

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
Petitioner

v.

G+ COMMUNICATIONS, LLC
Patent Owner

Patent No. 9,184,881

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,184,881**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	MANDATORY NOTICES	1
III.	PAYMENT OF FEES	2
IV.	GROUND FOR STANDING.....	2
V.	PRECISE RELIEF REQUESTED AND GROUNDS RAISED.....	2
VI.	LEVEL OF ORDINARY SKILL	4
VII.	SUMMARY OF THE '881 PATENT	4
VIII.	OVERVIEW OF THE PRIOR ART	9
	A. Malladi.....	9
	B. TDTech.....	10
	C. Kim	11
	D. Huawei.....	11
	E. Ericsson	11
	F. TS 36.211 V8.2.0	12
IX.	CLAIM CONSTRUCTION	12
X.	DETAILED EXPLANATION OF GROUNDS.....	13
	A. Ground 1: Malladi Anticipates Claim 9	13
	1. Claim 9	13
	B. Ground 2: Malladi in View of Kim Renders Obvious Claim 10	33
	1. Claim 10	33
	C. Ground 3: Malladi in View of TDTech Renders Obvious Claims 1, 4-6, 9, 13, and 14	40
	1. Claim 1	40
	2. Claim 4	54
	3. Claim 5	55
	4. Claim 6	56
	5. Claim 9	57
	6. Claims 13 and 14.....	58

D.	Ground 4: Malladi in View of TDTech and Huawei Renders Obvious Claims 2 and 11	58
1.	Claim 2	58
2.	Claim 11	61
E.	Ground 5: Malladi in View of TDTech and Ericsson Renders Obvious Claims 3 and 12	62
1.	Claim 3	62
2.	Claim 12	65
F.	Ground 6: Malladi in View of TDTech and Kim Renders Obvious Claims 7 and 10	65
1.	Claim 7	65
2.	Claim 10	67
G.	Ground 7: Malladi in View of TDTech and TS 36.211 V8.2.0 Renders Obvious Claim 8	67
1.	Claim 8	67
XI.	DISCRETIONARY DENIAL IS NOT APPROPRIATE	71
XII.	CONCLUSION.....	74
XIII.	APPENDIX A (CLAIM LISTING)	75

LIST OF EXHIBITS

EX1001	U.S. Patent No. 9,184,881 to Dai et al. (“the ’881 patent”)
EX1002	Declaration of Dr. Zhi Ding, Ph.D.
EX1003	Curriculum Vitae of Dr. Zhi Ding, Ph.D.
EX1004	Prosecution History of U.S. Patent No. 9,184,881
EX1005	U.S. Patent Publication No. 2008/0253318 to Malladi et al. (“Malladi”)
EX1006	TD Tech, “ACK/NACK Multiplexing in PUSCH in TDD,” 3rd Generation Partnership Project, Technical Specification Group, Radio Access Network, Working Group 1 Meeting #52bis, Shenzhen, China, TDoc R1-081339, March 26, 2008 (“TDTech”)
EX1007	U.S. Patent Publication No. 2008/0095252 to Kim et al. (“Kim”)
EX1008	Huawei, “UL index in UL schedule grant for LTE TDD,” 3rd Generation Partnership Project, Technical Specification Group, Radio Access Network, Working Group 1 Meeting #50bis, Shanghai, China, TDoc R1-074060, October 2, 2007 (“Huawei”)
EX1009	Ericsson, “Details of ACK/NACK Bundling for TDD,” 3rd Generation Partnership Project, Technical Specification Group, Radio Access Network, Working Group 1 Meeting #52bis, Shenzhen, China, TDoc R1-081528, March 27, 2008 (“Ericsson”)
EX1010	Technical Specification 36.211 V8.2.0 (2008-03), 3rd Generation Partnership Project, Technical Specification Group Radio Access Network, Evolved Universal Terrestrial Radio Access (E-UTRA), Physical Channels and Modulation, March 20, 2008 (“TS 36.211 V8.2.0”)
EX1011	Technical Specification 36.211 V8.1.0 (2007-11), 3rd Generation Partnership Project, Technical Specification Group Radio Access Network, Evolved Universal Terrestrial Radio Access (E-UTRA), Physical Channels and Modulation, December 18, 2007

EX1012	Technical Specification 36.212 V8.2.0 (2008-03), 3rd Generation Partnership Project, Technical Specification Group Radio Access Network, Evolved Universal Terrestrial Radio Access (E-UTRA), Multiplexing and Channel Coding, March 18, 2008
EX1013	U.S. Patent Publication No. 2008/0304404
EX1014	U.S. Patent No. 7,002,929
EX1015	<i>G+ Commc’n, LLC v. Samsung Elec.</i> , Case No. 2:22-cv-00078, Plaintiff G+ Communications, LLC’s Initial Disclosure of Asserted Claims and Infringement Contentions, Ex. B16
EX1016	Ericsson, “Uplink ACK/NACK timing for TDD,” 3rd Generation Partnership Project, Technical Specification Group, Radio Access Network, Working Group 1 Meeting #52, Sorrento, Italy, TDoc R1-080890, February 6, 2008
EX1017	Ericsson, “Combination of ACK/NACKs for TDD,” 3rd Generation Partnership Project, Technical Specification Group, Radio Access Network, Working Group 1 Meeting #52, Sorrento, Italy, TDoc R1-080870, February 6, 2008
EX1018	LG Electronics, “Handling Problem with Uplink ACK/NACK Bundling,” 3rd Generation Partnership Project, Technical Specification Group, Radio Access Network, Working Group 1 Meeting #52bis, Shenzhen, China, TDoc R1-081256, March 26, 2008
EX1019	Declaration of Craig Bishop
EX1020	Curriculum Vitae of Dr. Zhi Ding, Ph.D.
EX1021	3rd Generation Partnership Project, Partnership Project Description, December 4, 1998
EX1022	Introducing 3GPP, https://www.3gpp.org/about-us/introducing-3gpp (last visited Jan. 19, 2023)

EX1023	Karl H. Rosenbrock, The Third Generation Partnership Project (3GPP), in GSM and UMTS, The Creation of Global Mobile Communication, 238-40, 245 (John Wiley & Sons, Ltd 2002)
EX1024	3rd Generation Partnership Project, Working Procedures, July 7, 1999
EX1025	Antti Toskala, Background and Standardisation of WCDMA, in WCDMA for UMTS, Radio Access for Third Generation Mobile Communications, 45-50 (John Wiley & Sons, Ltd 2001)
EX1026	Adrian Scrase, MCC Activity Report to 3GPP PCG#23 (PCG23_12), Oct. 27, 2009
EX1027	Gonzalo Camarillo and Miguel A. Garcia-Martin, The 3G IP Multimedia Subsystem (IMS), Merging the Internet and the Cellular Worlds (John Wiley & Sons, Ltd 2004)
EX1028	3GPP Frequently Asked Questions, archived at Internet Archive Wayback Machine on December 13, 2007, at https://web.archive.org/web/20071213065021/http://www.3gpp.org:80/faq/faq_2005_2.htm
EX1029	3GPP FAQs, https://www.3gpp.org/about-us/3gpp-faqs (last visited Feb. 9, 2023)
EX1030	3GPP Specifications Home Page, archived at Internet Archive Wayback Machine on December 15, 2007, at https://web.archive.org/web/20071215013238/http://www.3gpp.org:80/specs/specs.htm
EX1031	3GPP Specifications – Numbering Scheme, archived at Internet Archive Wayback Machine on December 11, 2007, at https://web.archive.org/web/20071211024115/http://www.3gpp.org:80/specs/numbering.htm
EX1032	3GPP Specifications – Version Numbering Scheme, archived at Internet Archive Wayback Machine on December 20, 2007, at https://web.archive.org/web/20071220190806/http://www.3gpp.org:80/specs/version-numbering.htm

EX1033	3GPP File Server, archived at Internet Archive Wayback Machine on Dec. 11, 2007, at https://web.archive.org/web/20071211222823/http://www.3gpp.org:80/ftp/
EX1034	3GPP File Server – 36.211, https://www.3gpp.org/ftp/Specs/archive/36_series/36.211 (last visited Feb. 17, 2023)
EX1035	3GPP Membership, https://webapp.etsi.org/3gppmembership/Results.asp?Member=ALL_PARTNERS&SortMember=Name&DirMember=ASC&SortPartner=Name&%E2%80%A6 (last visited Feb. 17, 2023)
EX1036	RAN1 Homepage, archived at Internet Archive Wayback Machine on November 22, 2007, at https://web.archive.org/web/20071122093109/http://www.3gpp.org/tb/RAN/RAN1/RAN1.htm
EX1037	Archives of 3GPP_TSG_RAN_WG1@LIST.ETSI.ORG, archived at Internet Archive Wayback Machine on October 18, 2007, at https://web.archive.org/web/20071018204101/http://list.etsi.org:80/3gpp_tsg_ran_wg1.html
EX1038	3GPP Home Page, archived at Internet Archive Wayback Machine on December 16, 2007, at https://web.archive.org/web/20071216232421/http://www.3gpp.org:80/
EX1039	List Archives at LIST.ETSI.ORG, archived at Internet Archive Wayback Machine on December 14, 2007, at https://web.archive.org/web/20071214031911/http://list.etsi.org:80/
EX1040	3GPP_TSG_RAN_WG1 Archives, December 2007, https://list.etsi.org/scripts/wa.exe?A1=ind0712&L=3GPP_TSG_RAN_WG1&X=O66805947871594C369&Y=craigbishop%40aol.com (last visited Feb. 17, 2023)

EX1041	Participants at RAN WG1 Meeting #50b in October 2007, Annex A of report from RAN WG1 #50bis, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_50b/Report
EX1042	3GPP FAQs, https://www.3gpp.org/about-us/3gpp-faqs (last visited Feb. 9, 2023)
EX1043	3GPP File Server – 36.212, https://www.3gpp.org/ftp/Specs/archive/36_series/36.211 (last visited Feb. 17, 2023)
EX1044	3GPP TSG RAN Working Group 1 (Layer 1), List of WG1 Temporary Documents for 50b, Annex B of report from RAN WG1 #50bis, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_50b/Report
EX1045	3GPP File Server, TSG RAN WG1 50b Documents, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_50b/Docs (last visited Feb. 17, 2023)
EX1046	Report of 3GPP TSG RAN WG1 #50b v1.0.0, R1-075054, Shanghai, China, 8 – 12 Oct., 2007, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_50b/Report
EX1047	3GPP File Server, TSG RAN WG1 52b Documents, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_52b/Docs (last visited Feb. 20, 2023)
EX1048	3GPP TSG RAN Working Group 1 (Layer 1), List of WG1 Temporary Documents for 52b, Annex B of report from RAN WG1 #52bis, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_52b/Report
EX1049	Report of 3GPP TSG RAN WG1 #52bis v1.0.0, R1-081711, Shenzhen, China, 31 march – 4 Apr., 2008, https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_52b/Report
EX1050	October 2, 2007, Distribution Email, https://list.etsi.org/scripts/wa.exe?A2=3GPP_TSG_RAN_WG1;c054b090.0710A&S= (last visited Feb. 20, 2023)

EX1051	March 26, 2008, Distribution Email, https://list.etsi.org/scripts/wa.exe?A2=3GPP_TSG_RAN_WG1;c6a0d17d.0803D&S= (last visited Feb. 20, 2023)
EX1052	March 26, 2008, Distribution Email, https://list.etsi.org/scripts/wa.exe?A2=3GPP_TSG_RAN_WG1;d033aa64.0803D&S= (last visited Feb. 22, 2023)
EX1053	Memorandum from Director Vidal (June 21, 2022)
EX1054	Federal Court Management Statistics (March 2022)
EX1055	Docket Control Order of August 3, 2022, <i>G+ Communications, LLC v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:22-cv-0078-JRG (E.D. Tex.)

I. INTRODUCTION

Samsung Electronics Co., Ltd. (“Petitioner”) respectfully requests *inter partes* review of claims 1-14 (“challenged claims”) of U.S. Patent No. 9,184,881 (“the ’881 patent”) (EX1001), which, according to PTO records, is assigned to G+ Communications, LLC (“PO”). As discussed below, the challenged claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

Real Parties-in-Interest: Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner identifies the following as the real parties-in-interest: Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.

Related Matters: The ’881 patent is asserted in the following civil action: *G+ Communications, LLC v. Samsung Electronics Co., Ltd., et al.*, Case No. 2:22-cv-0078-JRG (E.D. Tex.).

Counsel and Service Information: Lead counsel is Naveen Modi (Reg. No. 46,224). Backup counsel is Joseph Palys (Reg. No. 46,508) and Phillip Citroën (Reg. No. 66,541). Service information is Paul Hastings LLP, 2050 M Street NW, Washington, D.C. 20036, Tel.: 202.551.1700, Fax: 202.551.1705, email: Samsung-G+-IPR@paulhastings.com. Petitioner consents to electronic service.

III. PAYMENT OF FEES

The PTO is authorized to charge any fees due during this proceeding to Deposit Account No. 50-2613.

IV. GROUNDS FOR STANDING

Petitioner certifies under 37 C.F.R. § 42.104(a) that the '881 patent is available for review and Petitioner is not barred or estopped from requesting review on the grounds identified herein.

V. PRECISE RELIEF REQUESTED AND GROUNDS RAISED

Petitioner requests review and cancellation of the challenged claims as unpatentable on the following grounds:

Ground 1: Claim 9 is unpatentable under pre-AIA 35 U.S.C. § 102(a) based on U.S. Patent Publication No. 2008/0253318 (“Malladi”) (EX1005);

Ground 2: Claim 10 is unpatentable under pre-AIA 35 U.S.C. § 103(a) based on Malladi in view of U.S. Patent Publication No. 2008/0095252 (“Kim”) (EX1007);

Ground 3: Claims 1, 4-6, 9, 13, and 14 are unpatentable under § 103(a) based on Malladi in view of TDTech (EX1006);

Ground 4: Claims 2 and 11 are unpatentable under § 103(a) based on Malladi in view of TDTech and Huawei (EX1008);

Ground 5: Claims 3 and 12 are unpatentable under § 103(a) based on Malladi in view of TDTech and Ericsson (EX1009);

Ground 6: Claims 7 and 10 are unpatentable under § 103(a) based on Malladi in view of TDTech and Kim; and

Ground 7: Claim 8 is unpatentable under § 103(a) based on Malladi in view of TDTech and TS 36.211 V8.2.0 (EX1010).

For purposes of this proceeding only, Petitioner assumes the earliest effective filing date of the '881 patent is April 25, 2008, the filing date of Chinese Application No. 200810096053.2. (EX1001, 1:5-9.)

Malladi published on October 16, 2008, from U.S. Application No. 12/047,562, filed March 13, 2008, and claims the benefit of Provisional Application No. 60/895,454, filed on March 17, 2007. (EX1005, Cover). Thus, Malladi qualifies as prior art under at least 35 U.S.C. § 102(e).

Kim published on April 24, 2008, from U.S. Application No. 11/764,069, filed June 15, 2007, and claims the benefit of Provisional Application No. 60/805,059, filed on June 16, 2006. (EX1007, Cover). Thus, Kim qualifies as prior art under at least 35 U.S.C. §§ 102(a) and 102(e).

TDTech published on March 26, 2008; Huawei published on October 2, 2007; Ericsson published on March 27, 2008; and TS 36.211 V8.2.0 published on March 20, 2008. (EX1006, 1; EX1008, 1; EX1009; EX1010; EX1019, ¶¶1-100.) Therefore, as supported by the declaration of Craig Bishop, TDTech, Huawei, Ericsson, and TS

36.211 V8.2.0 qualify as prior art under at least 35 U.S.C. § 102(a).¹ (EX1019, ¶¶52-93 (citing EX1020-EX1052).)

None of these references were considered during prosecution. (EX1004).

VI. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSITA”) at the time of the alleged invention of the ’881 patent, which for purposes of this proceeding is around April 2008, would have had at least an undergraduate degree in electrical engineering, computer engineering, computer science or a related field along with at least two years of work experience in the field of wireless communication technology. (EX1002, ¶¶24-25.)² More education can supplement practical experience and vice versa. (*Id.*)

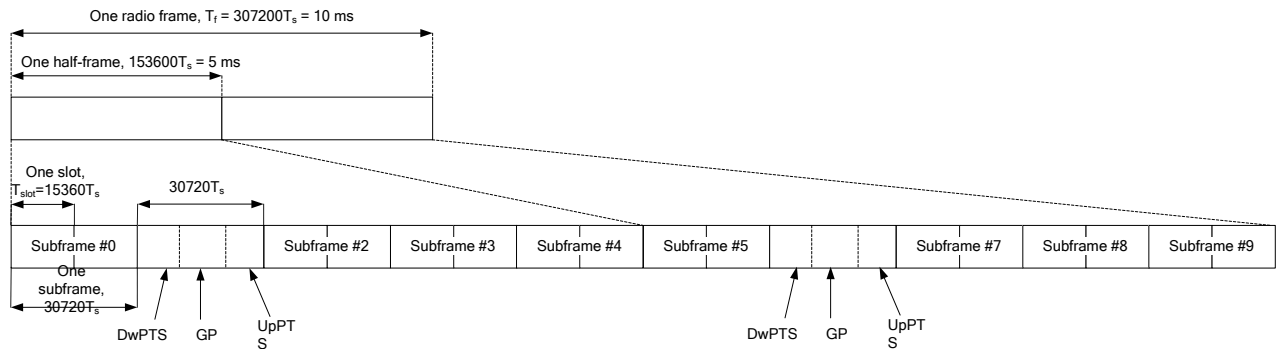
VII. SUMMARY OF THE ’881 PATENT

The ’881 patent relates to user equipment (UE) “feeding back confirmation information” to a base station (“eNodeB” or “eNB”) in “Time Division Duplex (‘TDD’ for short) mode.” (EX1001, 1:10-21.)

¹ Based on the March 25, 2009, filing date of PCT/CN2009/071008, Huawei and TS 36.211 V8.2.0 also qualify as prior art under 35 U.S.C. § 102(b).

² Petitioner submits the declaration of Dr. Zhi Ding (Ex. 1002), an expert in the field of the ’881 patent. (Ex. 1002, ¶¶1-186; Ex. 1003.)

The '881 patent admits that both TDD and feeding back confirmation information on a PUSCH were already known in the prior art. (*Id.*, 1:19-24, 6:13-14, Fig. 1.) Indeed, on December 18, 2007, the 3rd Generation Partnership Project (3GPP) Technical Specification Group (TSG) for Radio Access Network (RAN) published Technical Specification 36.211 V8.1.0 (2007-11) (“TS 36.211 V8.1.0”), which described the TDD frame structure, as illustrated below:



(EX1011, 9-10; EX1019, ¶¶52-57.)

This frame structure is a more detailed version of the frame structure illustrated in Figure 1 of the '881 patent, reproduced below, which the '881 patent describes as “the frame structure of the...TDD mode according to the related art.” (EX1001, 6:13-14.)

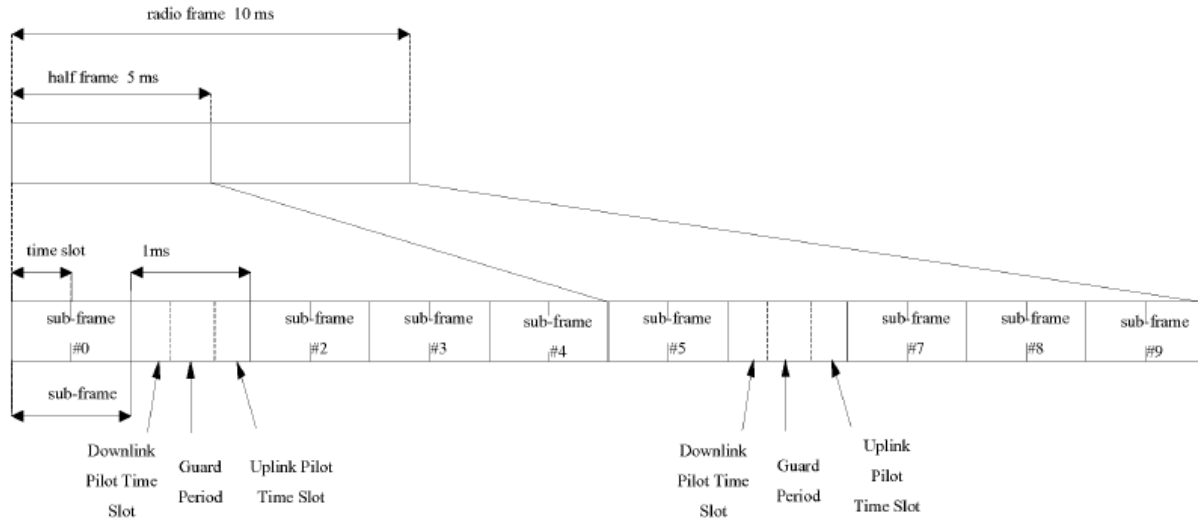


Figure 1

(*Id.*, Fig. 1) Thus, TDD was already known in the prior art, as was the fact that one TDD “radio frame” may be divided into 10 “sub-frames.” (*Id.*, 1:21-25; EX1002, ¶¶26-29.)

Additionally, on March 20, 2008, 3GPP’s TSG for RAN published Technical Specification 36.211 V8.2.0 (2008-03) (“TS 36.211 V8.2.0”), which included the following table of uplink-downlink configurations for TDD:

Configuration	Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	10 ms	D	S	U	U	U	D	S	U	U	D

(EX1010, 9-11; EX1019, ¶¶58-63.)

The same table appears as Table 1 in the '881 patent. (EX1001, 1:58-2:12.) Referring to Table 1, the '881 patent admits that it was known in the art that “LTE TDD defines 7 kinds of configuration solutions for the number of the uplink/downlink sub-frames.” (*Id.*, 1:33-40.) “Table 1 shows the LTE TDD uplink/downlink proportion configuration, wherein D represents the downlink sub-frame, U represents the uplink sub-frame and S represents the special sub-frame.” (*Id.*, 1:58-2:16.) It can be seen in Table 1 that certain known TDD configurations (e.g., configurations 2-5) have more downlink subframes than uplink subframes, while other known TDD configurations (e.g., configurations 0 and 6) have more UL subframes than DL subframes. (*Id.*; *id.*, 2:17-34, 2:52-60; EX1002, ¶¶30-31.)

Additionally, the '881 patent explains that it was already known in the prior art that an “acknowledgement/negative acknowledgement message (ACK/NACK)” may be fed back in the “[PUSCH] for transmitting the uplink data in this uplink subframe.” (EX1001, 2:35-43.) The '881 patent explains that it was known that, for

configurations where “the number of the downlink sub-frames allocated will be greater than the number of the uplink sub-frames allocated,” “one uplink sub-frame should feed back the ACK/NACK information of a plurality of PDSCH sub-frames.” (*Id.*, 2:52-57.) For example, for such configurations, the ’881 patent explains that one known “method is to transmit the ACK/NACK information of a plurality of the downlink sub-frames together with the uplink data on the [PUSCH].” (*Id.*, 2:60-67.)

The transmission of ACK/NACK information together with uplink data on the PUSCH was described, for example, in Technical Specification 36.212 V8.2.0 (2008-03) (“TS 36.212 V8.2.0”), which was published by 3GPP’s TSG for RAN on March 18, 2008. (EX1012; EX1019, ¶¶64-69.) For example, TS 36.212 V8.2.0 explains that ACK information may be “multiplexed with the data transmission in the uplink shared data channel.” (EX1012, 22; EX1002, ¶¶32-33.)

The ’881 patent alleges that this method may result in the well-known problem of a “Discontinuous Transmission (‘DTX’ for short).” (EX1001, 3:1-8.) The ’881 patent purports to address “the problem of the lost...downlink data [that] existed in the related art” by “provid[ing] an improved solution for feeding back messages on the [PUSCH].” (*Id.*, 3:28-33.) In particular, the ’881 patent describes downlink control information (DCI) carrying “the number of the downlink sub-frames corresponding to the confirmation information which is fed back by the one uplink sub-frame.” (*Id.*, 7:17-20; *id.*, 2:49-51.) According to the ’881 patent, this “number

value” is used by the UE during decoding. (*Id.*, 10:3-19; *id.*, 3:42-57, 6:32-50, 6:63-40, Fig. 2; EX1002, ¶¶34-35.)

The ’881 patent further describes sending “data in the downlink subframe” as either “a single codeword stream” or “multiple codeword streams.” (EX1001, 8:29-45.) Sending one or multiple codeword streams in one subframe was also a well-known feature of TDD. (EX1010, 35; EX1002, ¶36.)

As explained in more detail in Section X, the features discussed above and recited in the challenged claims were well known in the art. (EX1002, ¶37.)

VIII. OVERVIEW OF THE PRIOR ART

A. Malladi

Malladi describes “[t]echniques for sending and receiving ACK information in a wireless communication system.” (EX1005, ¶[0006].) Figure 1 (below) in Malladi illustrates such a “system 100,” which includes a “base station” (also referred to as an “eNB”) and a “UE” (also referred to as a “user equipment”). (*Id.*, ¶[0025], Fig. 1.)

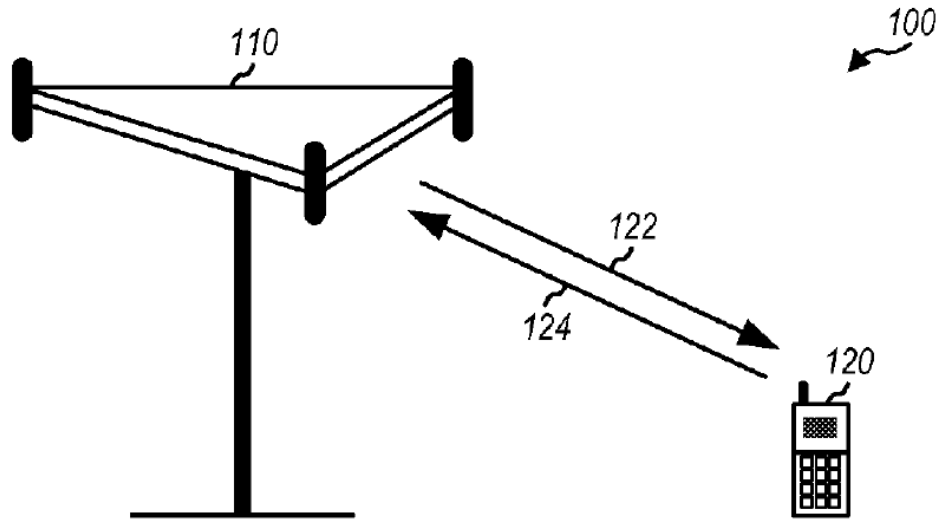


FIG. 1

(*Id.*, Fig. 1.) (EX1002, ¶¶38-44.)

B. TDTech

TDTech is a Temporary Document (“TDoc”), titled “ACK/NACK Multiplexing in PUSCH in TDD” (R1-081339), that was submitted to the 3GPP’s TSG for RAN Working Group 1 (WG1) Meeting #52, held March 31-April 4, 2008, in Shenzhen, China, and published on March 26, 2008. (EX1006, 1; EX1019, ¶¶78-85.) TDTech addressed features of TDD described in 3GPP’s technical specifications, such as TS 36.211 V8.1.0, TS 36.211 V8.2.0, and TS 36.212 V8.2.0, discussed above. It also proposes “inserting more bits in UL grant to indicate [to] the UE how many ACK/NACK spaces or bits need to be reserved for UL ACK/NACK in PUSCH,” referred to as “ACK-Num-bits.” (EX1006, 2.) (EX1002, ¶¶45-47.)

C. Kim

Kim describes a “user equipment, for encoding uplink acknowledgments to downlink transmissions.” (EX1007, Abstract; *id.*, ¶¶[0003], [0005], [0030].) Kim further relates “to an apparatus for transmitting ACK/NACK signal in a multiple codeword (MCW) type MIMO wireless system.” (*Id.*, ¶[0105].) For example, Kim describes combining a plurality of ACK/NACKs corresponding to a plurality of data streams into one or more ACK/NACK messages. (*Id.*, ¶¶[0108]-[0133], Figs. 10-12.) (EX1002, ¶¶48-49.)

D. Huawei

Huawei is a TDoc, titled “UL index in UL schedule grant for LTE TDD” (R1-074060), that was submitted to the 3GPP TSG RAN WG1 Meeting #50bis, held October 8-12, 2007, in Shanghai, China. (EX1008, 1.) It was a proposal published on October 2, 2007, and relates to TDD. (EX1019, ¶¶70-77.) Huawei describes, for example, using TDD’s UL index to indicate the UL subframe for transmitting the uplink data when there are more DL subframes than UL subframes. (EX1008, 1-3.) (EX1002, ¶50.)

E. Ericsson

Ericsson is a TDoc, titled “Details of ACK/NACK Bundling for TDD” (R1-081528), that was submitted to the 3GPP TSG RAN WG1 Meeting #52bis, held March 31-April 4, 2008, in Shenzhen, China. (EX1009, 1.) It was a proposal

published on March 27, 2008, and relates to TDD. (EX1019, ¶¶86-93.) Ericsson describes, for example, an “associated set of DL subframes...for the UL subframes of all configurations.” (EX1009, 1-2.) (EX1002, ¶51.)

F. TS 36.211 V8.2.0

TS 36.211 V8.2.0 is a technical specification published by 3GPP TSG RAN on March 20, 2008, and describes, among other things, the physical channels and modulation techniques used by TDD for uplink and downlink transmission. (*See, e.g.*, EX1010, 9-11, 11-31 (uplink), 31-61 (downlink); EX1019, ¶¶58-63.) (EX1002, ¶52.)

IX. CLAIM CONSTRUCTION

For IPR proceedings, the Board applies the claim construction standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). *See* 83 Fed. Reg. 51,340-59 (Oct. 11, 2018). The Board, however, only construes the claims when necessary to resolve the underlying controversy. *Toyota Motor Corp. v. Cellport Systems, Inc.*, IPR2015-00633, Paper No. 11 at 16 (P.T.A.B. Aug. 14, 2015) (citation omitted). For purposes of this proceeding, no constructions are necessary.³ (EX1002, ¶53.)

³ Petitioner reserves all rights to raise claim construction and other arguments in other venues.

X. DETAILED EXPLANATION OF GROUNDS

A. Ground 1: Malladi Anticipates Claim 9

1. Claim 9

i) [9.pre-1]⁴

To the extent the preamble of claim 9 is limiting, Malladi discloses these claim features. (EX1002, ¶¶55-63.)

First, Malladi discloses “[a] method for feeding back confirmation information on a physical uplink shared channel, wherein, when the confirmation information is fed back together with uplink data on the physical uplink shared channel,” as claimed.⁵ (EX1002, ¶¶56-59.) Referring to Figure 1 below, Malladi describes “a wireless communication system 100” including an eNB 110 and a UE 120. (EX1005, ¶[0025]; *id.*, ¶¶[0005]-[0006], [0024].)

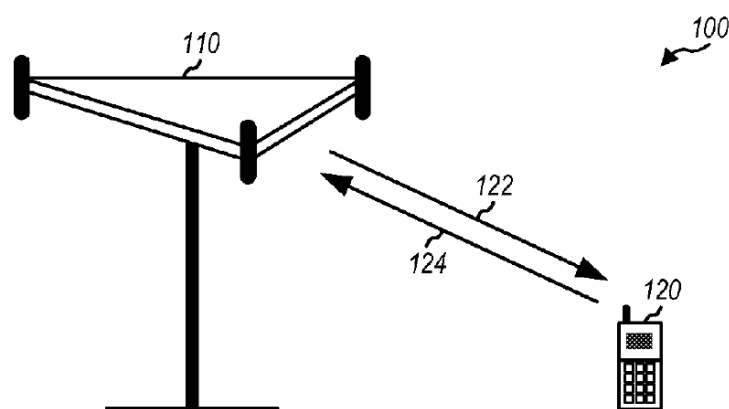


FIG. 1

⁴ All claim language appears in the claim listing provided in Appendix A.

⁵ Claim language is underlined in Section X.

(*Id.*, FIG. 1.) Malladi explains that the wireless network consists of “downlink 122” and “uplink 124,” where the “UE may receive data and control information from eNB 110 via downlink 122 and may transmit data and control information via uplink 124.” (*Id.*; *id.*, [0006].)

Malladi’s system includes “a set of physical channels for the downlink and another set of physical channels for the uplink,” as shown in Table 1 below.

TABLE 1

Channel	Channel Name	Description
PDCCH	Physical Downlink Control Channel	Carry scheduling assignments and other control information on the downlink for different UEs.
PDSCH	Physical downlink shared channel	Carry data on the downlink to different UEs.
PUCCH	Physical uplink control channel	Carry control information (e.g., ACK and CQI information) sent by a UE on the uplink.
PUSCH	Physical uplink shared channel	Carry data sent by a UE on the uplink.

(*Id.*, ¶[0026].) For example, Malladi explains that “eNB 110 may send control information on the PDCCH to the UE and may send data in accordance with the control information on the PDSCH to the UE.” (*Id.*, ¶[0027].) The UE may then “process the PDCCH to determine whether it has been scheduled,” and, if it has been scheduled, process the PDCCH “to obtain control information sent to the UE.” (*Id.*) Based on the downlink control information (DCI), the “UE may then process the PDSCH.” (*Id.*)

Malladi goes on to describe “sending and receiving ACK information.” (*Id.*, ¶[0007]; *id.*, Abstract, ¶[0003].) Malladi explains that, once the eNB sends the DCI and data to a UE, the UE may then encode and send the “ACK information to the base station.” (*Id.*, ¶[0007]; *id.*, Abstract, ¶¶[0009], [0030]-[0035], [0071]-[0102], [0105]-[0108], [0110]-[0111], Figs. 6-12.) Thus, Malladi discloses “[a] method for feeding back confirmation information,” as claimed. (EX1002, ¶58.)

Additionally, Malladi explains that the ACK information may be sent “on the PUSCH along with data,” (EX1005, ¶[0032]), where the “PUSCH” refers to the “Physical uplink shared channel,” (*id.*, ¶[0026]). Thus, Malladi also discloses feeding back the ACK information “on a physical uplink shared channel” and “the confirmation information is fed back together with uplink data on the physical uplink shared channel,” as claimed. (EX1002, ¶59.)

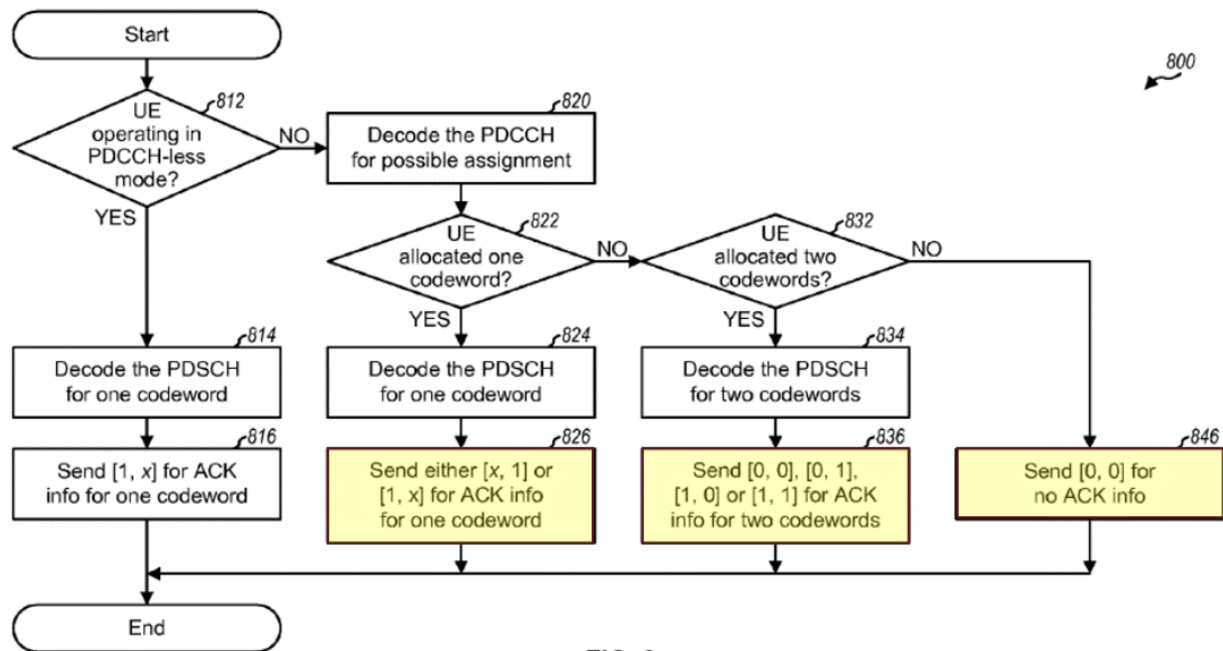


FIG. 8

(EX1005, Fig. 8 (annotated).)

Second, Malladi discloses “in a situation that a user equipment fails to detect a physical downlink control channel corresponding to transmitted data in a sub-frame transmitting data, the user equipment feeds back a negative acknowledgement message as confirmation information of this downlink sub-frame,” as claimed. (EX1002, ¶¶60-63.) Malladi explain that “the ACK information may have a fixed size,” such as “a fixed number of bits (e.g., two bits).” (EX1005, ¶[0009].) Because data blocks may be transmitted in the form of one or more codewords, (*id.*, ¶[0028]), Malladi explains that the “two bits may be defined based on one format if two codewords are sent and based on another format if one codeword is sent,” (*id.*, ¶[0009]). Malladi further explains that “[o]ne 2-bit value may indicate that the

control information is missed by the UE,” and the “remaining 2-bit values may convey decoding status of the one or two codewords sent to the UE.” (*Id.*; *id.*, ¶¶[0073], [0079], [0085]-[0086].)

The scenario where control information is missed, as described in Malladi, discloses “a situation that a user equipment fails to detect a physical downlink control channel corresponding to transmitted data in a sub-frame transmitting data,” as claimed. (EX1002, ¶61.) As Malladi explains, in this scenario, “the UE incorrectly decodes the PDCCH and misses the control information.” (EX1005, ¶[0061].) According to Malladi, “PDCCH” refers to the “Physical Downlink Control Channel.” (*Id.*, ¶[0026].) By incorrectly decoding the PDCCH and missing the control information, the UE fails to detect the PDCCH of a DL transmission carrying corresponding data. (*See, id.*, ¶[0007].) Additionally, with reference to Figure 2, Malladi explains that transmissions of DL control information and data are “partitioned into subframes.” (*Id.*, ¶[0030], Fig. 2.)

If the PDCCH for a DL subframe is missed, Malladi explains that the UE sends back a negative acknowledgement message for this DL subframe. For example, in this scenario, Malladi explains that the 2-bit value “[0, 0]” is sent as the ACK information for such a subframe. (*Id.*, ¶¶[0085], [0086], [0094], [0108], [0110], [0111], Figs. 6, 8, 11, 12.) Malladi describes this scenario as an “error scenario.” (*Id.*, ¶[0061]; *id.*, ¶¶[0030], [0094].) Indeed, as a POSITA would have

understood, in this scenario, data intended for the UE was not received and must be retransmitted. (*See id.*, ¶¶[0006], [0029], [0030]; EX1002, ¶62.) Thus, Malladi discloses that, in this situation, “the user equipment feeds back a negative acknowledgement message as confirmation information of this downlink sub-frame,” as claimed. (*Id.*)

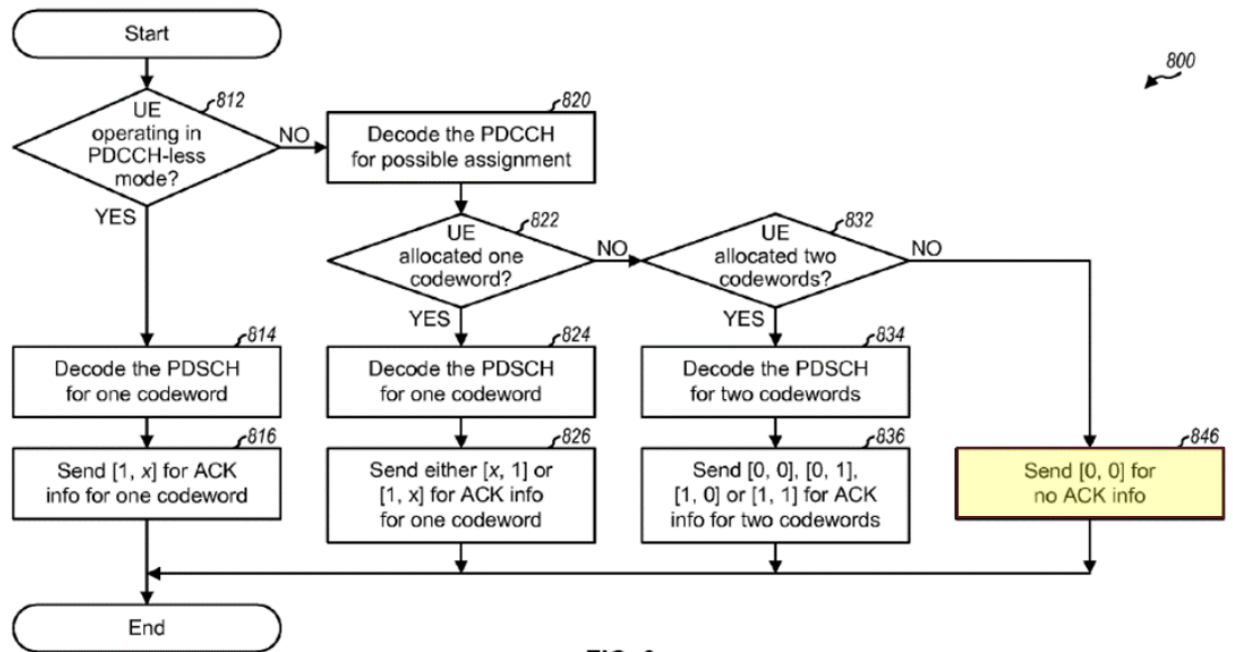


FIG. 8

(EX1005, Fig. 8 (annotated).)

Thus, Malladi discloses these claim features. (EX1002, ¶¶55-63.)

ii) [9.pre-2]

To the extent the preamble of claim 9 is limiting, Malladi discloses these claim features. (EX1002, ¶¶64-69.)

First, Malladi discloses “in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes data in this downlink sub-frame,” as claimed. (*Id.*, ¶65.) For example, Malladi describes a scenario where “the UE correctly decodes the PDCCH” (“in a situation that the user equipment detects the physical downlink control channel”). (EX1005, ¶[0093]; *id.*, ¶¶[0026], [0074]-[0077], [0100], Fig. 8.) According to Malladi, the eNB “send[s] data in accordance with the control information on the PDSCH to the UE” (“corresponding to the transmitted data”). (*Id.*, ¶[0027]; *id.*, ¶¶[0007], [0096]-[0097], [0098], Figs. 7-8.) And, as illustrated in Figure 2 of Malladi, transmissions of DCI and corresponding data are “partitioned into subframes” (in the sub-frame transmitting the data). (*Id.*, ¶[0030], Fig. 2.) In that scenario, Malladi explains that the data, which may be transmitted in the form of one or more codewords, is decoded by the UE (“the user equipment analyzes data in this downlink sub-frame”). (*Id.*, ¶[0093]; *id.*, ¶¶[0074]-[0077] (e.g., states A2 through A4), [0100]).

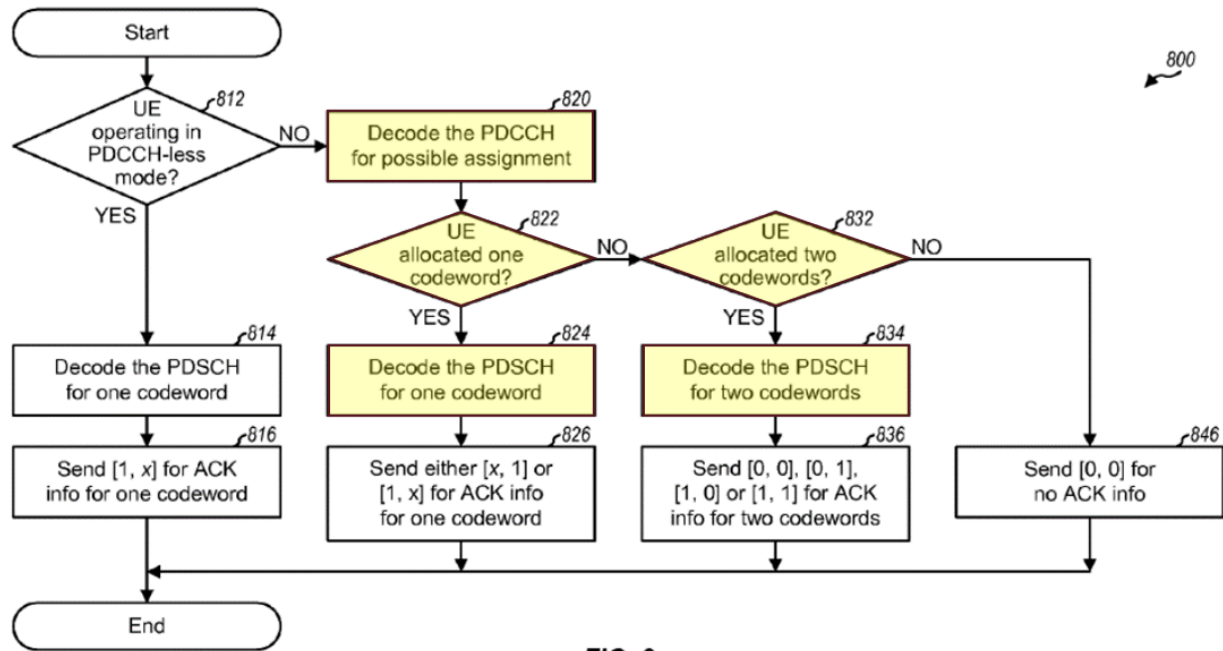


FIG. 8

(*Id.*, Fig. 8 (annotated).)

Second, Malladi discloses “feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information,” as claimed. (EX1002, ¶¶66-68.) For example, Malladi explains that the 2-bit ACK information “may convey decoding status of the one or two codewords sent to the UE.” (EX1005, ¶[0009].) The 2-bit value will differ depending on the number of codewords and the format used (e.g., formats 610, 620, or 630 if two codewords, and 640 if one codeword), but for each allocated codeword, it will indicate either an ACK (if correctly decoded) or a NAK (if not correctly decoded), as illustrated in Tables 2 and 3 below.

TABLE 2

<u>ACK information for two codewords</u>			
ACK Bits	Format 610	Format 620	Format 630
[0, 0]	Missed PDCCH	Missed PDCCH	Missed PDCCH or NAKs for both codewords
[0, 1]	ACKs for both codewords	ACKs for both codewords	ACK for only 2 nd codeword
[1, 0]	ACK for only 1 st codeword	ACK for only 2 nd codeword	ACK for only 1 st codeword
[1, 1]	NAKs for both codewords	NAKs for both codewords	ACKs for both codewords

(*Id.*, ¶[0085]; *id.*, ¶¶[0087]-[0089], [0091], Fig. 6.)

TABLE 3

<u>ACK information for one codeword</u>	
ACK Bits	Format 640
[0, 0]	Missed PDCCH
[x, 1]	x = 1 for ACK or x = 0 for NAK for 1 st codeword
[1, x]	x = 1 for ACK or x = 0 for NAK for 2 nd codeword

(*Id.*, ¶[0086]; *id.*, ¶[0090], Fig. 6.)

Malladi explains that each 2-bit value conveys one of the states A1 through A5 or B1 through B5, where states A2 through A5 and B2 through B5 reflect the various possible outcomes of codeword decoding. (*Id.*, ¶¶[0087]-[0091]; *id.*, ¶¶[0072]-[0083].)

Malladi further explains that the 2-bit value is sent back to the eNB, as illustrated in Figure 8. (*Id.*, ¶¶[0093], [0100].)

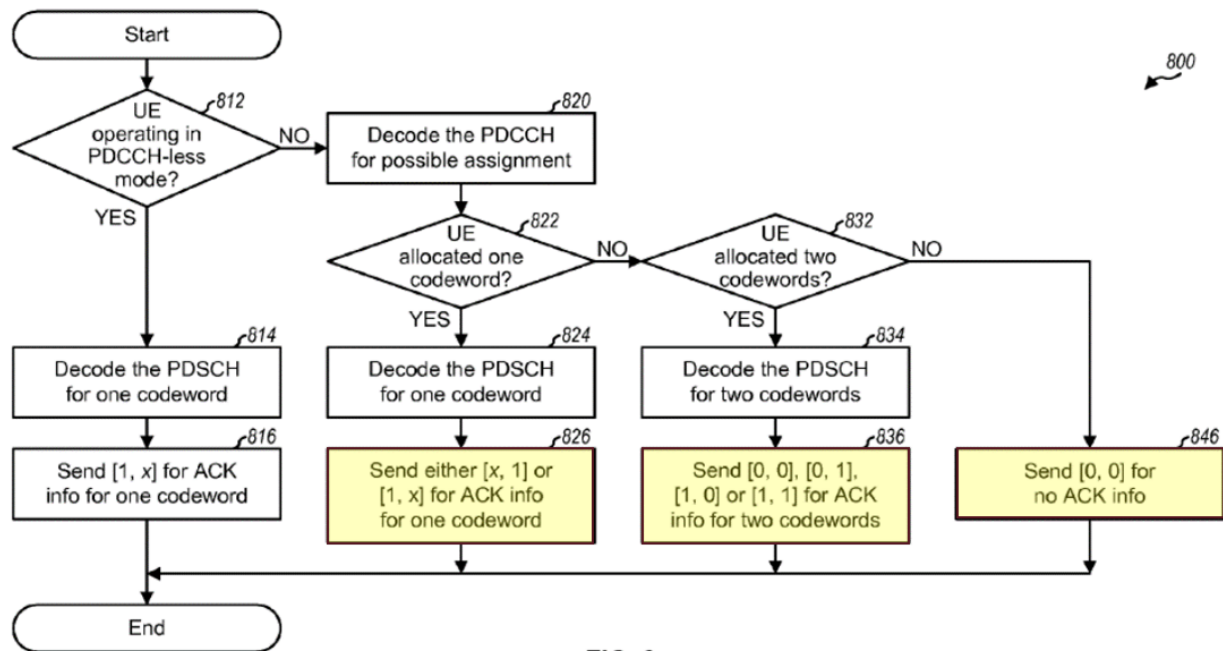


FIG. 8

(*Id.*, Fig. 8 (annotated).)

Thus, Malladi discloses these claim features. (EX1002, ¶¶64-69.)

iii) [9.a]

Malladi discloses these claim features. (EX1002, ¶¶70-82.)

First, Malladi discloses “wherein in a situation that the user equipment feeds back a plurality of groups of the confirmation information,” as claimed. (*Id.*, ¶¶71-74.) Regarding this claim feature, the specification of the ’881 patent explains that “each group corresponds to one downlink sub-frame and includes m pieces of the ACK/NAACK [*sic*] information,” where “m” refers to “the maximum number of codeword streams of the downlink sub-frames.” (EX1001, 9:14-26.) This explanation is consistent with subsequent claim language, which recites “respective

confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame.”

Similarly, Malladi describes the UE sending back to the eNB (“wherein in a situation that the user equipment feeds back”) 2-bit ACK information (“groups of the confirmation information”) for each subframe (“a plurality”). (EX1002, ¶¶72-74.) As illustrated in Figure 2, Malladi explains that DCI and data transmissions are “partitioned into subframes.” (EX1005, ¶[0030], Fig. 2.) As also illustrated in Figure 2, Malladi explains that the UE sends ACK information to the eNB for each DL subframe. (*Id.*, ¶[0030], Fig. 2.) And, referring to Figure 8, which “shows a design of a process 800 performed by the UE to send ACK information,” Malladi explains that the “UE may perform process 800 in each subframe in which data might be sent to the UE.” (*Id.*, ¶[0099], Fig. 8.) Malladi further explains that the ACK information is sent back to the eNB. (*Id.*, ¶¶[0093], [0100], Fig. 8.) Thus, according to Malladi, the UE sends to the eNB a plurality of ACK information, which correspond to a plurality of received DL subframes. (EX1002, ¶73.)

Additionally, Malladi explains that each of the plurality of ACK information is a group of information represented by a 2-bit value. (*Id.*, ¶74.) For example, as discussed in Section X.A.1.ii, Malladi explains that the ACK information is represented by two bits, where each 2-bit value conveys (i) whether the UE missed the PDCCH and (ii) the decoding status of the one or more codewords. (EX1005,

¶[0009].) The 2-bit value will differ depending on the number of codewords and the format used, but for each allocated codeword, it will indicate either an ACK (if correctly decoded) or a NAK (if not correctly decoded), as illustrated in Tables 2 and 3. (*Id.*, ¶¶[0072]-[0083], [0085]-[0091], Figs. 6, 8.) Thus, similar to as described in the specification of the '881 patent, Malladi's 2-bit value corresponds to the maximum number of codewords of the downlink subframes. (EX1002, ¶74.)

Second, Malladi discloses "an amount of the confirmation information fed back in each group is equal to a maximum number of codeword streams in this downlink sub-frame," as claimed.⁶ (*Id.*, ¶¶75-78.) For example, "for a design in which the UE may be scheduled with one or two codewords," (EX1005, ¶[0102]), Malladi explains that the UE may generate and send back a "fixed number of bits for the ACK information" (in this design, two bits) for each downlink subframe "regardless of the number of codewords received," (*id.*, ¶[0102]). This design is illustrated in Tables 2 and 3 and Figure 8. (*Id.*, ¶[0100], Fig. 8.)

⁶ A POSITA would have known that a codeword and a codeword-stream refer to the same concept and therefore mean the same thing.

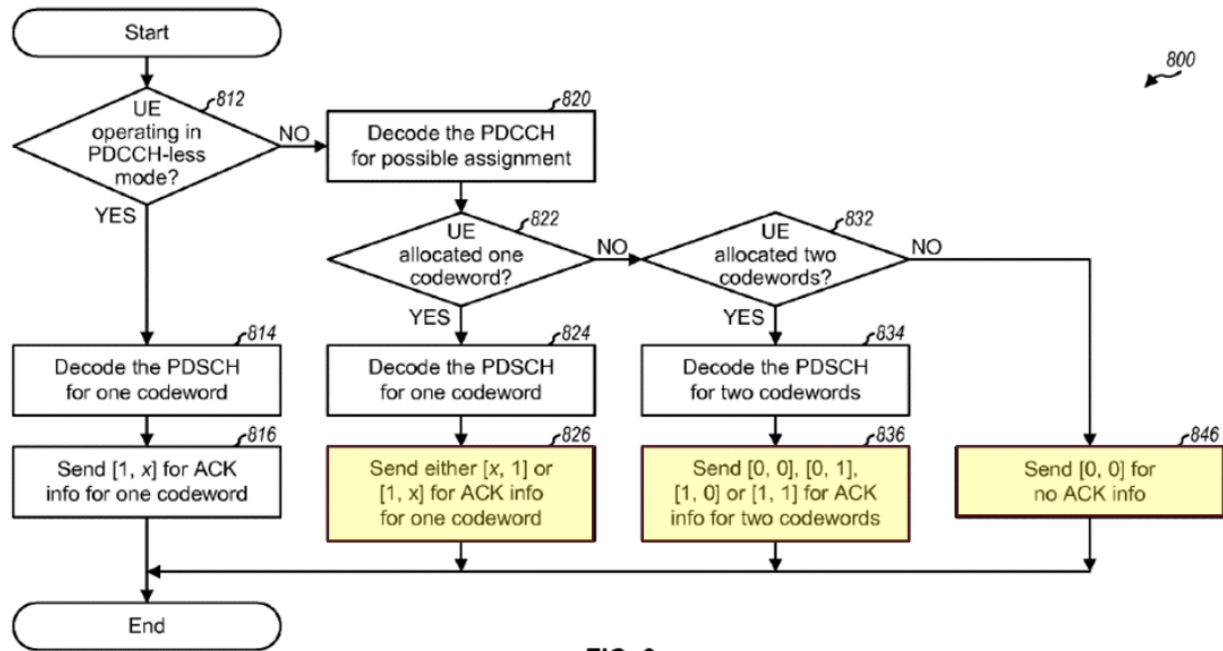


FIG. 8

(*Id.*, Fig. 8 (annotated).)

If two codewords are allocated, the ACK information will be represented by a 2-bit value, as illustrated in Table 2. (*Id.*, ¶¶[0085], [0087]-[0089], [0093], [0110], Fig. 6.) If one codeword is allocated, the ACK information is still represented by a 2-bit value, as illustrated in Table 3. (*Id.*, ¶¶[0086], [0090], [0093], [0110], Fig. 6.) Malladi explains that a 2-bit value (e.g., [0, 0]) is sent back even if no codewords are received. (*Id.*, ¶¶[0085]-[0092], [0094], Fig. 6.)

Malladi further explains that the “UE may also be scheduled...for more codewords,” in which case “the UE may send ACK information for all codewords received by the UE.” (*Id.*, ¶[0102]; *id.*, ¶¶[0009], [0035], [0110].)

Thus, in Malladi, the ACK information may be fixed such that the amount of information always equals the maximum number of codewords in the corresponding downlink subframe. (EX1002, ¶78.)

Third, Malladi discloses “respective confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame,” as claimed. (*Id.*, ¶¶79-81.) For example, for each downlink subframe, Malladi explains that each bit in the 2-bit ACK information (“respective confirmation information in each group”) reflects whether each allocated codeword in the corresponding downlink subframe is decoded correctly or in error (“corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame”). (*Id.*, ¶79.) Malladi explains that “[t]he eNB may send each codeword separately,” and that the “UE may decode each codeword separately and may send ACK information for one or two codewords received from the eNB.” (EX1005, ¶[0033]; *id.*, ¶[0030].)

If one codeword is allocated, Malladi describes using format 640, as illustrated in Table 3. (*Id.*, ¶¶[0078]-[0083], [0086], [0090], [0093], [0100], Figs. 6, 8.) According to Malladi, “[i]f only the first codeword is allocated, then the UE may send [x, 1] for the ACK information, where x=1 if the first codeword is decoded correctly and x=0 if the first codeword is decoded in error.” (*Id.*, ¶[0093].) Similarly, “[i]f only the second codeword is allocated, then the UE may send [1, x] for the ACK

information, where $x=1$ if the second codeword is decoded correctly and $x=0$ if the second codeword is decoded in error.” (*Id.*)

If two codewords are allocated for a downlink subframe, Malladi describes using formats 610, 620, or 630, as illustrated in Table 2. (*Id.*, ¶¶[0085], [0087]-[0089], [0093], [0100], [0110], Figs. 6, 8.) For example, if format 630 is used, the 2-bit value may be set to “[0, 0]” if the UE “decoded both codewords in error,” “[0, 1]” if the UE “correctly decodes only 2nd codeword,” “[1, 0]” if the UE “correctly decodes only 1st codeword,” and “[1, 1]” if the UE “correctly decoded both codewords.” (*Id.*, ¶¶[0072]-[0077], [0085], [0089], [0093], [0100], Figs. 6, 8.)

Malladi therefore discloses these claim features. (EX1002, ¶¶70-82.)

iv) [9.b]

Malladi discloses these claim features. (EX1002, ¶¶83-90.)

First, Malladi discloses “in the situation that the number of codeword streams of the downlink sub-frames is smaller than the maximum number of the codeword streams of the downlink sub-frame, the user equipment feeds back the confirmation information of the number of the maximum codeword streams,” as claimed. (*Id.*, ¶¶84-88.) As discussed in Section X.A.1.iii, Malladi describes a design in which (i) the UE may be scheduled for a maximum number of two codewords in a subframe, (ii) the UE is actually scheduled for less than the maximum number of codewords in

a subframe, and (iii) the UE always sends back to the eNB ACK information that equals the maximum number of two codewords. (*Id.*)

For example, Malladi explains that, “for a design in which the UE may be scheduled with one or two codewords,” (EX1005, ¶[0102]), the UE may generate and send back a “fixed number of bits for the ACK information” (in this design, two bits) for each downlink subframe “regardless of the number of codewords received,” (*id.*, ¶[0102]). To illustrate, referring to Figure 8, Malladi explains that, if the UE “determine[s]...[that] an assignment of one codeword has been received (block 822),” “the UE may decode the PDSCH for one codeword (block 824)” and “then send [x, 1] or [1, x] for ACK information for one codeword (block 826).” (*Id.*, ¶[0100]; *id.*, Fig. 8.) If the UE “determine[s]...[that] an assignment of two codewords has been received (block 832),” “the UE may decode the PDSCH for two codewords (block 834)” and “then send [0, 0], [0, 1], [1, 0], or [1, 1] for ACK information for two codewords (block 836).” (*Id.*, ¶[0100]; *id.*, Fig. 8.). Otherwise, “the UE may send [0, 0] for ACK information for no codewords (block 846).” (*Id.*, ¶[0101]; *id.*, ¶¶[0085]-[0092], [0094], Figs. 6, 8.)

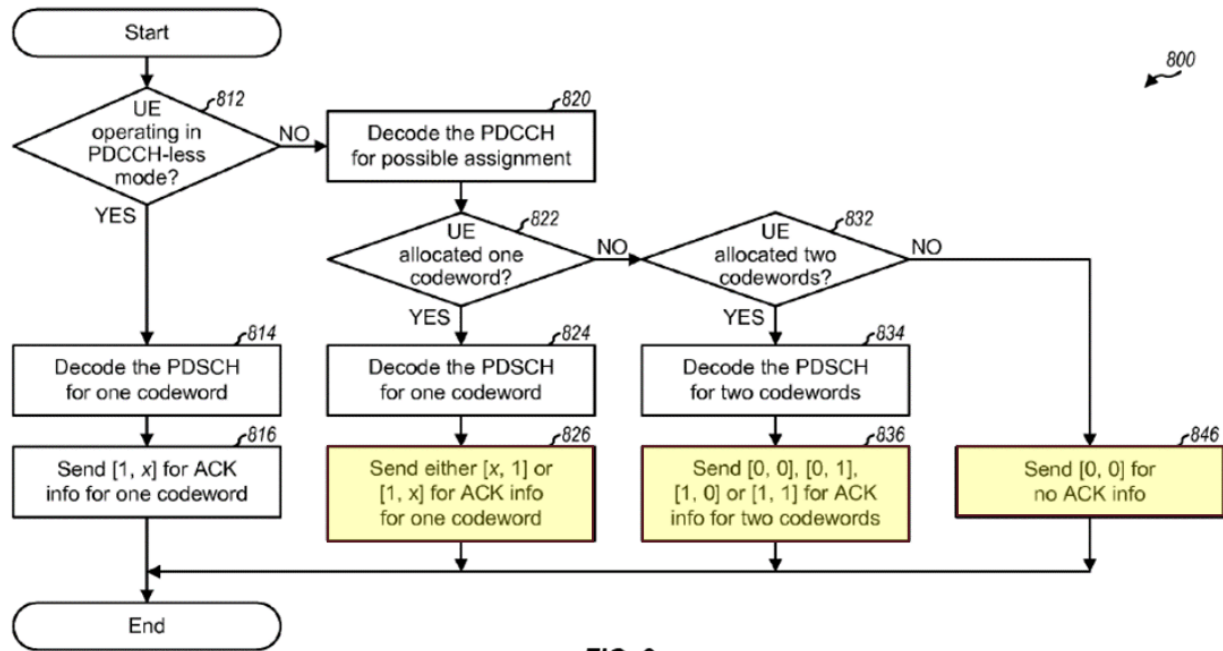


FIG. 8

(*Id.*, Fig. 8 (annotated).)

If an assignment of one codeword has been received, whether the UE sends “[x, 1]” or “[1, x]” and the value of “x” depends on which codeword was allocated and whether that codeword was decoded correctly. (*Id.*, ¶¶[0078]-[0083], [0086], [0090], [0093], [0100], Fig. 6.) As illustrated in Table 3, Malladi explains that, “[i]f only the first codeword is allocated, then the UE may send [x, 1] for the ACK information, where x=1 if the first codeword is decoded correctly and x=0 if the first codeword is decoded in error.” (*Id.*, ¶[0093]; *id.*, ¶[0086] (“x = 1 for ACK or x = 0 for NAK for 1st codeword”).) Similarly, “[i]f only the second codeword is allocated, then the UE may send [1, x] for the ACK information, where x=1 if the second

codeword is decoded correctly and $x=0$ if the second codeword is decoded in error.”
(*Id.*, ¶[0093]; *id.*, ¶[0086] (“ $x = 1$ for ACK or $x = 0$ for NAK for 2nd codeword”).)

Therefore, even if only one out of the two maximum number of possible codewords is allocated (“in the situation that the number of codeword streams of the downlink sub-frames is smaller than the maximum number of the codeword streams of the downlink sub-frame”), the ACK information sent back by the UE is still represented by a 2-bit value (e.g., “[x , 1]” or “[1, x])” (“the user equipment feeds back the confirmation information of the number of the maximum codeword streams”). (*Id.*, ¶¶[0086], [0090], [0093], [0100], [0110], Figs. 6, 8.)

Moreover, while the designs discussed above involve “one or two codewords,” Malladi explains that the “UE may also be scheduled...for more codewords,” in which case “the UE may send ACK information for all codewords received by the UE.” (*Id.*, ¶[0102].) Thus, Malladi discloses designs with a maximum number of codewords greater than two that disclose these claim features for reasons similar to those discussed above. (EX1002, ¶88.)

Second, Malladi discloses “wherein confirmation information without a corresponding codeword stream is set as a predefined fixed value,” as claimed. (*Id.*, ¶89.) For example, as discussed above, if “an assignment of one codeword has been received (block 822),” “the UE may decode the PDSCH for one codeword (block 824)” and “then send [x , 1] or [1, x] for ACK information for one codeword (block

826).” (EX1005, ¶[0100]; *id.*, Fig. 8.) If “the first codeword is allocated,” the “UE may send [x, 1] for the ACK information,” and if “the second codeword is allocated,” the “UE may send [1, x] for the ACK information,” where “x=1” if the codeword is “decoded correctly” and “x=0” if the codeword is “decoded in error.” (*Id.*, ¶[0093]; *id.*, ¶¶[0086], [0090], [0100].) The other bit is always set to “1.” (*Id.*, ¶¶[0086], [0090], [0093], [0100].) Accordingly, the bit corresponding to the codeword that was not allocated (“wherein confirmation information without a corresponding codeword stream”) is set to a predefined fixed value of “1” (“is set as a predefined fixed value”). (EX1002, ¶89.)

Malladi therefore discloses these claim features. (EX1002, ¶¶83-90.)

v) [9.c]

Malladi discloses these claim features. (EX1002, ¶¶91-95.)

Claim element 9.c is similar to the language in claim element 9.pre-1 that recites “in a situation that a user equipment fails to detect a physical downlink control channel corresponding to transmitted data in a sub-frame transmitting data, the user equipment feeds back a negative acknowledgement message as confirmation information of this downlink sub-frame.” Therefore, Malladi discloses the features in claim element 9.c for reasons similar to those discussed for claim element 9.pre-1. (Section X.A.1.i; EX1002, ¶92.)

The only meaningful difference between claim element 9.c and the above-identified language in claim element 9.pre-1 is that, in claim element 9.c, the UE feeds back the negative acknowledgement message as the confirmation information “of each codeword stream in a group corresponding to this downlink subframe.” (*Id.*, ¶¶93.) Malladi also discloses this feature. (*Id.*, ¶¶93-95.)

For example, for reasons similar to those discussed in Section X.A.1.i, Malladi describes a scenario where “the UE incorrectly decodes the PDCCH and misses the control information,” which discloses “when the user equipment fails to detect the physical downlink control channel corresponding to the transmitted data in the sub-frame which transmits the data,” as claimed. (EX1005, ¶[0061]; *id.*, ¶¶[0007], [0026], [0030], Fig. 2; EX1002, ¶¶94-95.)

In this scenario, Malladi explains that the UE sends back a negative acknowledgement message for each codeword in the downlink subframe (“the user equipment feeds back the negative acknowledgement message as the confirmation information of each codeword stream in a group corresponding to this downlink sub-frame”). (EX1002, ¶95.) For example, in this scenario, Malladi explains that the 2-bit value “[0, 0]” is sent as the ACK information for that subframe, where each “0” (i.e., a NACK) corresponds to a codeword, as illustrated in Table 3. (EX1005, ¶¶[0085]-[0090], [0094], [0101], [0108], [0110], [0111], Figs. 6, 8, 11, 12.) Malladi describes this scenario as an “error scenario.” (*Id.*, ¶[0061]; *id.*, ¶¶[0030], [0094].)

As a POSITA would have understood, in this scenario, data intended for the UE was not received and must be retransmitted. (*See id.*, ¶¶[0006], [0029], [0030].)

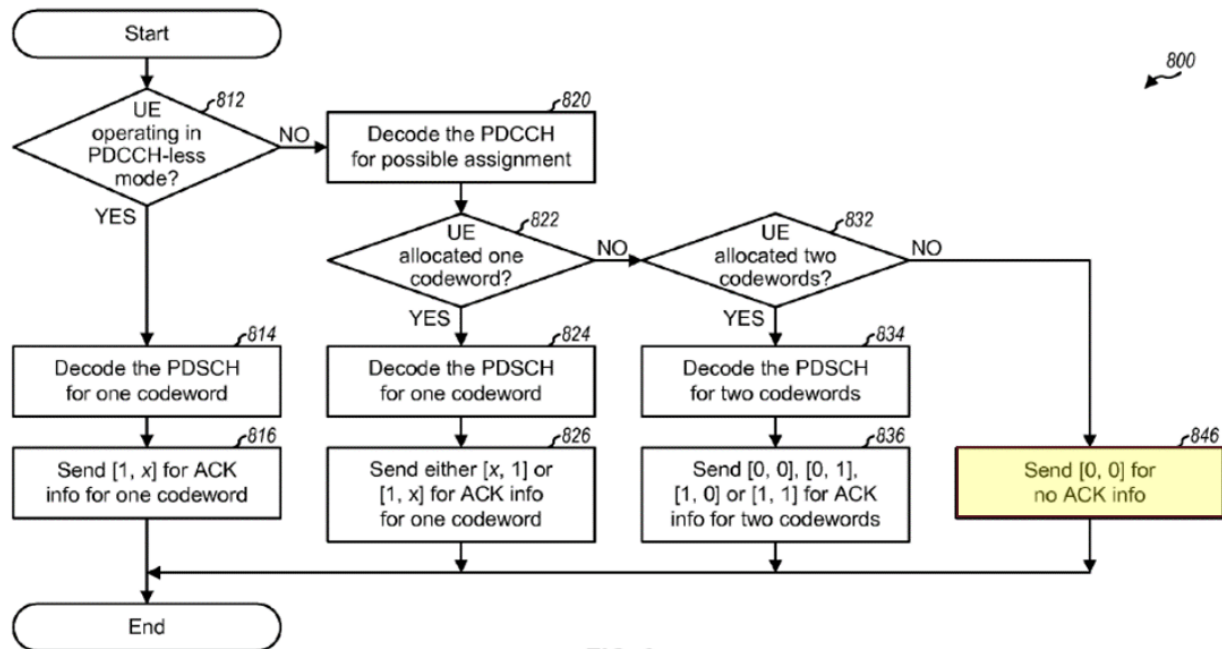


FIG. 8

(EX1005, Fig. 8 (annotated).)

B. Ground 2: Malladi in View of Kim Renders Obvious Claim 10

1. Claim 10

i) [10.a]

Malladi discloses these claim features for reasons similar to those discussed for claim elements 9.a-c. (Sections X.A.1.iii-v; EX1002, ¶¶96-98.)

First, Malladi discloses “wherein in a situation that the data in the downlink sub-frame that transmits the data is sent as a single codeword stream,” as claimed. (EX1002, ¶97.) For example, as discussed in Section X.A.1.ii, Malladi describes “a design in which the UE may be scheduled with one or two codewords.” (EX1005,

¶[0102]; *id.*, ¶[0028].) And Malladi explains that DCI and data transmissions are “partitioned into subframes.” (EX1005, ¶[0030], Fig. 2.)

Second, Malladi discloses “each piece of confirmation information in the uplink sub-frame fed back by the user equipment to an eNodeB corresponds to a codeword stream of one downlink sub-frame that transmits the data,” as claimed. (EX1002, ¶98.) For example, as discussed in Section X.A.1.ii, if one codeword is transmitted in one DL subframe, Malladi explains that the UE generates and sends back to the eNB in a UL subframe a “fixed number of bits for the ACK information” for the codeword in the format “[x, 1]” (if only first codeword is allocated) or “[1, x]” (if only second codeword is allocated), where the value of “x” depends on whether the single codeword was decoded correctly. (EX1005, ¶[0102]; *id.*, ¶¶[0078]-[0083], [0086], [0090], [0093], [0100], Figs. 6, 8.) Thus, in this situation, each piece of the ACK information sent back (i.e., the two bits “x” and “1”) corresponds to the one codeword transmitted in the one DL subframe. (EX1002, ¶98.)

ii) [10.b]

Malladi discloses these claim features. (EX1002, ¶¶99-101.)

First, Malladi discloses “in a situation that the data in the downlink sub-frame which transmits the data is sent as multiple codeword streams,” as claimed, for reasons similar to those discussed for claim elements 9.a-c. (EX1002, ¶100; Sections

X.A.1.iii-v.) For example, as discussed in Section X.A.1.ii, Malladi describes “a design in which the UE may be scheduled with one or two codewords.” (EX1005, ¶[0102]; *id.*, ¶[0028].) And Malladi explains that DCI and data transmissions are “partitioned into subframes.” (*Id.*, ¶[0030], Fig. 2.)

Second, Malladi discloses “for one downlink sub-frame that transmits the data, the user equipment acquires the confirmation information corresponding to each codeword stream thereof,” as claimed, for reasons similar to those discussed for claim elements 9.a-c. (EX1002, ¶101; Sections X.A.1.iii-v.) For example, as discussed in Section X.A.1.ii, Malladi explains that the 2-bit ACK information for a DL subframe carrying two codewords conveys (i) whether the UE missed the PDCCH and (ii) the decoding status of each of the two codewords. (EX1005, ¶[0009].) The 2-bit value will differ depending on the format used, but for each allocated codeword, one of the bits will indicate either an ACK (if correctly decoded) or a NAK (if not correctly decoded), as illustrated in Tables 2 and 3. (*Id.*, ¶¶[0072]-[0083], [0085]-[0091], Figs. 6, 8.)

iii) [10.c]

Malladi in view of Kim discloses these claim features. (EX1002, ¶¶102-109.)

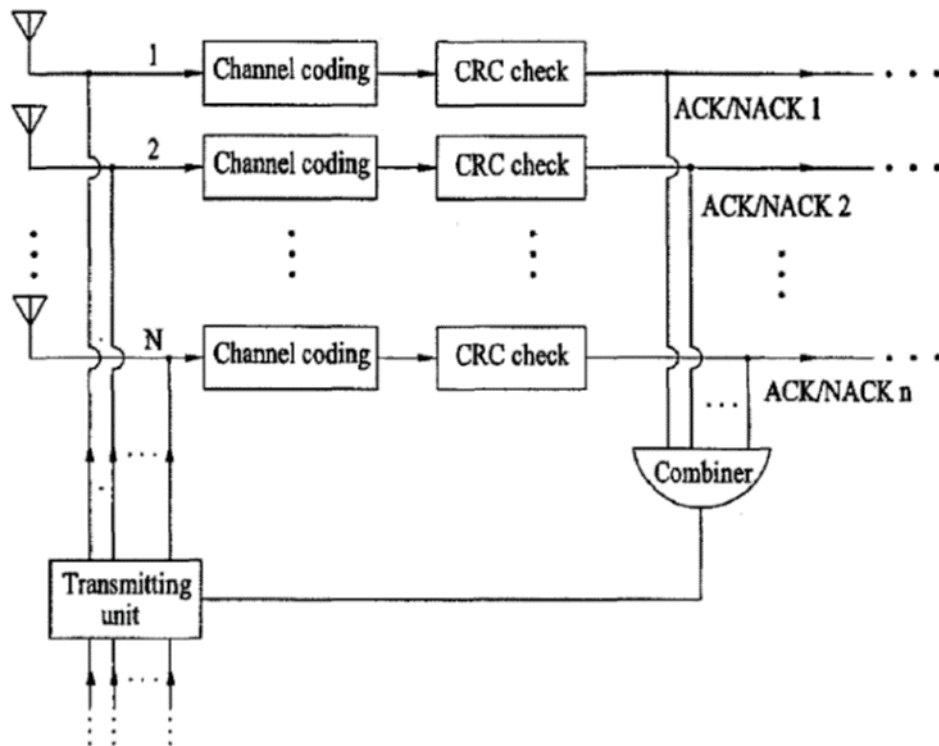
Malladi does not explicitly disclose these claims features, but they would have been obvious in view of Kim. (EX1002, ¶103.) Kim relates to “wireless communications” and “encoding uplink acknowledgements to downlink

transmission.” (EX1007, ¶[0003]; *id.*, ¶¶[0005], [0030].) As illustrated in Figure 11, Kim further relates to “transmitting ACK/NACK signal in a multiple codeword (MCW) type MIMO wireless system,” (*id.*, ¶[0105]), similar to as described in Malladi. (*Id.*, ¶¶[0122]-[0123].)

Kim explains that, for n information streams, “n ACK/NACKs [are] inputted to a combiner to be combined into one ACK NACK signal,” using, for example, “[a]n AND operation.” (*Id.*, ¶¶[0124]-[0126]; *id.*, ¶¶[0112]-[0121].) As a result, if all of the n ACK/NACKs indicate that “the entire n data” has been “successfully received,” “the combined ACK/NACK indicates 1” (claimed “acknowledgement message” situation). (*Id.*) If “at least one of the n data” is “not...successfully

received,” “the combined ACK/NACK indicates 0” (claimed “negative acknowledgement message” situation). (*Id.*)

FIG. 11

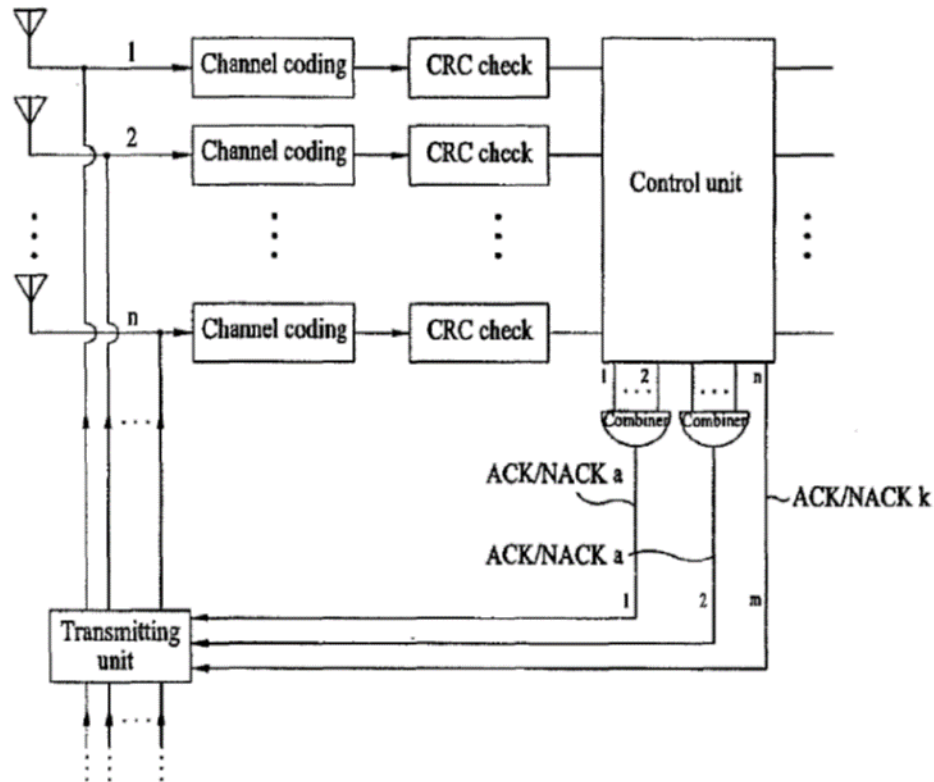


(*Id.*, Fig. 11.)

Kim further describes, with reference to Figure 12, “a block diagram of an ACK/NACK transmitting apparatus” like that shown in Figure 11 with “a control unit added.” (*Id.*, ¶[0127].) The control unit receives “n ACK/NACKs respectively generated by CRC checking units” and “groups the inputted ACK/NACKs into a plurality of groups.” (*Id.*, ¶[0128]; *id.*, ¶¶[0112]-[0113], [0117].) The “grouped

ACK/NACK signals are combined by a plurality of combiners to generate one ACK/NACK signal per group.” (*Id.*, ¶[0128].)

FIG. 12



(*Id.*, Fig. 12 (annotated).)

It would have been obvious to a POSITA to combine the teachings of Malladi and Kim, which both relate to HARQ in wireless communications systems, such that the two bits representing ACK information for two respective codewords, as described in Malladi, are combined into a single ACK message, as described in Kim. (EX1002, ¶108.) A POSITA would have had good reason to combine the teachings

of Malladi and Kim in such a way because, as described in Kim, “a number of ACK/NACK signals to be transmitted can be reduced [while] maintaining a high data rate.” (EX1007, ¶[0130].) Kim further explains that, by combining ACK information in such a way, “a frequency resource for control information transmission can be efficiently allocated.” (*Id.*, ¶[0126].) Additionally, according to Kim, the control unit can group ACK information by “the type of received data stream” or to achieve “a prescribed number of groups to appropriately select the size of control information to be transmitted.” (*Id.*, ¶[0128].)

A POSITA would have also had a reasonable expectation of success combining the teaching of Malladi and Kim in such a way. (EX1002, ¶109.) For example, as discussed above, Malladi describes a UE acquiring ACK information for each codeword and transmitting the information in a 2-bit format to an eNB. The combination results in combining the 2-bit information, and Kim describes techniques that a POSITA would have looked to for doing so (e.g., AND operation and/or combiner). (*Id.*; EX1007, ¶¶[0124]-[0133].) Thus, based on the teachings of

Malladi and Kim, it would have been well within the skill of a POSITA to achieve the combination described above.

Accordingly, the Malladi-Kim combination discloses these claim features.
(EX1002, ¶¶102-109.)

C. Ground 3: Malladi in View of TDTech Renders Obvious Claims 1, 4-6, 9, 13, and 14

1. Claim 1

i) [1.pre]

To the extent the preamble of claim 1 is limiting, Malladi in view of TDTech discloses the features therein. (EX1002, ¶¶110-122.)

First, Malladi discloses “[a] method for feeding back confirmation information on a physical uplink shared channel,” as claimed, for the same reasons discussed for claim element 9.pre-1, which recites the same claim feature. (Section X.A.1.i; EX1002, ¶111.)

Second, Malladi discloses “which is used for enabling a user equipment to feed back to an eNodeB whether data of a downlink sub-frame is correctly received,” as claimed, for the same reasons discussed for claim elements 9.pre-1 and 9.pre-2, which recite similar claim features. (Sections X.A.1.i-ii; EX1002, ¶¶112-115.) For example, as discussed in Section X.A.1.i, referring to Figure 1, Malladi describes a wireless network 100 comprising an eNB 110 (“an eNodeB”) and a UE 120 (“user equipment”), where the “UE may receive data and control information from eNB

110 via downlink 122 and may transmit data and control information via uplink 124.” (EX1005, ¶[0025]; *id.*, Fig. 1.) As shown in Figure 2, the transmissions of DL control information and data are “partitioned into subframes.” (*Id.*, ¶[0030], Fig. 2.) Malladi further explains that “eNB 110 may send control information on the PDCCH to the UE and may send data in accordance with the control information on the PDSCH to the UE.” (*Id.*, ¶[0027].) The UE may then “process the PDCCH to determine whether it has been scheduled,” and, if it has been scheduled, process the PDCCH “to obtain control information sent to the UE.” (*Id.*) Based on the control information, the “UE may then process the PDSCH.” (*Id.*)

As discussed in Section X.A.1.i, if the UE incorrectly decodes the PDCCH and misses the control information, Malladi explains that the 2-bit confirmation information sent to the eNB for this downlink subframe is set to “[0, 0].” (*Id.*, ¶¶[0061], [0085], [0086], [0094], [0108], [0110], [0111], Figs. 6, 8, 11, 12.) If “the UE correctly decodes the PDCCH,” Malladi explains that the data (e.g., codewords in PDSCH) is “decoded.” (*Id.*, ¶[0093]; *id.*, ¶¶[0074]-[0077], [0100]). Malladi further explains that the two bits “may convey decoding status of the one or two codewords sent to the UE.” (*Id.*, ¶[0009]; *id.*, ¶¶[0071]-[0083], [0085]-[0091], [0093], [0100], [0110], Figs. 6, 8.)

Thus, in Malladi, the 2-bit confirmation information sent from the UE to the eNB indicates whether the PDCCH and the one or two codewords were successfully

decoded, which discloses “enabling a user equipment to feed back to an eNodeB whether data of a downlink sub-frame is correctly received,” as claimed.

Third, Malladi in view of TDTech discloses “in a situation that a number of the downlink sub-frames is greater than a number of uplink sub-frames in a time division duplex system,” as claimed. (EX1002, ¶¶116-121.) For example, Malladi describes sending and receiving confirmation information for “various wireless communications systems,” including time division systems (e.g., TDMA). (EX1005, ¶[0024]; *id.*, Abstract, [0003], [0005].) Malladi does not, however, explicitly describe “a time division duplex system,” in which “a number of the downlink sub-frames is greater than a number of uplink sub-frames,” as claimed. But, as discussed in Section VII, the ’881 patent admits that such time division duplex (TDD) systems were well known at the time of the alleged invention, and, as discussed in more detail below, such a system would have been obvious to a POSITA in view of Malladi and TDTech. (EX1002, ¶116.)

For example, among other technical specifications, the 3GPP’s TSG for RAN published TS 36.211 V8.1.0, TS 36.211 V8.2.0, and TS 36.212 V8.2.0, discussed above, which describe TDD configurations where the number of DL subframes is greater than the number of UL subframes. (EX1010, 9-11 (Table 4.2-2); EX1002, ¶117.)

TDTech, which is related to the above TDD technical specifications, discloses “a time division duplex system,” in which “a number of the downlink sub-frames is greater than a number of uplink sub-frames,” as claimed. (EX1002, ¶118.) For example, TDTech’s Title indicates that it relates to “ACK/NACK” messages in “TDD” (“a time division duplex system”). (EX1006, 1.) According to TDTech, because in TDD “there exist configurations with more sub-frames configured as DL than UL” (“a number of the downlink sub-frames is greater than a number of uplink sub-frames”), TDD “requires several ACK/NACK be multiplexed in one PUSCH.” (*Id.*)

Based on TDTech’s teachings, a POSITA would have found it obvious to combine the teachings of Malladi and TDTech such that Malladi’s techniques for sending and receiving confirmation information is used for “a time division duplex system,” in which “a number of the downlink sub-frames is greater than a number of uplink sub-frames,” as claimed. (EX1002, ¶119.) As discussed above, Malladi describes techniques for feeding back confirmation information on a PUSCH to indicate whether DL data was correctly received, and explains that such techniques can be applied to “various wireless communications systems,” including time division systems. (EX1005, ¶[0024].) Malladi further describes its relationship to “3GPP” and “Evolved UTRA (E-UTRA),” (*id.*), which TDTech also relates to, (EX1006, 1; EX1010, 1; EX1011, 1; EX1012, 1). Thus, a POSITA would have

recognized that Malladi's techniques were relevant to 3GPP's wireless communication systems, such as the TDD system described in TDTech. (EX1002, ¶119.)

Additionally, a POSITA would have recognized that combining the teachings of Malladi and TDTech such that Malladi's techniques are used in a TDD system would have provided several well-known benefits. (*Id.*, ¶120.) For example, as a POSITA would have known, TDD provides "efficient...spectrum utilization." (EX1013, ¶[0003]; *id.*, ¶[0045]; EX1014, 14:13-16.) As a POSITA would have also known, TDD supports "asymmetric" DL/UL communications (e.g., more DL subframes than UL subframes), like described in TDTech, which "improves the radio transmission performance." (EX1013, ¶[0003]; *id.*, ¶[0045]; EX1010, 11.) Moreover, "TDD can adjust the downlink and uplink transmission resources based on the specific service requirements in both links, hence it improves the radio resource management and the corresponding spectrum utilization." (EX1013, ¶[0003]; *id.*, ¶[0045]; EX1014, 14:16-28.) Thus, a POSITA would have had good reason to combine the teachings of Malladi and TDTech, as the combination would have been predictable and resulted in a system that realizes the benefits of both TDD and Malladi's techniques relating to ACK information. (EX1002, ¶120.) *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007).

A POSITA would have also had a reasonable expectation of success combining the teachings of Malladi and TDTech in such a way. (EX1002, ¶121.) For example, Malladi describes how to send 2-bit confirmation information corresponding to a DL subframe on one PUSCH. (EX1005, ¶[0032].) And TDTech describes how to send confirmation information for multiple DL subframes on one PUSCH in a situation where there are more DL subframes than UL subframes in a TDD system. (EX1006, 1-2.) TDTech further explains how to avoid problems that may arise when sending confirmation information for multiple DL subframes on one PUSCH, as discussed in more detail for claim element 1.a. (*Id.*, 1-2; Section X.C.1.ii.) A POSITA therefore would have had a reasonable expectation of success combining the respective teachings of Malladi and TDTech, and could have done so in a way that predictably retains their respective functions when combined. (EX1002, ¶121.) For example, in one possible implementation of the combination, the UE would send 2-bit confirmation information in one PUSCH (which has a large payload capacity), similar to as described in Malladi, for a plurality DL subframes, similar to as described in TDTech. (*Id.*)

Thus, Malladi in view of TDTech discloses these claim features. (EX1002, ¶¶110-122.)

ii) [1.a]

The Malladi-TD Tech combination discloses these claim features. (EX1002, ¶¶123-135.)

First, the Malladi-TD Tech combination discloses “the eNodeB carries, in downlink control information, a number value of the downlink sub-frame corresponding to the confirmation information which is fed back by one uplink sub-frame,” as claimed. (EX1002, ¶¶124-131.) As an initial matter, the specification of the ’881 patent, which provides additional context for the claimed “number value,” explains that the “number (k)” is “sent in DCI format 0” and “represent[s] that k continuous downlink sub-frames, starting from the downlink sub-frame carrying DCI format 0, are sent with the data.” (EX1001, 7:24-40; *id.*, 10:3-8.) The number value can be selected from “a set of number values” “according to an amount of the data...to be transmitted.” (*Id.*, 3:65-4:5.) Consistent with the specification, during prosecution of U.S. Patent Application No. 12/905,299, which issued as the ’881 patent, the applicant explained that the “number value of the downlink sub-frame” represents “how many downlink sub-frames are used to transmit the data.” (EX1004, 219.)

While Malladi describes an eNB that sends DCI for a DL subframe on the PDCCH, (EX1005, ¶¶[0007], [0025]-[0027], [0033], Fig. 2), it does not explicitly state that the DCI includes a “number value,” as claimed. TD Tech, however,

describes carrying a “number value” in DCI for a DL subframe, and a POSITA would have found it obvious to include such a value in the DCI of the Malladi-TDTech combination. (EX1002, ¶125.)

For example, TDTech explains that, because in TDD “there exist configurations with more sub-frames configured as DL than UL,” TDD “requires several ACK/NACK be multiplexed in one PUSCH” (“the confirmation information which is fed back by one uplink sub-frame”). (EX1006, 1.) To avoid mistaking uplink data as ACK/NACK information when multiplexing several ACK/NACKs, TDTech proposes “inserting more bits in UL grant to indicate [to] the UE how many ACK/NACK spaces or bits need to be reserved for UL ACK/NACK in PUSCH.” (*Id.*, 1-2.) TDTech refers to these inserted bits as “ACK-Num-bits” (“number value of the downlink sub-frame corresponding to the confirmation information”). (*Id.*) TDTech also proposes inserting in DL grant “the same number of bits...for indicating the exact start position...of the corresponding DL ACK/NACK in the PUSCH,” which TDTech refers to as “Index-bits.” (*Id.*) As a POSITA would have known, the UL and DL grants correspond to DCI formats 0 and 1/1A/2, respectively, which are used for scheduling UL and DL subframe transmissions, respectively. (EX1012, 33-35.) By providing the ACK-Num-bits and Index-bits in DCI, TDTech explains that the UE can detect “when it has a DL grant missed,” because “the total number of ACK/NACK reservation counted in DL grant will not be equal to the

number of ACK/NACK indicated in the UL grant.” (EX1006, 2.) The UE can also detect which DL grant was missed based on the Index-bits. (*Id.*)

Thus, TDTech’s teaching of an eNB including ACK-Num-bits in the DCI’s UL grant discloses “the eNodeB carries, in downlink control information, a number value of the downlink sub-frame corresponding to the confirmation information which is fed back by one uplink sub-frame,” as claimed. (EX1002, ¶129.) Indeed, similar to the ’881 patent specification’s disclosure and the applicant’s statements during prosecution relating to the claimed “number value,” TDTech teaches, for example, that the ACK-Num-bits is transmitted in DCI format 0 and represents how many DL sub-frames are transmitted (e.g., the number of ACK/NACK spaces or bits corresponds to the number of DL sub-frames), as discussed above. (*Id.*, ¶129.)

Based on TDTech’s teachings, it would have been obvious to a POSITA for the eNB in the Malladi-TDTech combination to include ACK-Num-bits in a UL grant (i.e., DCI format 0), which corresponds to the confirmation information fed back in one UL subframe, and Index-bits in DL grants (i.e., DCI format 1/1A/2), similar to as described in TDTech, to improve system reliability and performance. (*Id.*, ¶130.) *See KSR*, 550 U.S. at 401. As discussed for claim element 1.pre, in one possible implementation of the Malladi-TDTech combination, the UE would send in one PUSCH respective 2-bit confirmation information for a plurality of DL subframes. (Section X.C.1.i; EX1002, ¶130.) As explained in TDTech, when

sending multiple ACK/NACKs like this, the eNB may mistake uplink data as ACK/NACK information when a DL grant is missed by a UE. (EX1006, 1-2.) Thus, as proposed in TDTech, (*id.*), a POSITA would have had good reason to include ACK-Num-bits and Index-bits in UL and DL grants, respectively. (EX1002, ¶130.) That way, like described in TDTech, (EX1006, 2), the UE can examine these bits to determine whether a DL grant was missed and which one, information the UE can then communicate to the eNB (e.g., in the form of ACK/NACKs) for resolution. (EX1002, ¶130.)

A POSITA would have also had a reasonable expectation of success combining the teachings of Malladi and TDTech in such a way. (*Id.*, ¶131.) For example, as explained in TDTech, adding the ACK-Num-bits and Index-bits would have merely required including additional bits in the DCI. (EX1006, 1-2.) It would have been well within the ordinary capabilities of a POSITA to insert such bits into the DCI. (EX1002, ¶131.) Indeed, as explained in TS 36.212 V8.2.0, TDD contemplates multiple DCI formats, including DCI formats 0 and 1/1A/2. (EX1012, 33-35.) A POSITA could have easily modified one of the preexisting DCI formats (e.g., DCI formats 0 and 1/1A/2, as TDTech suggests) or created a new DCI format to predictably carry such bits. (EX1002, ¶131.)

Second, the Malladi-TDTech combination discloses “the eNodeB...transmits data on a plurality of continuous downlink sub-frames after the sub-frame carrying

the downlink control information,” as claimed. (*Id.*, ¶¶132-134.) For example, as illustrated in Figure 2, Malladi describes an eNB sending a plurality of continuous DL subframes to the UE, where the “control information [is sent] on the PDCCH” and the “data in accordance with the control information [is sent] on the PDSCH.” (EX1005, ¶[0027]; *id.*, ¶¶[0007], [0027], [0030].) And TDTech explains that ACK-Num-bits (“number value”) and Index-bits are inserted into the UL grant and DL grants, respectively, and that each Index-bits (starting at 0) corresponds to a “DL transmission.” (EX1006, 2.) Based on the ACK-Num-bits and Index-bits, the UE can determine whether and which DL subframe(s) was missed. (*Id.*)

Thus, a POSITA would have understood that TDTech teaches (or at least renders obvious) inserting ACK-Num-bits (“number value”) in the UL grant and Index-bits in the DL grant of the first DL subframe sent to a UE, and Index-bits in the DL grant of every subsequent, continuous DL subframe carrying data to the UE. (EX1002, ¶133.) As a POSITA would have understood, it would have been necessary (or at least obvious) to insert the ACK-Num-bits into the first DL subframe, so that the UE is informed as to how many DL subframes carrying data to expect from the eNB. (*Id.*) That way, the UE is equipped with the information needed to detect and inform the eNB of any missed DL subframes carrying data as soon as the UE receives the first DL subframe, consistent with TDTech’s teachings. (EX1006, 2.) Accordingly, TDTech teaches (or renders obvious) that the eNB (i)

inserts ACK-Num-bits (“number value”) into the UL grant of the first DL subframe (e.g., DL subframe corresponding to Index-bits 0) (“the sub-frame carrying the downlink control information”) and (ii) sends a plurality of additional, continuous DL subframes carrying data after the first DL subframe (e.g., DL subframes corresponding to Index-bits 1, 2, and 3) (“transmits data on a plurality of continuous downlink sub-frames after”). (EX1002, ¶133.)

It would have been obvious to a POSITA to implement TDTech’s teachings relating to ACK-Num-bits (“number value”) and Index-bits in the Malladi-TDTech combination in a similar way and for similar reasons as discussed above for TDTech. (*Id.*, ¶134.) *See KSR*, 550 U.S. at 401. That is, in the combination, the eNB inserts ACK-Num-bits and Index-bits into the DCI of the first DL subframe sent to a UE, and inserts Index-bits into the DCI of each continuous DL subframe carrying data sent to the UE after the first DL subframe. (EX1002, ¶134.) As described in TDTech, in a TDD system where a UE sends multiple ACK/NACKs back to an eNB, similar to the Malladi-TDTech combination, such an implementation would (i) allow the UE to determine and inform the eNB whether and which DL subframe(s) was missed (e.g., so that the eNB can rectify) and (ii) avoid the problem of the eNB mistaking uplink data as ACK/NACK information. (EX1006, 2; EX1002, ¶134.) A POSITA would have had a reasonable expectation of success combining the teachings of

Malladi and TDTech in such a way for the same reasons discussed above for the previous claim feature. (EX1002, ¶134.)

Third, the Malladi-TDTech combination discloses “wherein the number of the downlink sub-frames which transmit the data is equal to a number of the downlink sub-frames corresponding to the confirmation information fed back by the one uplink sub-frame,” as claimed, for the reasons discussed above. (*Id.*, ¶135.) For example, as discussed above, the ACK-Num-bits (“number value”) correspond to the confirmation information fed back by the one UL subframe, because it “indicate[s] [to] the UE how many ACK/NACK spaces or bits need to be reserved for UL ACK/NACK in PUSCH.” (EX1006, 2.) Additionally, as discussed above, the number of spaces or bits is equal to the number of DL subframes carrying data. (*Id.*)

iii) [1.b]

The Malladi-TDTech combination discloses these claim features. (EX1002, ¶¶136-138.)

First, the Malladi-TDTech combination discloses “after the user equipment receives the downlink sub-frame which carries the downlink control information, the data is received from the downlink sub-frame which transmits the data after this downlink sub-frame,” as claimed, for the same reasons discussed for claim element 1.a. (Section X.C.1.ii; EX1002, ¶137.) For example, as discussed in Section X.C.1.ii,

in the combination, an eNB sends a first DL subframe having ACK-Num-bits (“number value”) in the subframe’s DCI to a UE and then sends subsequent DL subframes carrying data to the UE. (EX1002, ¶137.)

Second, the Malladi-TDTEch combination discloses “the confirmation information of receiving the data is fed back together with uplink data to the eNodeB through a physical uplink shared channel through an uplink sub-frame,” as claimed, for the same reasons discussed for claim element 1.pre. (Section X.C.1.i; EX1002, ¶138.) As discussed in Section X.C.1.i, in one example implementation of the combination, the UE would send to the eNB in one PUSCH respective 2-bit confirmation information for the plurality of DL subframes carrying data along with the data sent in the PUSCH.

iv) [1.c] / [1.d] / [1.e]

The Malladi-TDTEch combination discloses claim elements 1.c, 1.d, and 1.e for substantially the same reasons Malladi discloses claim elements 9.a, 9.b, and 9.c, respectively, which recite the same or substantially the same features. (Sections X.A.1.iii-v; EX1002, ¶¶139-141.) Regarding the disclosure relevant to the features of claim element 1.c, 1.d, and 1.e, the Malladi-TDTEch combination differs from Malladi alone in that the UE in the combination (i) sends back the 2-bit ACK information for a plurality of subframes in one UL subframe and (ii) utilizes the ACK-Num-bits and Index-bits to confirm all assigned DL subframes were properly

received. (Sections X.C.1.i-ii.) These differences, however, are immaterial, because the groups of ACK/NACK information are still fed back to the eNB (e.g., when the ACK-Num-bits and Index-bits are not equal). Therefore, the combination likewise discloses the features of claim elements 1.c, 1.d, and 1.e. (EX1002, ¶¶139-141.)

2. Claim 4

The Malladi-TD Tech combination discloses these claim features. (EX1002, ¶142.) For example, as discussed for claim element 1.a, in the combination, the eNB inserts ACK-Num-bits into the DCI of the first DL subframe. (Section X.C.1.ii.) The ACK-Num-bits constitutes “a control signaling associated with the allocation of the physical uplink shared channel,” as claimed, because it is DCI that “indicate[s] [to] the UE how many ACK/NACK spaces or bits need to be reserved for UL ACK/NACK in PUSCH.” (EX1006, 2; EX1002, ¶142.) In other words, the ACK-Num-bits is DCI that signals to the UE how to allocate the PUSCH to accommodate the needed spaces or bits for the ACK/NACKs. (EX1002, ¶142.) Additionally, because the ACK-Num-bits are included in the first DL subframe, which may be followed by subsequent DL subframes carrying data, and all of the DL subframes have corresponding ACK/NAKs in the reserved spaces or bits of the UL subframe, (Section X.C.1.ii), the combination also discloses that “the eNodeB sends” the ACK-Num-bits “on a first downlink sub-frame in the downlink sub-frames corresponding

to the confirmation information fed back by the uplink sub-frame,” as claimed.
(EX1002, ¶142.)

3. Claim 5

The Malladi-TD Tech combination discloses these claim features. (EX1002, ¶¶143-146.) As discussed for claim elements 1.a and 1.b, in one possible implementation of the combination, an eNB serially sends to a UE a plurality of DL subframes carrying data, where subframe is identified by an incrementing Index-bits value that starts at zero (“the user equipment, according to the order of serial numbers of the received downlink sub-frames which transmit the data, receives each downlink sub-frame which transmits the data”), (EX1006, 2), and the UE feeds back ACK/NACK information for all of those DL subframes in one UL subframe, where the ACK/NACK information is ordered according to the Index-bits values (e.g., by indicating start positions) (“in the uplink sub-frames fed back to the eNodeB, the user equipment, according to the order of serial numbers of the received downlink sub-frames which transmit the data,...feeds back corresponding confirmation information”), (*id.*). (Sections X.C.1.ii-iii; EX1002, ¶¶143-144.)

As discussed for claim element 1.a, a POSITA would have recognized that including Index-bits (“serial numbers”) in the DL subframes carrying data and organizing the ACK/NACK information according to the Index-bits in the UL subframe allows the UE to determine and inform the eNB whether and which DL

subframe(s) was missed (e.g., so that the eNB can rectify), consistent with TDTech’s teachings. (EX1006, 2; EX1002, ¶145.) If, for example, the ACK/NACK information was not ordered according to the Index-bits, the eNB may not be able to identify which DL subframe(s) (if any) was missed. (EX1002, ¶145.) Moreover, consistent with TDTech’s teachings, by including Index-bits, the combined Malladi-TDTech system avoids the problem of the eNB mistaking uplink data as ACK/NACK information, because the Index-bits inform the eNB where the ACK/BACK information for each DL subframe is located in the PUSCH. (EX1006, 2; EX1002, ¶145.)

Accordingly, the Malladi-TDTech combination discloses these claim features. (EX1002, ¶¶143-146.)

4. Claim 6

i) [6.a] / [6.b]

The Malladi-TDTech combination discloses claim elements 6.a and 6.b for substantially the same reasons Malladi discloses claim elements 9.pre-1 and 9.pre-2, respectively, which recite substantially the same features. (Sections X.A.1.i-ii; EX1002, ¶¶147-149.)

While claim element 6.a differs from the relevant language in claim element 9.pre-1 in that claim element 6.a recites failing to “receive the data...in the subframe” while claim element 9.pre-1 recites failing to “detect a physical downlink

control channel corresponding to transmitted data in a sub-frame transmitting data,”
this difference is immaterial, because failing to detect the PDDCH means the UE also fails to receive the data sent in accordance with the control information carried by the PDDCH. (Section X.A.1.i; EX1002, ¶¶147-149.)

Additionally, regarding the disclosure relevant to the features of claim 6, the Malladi-TD Tech combination differs from Malladi alone in that the UE in the combination (i) sends back ACK/NACK information for multiple DL subframes in one UL subframe and (ii) utilizes the ACK-Num-bits and Index-bits to confirm all assigned DL subframes were properly received. (Sections X.C.1.i-ii.) This difference, however, is immaterial, because the ACK/NACK information in the combination is still fed back to the eNB when the UE detects or fails to detect the PDCCH (e.g., when the ACK-Num-bits and Index-bits are equal or not equal). (Section X.C.1.ii.) Therefore, the combination likewise discloses the features of claim 6. (EX1002, ¶¶147-149.)

5. Claim 9

To the extent PO argues that claim 9 requires feeding back confirmation information for multiple DL subframes in one UL subframe, the Malladi-TD Tech combination would have rendered such a requirement obvious for the reasons discussed for claim elements 1.pre-1.b. (EX1002, ¶150.)

6. Claims 13 and 14

i) [13.a] / [14.a]

The Malladi-TDTEch combination discloses these claim features for substantially the same reasons the Malladi-TDTEch combination discloses claim element 6.a, which recites the same features. (Section X.C.4.i; EX1002, ¶¶151, 153.)

ii) [13.b] / [14.b]

The Malladi-TDTEch combination discloses these claim features for substantially the same reasons the Malladi-TDTEch combination discloses claim element 6.b, which recites the same features. (Section X.C.4.i; EX1002, ¶¶152, 154.)

D. Ground 4: Malladi in View of TDTEch and Huawei Renders Obvious Claims 2 and 11

1. Claim 2

Malladi in view of TDTEch and Huawei discloses these claim features. (EX1002, ¶¶155-160.)

As discussed for claim element 1.pre, the Malladi-TDTEch combination discloses a TDD system. (Section X.C.1.i.) While neither Malladi nor TDTEch explicitly describes “a signaling in the downlink control information for representing an index of the uplink sub-frame for transmitting uplink data in the situation that the number of the downlink sub-frames is smaller than the number of the uplink sub-frames,” as claimed, the inclusion of such a signaling in a TDD system was well known to a POSITA at the time of the alleged invention. (EX1002, ¶156.) This is

confirmed by the '881 patent, which describes known TDD “signaling used to represent the index of the uplink sub-frame where the uplink data is transmitted in the TDD system” when the number of DL subframes is smaller than the number of UL subframes. (*See* EX1001, 7:37-40; *id.*, 2:43-48, 7:27-30, 10:3-8.) TS 36.212 V8.2.0 also indicates that such signaling was included in TDD. (EX1012, 33 (“UL index”).)

It also would have been obvious and within the skill of a POSITA for the TDD system disclosed by the Malladi-TD Tech combination to include such a “signaling” in the UL grant portion of the DCI in view of Huawei’s teachings. (EX1002, ¶157.) For example, Huawei describes a “UL index...added into UL schedule grant” of the DCI. (EX1008, 1.) Huawei also describes an “[i]ndication of UL subframe to which the resource assignment relates to by adding explicit signaling to the scheduling information.” (*Id.*) As Huawei reflects, the UL index / indication signaling was proposed for TDD to 3GPP TSG RAN WG1, the same working group associated with TD Tech. (*Id.*)

Huawei also describes using the UL index to indicate the UL subframe for transmitting the uplink data in situations where the number of DL subframes is smaller than the number of UL subframes (e.g., the UL to DL ratio is “6:1,” “5:2,” and “4:3”). (*Id.*, 1-3.) As reflected in Huawei, the UL index is used in these scenarios because TDD is asymmetric and, for each DL subframe, there is more than one UL

subframe that can be scheduled for transmission. (*Id.*) It is therefore necessary for the DL subframe to indicate which UL subframe should transmit the UL data corresponding to the DL subframe to ensure no UL transmissions are missed by the eNB. (*Id.*) Huawei further describes using the UL index in these scenarios to indicate multiple UL subframes for transmission of UL subframe data. (*Id.*) Thus, based on the teachings of Huawei and the state of the art (e.g., as described in the '881 patent and in TS 36.212 V8.2.0), a POSITA would have had good reason and been able to include such a UL index (the claimed “signaling”) in the TDD system disclosed by the Malladi-TD Tech combination, because doing so would have, for example, avoided UL transmission misses and/or indicated multiple UL subframes for UL data transmission when there are more UL subframes than DL subframes. (EX1002, ¶158.) *See KSR*, 550 U.S. at 401.

It also would have been obvious for the UL index signaling in the Malladi-TD Tech-Huawei combination “to carry the number of the downlink subframes corresponding to the confirmation information which is fed back by the one uplink sub-frame,” as claimed. (EX1002, ¶159.) As discussed for claim element 1.a, the Malladi-TD Tech combination discloses carrying the number of the downlink subframes (e.g., the ACK-Num-bits) in the UL grant. (Section X.C.1.ii.) And, as discussed above, the UL grant includes the UL index, or, at a minimum, based on the teachings of Huawei, it would have been obvious for the UL grant to include the

UL index. A POSITA would have recognized that it would have been advantageous and predictable to use the UL index to carry the ACK-Num-bits, as the UL grant is limited in size and the UL index is one of a few known fields in the UL grant available for transmitting such scheduling information to the UE. (EX1002, ¶159.)
See KSR, 550 U.S. at 401-402.

A POSITA would have had a reasonable expectation of success implementing the combination discussed above, as the combination merely requires including bits in the UL index, a known field in the DCI, (EX1001, 7:37-40; EX1012, 33), and, as reflected in Huawei and TDTech, multiplexing was a well-known technique that could have been used to transmit the ACK-Num-bits along with other data, (EX1008, 3; EX1007, 1-2). (EX1002, ¶160.)

2. Claim 11

The Malladi-TDTech-Huawei combination discloses claim elements 11.a and 11.b for substantially the same reasons the Malladi-TDTech combination discloses claim elements 6.a and 6.b, respectively, which recite the same features. (Sections X.C.4.i-ii; EX1002, ¶¶161-162.) The introduction of Huawei's teachings do not alter or detract from the teachings of the Malladi-TDTech combination relating to these claim features. (EX1002, ¶¶161-162.)

E. Ground 5: Malladi in View of TDTech and Ericsson Renders Obvious Claims 3 and 12

1. Claim 3

The Malladi-TDTech combination does not explicitly disclose these claim features, but they would have been obvious in view of Ericsson, at least under PO’s infringement allegations in district court. (EX1002, ¶¶163-168.) For example, PO’s infringement allegations relating to claim 3 rely on “Downlink association sets from standard 3GPP TS 36.213 version 16.2.0 Release 16 supported by the Accused Device,” such as that shown in Table 10.1.3.1-1 below:

Table 10.1.3.1-1: Downlink association set $K : \{k_0, k_1, \dots, k_{M-1}\}$ for TDD

UL/DL Configuration	Subframe n									
	0	1	2	3	4	5	6	7	8	9
0	-	-	6	-	4	-	-	6	-	4
1	-	-	7, 6	4	-	-	-	7, 6	4	-
2	-	-	8, 7, 4, 6	-	-	-	-	8, 7, 4, 6	-	-
3	-	-	7, 6, 11	6, 5	5, 4	-	-	-	-	-
4	-	-	12, 8, 7, 11	6, 5, 4, 7	-	-	-	-	-	-
5	-	-	13, 12, 9, 8, 7, 5, 4, 11, 6	-	-	-	-	-	-	-
6	-	-	7	7	5	-	-	7	7	-

(EX1015, 31-36.) The prior art, such as Ericsson, discloses similar association sets.

For example, Ericsson proposes that “each UL subframe has an associated set of DL subframes.” (EX1009, 1.) The sets may also differ depending on the configuration. To illustrate, Ericsson provides Table 1, which shows (similar to Table 10.1.3.1-1 above) “the associated set of DL subframes...for the UL subframes of all configurations” according to one possible timing relationship:

Configuration	UL subframe n									
	0	1 (DwPTS)	2	3	4	5	6 (DwPTS)	7	8	9
0 (2DL:3UL)	-	-	6	-	0	-	-	1	-	5
1 (3DL:2UL)	-	-	5,6	9	-	-	-	0,1	4	-
2 (4DL:1UL)	-	-	4,5,6,8	-	-	-	-	0,1,3,9	-	-
3 (7DL:3UL)	-	-	1,5,6	7,8	0,9	-	-	-	-	-
4 (8DL:2UL)	-	0,1,4,5	6,7,8,9	-	-	-	-	-	-	-
5 (9DL:1UL)	-	-	0,1,3,4,5,6,7,8,9	-	-	-	-	-	-	-
6 (5DL:5UL)	-	-	5	6	9	-	-	0	1	-

(EX1009, 1-2.) As one example, for configuration 1 and UL subframe $n=2$, there is a set of two associated DL subframes (i.e., DL subframes 5 and 6). (*Id.*)

It would have been obvious to a POSITA for the eNB in the Malladi-TD Tech combination to determine a set of DL subframes for each UL subframe and configuration based on a timing relationship, like described in Ericsson. (EX1002, ¶¶165.) Ericsson refers to R1-080890 (also submitted by Ericsson) to support its proposal for such association sets, (EX1009, 1), which explains that, from a “UL performance perspective, primarily coverage,” it is “prefer[red] to distribute the ACK/NACKs in time domain to minimize the maximum number of ACK/NACKs to be transmitted in an UL subframe,” (EX1016, 2). Ericsson’s association sets reflect such distributions. Thus, a POSITA would have had good reason to combine the teachings of the Malladi-TD Tech combination and the teachings of Ericsson such that ACK/NACKs are distributed in the time domain, and, based on the

distribution, eNBs determine sets of DL subframes associated with UL subframes for each configuration, similar to as described in Ericsson. (EX1002, ¶165.)

Additionally, in the Malladi-TDTEch-Ericsson combination, a POSITA would have understood (or at least found it obvious) that, based on the amount of data to be transmitted, the eNB would have set the ACK-Num-bits to a number less than or equal to the maximum number of DL subframes of the set of DL subframes associated with a given UL subframe. (*Id.*, ¶166.) The ACK-Num-bits would have been set to the maximum if all DL subframes of the set are needed to transmit data to a UE, or the ACK-Num-bits would have been set to a number less than the maximum if fewer than the maximum number of DL subframes are needed to transmit data to the UE. (*Id.*) This understanding is consistent with Ericsson's teaching that an eNB may "assign[] only a single DL subframe" or "more than one DL subframe" to a UE, (EX1009, 2), and TDTEch's teaching that the ACK-Num-bits represent how many DL subframes are transmitted, (EX1006, 2). And a POSITA would have recognized that such a combination would have been predictable and beneficial, because only the necessary number of DL subframes needed to transmit the data would have been sent to avoid needless overutilization of limited resources, and setting the ACK-Num-bits to the number of DL subframes transmitted allows the UE to determine and inform the eNB whether and which DL subframe(s) were missed. (EX1002, ¶166.) *See KSR*, 550 U.S. at 401.

A POSITA would have also had a reasonable expectation of success combining the teachings of Malladi, TDTech, and Ericsson in such a way. (EX1002, ¶167.) For example, based on the teachings of Ericsson, a POSITA would have recognized that the combination would have merely required determining a distribution of ACK/NACKs and, based on the distribution, determining corresponding association sets for each configuration. (*Id.*) It would have been well within the skill of a POSITA to time the transmission of DL subframes according to such a distribution and determine and store such association sets. (*Id.*)

2. Claim 12

The Malladi-TDTech-Ericsson combination discloses claim elements 12.a and 12.b for substantially the same reasons the Malladi-TDTech combination discloses claim element 6.a and 6.b, respectively, which recite the same features. (Sections X.C.4.i-ii; EX1002, ¶¶169-170.) The introduction of Ericsson's teachings do not alter or detract from the teachings of the Malladi-TDTech combination relating to these claim features. (EX1002, ¶¶169-170.)

F. Ground 6: Malladi in View of TDTech and Kim Renders Obvious Claims 7 and 10

1. Claim 7

The Malladi-TDTech-Kim combination discloses the features of claim 7 for substantially the same reasons the Malladi-Kim combination discloses the features of claim 10, which recite the same claim features. (Section X.B.1; EX1002, ¶¶171-

174.) Regarding the disclosure relevant to the features of claim 7, the Malladi-TDTech-Kim combination differs from the Malladi-Kim combination in that the UE in the Malladi-TDTech-Kim combination sends back ACK/NACK information for multiple DL subframes in one UL subframe. (Section X.C.1.i.) These differences, however, are immaterial, because the ACK/NACK information in the Malladi-TDTech-Kim combination is still fed back to the eNB. (Section X.C.1.i.) Therefore, the Malladi-TDTech-Kim combination likewise discloses claim 7. (EX1002, ¶¶171-174.)

Additionally, compared to TDTech's technique of sending multiple ACK/NACKs in one UL subframe, which had its own well-known benefits, (Section X.C.1.i), Kim's technique of combining ACK/NACK information, has its own well-known benefits. (EX1002, ¶¶171-174.) Such benefits were identified by Kim, as discussed above. (Section X.B.1.iii.) Additionally, as a POSITA would have known, the 3GPP's TSG for RAN was aware of the strengths and weaknesses of these different techniques. For example, it was known that combining ACK/NACK information in such a way would have "improve[d]...UL coverage and capacity" and could have been achieved using "already defined PUCCH formats." (EX1017, 1-2; EX1002, ¶¶171-174.) It was also known that, while combining ACK/NACK information may require retransmitting all associated DL subframes in the case of a NACK, the resulting degradation of DL throughput would have been acceptable.

(EX1017, 1-2; EX1002, ¶¶171-174.) And there were also known solutions to handle the case of missed DL assignments, such as using a counter of the PDSCH assignments and/or indicating the number of bundled ACK/NACKs on the PUSCH. (EX1018, 1-4; EX1002, ¶¶171-174.) Thus, a POSITA would have had good reason and a reasonable expectation of success incorporating the teachings of Kim into the TDD system disclosed by the Malladi-TDTEch combination, such that the TDD system of the Malladi-TDTEch-Kim combination combines ACK/NACK information or offers different modes of operation, one of which combines ACK/NACK information and one of which does not. (EX1002, ¶¶171-174.)

2. Claim 10

The Malladi-TDTEch-Kim combination discloses claim 10 for the same reasons the Malladi-Kim combination discloses claim 10. (Section X.B.1; EX1002, ¶175.) For the reasons discussed for claim 7, (Section X.F.1), the inclusion of TDTEch in the combination does not detract from the obviousness of claim 10. (EX1002, ¶175.)

G. Ground 7: Malladi in View of TDTEch and TS 36.211 V8.2.0 Renders Obvious Claim 8

1. Claim 8

Malladi in view of TDTEch and TS 36.211 V8.2.0 discloses these claim features. (EX1002, ¶¶176-185.) As discussed with respect to claim elements 1.pre and 1.a, (Sections X.C.1.i-ii), Malladi describes a “process 800 performed by the UE

to send ACK information,” (EX1005, ¶¶[0099]-[0101], Fig. 8). Malladi further explain that the “UE may perform process 800 in each subframe in which data might be sent to the UE.” (*Id.*, ¶[0099].) Thus, to the extent a subframe does not transmit data, process 800 is not performed.

A POSITA would have known (or at least found it obvious) that in TDD systems, like the TDD system of the combination, special subframes without data may be transmitted by the eNB to the UE, for which Malladi’s process 800 would not be performed. (EX1002, ¶177.) For example, describing “the frame structure...under the TDD mode according to the related art,” the ’881 patent explains that TDD includes “special sub-frame[s],” each consisting of a “DwPTS,” “GP,” and “UpPTS.” (EX1001, 1:37-53.) TDTech’s reference to “DwPTS” also confirms that DL subframes in TDD included special subframes. (EX1006, 2.)

TS 36.211 V8.2.0 confirms that special subframes (i.e., referring to Table 4.2-2, subframe 1 in configurations 0-6 and subframe 6 in configurations 0-2 and 6) are comprised of “three special fields, DwPTS, GP, and UpPTS.” (EX1010, 9-11.) According to TS 36.211 V8.2.0, only DwPTS is used for “downlink transmissions,” but it is not able to transmit data in special subframe configurations 0 and 5 (as shown in Table 4.2-1) in certain situations. (*Id.*)

According to TS 36.211 V8.2.0, the total length of DwPTS in configurations 0 and 5 is “6592 *Ts*” (using normal cyclic prefix). (*Id.* (Table 4.2-1).) Because one

OFDM symbol is $2048 T_s$, and the cyclic prefix is $160 T_s$ for the first symbol in a DL subframe (i.e., $l=0$) and $144 T_s$ for the remaining symbols in the DL subframe (i.e., $l=1,2,\dots,6$), (*id.*, 60-61), in these configurations, DwPTS can fit only three OFDM symbols. (EX1002, ¶¶178-179.) In certain situations, all three of the OFDM symbols are used to transmit control information (e.g., PHICH, PCFICH, PDCCH) and a primary synchronization signal (PSS), leaving no room for the transmission of data (e.g., PDSCH). (*Id.*, ¶180.)

Table 4.2-1: Lengths of DwPTS/GP/UpPTS.

Configuration	Normal cyclic prefix			Extended cyclic prefix		
	DwPTS	GP	UpPTS	DwPTS	GP	UpPTS
0	$6592 \cdot T_s$	$21936 \cdot T_s$	$2192 \cdot T_s$	$7680 \cdot T_s$	$20480 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$	$8768 \cdot T_s$		$20480 \cdot T_s$	$7680 \cdot T_s$	
2	$21952 \cdot T_s$	$6576 \cdot T_s$		$23040 \cdot T_s$	$5120 \cdot T_s$	
3	$24144 \cdot T_s$	$4384 \cdot T_s$		$25600 \cdot T_s$	$2560 \cdot T_s$	
4	$26336 \cdot T_s$	$2192 \cdot T_s$		$7680 \cdot T_s$	$17920 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$19744 \cdot T_s$	$4384 \cdot T_s$	$20480 \cdot T_s$	$5120 \cdot T_s$	
6	$19760 \cdot T_s$	$6576 \cdot T_s$		$23040 \cdot T_s$	$2560 \cdot T_s$	
7	$21952 \cdot T_s$	$4384 \cdot T_s$		-	-	
8	$24144 \cdot T_s$	$2192 \cdot T_s$		-	-	

(EX1010, 10 (annotated).)

For example, in the situation where the smallest downlink bandwidth (i.e., $N_{RB}^{DL}=6$) is configured in the cell and normal cyclic prefix is used, such that the number of subcarriers per resource block (RB) is 12 (i.e., $N_{sc}^{RB}=12$), every downlink OFDM symbol will only have 72 subcarriers ($N_{RB}^{DL} N_{sc}^{RB}=72$). (*Id.*, 32-34; EX1002,

¶¶181-182.) Because PSS requires 72 subcarriers (i.e., $k=0,1,\dots,71$), the entirety of the third OFDM symbol of the special subframes is needed to transmit the PSS, leaving no room for the transmission of DL data (e.g., PDSCH). (EX1010, 57; EX1002, ¶¶181-182.)

Furthermore, as TS 36.211 V8.2.0 explains for TDD, for the special subframes, the number of OFDM symbols for PCFICH can be 1, (EX1010, 43-44), the number of OFDM symbols for PHICH can be 1 (normal) or 2 (extended), (*id.*, 50), and the number of OFDM symbols for PDCCH can be 1 or 2 (if more control information must be sent), (*id.*, 43). Thus, either when extended PHICH duration is used or the maximum number of OFDM symbols are used for PDCCH, the number of OFDM symbols in the control region would be 2. (EX1002, ¶183.) In this situation, all three symbols for DwPTS are needed for PHICH, PCFICH, PDCCH, and PSS, leaving no room for data symbols (e.g., PDSCH). (*Id.*, ¶183.) For these reasons, it would have been well known to a POSITA that, in certain situations, there are special subframes in TDD that cannot transmit data. (*Id.*, ¶183.)

Because (i) such special subframes in TDD do not transmit data, (ii) the Malladi-TDTEch combination is a TDD system, and (iii) Malladi's process 800 is not performed for subframes that do not transmit data, a POSITA would have understood (or at least found it obvious) that the Malladi-TDTEch combination discloses the features of claim 8. (*Id.*, ¶184.)

Nevertheless, to the extent PO argues that the Malladi-TDTEch combination does not explicitly disclose these claim features, it would have also been obvious to a POSITA based on TS 36.211 V8.2.0 to not perform Malladi's process 800 for any special subframes that cannot transmit data. (*Id.*, ¶185.) See *KSR*, 550 U.S. at 401. As a POSITA would have understood, for a special subframe, it is desirable to have a larger GP in certain situations, such as when interference is possible due to propagation distance in a larger cell size, resulting in a DwPTS length (e.g., 6592 Ts) that is too short to transmit data. (EX1002, ¶185.) Additionally, because such special subframes do not transmit data, it is less important for the UE to acknowledge the special subframe, consistent with Malladi's teaching that process 800 is only performed for subframes transmitting data. (*Id.*, ¶185.) And a POSITA would have had a reasonable expectation of success implementing the combined teachings of Malladi, TDTEch, and TS 36.211 V8.2.0, given TS 36.211 V8.2.0 is a detailed specification describing how to implement such a TDD system. (*Id.*, ¶185.)

XI. DISCRETIONARY DENIAL IS NOT APPROPRIATE

The *Fintiv* factors do not justify denying institution. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (P.T.A.B. Mar. 20, 2020) (precedential).

The **first factor** (stay) is neutral, because Samsung has not yet moved for a stay. See *Hulu LLC v. SITO Mobile R&D IP, LLC et al.*, IPR2021-00298, Paper 11 at 10-11 (P.T.A.B. May 19, 2021).

The **second factor** (proximity) is neutral. “The PTAB will weigh this factor against exercising discretion to deny institution under *Fintiv* if the median time-to-trial is around the same time or after the projected statutory deadline for the PTAB’s final written decision” (FWD). (EX1053, 9.) The median time from filing to trial in the Eastern District of Texas is 21 months, meaning trial will be no earlier than December 2023. (EX1054, 35.) With this petition filed in March 2023, a FWD may be expected by September 2024, not long after the trial date.

The fact that the FWD may come after the trial date is not dispositive. The Board has granted institution in cases where the FWD issued months after the scheduled trial date. The Board has relied on various justifications, such as diligence in filing the petition, a stipulation not to pursue the asserted grounds in litigation, minimal investment in litigation, and the merits of the invalidity challenge were strong. *Verizon Business Network Services, Inc. v. Huawei Techs. Co.*, IPR2020-01141, Paper 12 (Jan. 14, 2021). The same factors are present in this case. For instance, Petitioner diligently filed this petition (challenging long, convoluted claims) in advance of the one-year bar date. Fact discovery is not anticipated to close until June 2023. Expert discovery has not yet started. And the *Markman* hearing has been scheduled for May 24, 2023, after the filing of this petition.

The **third factor** (investment) also weighs against denial. The district court case is in the early stages. Fact discovery is ongoing and the parties have not engaged

in expert discovery. (EX1055, 1-5.) The parties have not yet identified terms for construction. Nor have there been any substantive orders in this case.

The **fourth factor** (overlap) also weighs against denial. Petitioner hereby stipulates that, if the IPR is instituted, Petitioner will not pursue the IPR grounds in the district court litigation. Thus, “[i]nstituting trial here serves overall system efficiency and integrity goals by not duplicating efforts and by resolving materially different patentability issues.” *Apple, Inc. v. SEVEN Networks, LLC*, IPR2020-00156, Paper 10 at 19 (P.T.A.B. June 15, 2020); *see also Sand Revolution II, LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 12 (P.T.A.B. June 16, 2020).

While the **fifth factor** (parties) may weigh slightly in favor of denial, because the Petitioner and PO are the same parties as in district court, based on a “holistic view,” the factors favor institution. *Samsung Elecs. Co. Ltd. v. Dynamics Inc.*, IPR2020-00505, Paper 11 at 15 (P.T.A.B. Aug. 12, 2020).

Even if the Board determines that the above factors favor denial, the Board should not discretionarily deny institution, because this petition presents compelling merits. *See Commscope Tech. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 at 4-5 (P.T.A.B. Feb. 27, 2023) (precedential). As discussed above (Sections VII and X), the ’881 patent admits that many of the features in the challenged claims were already known in the art (e.g., TDD, transmitting confirmation information with data

in PUSCH, codewords), as confirmed by the 3GPP technical specifications that described ACK/NACK techniques in TDD systems and the other prior art of record. The remaining features (e.g., number value) were likewise known in the art, and in fact, were largely concepts presented at 3GPP meetings relating to TDD (e.g., in TDTech, Huawei, and Ericsson). The fact that the '881 patent is primarily directed to standardized technology and/or concepts publicly proposed during the standardization process supports a determination of compelling merits.

XII. CONCLUSION

For the foregoing reasons, this IPR should be instituted.

Respectfully submitted,

Dated: March 6, 2023

By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)
Counsel for Petitioner

XIII. APPENDIX A (CLAIM LISTING)⁷

Claim 1

[1.pre] A method for feeding back confirmation information on a physical uplink shared channel, which is used for enabling a user equipment to feed back to an eNodeB whether data of a downlink sub-frame is correctly received in a situation that a number of the downlink sub-frames is greater than a number of uplink sub-frames in a time division duplex system, wherein the method comprises:

[1.a] the eNodeB carries, in downlink control information, a number value of the downlink sub-frame corresponding to the confirmation information which is fed back by one uplink sub-frame, and transmits data on a plurality of continuous downlink sub-frames after the sub-frame carrying the downlink control information, wherein the number of the downlink sub-frames which transmit the data is equal to a number of the downlink sub-frames corresponding to the confirmation information fed back by the one uplink sub-frame;

[1.b] after the user equipment receives the downlink sub-frame which carries the downlink control information, the data is received from the downlink sub-frame which transmits the data after this downlink sub-frame, and the confirmation

⁷ 37 C.F.R. 42.24(1) (“The word count...does not include...[an] appendix of exhibits or claim listing.”)

information of receiving the data is fed back together with uplink data to the eNodeB through a physical uplink shared channel through an uplink sub-frame;

[1.c] wherein, in a situation that the user equipment feeds back a plurality of groups of the confirmation information, an amount of the confirmation information fed back in each group is equal to a maximum number of codeword streams in this downlink sub-frame, and respective confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame;

[1.d] in the situation that the number of codeword streams of the downlink sub-frames is smaller than the maximum number of the codeword streams of the downlink sub-frame, the user equipment feeds back the confirmation information of the number of the maximum codeword streams, wherein confirmation information without a corresponding codeword stream is set as a predefined fixed value;

[1.e] when the user equipment fails to detect the physical downlink control channel corresponding to the transmitted data in the sub-frame which transmits the data, the user equipment feeds back the negative acknowledgement message as the confirmation information of each codeword stream in a group corresponding to this downlink sub-frame.

Claim 2

[2] The method according to claim 1, wherein the eNodeB uses a signaling in the downlink control information for representing an index of the uplink sub-frame for transmitting uplink data in the situation that the number of the downlink sub-frames is smaller than the number of the uplink sub-frames to carry the number of the downlink sub-frames corresponding to the confirmation information which is fed back by the one uplink sub-frame.

Claim 3

[3] The method according to claim 1, wherein the eNodeB determines a set of number values of all the downlink sub-frames corresponding to information which is fed back by the one uplink sub-frame according to a configuration pattern for the current number of downlink/uplink sub-frames, and selects corresponding number values from the set according to an amount of the data actually required to be transmitted to be carried in the downlink control information.

Claim 4

[4] The method according to claim 1, wherein the eNodeB sends a control signaling associated with the allocation of the physical uplink shared channel on a first downlink sub-frame in the downlink sub-frames corresponding to the confirmation information fed back by the uplink sub-frame.

Claim 5

[5] The method according to claim 1, wherein in the uplink sub-frames fed back to the eNodeB, the user equipment, according to the order of serial numbers of the received downlink sub-frames which transmit the data, receives each downlink sub-frame which transmits the data and feeds back corresponding confirmation information.

Claim 6

[6.a] The method according to claim 1, wherein in a situation that the user equipment fails to receive the data of in the sub-frame, the user equipment feeds back a negative acknowledgement message as the confirmation information of this downlink sub-frame;

[6.b] in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes the data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information.

Claim 7

[7.a] The method according to claim 6, wherein in a situation that the data in the downlink sub-frame that transmits the data is sent as a single codeword stream, each piece of confirmation information in the uplink sub-frame fed back by the user

equipment to the eNodeB corresponds to a codeword stream of one downlink sub-frame that transmits the data;

[7.b] in a situation that the data in the downlink sub-frame that transmits the data is sent as multiple codeword streams, for one downlink sub-frame that transmits the data, the user equipment acquires the confirmation information corresponding to each codeword stream thereof,

[7.c] in a situation that any one or more pieces of confirmation information among the confirmation information acquired is the negative acknowledgement message, the user equipment sets the confirmation information of this downlink sub-frame as a negative acknowledgement; in a situation that all the confirmation information acquired is the acknowledgement message, the user equipment sets the confirmation information of this downlink sub-frame as an acknowledgement.

Claim 8

[8] The method according to claim 1, wherein in a situation that the downlink sub-frames sent by the eNodeB to the user equipment includes special sub-frames which cannot transmit data, the user equipment does not consider the special sub-frames when feeding back the confirmation information.

Claim 9

[9.pre-1] A method for feeding back confirmation information on a physical uplink shared channel, wherein, when the confirmation information is fed back

together with uplink data on the physical uplink shared channel, in a situation that a user equipment fails to detect a physical downlink control channel corresponding to transmitted data in a sub-frame transmitting data, the user equipment feeds back a negative acknowledgement message as confirmation information of this downlink sub-frame;

[9.pre-2] in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information;

[9.a] wherein in a situation that the user equipment feeds back a plurality of groups of the confirmation information, an amount of the confirmation information fed back in each group is equal to a maximum number of codeword streams in this downlink sub-frame, and respective confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame;

[9.b] in a situation that the number of the codeword streams of the downlink sub-frame is smaller than the maximum number of the codeword streams of the downlink sub-frame, the user equipment feeds back the confirmation information of

the maximum number of the codeword streams, wherein confirmation information without a corresponding codeword stream is set as a predefined fixed value;

[9.c] when the user equipment fails to detect the physical downlink control channel corresponding to the transmitted data in the sub-frame which transmits the data, the user equipment feeds back the negative acknowledgement message as the confirmation information of each codeword stream in a group corresponding to this downlink sub-frame.

Claim 10

[10.a] The method according to claim 9, wherein in a situation that the data in the downlink sub-frame that transmits the data is sent as a single codeword stream, each piece of confirmation information in the uplink sub-frame fed back by the user equipment to an eNodeB corresponds to a codeword stream of one downlink sub-frame that transmits the data;

[10.b] in a situation that the data in the downlink sub-frame which transmits the data is sent as multiple codeword streams, for one downlink sub-frame that transmits the data, the user equipment acquires the confirmation information corresponding to each codeword stream thereof,

[10.c] in a situation that any one or more pieces of confirmation information among the confirmation information acquired is the negative acknowledgement message, the user equipment sets the confirmation information of this downlink sub-

frame as a negative acknowledgement; in a situation that all the confirmation information acquired is the acknowledgement message, the user equipment sets the confirmation information of this downlink sub-frame as an acknowledgement.

Claim 11

[11.a] The method according to claim 2, wherein in a situation that the user equipment fails to detect a physical downlink control channel corresponding to transmitted data in the sub-frame transmitting the data, or fails to receive the data thereof, the user equipment feeds back a negative acknowledgement message as the confirmation information of this downlink sub-frame;

[11.b] in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes the data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information.

Claim 12

[12.a] The method according to claim 3, wherein in a situation that the user equipment fails to detect a physical downlink control channel corresponding to transmitted data in the sub-frame transmitting the data, or fails to receive the data

thereof, the user equipment feeds back a negative acknowledgement message as the confirmation information of this downlink sub-frame;

[12.b] in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes the data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information.

Claim 13

[13.a] The method according to claim 4, wherein in a situation that the user equipment fails to detect a physical downlink control channel corresponding to transmitted data in the sub-frame transmitting the data, or fails to receive the data thereof, the user equipment feeds back a negative acknowledgement message as the confirmation information of this downlink sub-frame;

[13.b] in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes the data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information.

Claim 14

[14.a] The method according to claim 5, wherein in a situation that the user equipment fails to detect a physical downlink control channel corresponding to transmitted data in the sub-frame transmitting the data, or fails to receive the data thereof, the user equipment feeds back a negative acknowledgement message as the confirmation information of this downlink sub-frame;

[14.b] in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes the data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information.

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 19,184,881 contains, as measured by the word-processing system used to prepare this paper, 13,838 words. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Respectfully submitted,

Dated: March 6, 2023

By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)
Counsel for Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on March 6, 2023, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 9,184,881 and supporting exhibits to be served via express mail on the Patent Owner at the following correspondence address of record as listed on PAIR:

MaioranaPC
24840 Harper, Suite 100
St. Clair Shores, MI 48080

By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)