

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.

IPR2024-00614
Patent No. 10,187,878

**PETITION FOR *INTER PARTES* REVIEW OF
CLAIMS 1-28 OF U.S. PATENT 10,187,878 UNDER
35 U.S.C. §§ 311-319 AND 37 C.F.R. §§ 42.100 ET SEQ.**

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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

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	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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TABLE OF AUTHORITIES

Cases

<i>Advanced Bionics LLC v. Med-EL Elektromedizinische Geräte GMBH</i> , IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020)	11
<i>Apple Inc. v. Fintiv, Inc.</i> , IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020).....	9, 10
<i>Becton Dickinson & Co. v. B. Braun Melsungen AG</i> , IPR2017-01586, Paper 8 (PTAB Dec. 15, 2017)	11
<i>Hulu LLC v. SITO Mobile R&D, LLC</i> , IPR2021-00298, Paper 11 (May 19, 2021)	10
<i>KSR Int’l Co. v. Teleflex Inc.</i> , 550 U.S. 398 (2007)	28, 29, 59

I. Introduction

Samsung Electronics Co., Ltd. (“Petitioner”) hereby seeks *inter partes* review of claims 1-28 (the “Challenged Claims”) of U.S. Patent No. 10,178,878 (Ex-1001, the “’878 patent”).

II. Mandatory Notices Under 37 C.F.R. §42.8

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

Petitioner certifies that the real parties-in-interest are Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., and Samsung Research America.

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

The ’878 patent is currently the subject of pending litigation involving Petitioner: *Asus Technology Licensing Inc. et al. v. Samsung Elecs. Co. Ltd. et al.*, Case No. 2:23-cv-00409 (E.D. Tex.) filed on September 12, 2023 (the “Asus Litigation”).¹ Petitioner is not aware of any other matters involving the ’878 patent.

C. Lead and Back-up Counsel Under 37 C.F.R. §42.8(b)(3) and Service Information under 37 C.F.R. §42.8(b)(4)

Petitioner designates the following lead and back-up counsel:

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¹ Asus did not serve Samsung with the complaint until November 21, 2023.

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Service on Petitioner may be made by mail or hand delivery to: Greenberg Traurig, LLP, 1144 15th St., Suite 3300, Denver, CO 80202. Petitioner also consents to and prefers electronic service by emailing Samsung-ASUS-IPRs@gtlaw.com and counsel of record.

III. Word Count

Petitioner certifies this Petition is 13,640 words, as counted by the word-processing program (Microsoft Word for Office 365) used to generate this Petition (excluding the table of contents, table of authorities, mandatory notices, certificate of service, and this certificate). This Petition complies with the 14,000 word limit (37 C.F.R. §42.24(a)(1)(i)).

IV. IPR Eligibility and Fees

Petitioner certifies under 37 C.F.R. §42.104(a) that the '878 patent is available for IPR and Petitioner is not barred or estopped from requesting cancellation of the Challenged Claims on the grounds identified below.

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)

Any and all fees may be charged to Deposit Account No. 502638.

V. The '878 Patent

A. General Overview

The '878 patent relates to a standard wireless network having user equipment (“UE”) and base stations (“BSs”). (Ex-1001 at 3:53-60.) UEs include devices like 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 is) a well-known consortium that specifies the details of well-known communications networks, including LTE and 5G. (Ex-1003-Bims at ¶¶49-50.)

The '878 patent focuses on UE uplink (“UL”) transmissions. Typically, a UE received 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.) If the UE had nothing to transmit, the UE sent empty padding transmissions to the BS pursuant to its UL

grant. (*Id.*) As 3GPP standard development continued, shorter TTIs and pre-scheduled UL grants were added to reduce latency and improve performance, but these changes made empty padding transmissions more wasteful. (*E.g., id.* at 5:37-6:41.) The '878 patent purports to invent a scheme where a UE sends data and/or control information on a data channel called "PUSCH" (Physical Uplink Shared Channel) pursuant to a UL grant, and skips the UL grant (rather than send empty padding) if it has neither data nor control information to send. (*Id.* at 1:41-54 & claims 1-28; Ex-1003-Bims at ¶¶51-53.)

The '878 patent did not invent this scheme. Instead, the '878 patent's specification copied large portions of prior art 3GPP documents:²

'878 patent	3GPP Source	Ex No.
17:18-35:43	3GPP TS 36.212 v13.0.0	Ex-1009
15:56-16:24, 16:36-17:17, 36:8-33	3GPP TS 36.213 v12.5.0	Ex-1010
5:39-6:3	RP-150465, <i>New SI proposal: Study on Latency reduction techniques for LTE</i> (March 12, 2015) Source: Ericsson, Huawei	Ex-1016

² Each of the exhibits identified in the table qualify as prior art. (Ex-1024-Bishop at §§IV.E-F & IV.J-N.)

6:9-16, 35:44-36:7	RP-150310, Motivation for new SI: Study on Latency reduction techniques for LTE (March 3, 2015) Source: Ericsson	Ex-1017
8:52-12:48	3GPP TS 36.321 v12.5.0	Ex-1018
12:49-15:40	3GPP TS 36.331 v12.5.0	Ex-1019
6:17-7:54	3GPP TR 36.881 v0.6.0	Ex-1020

(See Ex-1026; Ex-1003-Bims at ¶¶53-54.)

The copied 3GPP materials show that the inventor sought to patent what was already known. For example, the '878 patent quotes 3GPP TR 36.881 v0.6.0, which discloses that UEs should be allowed to skip UL grants:

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.)³

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

³ Emphasis is added herein unless otherwise noted.

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).)

Similarly, 3GPP TS 36.212 v13.0.0 indicates that the “control data” is “in the form of channel quality information (CQI and/or PMI)...and rank indication [RI].” (Ex-1009-3GPP-36.212 at §5.2.4.1.) This is the same type of “physical control information” recited in the ’878 patent. (*See, e.g.*, claim 21.)

Traditional UE behavior also admittedly 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).) This traditional behavior is disclosed in §7.2 of 3GPP TS 36.213 v12.5.0: 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 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.

(Ex-1010-3GPP-36.213 at §7.2.) Thus, 3GPP TS 36.212 v13.0.0 and 3GPP TS 36.213 v12.5.0 together show that a UE traditionally transmitted PCI on PUSCH, including when the UE had an uplink grant and no data to transmit.⁴ (*See also* Ex-1003-Bims at ¶¶55-58 (citing 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); Ex-1024-Bishop at §§IV.G-I (explaining that each of Exs-1013-1015 are prior art).)

B. Effective Filing Date

The '878 patent claims priority to Provisional 62/316,799 filed April 1, 2016. (Ex-1001, (60).) Petitioner applies this date herein without conceding the '878 patent is entitled to claim priority thereto.

⁴ The 3GPP specification continued to specify the same behavior after the '878 patent's filing date. (*See, e.g.*, Ex-1021 (3GPP TS 36.212 v13.6.0 (June 23, 2017)) at §5.2.4–5.2.4.1; Ex-1022 (3GPP TS 36.213 v13.6.0 (June 23, 2017)) at §7.2.)

C. Prosecution History

Prosecution of the '878 patent was minimal, with only a single rejection issued. In the first and only non-final action, the Office noted:

“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.)

This interpretation is correct and applied by Petitioner herein.

Next, the examiner rejected the claims based on Kim (US2011/0205991), Ratilainen (US2018/0091269), Pelletier (US2017/0013565), and Sun (US2016/0242176). (*Id.* at 187-200.) None of these references are at issue in this Petition.

Applicant amended claim 1 to recite: “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.” (*Id.* at 232.) A similar limitation was added to independent claim 6. (*Id.* at 233.) Applicant also added new dependent claims. (*Id.* at 235.)

Applicant's response argued that the prior art failed to disclose skipping an uplink grant or sending physical control information on a data channel. (*Id.* at 237, 241-42.) A Notice of Allowance followed. (*Id.* at 259-60.)

This Petition relies on prior art not previously analyzed or discussed by the examiner. Indeed, the examiner missed key details in the prior art and erred by relying on PUCCH (a control channel) rather than PUSCH (a data channel) transmissions. This Petition remedies the examiner's error and presents new prior art not previously considered by the Office.

D. The Challenged Claims

Petitioner challenges claims 1-28, of which claims 1, 6, 11, 16 are independent.

VI. Discretionary Denial is Unwarranted

A. 35 U.S.C. §314(a) Does Not Favor Denial

In *Apple Inc. v. Fintiv, Inc.*, the Board enumerated six factors to determine whether a petition should be discretionarily denied institution under §314(a). IPR2020-00019, Paper 11 at 2-3 (PTAB Mar. 20, 2020) (precedential) ("*Fintiv*"). In June 2022, the USPTO issued updated discretionary denial guidance in view of the *Fintiv* factors and expressly noted that the PTAB will not discretionarily deny institution when, as here, Petitioner presents a *Sotera* stipulation. (Ex-1027.) *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020)

(precedential). For at least this reason, the Board should not discretionarily deny this petition.

The *Fintiv* factors also favor institution. Factor 1 (stay) is neutral because Samsung has not yet moved for a stay. *Hulu LLC v. SITO Mobile R&D, LLC*, IPR2021-00298, Paper 11 at 10-11 (May 19, 2021).

Factor 2 (proximity) favors institution. Petitioner is filing this Petition in March 2024, which suggests a final written decision around September 2025. The Court has not yet set a case schedule or trial date.

Factor 3 (investment) heavily favors institution. Fact and expert discovery have not begun, the initial case management conference has not yet occurred, and the Court has not issued any orders regarding the '878 patent. This Petition is also being filed the same week Patentee served its infringement contentions. *See Fintiv*, IPR2020-00019, Paper 11 at 10.

Factor 4 (overlap) heavily favors institution. Petitioner's *Sotera* stipulation (Ex-1027) obviates the risk of overlap, as noted above.

Factor 5 (same parties) does not weigh against discretionary denial, because the parties in this IPR are the same as in the Asus Litigation. *See Fintiv*, IPR2020-00019, Paper 11 at 13-14.

Factor 6 (merits) heavily favors institution. The compelling merits of Petitioner's arguments herein warrant institution because the Challenged Claims are

unpatentable over references that were not considered by the Office during prosecution. Further, this is the only petition challenging the '878 patent, so adjudicating invalidity in this proceeding would conserve resources.

B. 35 U.S.C. §325(d) Does Not Favor Denial

Non-institution under §325(d) would be improper in view of the *Advanced Bionics* framework and the *Becton Dickinson* factors. See *Advanced Bionics LLC v. Med-EL Elektromedizinische Geräte GMBH*, IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020) (precedential); *Becton Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 (PTAB Dec. 15, 2017) (precedential).

The evidence identified in this Petition was not before the examiner during prosecution. The prior art of Ekpenyong, Huawei-374, Huawei-192, 3GPP TS 36.212 v13.0.0, 3GPP TS 36.213 v12.5.0, Samsung-332, Samsung-333, and Novlan (Exs-1004-1011) were not cited by the examiner in any Office Action. (Ex-1001 at 1-2.) As shown above in §V.C, the examiner erroneously issued a single non-final rejection that relied on transmitting control information on a PUCCH rather than PUSCH. The prior art cited herein remedies that error. Furthermore, the examiner did not have the benefit of Dr. Bims's declaration, which explains what a POSITA would have understood from the prior art as of the filing date of the '878 patent. (Ex-1003-Bims at §§VII-IX.) Accordingly, discretionary denial under 35 U.S.C. §325(d) would be improper.

VII. Person of Ordinary Skill in the Art (“POSITA”)

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. (Ex-1003-Bims, ¶¶66-72.)

VIII. Claim Construction

As noted above in §V.C, the Office properly interpreted skipping to refer to non-transmission, which Petitioner applies herein. Petitioner does not believe any formal claim constructions are required and construes the claims at issue in accordance with their ordinary and customary meanings. 37 C.F.R. §41.100(b).

IX. Overview of the Prior Art

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

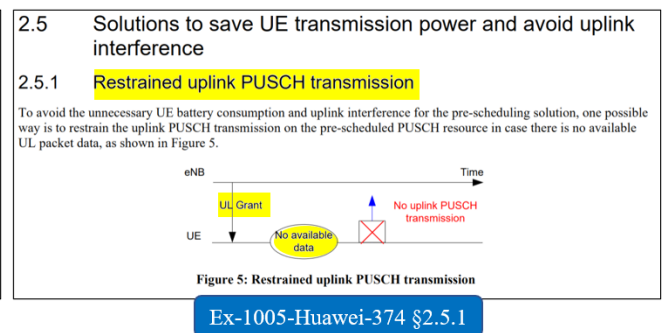
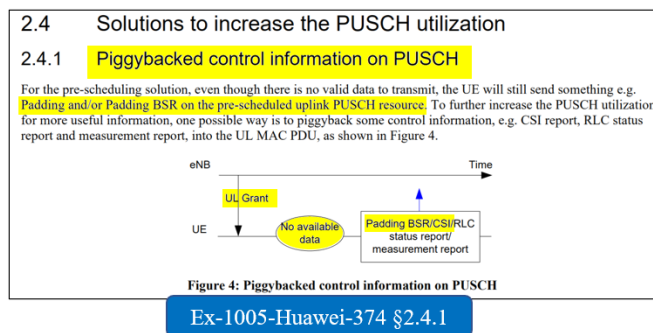
Ekpenyong is U.S. Patent 9,762,372, filed June 15, 2011. Ekpenyong is in the same field as the ’878 patent (wireless communication networks) and is prior art under at least AIA §102(a)(2). Ekpenyong discloses a UE that transmits physical control information (e.g., Channel State Information (“CSI”)) on a data channel (e.g., a Physical Uplink Shared Channel (“PUSCH”)) when an uplink grant is available to the UE even when the UE does not have data to transmit. (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)

Huawei-374 is a proposal titled “Uplink latency reduction for synchronized UEs.” Huawei-374 is in the same field as the ’878 patent and is AIA §102(a)(1) prior art, being published and publicly accessible by at least August 14, 2015. (Ex-1024-Bishop at ¶¶54-58.)

Huawei-374 discloses problems that may result when UEs must “send something e.g. Padding and/or Padding BSR on...pre-scheduled uplink resources even though there is no valid data to transmit,” and corresponding solutions for improving “[u]nnecessary uplink PUSCH resource waste,” “[u]nnecessary uplink interference,” and “[u]nnecessary UE battery consumption.” (Ex-1005-Huawei-374 at §§2.1, 2.4, 2.5.)

These solutions include “piggybacking” and “skipping,” which are discussed in Ground 1 and illustrated in figures 4-5:



(Ex-1005-Huawei-374 at §2.4.1, Figure 4, §2.5.1, Figure 5.)

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

Huawei-192 is a proposal titled “Further analysis on uplink transmission skipping.” Huawei-192 is in the same field as the ’878 patent and is AIA §102(a)(1) prior art, being published and publicly accessible by at least September 26, 2015. (Ex-1024-Bishop at ¶¶59-63.) Huawei-192 confirms skipping would not impact control-related transmissions and should be used for dynamic and periodic uplink grants. (Ex-1006-Huawei-192 at §§1, 2.)

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

3GPP TS 36.212 v13.0.0 (hereinafter “3GPP-36.212”) is a technical specification titled “Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding.” 3GPP-36.212 is in the same field as the ’878 patent and is AIA §102(a)(1) prior art, being published and publicly accessible by at least January 05, 2016. (Ex-1024-Bishop at ¶¶74-80.) 3GPP-36.212 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.)

3GPP TS 36.213 v12.5.0 (hereinafter “3GPP-36.213”) is a technical specification titled “Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures.” 3GPP-36.213 is in the same field as the ’878 patent and

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is AIA §102(a)(1) prior art, being published and publically accessible by at least March 25, 2015. (Ex-1024-Bishop at ¶¶81-87.) 3GPP-36.213 generally 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)

Samsung-332 is a proposal titled “Skipping uplink transmission with no data to transmit;” Samsung-333 is the corresponding change request for 3GPP TS 36.321 v12.6.0 having the same title.

Samsung-332 is in the same field as the ’878 patent and is AIA §102(a)(1) prior art, being published and publicly accessible by at least August 14, 2015. (Ex-1024-Bishop at ¶¶64-68.) 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.)

Samsung-333 is in the same field as the ’878 patent and is AIA §102(a)(1) prior art, being published and publicly accessible by at least August 14, 2015. (Ex-1024-Bishop at ¶¶69-73.) 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)

Novlan is U.S. Patent 10,129,782, filed January 25, 2016. Novlan is prior art under at least AIA §102(a)(2). Novlan is a Samsung patent in the same field as the '878 patent, and it 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

Petitioner relies on several 3GPP documents herein, including Huawei-374, Huawei-192, 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333. 3GPP-36.212 and 3GPP-36.213 are expressly incorporated by reference in the '878 patent. (Ex-1001 at 3:1-18.) 3GPP technical specifications and proposals including all of the 3GPP exhibits in this IPR were published and publicly accessible prior to the effective filing date of the '878 patent, and would have been located by a POSITA exercising reasonable diligence. (Ex-1024-Bishop at ¶¶19-53.) Mr. Craig Bishop is knowledgeable regarding 3GPP's relevant publishing and distribution procedures,. (*Id.* at ¶¶6-18.) His analysis shows that the 3GPP exhibits cited were accessible to the general public, including via the 3GPP website. (*Id.* at ¶¶19-53, §IV.) As one example, Mr. Bishop explains that Huawei-374 (R2-153374, Ex-1005) is a technical contribution submitted to 3GPP TSG RAN WG2 meeting #91 in Beijing in August 2015. (Ex-1024-Bishop at ¶¶54-58.) The naming convention indicates the following:

(1) “R2” means the contribution was submitted to RAN WG2; (2) “15” indicates the submission year (2015); and (3) “3374” is a unique number that was assigned to the contribution document. (*Id.* at ¶54.) Mr. Bishop further explains that a POSITA exercising reasonable diligence would have found Huawei-374 on the 3GPP website by navigating a drop-down menu on the website, and would have been able to download the document from the 3GPP file server website; the website also included a search portal where documents could be searched, *inter alia*, by title and source. (*Id.* at ¶¶55-57, 41-53.) The website has a date stamp for each document that indicates when the document was uploaded and became publicly available. (*Id.*) 3GPP also provided reports for each meeting, which provided various details about each document and indicated when the document first became publicly available. (*Id.*) Using this information, Mr. Bishop confirmed that Huawei-374 was publicly available no later than August 14, 2015. (*Id.* at ¶¶54-58)

A POSITA in this case would have been particularly capable of finding relevant 3GPP documents using reasonable diligence. A POSITA in the field of the ’878 patent would have familiarity with 3GPP documents given the nature of the ’878 patent itself—more than half of the ’878 patent consists of copied-and-pasted portions of 3GPP documents. (Ex-1026; Ex-1003-Bims at ¶¶49-58.) Moreover, the prior art patents (Ex-1004-Ekpenyong and Ex-1011-Novlan) repeatedly refer to prior art 3GPP documents including earlier iterations of 3GPP documents referenced

herein, which shows that such documents were well known to and readily accessible by a POSITA. (*See, e.g.*, 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”); Ex-1003-Bims at ¶¶101-06 (noting that Novlan is referring to “Release 12” specifications that are slightly earlier versions of Exs-1009-10).)

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

A. Scope, Content, and Rationale for Combining Prior Art

Ground 1 relies on Ekpenyong in view of Huawei-374 and Huawei-192.

Ekpenyong is titled “CSI reporting on PUSCH for carrier aggregation” and generally relates to wireless communications networks. (Ex-1004-Ekpenyong at 1:29-34.) Ekpenyong discloses:

“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.)

FIG. 7 discloses a UE device 1001 that communicates with a base station (NodeB 1002) via multiple channels, including a data channel (PUSCH) and a control channel (PUCCH). (*Id.* at 5:9-11.)

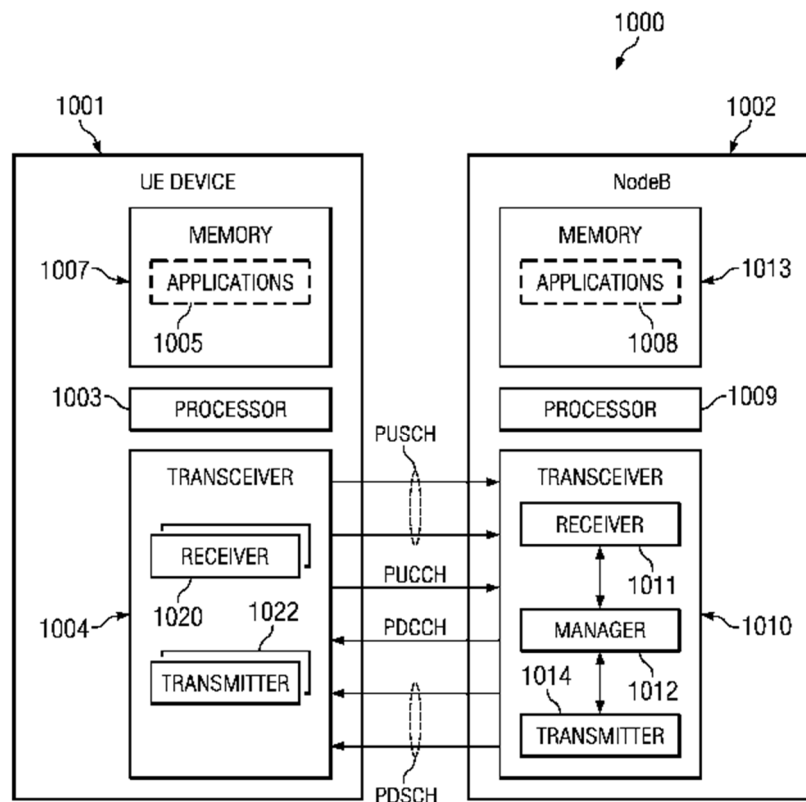


FIG. 7

(*Id.* at FIG. 7.) The specification notes that 3GPP working groups were continuing their standardization work for LTE networks:

“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;

see id. at 1:65-2:5 (noting that the “Technical Standards Group Radio Access Network” is referred to as “TSG RAN”).)

Ekpenyong recognized that it was important for UEs to report CSI⁵ feedback to BSs, and explained that there were several mechanisms for doing so:

“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.)

CSI feedback comprising CQI, PMI, and RI was ideally derived at a UE based then provided to a BS:

“[A] transmitter must have knowledge of the channel, which is provided by the UE on the uplink control channel. This process is

⁵ CSI in Ekpenyong includes what the ’878 patent defines as “physical control information” or “PCI”—CQI, PMI, and RI in particular. (*See* Ex-1001 at claim 21; Ex-1004-Ekpenyong at 5:44-52.)

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).)

While providing CSI feedback using PUCCH was one conventional option, it was often inadequate, as was well known. (Ex-1013-R1-073322 at §1; Ex-1024-Bishop at ¶¶88-92; Ex-1003-Bims at ¶¶107-115.) The problem worsened with larger CSI payloads:

“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.)

Accordingly, Ekpenyong discloses “[s]everal embodiments for improved CSI feedback on the PUSCH.” (*Id.* at 5:39-43.) Stated differently, Ekpenyong recognized that periodic CSI feedback was conventionally provided via PUCCH (control channel), aperiodic CSI feedback was provided via PUSCH (a shared data channel), and that performance could be improved by transmitting both types of CSI feedback via PUSCH. (*Id.*)

Ekpenyong also discloses schemes for providing aperiodic CSI feedback on PUSCH without uplink data and periodic CSI feedback on PUSCH when the periodic feedback coincides with a UL grant. (*Id.* at 13:10-35 (section 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.”).) Ekpenyong teaches a network in which UEs receive UL grants from a BS and transmit CSI feedback via PUSCH pursuant to a UL grant. (*Id.*; Ex-1003-Bims at ¶¶116-19.)

In August 2015, Huawei-374 suggested ways to improve a 3GPP network like LTE. 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.” (Ex-1005-Huawei-374 at §1.)

Huawei-374 further explains 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; Ex-1003-Bims at ¶¶120-21.) These shorter periods caused unnecessary UE battery consumption and uplink interference:

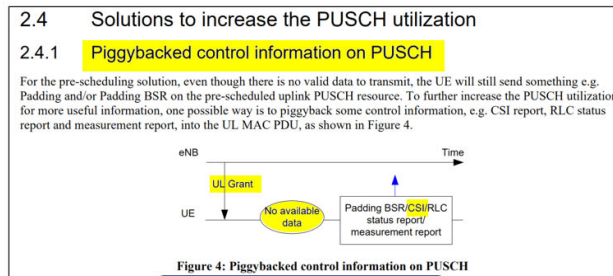
For the pre-scheduling solution, according to the current specification, the UE will anyway send something e.g. Padding and/or Padding BSR on the pre-scheduled uplink resources even though there is no valid data to transmit. This will cause unnecessary UE battery consumption as well as unnecessary uplink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

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

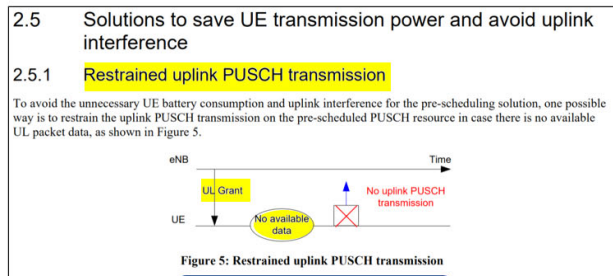
- Significant PDCCH overhead
- Unnecessary uplink PUSCH resource waste
- Unnecessary uplink interference
- Unnecessary UE battery consumption

(Ex-1005-Huawei-374 at §2.1.)⁶

To address these problems, Huawei-374 discloses two pertinent solutions: (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:”



Ex-1005-Huawei-374 §2.4.1



Ex-1005-Huawei-374 §2.5.1

(Ex-1005-Huawei-374 at §§2.4-2.5.)⁷ One solution involves piggybacking control information (PCI feedback and the like) on PUSCH when there is no data to send,

⁶ Huawei-192 discloses the same problem and root cause. (Ex-1006-Huawei-192 at §2.)

⁷ Yellow highlights/annotations added by Petitioner unless otherwise noted.

and the other involves skipping the uplink transmission entirely (e.g., when there is neither data nor PCI feedback to send). (Ex-1003-Bims at ¶¶121-25.) For brevity, these solutions are referred to as “piggybacking” and “skipping” herein.

In October 2015, Huawei-192 submitted a follow-up contribution further confirming the benefits of skipping. Indeed, Huawei-192 notes that the working group agreed that skipping should be used:

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:

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.

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.

(Ex-1006-Huawei-192 at §1.) Huawei’s skipping solution “[a]ccording to the RAN2 agreement” would not be used for control transmissions (“MAC CE” in §1), but should be used for at least two known types of UL grants: dynamic scheduling and SPS (semi-persistent scheduling). (*Id.* at §2.) Additionally, Huawei-192 establishes that the 3GPP working group recognized the benefit of implementing the skipping solution despite a potential problem, namely, the BS would not know whether it failed to receive a UL transmission due to transmission errors. (*Id.*) Huawei-192 discloses that the skipping approach was still beneficial despite this minor drawback 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.*; Ex-1003-Bims at ¶¶126-28.)

A POSITA would have been motivated and found it obvious to enhance 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. (Ex-1003-Bims at ¶129.) Ekpenyong itself discloses transmitting CSI via PUSCH without data (in the aperiodic CSI feedback scenario), while the Huawei references disclose that further benefits would be realized by implementing piggybacking and skipping. (Ex-1003-Bims at ¶130 (citing Ex-1005-Huawei-374 at §§2.4-2.5; Ex-1006-Huawei-192 at §§1-2).) In particular, Huawei-374 expressly discloses problems with PUSCH utilization, uplink interference, and unnecessary UE battery consumption, then proposes solving these problems with piggybacking (for PUSCH utilization) and skipping (for uplink interference and UE battery consumption). (Ex-1005-Huawei-374 at §§2.1, 2.4-2.5.) Huawei-192 published after Huawei-374 and specifically recommends implementing the skipping approach for 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).) Accordingly, a POSITA would have been motivated and found it obvious to implement both piggybacking and skipping in a complementary way with Ekpenyong's system as taught in Huawei-374 and further supported in Huawei-192. (*Id.* at ¶¶131-32.) Doing so would have increased PUSCH utilization, improved battery consumption, and reduced uplink interference for Ekpenyong's system. (Ex-1003-Bims at ¶132 (citing Ex-1005-Huawei-374 at §§2.4-2.5).)

As Dr. Bims explains, a POSITA would have been motivated and found it obvious to implement skipping in such a way that piggybacked control information was not skipped. (Ex-1003-Bims at ¶133.) Specifically, Ekpenyong disclosed the growing importance of transmitting control information on PUSCH that accompanied the increased data rates in the 3GPP standards. (*Id.* (citing Ex-1004-Ekpenyong at 5:31-38; Ex-1013-R1-073322 at §1).) Pre-scheduling led to a problem because UEs had to transmit empty padding transmissions every time the UE had a UL grant with nothing to send—since pre-scheduling resulted in many unneeded UL grants of short duration, a UE had to send many empty padding transmissions that rapidly drained the UE's battery. (Ex-1003-Bims at ¶134 (citing Ex-1005-Huawei-

374 at §§2.1, 2.5; Ex-1006-Huawei-192 at §1).) The piggybacking solution addressed wasted UL resources by “increas[ing] the PUSCH utilization for more useful information.” (Ex-1003-Bims at ¶135 (citing Ex-1005-Huawei-374 at §2.4).) Thus, a POSITA would have been motivated to use Huawei-374’s piggybacking and skipping 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. (Ex-1003-Bims at ¶135.)

A POSITA would have considered this the preferable, logical, and most reasonable way to use piggybacking and skipping together, and it was at least obvious to try given the rationales underlying Huawei’s piggybacking and skipping solutions. (Ex-1003-Bims at ¶¶135-36.) A POSITA could have designed Ekpenyong’s UEs to (1) skip UL grants that would result in transmitting anything other than data or (2) skip UL grants that would only result in transmitting empty padding. (Ex-1003-Bims at ¶¶135-36.) Option (2) would have been the clear choice for a POSITA, while option (1) was illogical. (*Id.* at ¶136 (citing Ex-1004-Ekpenyong at 5:31-38).) Indeed, Huawei-192 explicitly states that skipping was beneficial for “most” rather than all uplink grants when there was no data to transmit. (Ex-1003-Bims at ¶136.) Moreover, Huawei-192 expressly discloses that skipping should be implemented in such a way that some non-data transmissions would not

be skipped: “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., PCI refers to reports like Ekpenyong’s and Huawei’s CSI reports comprising CQI, PMI, and/or RI), the rationale is the same: this was useful information that should not be skipped. (Ex-1003-Bims at ¶¶136-37.) Moreover, Huawei-192’s teaching that MAC CEs would not be skipped confirms that piggybacking was compatible with skipping because MAC CEs were contained in MAC UL PDUs—thus, piggybacking PCI into a MAC UL PDU would still be available when skipping was enabled, as disclosed in Huawei-192. (*See, e.g.*, Ex-1003-Bims at ¶¶187-91 (citing 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”).) A POSITA is not an automaton and can fit prior art disclosures together like a puzzle—here, that means a POSITA would not blindly skip important PCI transmissions and would instead choose the more logical and reasonable option of skipping UL grants when there was no data and no PCI to transmit. (*Id.* at ¶136.) *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 420-21 (2007).

A POSITA would have expected to succeed in implementing Huawei-374’s piggybacking and skipping solutions with Ekpenyong’s system. Ekpenyong already taught transmitting CSI on PUSCH when the UE had a UL grant, and did so without

data for aperiodic transmissions; thus, a POSITA would have easily implemented Huawei-374's piggybacking technique to transmit CSI on PUSCH without data when the UE had a UL grant. (*Id.* at ¶138.) Meanwhile, a POSITA would have easily modified Ekpenyong's system to skip UL grants when the UE had neither data nor CSI to send. (*Id.* at ¶139.) This would have been achieved via simple programming to remove the requirement of sending empty padding transmissions. (*Id.*)

Mere ordinary skill would have been needed to add Huawei's piggybacking and skipping solutions to the Ekpenyong system. (Ex-1003-Bims at ¶140.) Doing so only required using known prior art solutions (transmitting CSI feedback via PUSCH without data and skipping an uplink grant when there was nothing to send) to known problems (e.g., unnecessary uplink interference and unnecessary UE battery consumption) to yield predictable results (a network in which 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). (*Id.*) *KSR*, 550 U.S. at 415-421 (“[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious.”)

Notably, both Huawei-374 and Huawei-192 acknowledged potential downsides with skipping UL grants because a BS would not necessarily be able to

distinguish between an intentional skip and a failed transmission. (Ex-1005-Huawei-374 at §2.5 (“the eNB cannot distinguish if it is because there is no available UL packet data, or because the eNB [sic] was failed to detect the uplink transmission due to poor radio condition. ... Solutions need to be considered to address such a problem.”); Ex-1006-Huawei-192 at §2 (“in case of no UL PUSCH transmission, the eNB cannot distinguish if it is because of PDCCH loss or because of UL PUSCH transmission skipping due to no available data; for SPS...the ENB cannot distinguish if it is because of PDCCH...los[s] or because of UL PUSCH transmission skipping due to no available data.”).) However, Huawei-192 further notes:

“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’.”
(*Id.*; *see id.* (noting the low rate of PDCCH loss).)

Accordingly, a POSITA would have been motivated and found it obvious to modify Ekpenyong with the teachings of Huawei-374 and Huawei-192. (Ex-1003-Bims at ¶141.)

B. Challenged Claims

Petitioner challenges all claims 1-28, grouped 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:”⁸

Ekpenyong in view of Huawei-374 and Huawei-192 teaches the preamble. For example, Ekpenyong explains that “[w]ireless cellular communication networks incorporate a number of mobile UEs and a number of NodeBs.”⁹ (Ex-1004-Ekpenyong, 1:36-39.)

Ekpenyong further explains that UEs were “also commonly referred to as 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.) Ekpenyong discloses that UEs typically used transmitters and receivers to communicate directly with a NodeB, rather than directly with other UEs. (*Id.* at 1:57-61.) As detailed in §X.A, Huawei-374 and Huawei-192 teach modifying the way Ekpenyong’s UEs would operate via the use of piggybacking and skipping. (Ex-

⁸ Claim limitations are italicized and quoted herein.

⁹ 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.)

1003-Bims at ¶¶143-47 (citing 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;”

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

Ekpenyong discloses that a UE receives an uplink grant from a base station:

“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.)

Thus, Ekpenyong teaches that a Base Station (“BS”) allocates an uplink grant to a UE (“the parameters of the resources allocated for UE 109 uplink

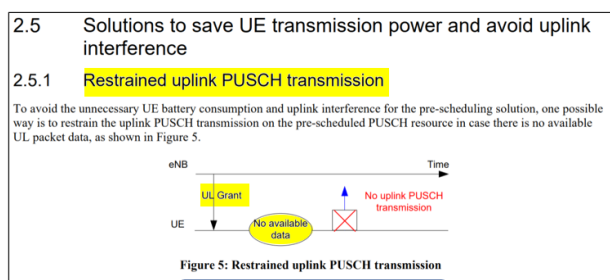
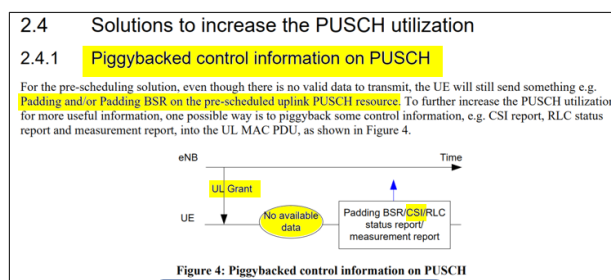
transmission”), pursuant to which the UE can transmit data in a TTI (“transmit the data on up-link 112 employing the allotted resources during the prescribed time interval”). (*Id.*) Further, the above excerpt discloses the claimed relationship between a UL grant and a TTI, because it indicates that the UE received allocated resources for transmitting back to the BS in a prescribed time interval. (*See also* Ex-1003-Bims at ¶¶148-51 (explaining that an uplink grant is considered available to a UE in a TTI and citing 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)”).).

Ekpenyong further discloses that a UE may have a UL grant but no data to send:

“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.)

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.*; Ex-1003-Bims at ¶153.) Ekpenyong elaborates on this teaching in column 13, where it provides two schemes for aperiodic CSI transmission pursuant to an uplink 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.”).) These schemes in Ekpenyong disclose that an uplink grant is available for the UE in a TTI even though the UE does not have data available for transmission, as required by this claim limitation. (Ex-1003-Bims at ¶¶154-56.) Likewise, Huawei-374 and Huawei-192 propose modifying a UE to use piggybacking and skipping when a UE has an uplink grant but no data to send:



(§X.A; Ex-1003-Bims at ¶156 (citing Ex-1005-Huawei-374 at §§2.4-2.5); *see also* Ex-1006-Huawei-192 at §§1-2.)

[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”

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

This limitation uses the term “physical control information.” Claim 21 expressly states that the term “*physical control information*” includes at least “*Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.*” (Ex-1001 at Claim 21.)

Ekpenyong also discloses the importance of transmitting PCI:

“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.)

Ekpenyong further discloses that a UE must provide channel information in the form of “channel state information (CSI) feedback” to “have knowledge of the channel.” (*Id.* at 5:44-47.) Ekpenyong’s “CSI” feedback includes CQI, RI, PMI, all of which are expressly identified in the ’878 patent as examples of the claimed “*physical control information*:”

“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.)

Although Ekpenyong discloses the importance of transmitting PCI, Ekpenyong does not expressly disclose skipping an uplink grant based on whether PCI needs to be transmitted. However, as explained in §X.A, a POSITA would have been motivated and found obvious to employ the piggybacking and skipping approaches of Huawei-374 with the Ekpenyong system. (Ex-1003-Bims at ¶¶157-162.) Specifically, Huawei-374 explains that a UE would conventionally send padding even when it had no data to transmit. (Ex-1005-Huawei-374 at § 2.4.1.) Rather than send empty padding PDUs, Huawei-374 discloses improving 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.

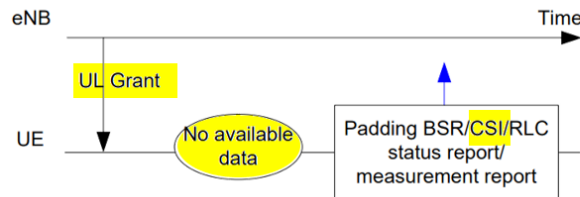


Figure 4: Piggybacked control information on PUSCH

Ex-1005-Huawei-374 §2.4.1

(*Id.*) Accordingly, Huawei-374 teaches the benefits of sending control information on PUSCH when “there is no valid data to send,” thereby “increasing PUSCH utilization.” (*Id.*; Ex-1003-Bims at ¶¶163-65.) Figure 4 (reproduced above) discloses this improvement by illustrating that the UE will send PCI (“CSI” report) on PUSCH pursuant to a UL grant even when there is “[n]o available data.” (Ex-1005-Huawei-374 at §2.4.1; Ex-1003-Bims at ¶¶163-65.) Huawei-374 also discloses the benefit of “sav[ing] UE transmission power” by skipping UL transmissions when there is “no available UL packet data:”

2.5 Solutions to save UE transmission power and avoid uplink interference

2.5.1 Restrained uplink PUSCH transmission

To avoid the unnecessary UE battery consumption and uplink interference for the pre-scheduling solution, one possible way is to restrain the uplink PUSCH transmission on the pre-scheduled PUSCH resource in case there is no available UL packet data, as shown in Figure 5.

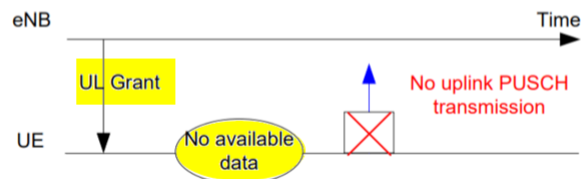


Figure 5: Restrained uplink PUSCH transmission

Ex-1005-Huawei-374 §2.5.1

(Ex-1005-Huawei-374 at §2.5.1, Figure 5; Ex-1003-Bims at ¶¶166-67.) Huawei-192 discloses the same skipping feature and adds that this may be done for dynamic and SPS uplink 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.)

Huawei's skipping functionality would have 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; Ex-1003-Bims at ¶¶168-69.)

A POSITA also would have been motivated to improve Ekpenyong's system by adding piggybacking and skipping in view of the Huawei references. (§X.A; Ex-1003-Bims at ¶¶170-71.) 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. (*Id.*)

[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.”

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

Claim 25 expressly states that “PUSCH” is an example of the claimed “data channel.” (Ex-1001 at Claim 25.)

As set forth above relative to limitations 1.1-1.2, Ekpenyong discloses transmitting PCI (i.e., CSI comprising CQI, PMI, and/or RI) on PUSCH. (Ex-1004-Ekpenyong at 5:23-31 (“CSI feedback can be periodic on PUCCH and aperiodic on PUSCH. ...[P]eriodic CSI is transmitted on the PUSCH when a UL grant coincides in the same subframe with a periodic CSI report. ...[A]periodic 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.)

Huawei-374's piggybacking solution discloses the same, with the express intent of increasing PUSCH utilization for transmitting useful PCI information. (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”); Ex-1003-Bims at ¶¶172-76.)

A POSITA also would have been motivated to improve Ekpenyong's system by adding piggybacking in view of the Huawei references. (§X.A; Ex-1003-Bims at ¶175.)

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.”

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

Claim 2 uses the phrase “configured uplink grant that is periodically available.” “Semi-persistent scheduling” or “SPS” is considered a periodically available UL grant in the '878 patent:

“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.)

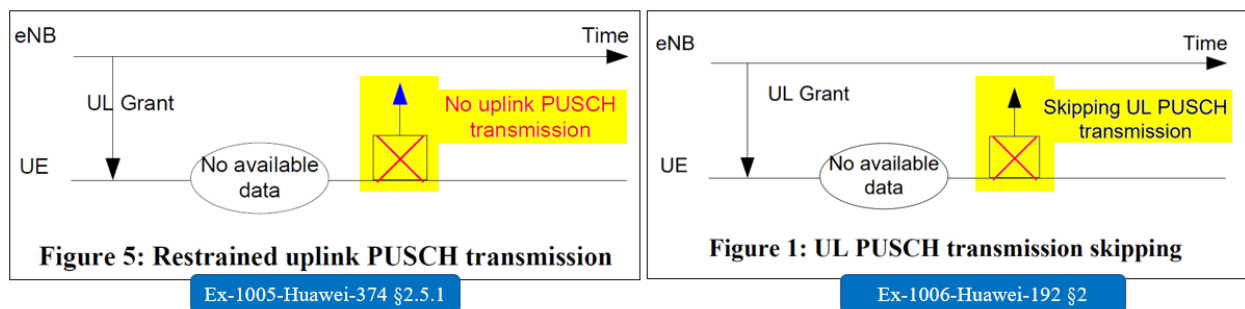
Huawei-192 discloses that the UE may skip a UL grant that was provided “by either dynamic scheduling or SPS.” (Ex-1006-Huawei-192 at §2.) It would have

been obvious to a POSITA that a UL grant provided by “dynamic scheduling” is one that “*is a dynamic grant specific for the TTT*” (claim 3), and a UL grant provided by SPS is one that “*is a configured uplink grant that is periodically available*” (claim 2). (Ex-1003-Bims at ¶¶177-82; Ex-1006-Huawei-192 at §2.) In view of Huawei-192 and the reasons set forth in §X.A, it would have been obvious to modify Ekpenyong’s UEs to skip either type of common UL grant when such UEs had nothing useful to send. (Ex-1003-Bims at ¶181; §X.A.)

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.”

Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation. (See also Claim 1.) Specifically, Huawei-374 and Huawei-192 show that UL transmission on PUSCH will not occur when the decision has been made to skip the UL grant:



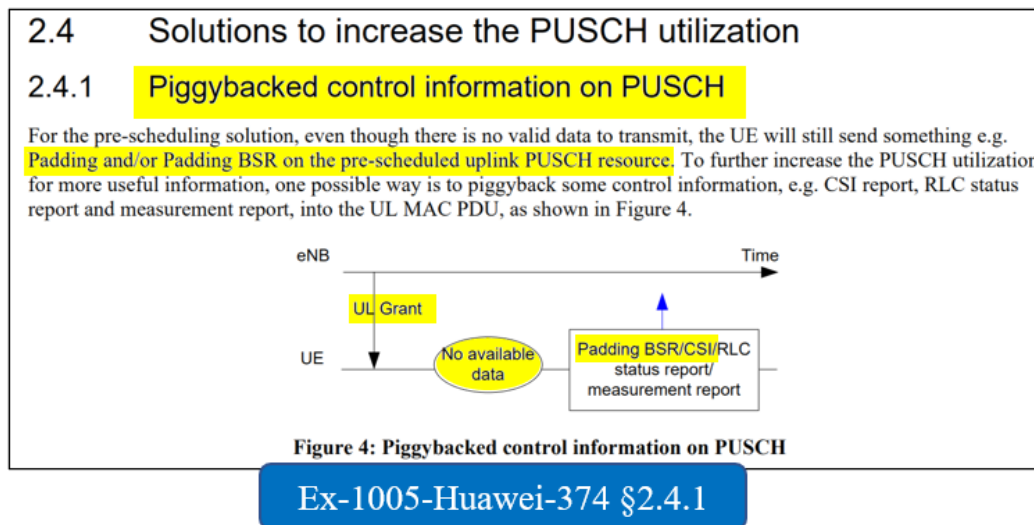
(Ex-1005-Huawei-374 at Figure 5; 1006-Huawei-192 at Figure 1.) Huawei-374 also explicitly states “No uplink PUSCH transmission.” (Ex-1005-Huawei-374 at Figure 5.) As explained above in §X.A, it would have been obvious for a POSITA to

improve the Ekpenyong system with such skipping functionality. (Ex-1003-Bims at ¶¶183-86.)

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.”¹⁰

Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation. Huawei-374 discloses that it piggybacks CSI into a UL MAC PDU that contains “padding and/or padding BSR.” (Ex-1005-Huawei-374 at §2.4.1) This is also shown in Figure 4:



¹⁰ This claim and corresponding dependent claims 10, 15, and 20 appear to have a typographical error (“comprise”). Petitioner assumes the word “comprise” means the same thing as “comprising” in this limitation.

(Ex-1005-Huawei-374 at Figure 4.) A POSITA would have understood padding BSR to be a MAC control element. (Ex-1003-Bims at ¶¶187-91 (citing 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.”)).) It also would have been obvious for a POSITA to improve the Ekpenyong system with this piggybacking functionality. (§X.A; Ex-1003-Bims at ¶190.)

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 (HARO) feedback.”

Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation for the reasons described above regarding claim 1. Specifically, Ekpenyong and Huawei-374 disclose transmitting “CSI” on PUSCH, and CSI is at least one of CQI, PMI, and/or RI as required by this limitation. (Ex-1004-Ekpenyong at 5:23-31, 5:44-57, 8:54-62, 13:10-35; Ex-1005-Huawei-374 at §2.4.1; Ex-1003-Bims at ¶¶192-94.)

Thus, Ground 1 renders obvious claim 21.

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

Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation for the reasons described above regarding limitation 1.3. (Ex-1003-Bims at ¶195.) Specifically, all three references address transmitting on PUSCH, as discussed above.

Thus, Ground 1 renders obvious claim 25.

2. Claim Set B

As shown below, claim 6 and its dependents correspond directly to similar limitations in Claim Set A.

[6.0] “A User Equipment (UE).”

Ekpenyong in view of Huawei-374 and Huawei-192 teaches this limitation. As explained above regarding claim 1, Huawei-374 and Huawei-192 disclose how Ekpenyong’s UE would utilize a UL grant. (*See, e.g.*, Ex-1005-Huawei-374 at §§2.4-2.5; Ex-1006-Huawei-192 at §2.) Ekpenyong also discloses that its UE may be a mobile device, like a phone. (Ex-1004-Ekpenyong at 1:48-61 (describing a UE as a terminal or mobile that may be a wireless device, cellular phone, PDA, etc.).) Ekpenyong further discloses basic elements of its UE, as discussed further regarding limitations 6.1.1-6.1.3. (Ex-1003-Bims at ¶¶196-99.)

[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:”

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;”

Ekpenyong teaches these limitations. Specifically, Ekpenyong’s UE comprises a control circuit having 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; *see id.* at claims 11, 14, 19, 23.)

“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.)

Accordingly, Ekpenyong teaches that its UE has a “processor 1003 coupled to a memory 1007” and the “memory 1007 stores (software) applications 1005 for execution by the processor.” (*Id.*; *see also* Ex-1003-Bims at ¶¶200-203.)

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

Ekpenyong teaches this limitation. As shown above with respect to limitations 6.1.1-6.1.3, Ekpenyong discloses a UE having a processor and memory, where “[t]he memory 1007 stores (software) applications 1005 for execution by the processor 1003.” (Ex-1004-Ekpenyong at 14:9-12.) Ekpenyong further discloses that “at least some of the applications” were used for transmitting and receiving between a UE and BS, and the memory further stored instructions for uplink and downlink operations involving the physical and MAC layer of the UE’s transceiver. (*Id.* at 14:24-34; Ex-1003-Bims at ¶¶204-06.)

[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”

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.”

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

Thus, 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.”

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.”

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.”

Ekpenyong teaches a processor configured to execute a program code stored in the memory for the reasons described above relative to limitations 6.1-6.2. 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 per §X.A. (Ex-1003-Bims at ¶¶211-13.) Thus, Ekpenyong in view of Huawei-374 and Huawei-192 disclose transmitting “*the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.*”

Thus, 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.”

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).”

Claim 26 is obvious based on Ekpenyong in view of Huawei-374 and Huawei-192 for the same reasons provided above for claim 25.

3. Claim Set C

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

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;”

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”

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.”

This limitation is obvious for the reasons provided above regarding limitation

1.3.

Thus, 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.”

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.”

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.”

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 (HARO) feedback.”

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).”

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

4. Claim Set D

[16.0] “A User Equipment (UE),”

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:”

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:”

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”

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.”

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

Thus, 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.”

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.”

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.”

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 (HARO) feedback.”

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).”

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

XI. GROUND 2: Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333

A. Scope, Content, and Rationale for Combining Prior Art

Novlan discloses a UE for use in 3GPP standard networks, including networks like those specified (in part) by 3GPP-36.212 (Ex-1009) and 3GPP-36.213 (Ex-1010). (Ex-1011-Novlan at 4:21-35 (referencing Release 12 LTE standards including 36.212 and 36.213); 4:58-5:8 (identifying “UE 116” as a device like “a cell phone, a wireless laptop, a wireless PDA, or the like” and explaining that such devices communicate with base stations (“eNBs”) via networks including “5G, LTE, LTE-A, WiMax, Wifi, LTE-U(LAA) or other wireless communication techniques”), 7:60-9:13 (describing UE 116 and its components).) Novlan’s UE 116 features conventional elements of a UE, including control circuitry comprising a processor, memory, and corresponding reception/transmission circuitry, as shown in FIG. 3:

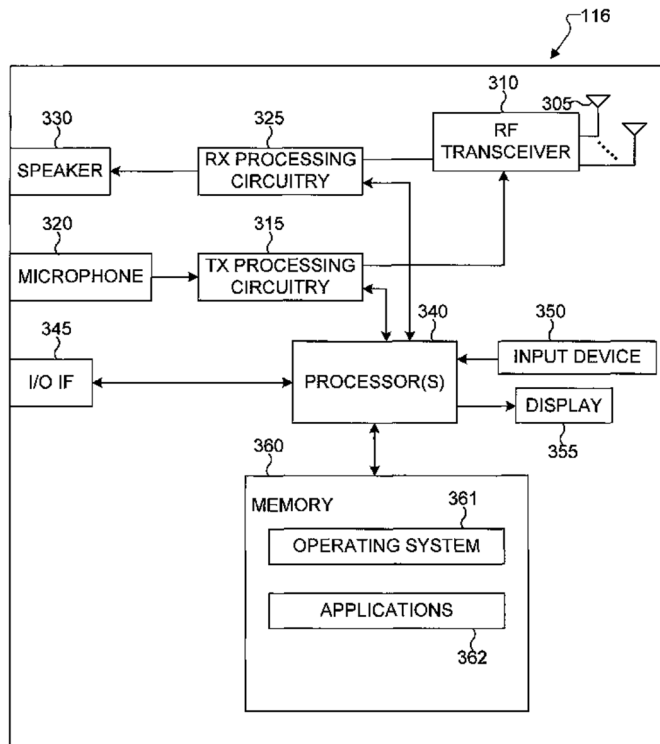


FIGURE 3

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

Furthermore, Novlan discloses that its UEs included conventional elements like control circuitry comprising a processor and memory, and that these elements worked together to implement the device's functionality. (Ex-1011-Novlan at 4:21-35, 7:60-9:13; Ex-1003-Bims at ¶¶235-37.)

The 3GPP standard provided details for transmitting PCI from a UE to a BS in 3GPP-36.212 and 3GPP-36.213. 3GPP-36.212 is a "Release 13" 3GPP technical specification from January 2016. (Ex-1009-3GPP-36.212 at 1; Ex-1024-Bishop at ¶¶74-80.) This specification discloses conventional PCI reporting behavior for a UE

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in §5.2.4 (titled “Uplink control information on PUSCH without UL-SCH data”).

§5.2.4 discloses transmitting PCI on PUSCH without accompanying uplink data.

(Ex-1009-3GPP-36.212 at §5.2.4.)

3GPP-36.213 is a “Release 12” 3GPP technical specification from 2015. (Ex-1010-3GPP-36.213 at 1; Ex-1024-Bishop at ¶¶81-87.) This specification specifies “UE procedure[s] for reporting Channel State Information (CSI).” For example, §7.2 discloses that a UE transmits PCI on PUSCH when the UE has an uplink grant. (Ex-1010 at §7.2.) Petitioner relies on this specific Release 12 document in view of Patentee’s admission that it was part of the 3GPP standard. (Ex-1001 at 3:1-17.) Subsequent “Release 13” iterations of this specification retained the same behavior. (*See, e.g.*, Ex-1022 (3GPP TS 36.213 13.6.0) at 1 (identifying Release 13), §7.2 (disclosing CSI reporting procedures); Ex-1003-Bims at ¶¶238-40.)

A POSITA would have been familiar with conventional UE behavior. (Ex-1003-Bims at ¶241.) Specifically, a UE transmitted 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. (*Id.* (citing Ex-1009-3GPP-36.212 at §5.2.4.1; Ex-1010-3GPP-36.213 at §7.2).) This had long been conventional PCI reporting behavior for UEs in 3GPP networks. (Ex-1003-Bims at ¶241 (citing 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).)

3GPP members were also working on updates to Release 12 of the 3GPP standard for Release 13. (Ex-1003-Bims at ¶¶242.) Petitioner Samsung submitted two related contributions to the appropriate 3GPP working group in August 2015: Samsung-332 and Samsung-333. (Exs-1007-08.) Both relate to a proposed enhancement to 3GPP TS 36.321 v12.6.0 (a Release 12 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; Ex-1024-Bishop at ¶¶64-73.) Samsung-332 described the root of the problem and disclosed a “straightforward” solution of skipping UL grants when there was no data to transmit:

“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.)

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”)); Ex-1003-Bims at ¶¶243-46 (describing the relationship between Samsung’s “Discussion” document and the related CR); Ex-1007-Samsung-332 at §2.3 (identifying Samsung-333).)

Thus, Samsung-332 and Samsung-333 were related documents directed at solving a well-understood problem with “pre-scheduling:” 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 use these unnecessary UL grants by sending empty padding transmissions that wasted UL transmission resources and rapidly drained UE battery. (Ex-1007-Samsung-332 at §2.1; Ex-1003-Bims at ¶247.)

It would have been obvious to a POSITA to enhance the UEs disclosed in Novlan (a patent filed by Samsung), implementing the 3GPP standard’s conventional techniques for PCI reporting, with Samsung’s 3GPP contributions that disclosed skipping UL grants. (Ex-1003-Bims at ¶¶248-49; *see* Ex-1007-Samsung-332; Ex-1008-Samsung-333.)

Samsung-332 and Samsung-333 disclosed that skipping the specification-mandated padding transmissions was a straightforward fix to the pre-scheduling problem identified above. (Ex-1003-Bims at ¶249; 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 an unnecessary UL grant, Novlan's UE would preserve battery life and avoid wasting UL resources. (Ex-1003-Bims at ¶249.)

A POSITA implementing Samsung's skipping functionality also would have had to choose between two possible options: (1) skip the uplink grant entirely, even if Novlan's 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. (Ex-1003-Bims at ¶250.) Samsung-333 discloses and teaches option (2) by proposing the following: “the MAC entity considers itself having a valid uplink grant only if there is data available for transmission.” (*Id.* at ¶251 (citing Ex-1008-Samsung-333 at §5.4.1; *id.* at cover page).) A POSITA would have understood that the “MAC entity” is not the entire UE—it is within layer 2, above layer 1 where PCI is coded and added to a UL transmission. (Ex-1003-Bims at ¶251.) Accordingly, Samsung-333 discloses and teaches that Samsung's proposed skipping functionality would be implemented by having the UE's MAC entity not generate and transmit empty padding only, while the UE would still transmit PCI on PUSCH pursuant to the UL grant when necessary (as was conventional). (Ex-1003-Bims at ¶251.) Thus, a POSITA would have been motivated and found it obvious to modify Novlan's UE in view of Samsung-332 and Samsung-333 to transmit data and/or physical control

information pursuant to an uplink grant and skip the uplink grant if the UE did not have either type of information to transmit. (Ex-1003-Bims at ¶251.) A POSITA would have understood that this combined Samsung's skipping solution with conventional PCI reporting in a predictable way, by maintaining the 3GPP standard's existing PCI reporting scheme and adding the ability to skip uplink grants when there was nothing useful to transmit. (Ex-1003-Bims at ¶252.) At the very least, it would have been obvious in view of Samsung-332 and Samsung-333 to skip only the empty padding transmissions while still transmitting data or PCI. (Ex-1003-Bims at ¶252.) Since both Samsung-332 and Samsung-333 identified padding transmissions as the cause of the UL resource waste and UE battery drain problem, a POSITA would have been motivated to choose the logical option of continuing to transmit PCI on PUSCH. (Ex-1003-Bims at ¶252 (explaining that a POSITA was capable of fitting the prior art together in a coherent manner and was not an automaton who would blindly redesign Novlan's UE to skip useful PCI transmissions).)

A POSITA also would have reasonably expected to succeed using a minor implementation change to Novlan's UEs, which would simply need to refrain from sending UL transmissions that contained only empty padding transmissions, with no effect on how Novlan's UE transmitted useful information (i.e., data or PCI). (*Id.* at ¶¶252-53.) This was a "straightforward solution" as expressly set forth in Samsung-

332 and Samsung-333; the UE transmit data and/or PCI on PUSCH in the conventional manner and skip the UL grant otherwise. (*Id.* at ¶¶252-53.) *KSR*, 550 U.S. at 415-421 (2007) (“If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.”). A POSITA would have had no difficulty implementing this enhanced functionality, in particular because doing so merely required skipping unnecessary affirmative steps (preparing and transmitting empty padding transmissions). (Ex-1003-Bims at ¶¶252-54.)

B. Challenged Claims

1. Claim Set A

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

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach the preamble. As described above in §XI.A, 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-1011-Novlan at 4:21-35; 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); Ex-1003-Bims at ¶¶255-57.) Novlan’s UE operation would also be enhanced with UL grant skipping in view of Samsung-332 and Samsung-333. For example, Samsung-332 “discusses the problem of the pre-scheduling in terms of battery consumption, and proposes a UE enhancement to mitigate the problem.” (Ex-1007-Samsung-332 at

§1; *see also* Ex-1008-Samsung-333 at cover page [“Reason for change” (“Uplink latency can be reduced by pre-scheduling, which drains UE battery due to the constraints that when uplink resource is granted UE shall transmit UL-SCH even it does not have any data to send”) and “Summary of change” (“UE behaviour is updated such that UE does not consider itself having a valid uplink grant if there is no data available for transmission”)].)

[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;”

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation. 3GPP-36.212 §5.2.4 discloses coding steps for transmitting “control data...via PUSCH without UL-SCH data” (“Uplink control information on PUSCH without UL-SCH data”). (Ex-1009-3GPP-36.212 at §5.2.4.) Accordingly, Novlan’s UE operating in accordance with the 3GPP-36.212 specification would transmit PCI on PUSCH without data. Samsung’s proposals also noted that problem:

“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.)

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.*) (*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...” & “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”).) Thus, both Samsung-332 and Samsung-333 acknowledged that a UE would at times have a UL grant without any data to transmit. (Ex-1003-Bims at ¶¶258-62.)

[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”

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation. As noted above regarding limitation 1.1, a Novlan UE operating in accordance with the 3GPP standard (the 3GPP-36.212 and 3GPP-36.213 specifications in particular) would transmit PCI on PUSCH without accompanying data. (Ex-1009-3GPP-36.212 at §5.2.4 (“Uplink control information on PUSCH without UL-SCH data”).) 3GPP-36.213 §7.2 discloses when a Novlan UE operating in accordance with the standard would report PCI on PUSCH: for periodic PCI reporting 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 *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.

(Ex-1010-3GPP-36.213 at §7.2; Ex-1003-Bims at ¶¶263-65.)

As explained in §XI.A, it would have been 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. (See §XI.A.) Specifically, 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; Ex-1003-Bims at ¶266.) In addition, Samsung-333 disclosed that Samsung’s skipping functionality would be implemented by having the “MAC entity”—a portion of layer 2 of the UE, not the UE as a whole—act 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 (such that empty padding transmissions would have been skipped), without simultaneously requiring the UE’s physical layer (layer 1) to skip useful PCI transmissions. (*Id.*; Ex-1003-Bims at ¶267; §XI.A.)

Thus, it would have been obvious for a POSITA to enhance Novlan's UE with Samsung's skipping functionality, so that the UE would skip a UL grant when it had no data to transmit based if the UE also did not have PCI to send pursuant to the UL grant. (Ex-1003-Bims at ¶267.) In particular, when Novlan's UE had no data to transmit, it would determine not to skip the UL grant if it had PCI to transmit on PUSCH, because such transmissions conveyed important control information and were not the type of empty, repetitive, battery-draining transmissions that Samsung proposed skipping. (Ex-1003-Bims at ¶¶267-68; §XI.A.) However, Novlan's UE would skip the UL grant when it had neither data nor PCI to send, so as to avoid transmitting empty padding that wasted UL resources and UE battery. (§XI.A; Ex-1009-3GPP-36.212 at §5.2.4.1; Ex-1010-3GPP-36.213 at §7.2; Ex-1003-Bims at ¶268.)

[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.”

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation. As shown in §XI.A, 3GPP-36.212 and 3GPP-36.213 disclose that Novlan's UE would have transmitted PCI reports in the conventional manner on PUSCH—CQI, PMI, and RI in particular. (Ex-1009-3GPP-36.212 at §5.2.4–5.2.4.1; Ex-1010-3GPP-36.213 at §7.2; §XI.A; Ex-1003-Bims at ¶¶269-70.) For example, periodic PCI reports were conventionally transmitted on PUSCH

pursuant to a UL grant even when there was no data to transmit, as required by this limitation. (Ex-1003-Bims at ¶271 (citing Ex-1010-3GPP-36.213 at §7.2 (“[A UE] shall transmit periodic CSI reporting on PUSCH...in subframes with a PUSCH allocation [i.e., a UL grant]”); 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...” & “for each grant received for this TTI”).) It would have been obvious for Novlan’s UE to maintain this functionality when combined with the skipping functionality of Samsung-332 and Samsung-333. 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, while at the same time not modifying the UE’s physical layer (layer 1). Since UE transmissions of PCI on PUSCH conveyed important information to a BS, a POSITA would not have further modified Novlan’s UE to skip PCI transmissions on PUSCH, and instead would have maintained the conventional functionality whereby the UE would transmit PCI on PUSCH pursuant to a UL grant. (Ex-1003-Bims at ¶¶271-73; *see* §XI.A, limitation 1.2.)

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.”

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach claims 2-3.¹¹ In particular, 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); *see* Ex-1008-Samsung-333 at §5.4.1 (noting that an uplink grant may be dynamic or configured); Ex-1003-Bims at ¶¶274-77.) Thus, Samsung-332 and Samsung-333 disclose that either type of UL grant may be skipped. (*Id.*)

Thus, Ground 2 renders obvious claims 2-3.

¹¹ The phrase “configured uplink grant that is periodically available” includes “Semi-persistent scheduling” or “SPS,” (Ex-1001 at 35:44-47.)

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

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation. Samsung-332 teaches that Novlan’s UE should “skip uplink transmission if no data is available for transmission.” (Ex-1007-Samsung-332 at §2.1) This is contrasted with empty padding transmissions, so a POSITA would have understood it to mean that the UE would not transmit anything on PUSCH when it “skips” a UL grant. (*Id.* at §§2.1-2.2; Ex-1003-Bims at ¶¶278-81.) Samsung-333 also teaches that Novlan’s UE would not transmit without a valid uplink grant, 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.)

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.”

Novlan in view of 3GPP-36.212, 3GPP-36.213, Samsung-332, and Samsung-333 teach this limitation. In particular, Samsung-332 discloses 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.) The “current specification” in the Samsung references included 3GPP TS 36.321 v12.6.0 (Ex-1023), which was the technical specification that the Samsung-333 CR proposed to

modify. (Ex-1008-Samsung-333 at cover page.) Pursuant to that standard, the UE's MAC layer would have received HARQ information (e.g., transport block size) and up to two UL grants for a TTI from lower layers (e.g., the UE's physical layer) when the UE's UL transmission had enough room to include both PCI and a MAC PDU. (Ex-1010-36.213 at §8.6.2 (disclosing the UE's procedure for signaling the availability and size of a transport block to the MAC layer), §7.1.7-7.1.7.2.2 (regarding transport block size determination), §8.6.3 (regarding "Control information MCS offset determination"); §7.2 (regarding "UE procedure for reporting" PCI); Ex-1023-36.321 at §§3.1 (disclosing that HARQ information comprises transport block size), 4.4 (disclosing that MAC SDUs are multiplexed onto transport blocks to be delivered to the physical layer), 5.4.1 (disclosing that a MAC layer receives HARQ information from lower layers and the MAC layer receives up to two UL grants).) The UE's "multiplexing and assembly" entity would provide a MAC PDU in accordance with the "logical channel prioritization," which would have included "*a padding or a padding MAC (Medium Access Control) control element*" if higher-priority elements were unavailable. (*Id.* at §5.4.3.1.) The UE's HARQ entity would then obtain a MAC PDU from that "multiplexing and assembly" entity and trigger a transmission. (*Id.* at §5.4.2.1; *see id.* at §5.4.5 (disclosing when a BSR report would have been triggered), §6.2.1 (disclosing that a MAC PDU comprises one or more MAC CEs and (optionally) padding).) At the

physical layer, a transport block carrying the MAC PDU would then be multiplexed with PCI as disclosed in the “data and control multiplexing” section of 3GPP-36.212. (Ex-1009-36.212 at §5.2.2.7; *see id.* at §5.2.2 (regarding the UL shared channel) & §5.2.4 (“Uplink control information on PUSCH without UL-SCH data).) Thus, Novlan’s UE would have multiplexed PCI with a transport block comprising padding and transmitted the result on PUSCH when there was enough space to do so (as indicated by the physical layer’s signaling of a transport block of a given size) and when higher-priority control elements were not available. (Ex-1023-36.321 at §§3.1, 4.4, 5.4.1, 5.4.3.1; Ex-1009-36.212 at §5.2.2.7; Ex-1003-Bims at ¶¶282-86 (citing Ex-1023-36.321 at §§3.1, 4.4, 5.4.1–5.4.5, 6.1.2; Ex-1009-36.212 at §5.2.2.7; Ex-1010-36.213 at §8.6.2).) Accordingly, claim 5 would have been obvious because Novlan’s UE would transmit PCI pursuant to an uplink grant, and would multiplex a transport block comprising padding with the PCI when possible. (Ex-1003-Bims at ¶¶282-86.)

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 (HARO) feedback.”

This limitation is obvious for the reasons provided above regarding Ground 2, limitation 1.3.

Thus, Ground 2 renders obvious claim 21.

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

This limitation is obvious for the reasons provided above regarding Ground 2, limitation 1.3.

Thus, Ground 2 renders obvious claim 25.

2. Claim Set B

[6.0] “A User Equipment (UE),”

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:”

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:”

Novlan teaches these limitations. Specifically, Novlan discloses a UE in FIG. 3 and corresponding text:

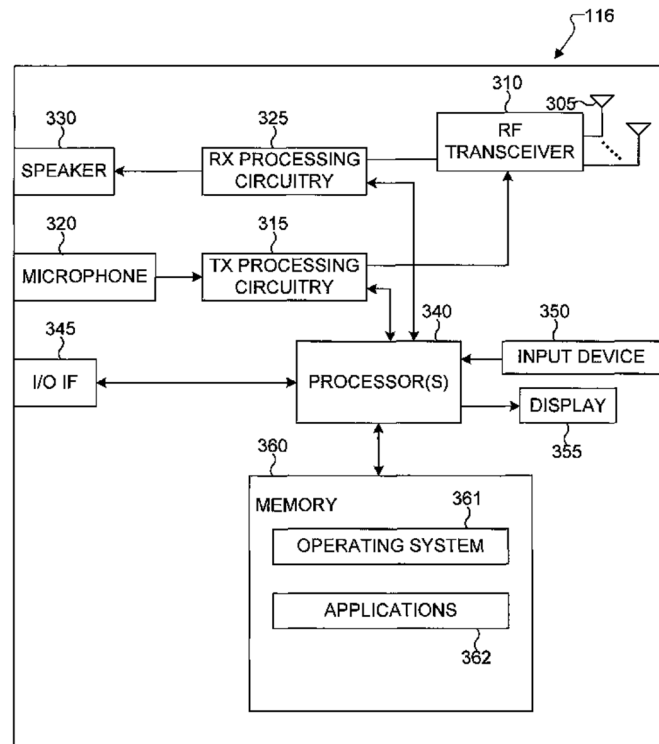


FIGURE 3

(Ex-1011-Novlan at FIG. 3.) The corresponding text explains that 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.)

As shown, Novlan discloses a typical UE such as a mobile station (*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). For example, Novlan discloses:

“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.)

Novlan further discloses that the processor and memory are coupled 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).” (*Id.* at 8:64-67.)

Novlan also discloses that its processor executes programs in memory regarding 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.)

Thus, Novlan discloses the limitations of claim 6’s UE, including the configuration whereby Novlan’s processor executes code stored in memory to perform functions relating to transmitting PCI. (Ex-1003-Bims at ¶¶291-98.)

[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”

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.”

This limitation is obvious for the reasons provided above regarding Ground 2, limitation 1.3.

Thus, Ground 2 renders obvious claim 6.

[Claims 7-9]

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.”

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. 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. Thus, Ground 2 renders obvious claim 10.

[Claims 22 and 26]

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

3. Claim Sets C-D

The claims in Claim Sets C-D correspond to those previously addressed in claim sets A-B. The correspondence is as follows:

Claim/Limitation (Claim Sets C-D)	Corresponding Claim/Limitation (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

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

XII. Conclusion

For the foregoing reasons, Petitioner respectfully requests cancellation of claims 1-28.

Respectfully submitted,
GREENBERG TRAURIG, LLP

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Petition Requesting *Inter Partes* Review

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CERTIFICATE OF SERVICE

The undersigned certifies that a true and correct copy of the Petition together with all exhibits identified in the above Table of Exhibits and Petitioner's Power of Attorney, have been served on the Patentee via Priority Mail Express or by means at least as fast and reliable as Priority Mail Express on the below date, at the following address:

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