) Thus, Samsung-332’s use of “skip” means that the UE would not transmit on PUSCH.

280. Samsung-333 offers the same teaching, and further teaches that the UE will not consider itself to have a valid uplink grant when it has nothing to transmit if

“*SkipUplinkTransmission* is configured.” (Ex-1008-Samsung-333 at §5.4.1.)

281. Thus, Ground 2 renders obvious claim 4.

[Claim 5] “The method of claim 1, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.”

282. Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation.

283. First, Samsung-332 states that the “[c]urrent specification mandates [a] UE to produce and transmit a padding MAC PDU” even when it had no data to transmit. (Ex-1007-Samsung-332 at §2.1.)

284. A POSITA would have understood that the “current specification” in the Samsung references included 3GPP TS 36.321 V12.6.0 (Ex-1023). A POSITA would have had that understanding because V12.6.0 was the version that Samsung proposed modifying—Samsung-333 was a “CR” for that version, with the idea being that the changes would be reflected in a Release 13 version of 3GPP TS 36.321. (Ex-1008-Samsung-333 at cover page.)

285. Novlan’s UE behavior at the time (i.e., as specified by 3GPP TS 36.321 V12.6.0) would have been to multiplex PCI with a transport block comprising padding and transmit the result on PUSCH, space permitting and according to the logical channel prioritization scheme set forth in 3GPP-36.212. (Ex-1023-36.321 at §§3.1, 4.4, 5.4.1–5.4.5, 6.1.2; Ex-1010-36.213 at §8.6.2; Ex-1009-36.212 at

§5.2.2.7; *see also* Ex-1010-36.213 at §§7.1.7-7.2, 8.6.3).) By “space permitting,” I simply mean PCI was sometimes too big to be multiplexed with a transport block. (Ex-1010-36.213 at §8.6.2; *see also id.* at §§7.1.7-7.2, 8.6.3.) The physical layer would signal to higher layers whether a transport block should be created accordingly. (Ex-1009-36.212 at §5.2.2.7; Ex-1010-36.213 at §8.6.2; Ex-1023-36.321 at §§3.1, 4.4, 5.4.1, 5.4.3.1.)

286. Thus, Ground 2 renders obvious claim 5.

[Claim 21] “The method of claim 1, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.”

287. This limitation is obvious for the reasons provided above regarding Ground 2, limitation 1.3, and Ground 2 renders obvious claim 21.

[Claim 25] “The method of claim 1, wherein the data channel is Physical Uplink Shared Channel (PUSCH).”

288. This limitation is obvious for the reasons provided above regarding Ground 2, limitation 1.3, and Ground 2 renders obvious claim 25.

2. Claim Set B

[6.0] “A User Equipment (UE),”

289. This preamble is obvious for the reasons provided above regarding Ground 2, preamble 1.0.

[6.1] “wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission comprising:”

290. This limitation is obvious for reasons provided above regarding Ground 2, limitation 1.1.

[6.1.1] “a control circuit;”

[6.1.2] “a processor installed in the control circuit; and”

[6.1.3] “a memory installed in the control circuit and operatively coupled to the processor;”

[6.2] “wherein the processor is configured to execute a program code stored in the memory to:”

291. Novlan teaches these limitations.

292. Novlan’s UE is depicted in FIG. 3:

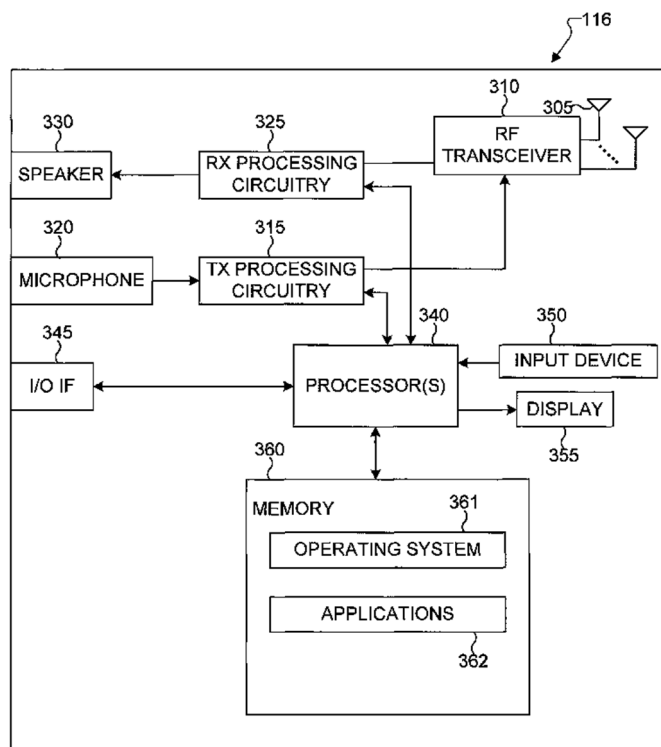


FIGURE 3

293. UE 116 includes:

[A] radio frequency (RF) transceiver 310, TX processing circuitry 315,...receive (RX) processing circuitry 325[,]...a processor 340..., and a memory 360. The memory 360 includes an operating system (OS) 361 and one or more applications 362.

(*Id.* at 7:60-67.)

294. Novlan's UE may be a mobile station ("FIG. 3 illustrates the UE 116 configured as a mobile telephone or smartphone," *id.* at 9:11-12) that has control circuitry (limitation 6.1.1) comprising a processor (limitation 6.1.2) and memory (limitation 6.1.3).

295. Novlan discloses that its processor executes an operating system stored in memory to control the UE's operations:

The processor 340 can include one or more processors or other processing devices and execute the OS 361 stored in the memory 360 in order to control the overall operation of the UE 116.

(*Id.* at 8:32-35; *see id.* at FIG. 3, 8:35-9:13.)

296. Novlan couples its processor and memory together (limitation 6.1.3):

The memory 360 is coupled to the processor 340. Part of the memory 360 could include a random access memory (RAM), and another part of the memory 360 could include a Flash memory or other read-only memory (ROM).

297. Novlan also uses its processor to execute programs in memory that relate to measuring and transmitting CSI (limitation 6.2):

The processor 340 is also capable of executing other processes and programs resident in the memory 360, such as processes a reference signal to measure CSI in order to transmit a CSI measurement report to eNBs 101-103 operating an LAA cell over unlicensed spectrum and/or licensed spectrum.

(*Id.* at 8:42-47; *see id.* at 8:32-9:13.)

298. Thus, Novlan discloses the physical elements of claim 6's UE. These elements included the control circuit, the processor and memory that are installed in the control circuit and operatively connected, as well as the configuration whereby Novlan's processor executes code stored in memory to perform functions relating to transmitting PCI.

[6.2.1] "determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not; and"

299. This limitation is obvious for the reasons provided above regarding Ground 2, limitation 1.2.

[6.2.2] "transmit the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI."

300. This limitation is obvious for the reasons provided above regarding

Ground 2, limitation 1.3 and Ground 2 renders obvious claim 6.

[Claims 7-9]

301. Claims 7-9 are obvious for the reasons provided above regarding Ground 2, claims 2-4.

[Claim 10] “The UE of claim 6, wherein the processor is further configured to execute a program code stored in the memory to: transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.”

302. Novlan teaches “the processor is further configured to execute a program code stored in the memory to” for the reasons provided above relative to limitations 6.1.1-6.2.

303. Samsung-332 and Samsung-333 teach “transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element” for the reasons provided above regarding Ground 2, claim 5.

304. Thus, Ground 3 renders obvious claim 10.

[Claims 22 and 26]

305. Claims 22 and 26 are obvious for the reasons provided above regarding Ground 2, claims 21 and 25.

3. Claim Sets C-D

306. Claim Sets C-D correspond Claim Sets A-B as follows:

Claim/Limitation	Corresponding Claim/Limitation
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(Claim Sets C-D)	(Claim Sets A-B)
11.0	1.0
11.1	1.1
11.2	1.2
11.3	1.3
12, 17	2
13, 18	3
14, 19	4
15, 20	5
23, 24	21
27, 28	25
16.0	1.0, 6.0
16.1	6.1.1
16.2	6.1.2
16.3	6.1.3
16.2.1	1.3, 6.2.1
16.2.2	1.2, 6.2.2

307. Thus, Ground 2 renders obvious claim sets C-D for the reasons provided above regarding Ground 2, claim sets A-B.

X. DECLARATION IN LIEU OF OATH

I hereby declare that all statements made herein of 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 § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. If called to testify as to the truth of the matters stated herein, I could and would testify competently.

I declare under penalty of perjury that the foregoing is true and correct.

March 8, 2024

A handwritten signature in black ink, appearing to read "Harry Bims", written over a horizontal line.

Harry V. Bims, Ph. D.