UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD.

Petitioner

v.

PANTECH CORPORATION

Patent Owner

_____

IPR2025-00888

U.S. PATENT 9,369,251

_____

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT 9,369,251

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LIST OF EXHIBITS

Exhibit	Description
EX1001	U.S. Patent No. 9,369,251 to Yoon *et al*.
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EX1005	U.S. Provisional Application No. 61/365,174
EX1006	U.S. Patent No. 8,514,738 to Chandrasekhar *et al*.
EX1007	U.S. Provisional Application No. 61/320,900
EX1008	"CSI-RS Patterns for LTE-Advanced" by Texas Instruments, 3GPP TSG RAN WG1 #61bis, R1-103696, Dresden, Germany, June 28 - July 2, 2010
EX1009	Declaration of Friedhelm Rodermund
EX1010	"On Aperiodic SRS Transmission in LTE-A" by CATT, 3GPP TSG RAN WG1 #61bis, R1-103486, Dresden, Germany, June 28 - July 2, 2010
EX1011	"E-Mail Discussion on PDSCH Muting for CSI RS Design" by NTT DOCOMO, 3GPP TSG RAN WG1 #61bis, R1-104027, Dresden, Germany, June 28 - July 2, 2010
EX1012	"Considerations on CSI-RS Design" by Ericsson and ST-Ericsson, 3GPP TSG-RAN WG1 #61, R1-102628, Montreal, Canada, May 10 - 14, 2010
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EX1015	E. Dahlman *et al*., "4G LTE/LTE Advanced for Mobile Broadband," 1st ed. Elsevier, 2011
EX1016	U.S. Patent No. 9,143,207 to Kim *et al*.
EX1017	U.S. Patent Application Publication No. 2012/0220327 in the name of Lee *et al*.
EX1018	"Discussion on the Overhead of Muting" by Samsung, 3GPP TSG RAN WG1 #60bis, R1-103657, Dresden, Germany, June 28 - July 2,

Exhibit	Description
	2010
EX1019	E. Dahlman *et al*., "3G Evolution: HSPA and LTE for Mobile Broadband," 2nd ed. Elsevier, 2008
EX1020	U.S. Patent Application Publication No. 2011/0134774 in the name of Pelletier *et al.*
EX1021	U.S. Patent No. 8,964,657 to Farajidana *et al*.
EX1022	U.S. Patent No. 6,317,495 to Gaikwad *et al*.
EX1023	U.S. Patent No. 9,439,172 to Mazzarese *et al*.

All citations to 35 U.S.C. §§ 102 and 103 in this paper refer to the Pre-AIA statutes.

All emphases in quotations are added unless otherwise noted.

Direct quotations of claim language are italicized.

This paper includes color illustrations and should be viewed in color.

I. INTRODUCTION

OnePlus Technology (Shenzhen) Co., Ltd. (hereinafter "Petitioner") petitions for *inter partes* review (IPR) of claims 7, 9-12, and 14-16 (hereinafter "challenged claims") of U.S. Patent No. 9,369,251 (hereinafter "'251 patent," EX1001) assigned to Pantech Corporation (hereinafter "Patent Owner").

The challenged claims recite well-known Physical Downlink Shared CHannel (PDSCH) muting techniques for Channel State Information-Reference Signals (CSI-RS) measurement in wireless communication. These techniques had been extensively proposed, discussed, and publicly released before the '251 patent, and were ultimately incorporated into the 3rd Generation Partnership Project (3GPP) Long-Term Evolution (LTE) standard Release 10 (Rel-10). *See generally* EX1011.

For example, U.S. Patent Application Publication No. 2012/0264441 in the name of Chandrasekhar *et al*. (hereinafter "Chandrasekhar-I," EX1004) anticipates or otherwise renders obvious all the challenged claims. Furthermore, the features recited in the challenged claims merely reflect obvious design choices or established industry-standard practices, all of which were known or would have been obvious, as demonstrated by additional prior art references, including U.S. Patent No. 8,514,738 to Chandrasekhar *et al*. (hereinafter "Chandrasekhar-II," EX1006) and published 3GPP LTE standard proposal R1-103696, titled "CSI-RS Patterns for LTE-Advanced," submitted by Texas Instruments (hereinafter "TI," EX1008).

Petitioner's expert, Dr. Robert Akl, who has over three decades of experience in wireless telecommunication, confirms that the challenged claims are unpatentable over these references, as well as others predating the '251 patent.

Petitioner thus respectfully requests the Board cancel the challenged claims.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Party-in-Interest

The real parties-in-interest are OnePlus Technology (Shenzhen) Co., Ltd. and Guangdong OPPO Mobile Telecommunications Corp., Ltd.

B. Related Matters

The '251 patent is asserted in *Pantech Corp. et al. v. OnePlus Tech. (Shenzhen) Co., Ltd.*, No. 5:24-cv-00038-RWS-JBB (E.D. Tex.) ("EDTX case").

C. Lead and Back-up Counsel and Service Information

Petitioner identifies the following lead and back-up counsels:

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Petitioner consents to electronic service at OnePlus-Pantech-IPR@bayes.law, as well as the above email addresses.

III. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies under 37 C.F.R. § 42.104(a) that the '251 patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds identified in this Petition.

IV. RELIEF REQUESTED

A. Claims for Which Review Is Requested

Petitioner requests IPR and cancellation of claims 7, 9-12, and 14-16 of the '251 patent under 35 U.S.C. § 311 based on the following grounds. This Petition is supported by the Declaration of Dr. Robert Akl (hereinafter "Akl Decl.," EX1003) and the Declaration of Friedhelm Rodermund (hereinafter "Rodermund Decl.," EX1009).

B. Specific Art on Which the Challenge Is Based

Petitioner relies on the following prior art:

EX.	Reference	Relevant Date	Prior Art Under At Least
1004	US2012/0264441 ("Chandrasekhar-I")	7/16/2010[1]	§ 102(e)
1006	US8,514,738 ("Chandrasekhar-II")	4/5/2010[2]	§ 102(e)
1008	R1-103696 ("TI")	6/22/2010	§ 102(a)

(1) Chandrasekhar-I is entitled to the priority date of Chandrasekhar-I-Prov, July 16, 2010, because (i) at least claims 13 and 30 of Chandrasekhar-I are supported by the disclosures from Chandrasekhar-I-Prov, as set forth in the table below,[3] and (ii) Chandrasekhar-I-Prov provides written description for the specific disclosures in Chandrasekhar-I that are identified and relied on in Grounds 1-5 of this Petition, as discussed in Sections VII-X, *infra*. *See In re Riggs*, 131 F.4th 1377,

[1] As discussed in Section V.B, *infra*, the '251 patent is not entitled to a priority date earlier than August 11, 2011. Thus, Chandrasekhar-I qualifies as prior art under 35 U.S.C. § 102(e) because its filing date of July 18, 2011 precedes August 11, 2011. Even if the Board determines that the '251 patent is entitled to a foreign priority date before July 18, 2011, Chandrasekhar-I still qualifies as prior art under 35 U.S.C. § 102(e) based on its entitlement to the July 16, 2010 filing date of U.S. Provisional Application No. 61/365,174 ("Chandrasekhar-I-Prov," EX1005), as explained in this section, *infra*.

[2] As discussed in Section V.B, *infra*, the '251 patent is not entitled to a priority date earlier than August 11, 2011. Thus, Chandrasekhar-II qualifies as prior art under 35 U.S.C. § 102(e) because its filing date of March 30, 2011 precedes August 11, 2011. Even if the Board determines that the '251 patent is entitled to a foreign priority date before March 30, 2011, Chandrasekhar-II still qualifies as prior art under 35 U.S.C. § 102(e) based on its entitlement to the April 5, 2010 filing date of U.S. Provisional Application No. 61/320,900 ("Chandrasekhar-II-Prov," EX1007), as explained in this section, *infra*.

[3] Claims 13 and 30 of Chandrasekar-I are substantially the same. Thus, claim 13 can be supported by the same disclosures of Chandrasekhar-I-Prov in substantially the same manner shown in the table for claim 30.

1384 (Fed. Cir. 2025) (citing, *inter alia*, *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1382 (Fed. Cir. 2015)); EX1003, ¶¶69-78. Chandrasekhar-I's July 16, 2010 priority date predates the '251 patent's claimed earliest priority date of August 11, 2010. Thus, Chandrasekhar-I qualifies as prior art under 35 U.S.C. § 102(e) regardless of whether the '251 patent is entitled to its right of foreign priority.

Chandrasekhar-I Claim 30	**Exemplary Disclosures from Chandrasekhar-I-Prov**
[30.P] [A] method of scheduling physical downlink shared channel muting and channel state information reference signal measurement in a telephonic system including plural base stations, each base station serving at least one user equipment, the method comprising the steps of:	EX1005, 2 (§3. What is the problem solved by your invention: *e.g.*, "Our invention describes signaling schemes for communicating the PDSCH muting configuration from the eNodeB to its UEs so that they can measure inter-cell CSI if configured") EX1005, 6 (§1. Introduction) EX1005, 12 (§1. Introduction)
[30.a] receiving at each user equipment a physical downlink shared channel muting enable/disable signal indicating each muting configuration is enabled or disabled;	EX1005, 7 (§2.1 Interference Estimation: *e.g.*, "Proposal 5: Muting pattern(s) will specify the following," "Proposal 6: Muting configuration is communicated to the UE") EX1005, 7-8 (§2.2 Configuration of PDSCH muting and CSI-RS measurement: *e.g.*, "*PDSCHmutingenabled*") EX1005, 9-10 (§3.2 Duty Cycle Configuration: *e.g.*, "If the *PDSCHmutingenabled* parameter … is

	enabled for that corresponding pattern (cell), then the PDSCH REs shall be muted on the CSI-RS locations for that pattern (cell) with muting periodicity given by *PDSCHmutingdutycycle*") EX1005, 10-11 (§3.3 CSI-RS Pattern and PDSCH Muting Configuration: *e.g.*, "A bitmap of length N, where N is the reuse factor, signals the PDSCH muting pattern (*e.g.*, *PDSCHmutingenabled*) for that particular cell") EX1005, 14 (§3 Conclusions: *e.g.*, "Proposal 5: Muting pattern(s) will specify the following …" "Proposal 6: Muting configuration is communicated to the UE")
[30.b] receiving at each user equipment a measurement enable/disable signal indicating each measurement configuration is enabled or disabled;	EX1005, 7 (§2.1 Interference Estimation: *e.g.*, "Proposal 5: Muting pattern(s) will specify the following") EX1005, 7-8 (§2.2 Configuration of PDSCH muting and CSI-RS measurement: *e.g.*, "*CSIRSpattern*") EX1005, 10-11 (§3.3 CSI-RS Pattern and PDSCH Muting Configuration)
[30.c] each user equipment muting a physical downlink shared channel according to one of the allowed muting configurations if the muting enable/disable signal indicates the corresponding muting configuration is enabled;	EX1005, 6-7 (§2. PDSCH Muting) EX1005, 10-11 (§3.3 CSI-RS Pattern and PDSCH Muting Configuration: *e.g.*, "*PDSCHmutingenabled*," "A bit value 1 on the *k*-th bit position indicates that PDSCH is muted on the RE corresponding to the *k*-th CSI-RS pattern")

[30.d] each user equipment not muting a physical downlink shared channel according to one of the allowed muting configurations if the muting enable/disable signal indicates the corresponding muting configuration is disabled;	EX1005, 6-7 (§2. PDSCH Muting) EX1005, 10-11 (§3.3 CSI-RS Pattern and PDSCH Muting Configuration: *e.g.*, "*PDSCHmutingenabled*," "a bit value 0 indicates that PDSCH is not muted on the corresponding CSI-RS pattern")
[30.e] each user equipment measuring a channel state information reference signal according to one of the allowed measurement configurations if the measurement enable/disable signal indicates the corresponding measurement configuration is enabled; and	EX1005, 10-11 (§3.3 CSI-RS Pattern and PDSCH Muting Configuration: *e.g.*, "*CSIRSpattern*," "A bit value 1 on the *k*-th bit indicates that CSI measurement shall be done for the *k*-th CSI-RS pattern")
[30.f] each user equipment not measuring a channel state information reference signal according to one of the allowed measurement configurations if the measurement enable/disable signal indicates the corresponding measurement configuration is disabled.	EX1005, 10-11 (§3.3 CSI-RS Pattern and PDSCH Muting Configuration: *e.g.*, "*CSIRSpattern*," "a bit value 0 indicates that CSI measurement is not needed for the *k*-th CSI-RS pattern")

(2) Chandrasekhar-II is entitled to at least the priority date of Chandrasekhar-II-Prov, April 5, 2010, because (i) at least claim 1 of Chandrasekhar-II is supported by the disclosures from Chandrasekhar-II-Prov, as set forth in the table below, and (ii) Chandrasekhar-II-Prov provides written description for the specific disclosures in Chandrasekhar-II that are identified and relied on in Grounds 3 and 5 of this Petition, as discussed in Sections VIII and X, *infra*. *See In re Riggs*,

at 1384; EX1003, ¶¶86-92. Chandrasekhar-II's April 5, 2010 priority date predates the '251 patent's claimed earliest priority date of August 11, 2010. Thus, Chandrasekhar-II qualifies as prior art under 35 U.S.C. § 102(e) regardless of whether the '251 patent is entitled to its right of foreign priority.

Chandrasekhar-II Claim 1	**Exemplary Disclosures from Chandrasekhar-II-Prov**
[1.P] A method of inter-cell channel quality information (CSI) estimation in a wireless telephony system having plural base stations each having plural antenna ports and plural mobile user equipment, each mobile user equipment having a primary serving base station, at least one mobile user equipment having a Coordinated Multipoint Reception relationship to a base station not its primary servicing base station, the method comprising:	EX1007, 1 (§1. Introduction: *e.g.*, "This document describes exemplary schemes for performing intercell CSI estimation using the existing cell-specific reference symbols (CRS) in Rel-8 LTE") EX1007, 1 (§2. PDSCH muting on Inter-cell CRS: *e.g.*, "We now propose PDSCH RE muting schemes for performing inter-cell CSI estimation at an advanced UE configured for CoMP reception") EX1007, 3 (Figures 1-2) EX1007, 5 (§4. Exemplary PDSCH muting patterns: *e.g.*, "Figure 3 through Figure 6 illustrate PDSCH muting patterns on inter-cell CRS for an eNodeB … equipped four antenna transmission ports")
[1.a] transmitting to the at least one user equipment on its Physical Downlink Shared CHannel (PDSCH) from the corresponding primary serving base station a mute PDSCH having zero energy on a resource element (RE) location of	EX1007, 1 (§2. PDSCH muting on Inter-cell CRS) EX1007, 2 (Claim 1)

each non-serving base station, the muted PDSCH RE positions on cell-specific reference symbol (CRS) locations of each transmission antenna port from the primary serving base station given as: $M_y=\{6*k+[3*m_y+CellID(CoMP\ Cell_j)modulo6]\}modulo12$ where: M_y is the muted PDSCH RE at antenna port y; k is 0 or 1, where k takes the values of either 0 or 1 for any transmission antenna port y; y is index number of the selected antenna port; m_y is an integer, where m_y takes a value dependent upon which Orthogonal Frequency Division Multiplexing (OFDM) symbol is configured for PDSCH muting; j=1, 2, . . . N, where N is a number of base stations having a Coordinated Multipoint Reception relationship to the at least one user equipment and j does not equal the cell ID of the primary servicing base station;	
[1.b] performing rate-matching at the primary servicing base station of its PDSCH around the inter-cell CSR pilot locations of the muted PDSCH; and	EX1007, 2 (Claim 1, FN 1)
[1.c] the at least one user equipment performing inter-cell CSI estimation with respect to a selected base station having a Coordinated Multipoint Reception relationship to the at least one user equipment.	EX1007, 1 (§2. PDSCH muting on Inter-cell CRS: *e.g.*, "We now propose PDSCH RE muting schemes for performing inter-cell CSI estimation at an advanced UE configured for CoMP reception")

(3) TI is a proposal submitted by Texas Instruments to the 3GPP Technical Specification Group (TSG) Radio Access Network (RAN) Working Group 1 (WG1). EX1008, 1; EX1009, ¶¶56-57. TI was published and freely available on 3GPP's File Transfer Protocol (FTP) server no later than June 22, 2010, and thus, qualifies as prior art under at least 35 U.S.C. §102(a).[4] EX1009, ¶¶21, 56-66.

C. Specific Ground on Which the Challenge Is Based

Petitioner relies on the following statutory grounds:

Ground	Claims	Basis	References
1 & 2	7, 9-12, and 14-16	§§ 102/103	Chandrasekhar-I
3	7, 9-12, and 14-16	§ 103	Chandrasekhar-I in view of Chandrasekhar-II
4	7, 9-12, and 14-16	§ 103	Chandrasekhar-I in view of TI
5	7, 9-12, and 14-16	§ 103	Chandrasekhar-I in view of Chandrasekhar-II and TI

V. THE '251 PATENT

A. Overview

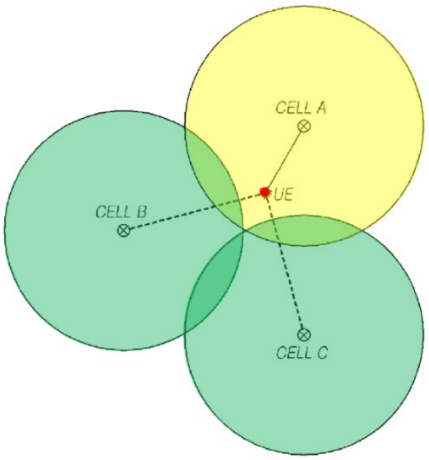
The '251 patent relates to a wireless communication system for performing muting for all or a partial resource region in PDSCH for data transmission of a serving cell. EX1001, 1:26-31. The purpose of the '251 patent is to "avoid interference from a neighboring cell at the time of allocating a resource of a channel

[4] TI also qualifies as prior art under 35 U.S.C. § 102(b) if the Board finds the '251 patent, including the challenged claims, is not entitled to the right of priority before August 11, 2011. *See* Section V.B.

state information-reference signal ([] "CSI-RS") in a wireless communication system, and using muting information for muting." EX1001, 1:31-35.

FIG. 14 of the '251 patent illustrates a multicell environment, *e.g.*, a cooperative multipoint (CoMP) system, to which the alleged invention can be applied. EX1001, 9:62-66. As shown in the annotated FIG. 14 (EX1003, FIG. C) below, a UE (highlighted in red) receives CSI-RS from a serving cell—Cell A (highlighted in yellow)—and neighboring cells—Cell B and Cell C (highlighted in green)—to measure channel state information. EX1001, 10:17-21; EX1003, ¶51. According to the '215 patent, "Cell A may perform muting, which implies zero power transmission without transmitting data to a resource region to which Cell B transmits CSI-RS, so that the UE in Cell A receives CSI-RS information from Cell B without intervention." EX1001, 10:51-55.

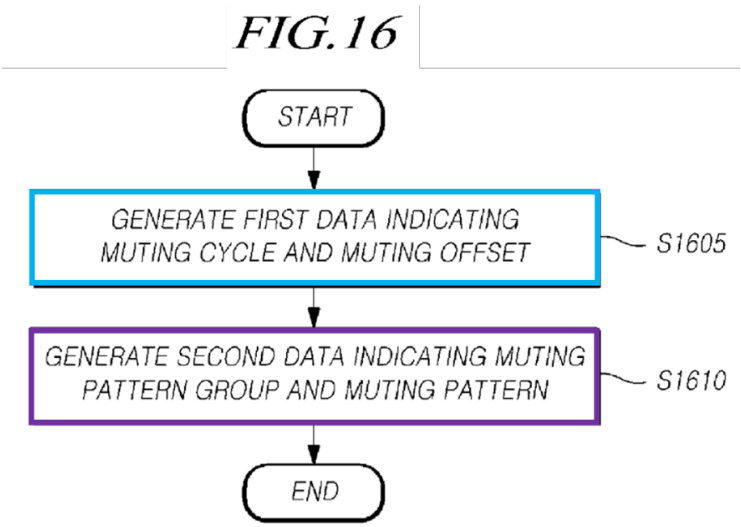
FIG. 14



EX1003 — FIG. C

As shown in the annotated FIG. 16 of the '251 patent (EX1003, FIG. D) below,

generating muting information includes a first step S1605 (highlighted in the blue box) of "generating a first data field for determining a muting duty cycle and a muting offset and indicating the muting duty cycle and the muting offset," and a second step S1610 (highlighted in the purple box) of "generating a second data field indicating one or more of a muting pattern group and a specific muting pattern in one muting subframe." EX1001, 13:20-26; EX1003, ¶54.



EX1003 — FIG. D

According to the '251 patent, "the first step may be realized by differentiation in various ways according to a relation of a subframe which requires muting (that is, a muting subframe) among CSI-RS of a serving cell with a CSI-RS transmission cycle and a CSI-RS transmission offset of the serving cell or the neighboring cell in consideration of intervention with the neighboring cells." EX1001, 14:25-31. Specifically, the '251 patent explains five exemplary cases in which the first step can be realized "according to a relation of a muting duty cycle and a muting subframe

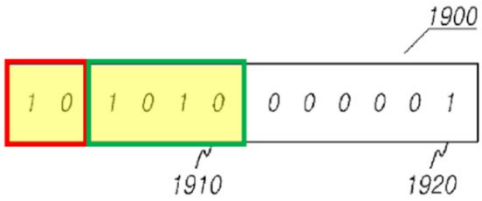
offset with a CSI-RS transmission cycle and a CSI-RS transmission offset of a serving cell." EX1001, 14:20-24.

For instance, in Case 3, the muting subframe offset is the same as a CSI-RS transmission offset of a serving cell, while the muting cycle may be different from a CSI-RS transmission cycle of the serving cell. EX1001, 16:58-62. In particular, under Method 3-1 of Case 3, the'251 patent states that "the number of information bits configuring a first data field may be '2 bits or 3 bits to be determined according to the number N of neighboring cells as an object of each muting × the number of kinds of muting duty cycle." EX1001, 17:10-14. In Case 3, a first data field does not contain information bits that expressly represent the muting subframe offset, as the muting subframe offset is known from the CSI-RS transmission offset in this case. EX1001, 17:29-40; EX1003, ¶56.

According to the '251 patent, the first data field can include two distinct regions: a first region indicating a configuration bit value, and a second region indicating the actual muting cycle. For example, as shown in the annotated FIG. 19 (EX1003, FIG. E) below, a first data field 1910 (highlighted in yellow) includes these two separate signaling regions: a first region (highlighted in the red box) having a 2-bit value ("10"), which represents a configuration bit value (M=4), and a second region (highlighted in the green box) having a 4-bit value ("1010"), which specifies the actual muting duty cycle. EX1001, 27:39-50, 27:62-65, 28:1-11;

EX1003, ¶57. As with other embodiments under Case 3, first data field 1910 does not include information bits that explicitly represent the muting subframe offset, because the muting subframe offset is known from the CSI-RS transmission offset in this case as well. EX1001, 27:39-44, 27:62-65, 28:17-21; EX1003, ¶58.

FIG. 19



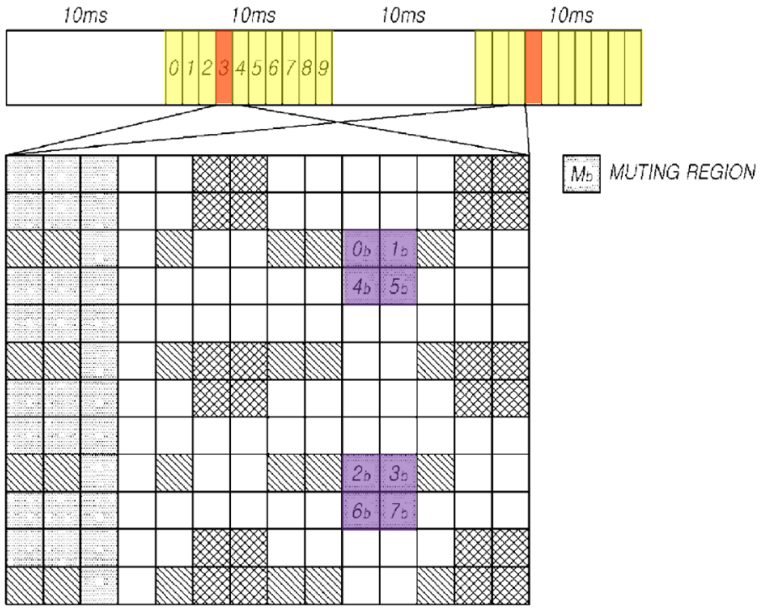
EX1003 — FIG. E

As to the second step for generating the second data field of the muting information, the '251 patent's disclosure in "Method 3 of Directly Indicating a Muting Pattern: Configuration is Made with a Bitmap of 12 to 28" under Type 2-1 directly pertains to the claim language that requires "*a second data field having n-bit bitmap, the n being an integer among 12 to 28*." EX1001, 23:11-12; EX1003, ¶59. In Method 3 of Type 2-1, the '251 patent provides four discrete examples of 12-bit, 16-bit, 20-bit, and 28-bit bitmaps corresponding to the CSI-RS patterns shown in FIGs. 11, 9, 3, and 13, respectively. EX1001, 23:16-65; EX1003, ¶60. For example, as shown in the annotated FIG. 19 above, a second data field 1920 has a 6-bit value ("000001") indicating CSI-RS Pattern b shown in FIG. 3. EX1001, 28:22-

34, FIGs. 3, 9; EX1003, ¶60.

Muting is then performed on muting regions (*e.g.*, REs) in muting subframe based on the muting information. EX1001, 12:47-59. For example, as shown in the annotated FIG. 20 (EX1003, FIG. F) below, "[a]ccording to the muting information of FIG. 19, in the second and fourth CSI-RS transmission cycle [(highlighted in yellow)], a fourth subframe (subframe number is 3) becomes a muting subframe [(highlighted in red)] and in the resource space in the subframe, REs corresponding to Pattern b of FIG. 3 (indicated with dark shadows in FIG. 20) become muting regions [(highlighted in purple)], and in the region, muting which is non-allocation of data or zero power transmission is performed." EX1001, 28:45-53, EX1003, ¶61.

FIG.20



EX1003 — FIG. F

B. Priority Date

The ’251 patent claims foreign priority to Korean Patent Application No. 10-2010-0077590, filed on August 11, 2010, Korean Patent Application No. 10-2010-0078536, filed on August 13, 2010, Korean Patent Application No. 10-2010-0098005, filed on October 7, 2010, and Korean Patent Application No. 10-2010-0098006, filed on October 7, 2010 (hereinafter collectively “Korean applications”). EX1001, Code (30). However, no certified English translation of any of the Korean applications was submitted during the prosecution of the ’251 patent and its parent patents, and therefore Patent Owner’s foreign priority claim has not been perfected yet. *See e.g., generally* EX1002.

Moreover, Korean applications lack written descriptions for at least the following limitations of the challenged claims: “*CSI-RS muting information including … a second data field having n-bit bitmap, the n being an integer among 12 to 28*” (claims 7 and 12), and “*the first data field is configured based on … a relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell*” (claims 9 and 14). *See* 35 U.S.C. § 119(a)-(d).

For instance, for the claim limitation that “*the first data field is configured based on … a relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell*” (hereinafter “relation limitation”), even the ’251 patent itself does not provide a description that “in a definite way

identifies the claimed invention" in sufficient detail that a person of ordinary skill in the art (POSITA) would understand that the inventor was in possession of it at the time of filing. *See Alcon Research Ltd. v. Barr Labs., Inc.*, 745 F.3d 1180, 1190-91 (Fed. Cir. 2014).

The specification of the '251 patent recites the term "*a relation*" three times, two of which occur in connection with the first step (*e.g.*, S1605) for generating the first data field.[5] EX1001, 14:20-21, 14:26. As discussed in Section V.A, the specification of the '251 patent explains how to configure the first data field in the first step based on "a relation of **a muting duty cycle and a muting offset with a CSI-RS transmission cycle and a CSI-RS transmission offset** of a serving cell," rather than "*a relation between **CSI-RS transmission cycles and CSI-RS transmission offset** of the serving cell or the neighboring cell*." EX1001, 14:20-31; *see also generally* EX1001, 13:63-19:63; EX1003, ¶66. None of the Korean applications provides written descriptions for the relation limitation either.

Accordingly, the '251 patent, including the challenged claims, is not entitled to the claimed foreign priority and thus, may be entitled to a priority date no earlier than August 11, 2011, the filing date of its earliest parent patent—U.S. Patent No.

[5] The third instance of the term "a relation" merely repeats the same claim language and refers to the disclosed first step for further details, offering no additional description or explanation. EX1001, 12:12-17; EX1003, ¶65.

8,897,182 (hereinafter "'182 patent").[6] EX1001, Code (63).

C. Prosecution History

In the first Office Action, the Examiner rejected independent claims 1-6 of the '251 patent under 35 U.S.C. § 101 as claiming the same invention as that of claims 1-6 of U.S. Patent No. 9,088,396 (hereinafter "'396 patent"), and rejected claims 7-11 on the ground of nonstatutory double patenting over claims 1-6 of the '396 patent. EX1002, 100-102.

In response, Patent Owner amended claims 1-6 by "changing the category from method claims to apparatus claims," filed a terminal disclaimer against the '396 patent without presenting arguments on the merits, and added new claims 12-16. EX1002, 85-86.

The Examiner subsequently issued the Notice of Allowance. EX1002, 59. The Examiner stated that the "novel and unobvious limitations" of the challenged independent claims 7 and 12 are "*a processor configured to receive and determine CSI-RS muting information including a first data field that indicates a cycle and an*

[6] It is Patent Owner's burden to establish that the claims are entitled to the priority date of the earlier-filed application. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1379–80 (Fed. Cir. 2015) (internal citations omitted). Petitioner reserves the right to rebut in a Petitioner's Reply to any allegation by Patent Owner in the Patent Owner Preliminary Response (POPR) that the '251 patent is entitled to a priority date predating any of the relevant dates of the prior art relied upon in this IPR. *See* Section IV.B.

offset of muting subframes and a second data field having n-bit bitmap, the n being an integer among 12 to 28, each bit of the n-bit bitmap indicating whether to apply muting in the muting subframes; and a receiver to receive a signal including data, mapped to resource elements using the CSI-RS muting information, the mapping process including a muting for zero power transmission." EX1002, 65.

None of the prior art relied upon in this Petition was presented or considered by the Office during the prosecution of the '251 patent. *See generally* EX1002.

D. The Level of Ordinary Skill in the Art

A POSITA at the time of the claimed invention would have had a Bachelor's degree in electrical engineering, computer engineering, computer science, or a related field, and two to three years of experience in the design or development of telecommunication systems, or the equivalent. EX1003, ¶22. A higher level of education might make up for less experience, and vice versa. *Id*.

VI. CLAIM CONSTRUCTION

Claim terms subject to IPR are construed under the framework established in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005). *See* 37 C.F.R. § 42.100(b). Only terms necessary to resolve the controversy need construction. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). For all claim limitations, because the prior art relied on herein discloses embodiments within the claims' scope, the Board need not construe the claims' outer

bounds, and all claim terms should be construed according to their plain and ordinary meaning as would have been understood by a POSITA.

VII. GROUNDS 1 AND 2: CHANDRASEKHAR-I ANTICIPATES OR OTHERWISE RENDERS OBVIOUS CLAIMS 7, 9-12, AND 14-16

A. Overview of Chandrasekhar-I

Chandrasekhar-I is directed to wireless communication, in particular, LTE. EX1004, [0002], [0004]; EX1005, 2-3 (§§3-4). Similar to the '251 patent, Chandrasekhar-I addresses the need for "standardizing PDSCH muting to take into account the intra/inter-cell CSI-RS pattern as well as provision for interference estimation on intra-/inter-cell CSI-RS on non-muted CSI-RS subframes." EX1004, [0033]; EX1005, 7 (§2.1, ⁋2)[7]. To address such a need, Chandrasekhar-I discloses "signaling schemes for communicating the PDSCH muting configuration from the eNodeB to its UEs so that they can measure inter-cell CSI if configured." EX1004, [0004], [0029]; EX1005, 2-3 (§§3-4). Like the '251 patent, Chandrasekhar-I also focuses on PDSCH muting in a CoMP environment having a serving cell and non-serving cells. EX1004, [0032], [0049]; EX1005, 7 (§2), 12 (§2.3, ⁋⁋1-2); EX1003, ¶80.

Specifically, Chandrasekhar-I discusses various aspects related to the configurations of PDSCH muting, including muting patterns, and introduces

[7] The citation "EX1005, 7 (§2.1, ⁋2)" refers to Bates page 7 of EX1005, specifically to Section 2.1 on that page, and paragraph 2 within that section on that page.

parameters of the muting patterns: (i) a PDSCH muting pattern represented as *PDSCHmutingenabled*, which signals the CSI-RS pattern RE positions around which its PDSCH is rate-matched; (ii) a CSI-RS pattern represented as *CSIRSpattern*, which signals the intra-cell and inter-cell CSI measurements; (iii) a CSI-RS subframe offset represented as *CSIRSoffset*, which signals the intra-cell CSI-RS subframe offset; (iv) a CSI-RS duty cycle represented as *CSIRSpatterndutycycle;* and (v) PDSCH muting configurations, each including (1) a PDSCH RE muting duty cycle represented as *PDSCHmutingdutyCycle*, and (2) a PDSCH RE muting subframe offset known from *CSIRSoffset*. EX1004, [0034]-[0049], [0051]; EX1005, 7-8 (§§2.1-2.2, §3, ⁋1), 14 (§3); EX1003, ¶81.

Chandrasekhar-I's signaling schemes include two aspects: (i) "eNodeB configuration of the UE to receive its CSI-RS including the subframe offset and duty cycle periodicity," and (ii) "to communicate muting patterns for intra-/inter-cell CSI estimation and for determining the RE positions around which its PDSCH is rate-matched." EX1004, [0051]; EX1005, 8 (§3, ⁋1).

In the first aspect, Chandrasekhar-I discusses in detail how to set the PDSCH muting configurations, for example, the PDSCH RE muting duty cycle and subframe offset. EX1004, [0052]-[0057]; EX1005, 8-10 (§§3.1-3.2); EX1003, ¶83. Specifically, "muting duty cycle is configured separately from the CSI-RS duty cycle," while "CSI-RS subframe offset … implicitly equals the subframe offset of

PDSCH RE muting." EX1004, [0038], [0046]; EX1005, 7 (§2.1, ⁋6), 8 (§2.2).

As to the PDSCH muting pattern *PDSCHmutingenabled*, "a bitmap of length N, where N is the re-use factor, signals the PDSCH muting pattern *PDSCHmutingenabled* for that particular cell." EX1004, [0060]; EX1005, 10 (§3.3, ⁋2). For example, the annotated TABLE 5 (EX1003, FIG. G) below shows "the available reuse factor (N) for different number[s] of eNodeB CSI-RS antenna ports," in which the specific numbers falling within the range "*among 12 to 28*" recited in the challenged independent claims 7 and 12 are highlighted in the red and green boxes. EX1004, [0058]; EX1005, 6, (§1, ⁋2); EX1003, ¶84.

TABLE 5

Configuration	2 CSI-RS ports	4 CSI-RS ports	8 CSI-RS ports
Normal CP (FS1)	20	10	5
Normal CP (FS2)	32	16	8
Extended CP (FS1)	16	8	4
Extended CP (FS2)	28	14	7

EX1003 — FIG. G

In the second aspect, Chandrasekhar-I discusses in detail how to determine PDSCH muting on REs based on the received muting patterns, including the PDSCH muting configurations ("subframe offset and duty cycle periodicity") and the PDSCH muting pattern ("*PDSCHmutingenabled*"). EX1004, [0058]-[0066]; EX1005, 6, (§1, ⁋2), 10-11 (§3.3); EX1003, ¶85. Specifically, Chandrasekhar-I

discloses that "[i]f the *PDSCHmutingenabled* parameter is enabled for that corresponding pattern (cell), then the PDSCH REs shall be muted on the CSI-RS locations for that pattern (cell) with muting periodicity given by *PDSCHmutingdutycycle* [and] the corresponding subframe offset [] determined by the parameter *CSIRSoffset*." EX1004, [0056]; EX1005, 9 (§3.2, ¶6).

B. Independent Claim 7

1. Chandrasekhar-I discloses "*[a] method for receiving Channel State Information-Reference Signal (CSI-RS) muting information from a serving cell, the method comprising*" [7.P].

To the extent that the preamble is limiting, Chandrasekhar-I discloses signaling schemes ("*method*") for receiving muting patterns (*e.g.*, including PDSCH muting configurations) for CSI-RS measurement/estimation ("*Channel State Information-Reference Signal (CSI-RS) muting information*") from a serving cell eNodeB ("*serving cell*"). *See* Section VII.A.

For instance, Chandrasekhar-I discloses "signaling schemes for communicating the PDSCH muting configuration from the eNodeB to its UEs so that they can measure inter-cell CSI if configured." EX1004, [0004], [0029]; EX1005, 2-3 (§§3-4).[8] Specifically, Chandrasekhar-I presents "signaling schemes

[8] Dual citations to Chandrasekhar-I (EX1004) and Chandrasekhar-I-Prov (EX1005) are provided to demonstrate that the specific disclosures identified and relied upon in this Petition from Chandrasekhar-I are supported by the written description in

during eNodeB configuration of the UE to receive its CSI-RS including the subframe offset and duty cycle periodicity," and "signaling schemes to communicate muting patterns for intra-/inter-cell CSI estimation and for determining the RE positions around which its PDSCH is rate-matched." EX1004, [0051]; EX1005, 8 (§3, ⁋1). That is, the muting patterns of Chandrasekhar-I are configured by a serving cell eNodeB for CSI-RS measurement/estimation to be sent to a UE. EX1003, ¶100.

Chandrasekhar-I further discloses that the muting patterns are "determined by the network and communicated to the UEs," and that the muting patterns specify various types of information and parameters for determining "RE locations on which PDSCH RE muting occurs," which are the designated muting regions consistent with the '251 patent's disclosures. EX1004, [0039]-[0040]; EX1005, 7 (§2.1, ⁋⁋7-8); EX1001, 2:66-3:2, 13:10-14; EX1003, ¶102. Specifically, as discussed above in Section VII.A, Chandrasekhar-I discloses that the following pieces of information are parts of and specified by the muting patterns:

> CSI-RS pattern: "the index set of patterns (cells) corresponds to RE locations on which the UE estimates its CSI";
> PDSCH muting pattern: "the index set of patterns (cells) corresponds to RE locations on which PDSCH RE muting occurs";
> CSI-RS subframe offset/muting subframe offset: "a subframe offset relative to the starting subframe on each frame on which intra-cell CSI-

Chandrasekhar-I-Prov. To the extent it becomes necessary to rely on the filing date of Chandrasekhar-I-Prov as the U.S. effective filing date of Chandrasekhar-I under 35 U.S.C. § 102(e), the requisite written description support is established by the dual citations. *See* Section IV.B.

> RS is transmitted, which is identical to the subframe offset on which muting is carried out"; and
> CSI-RS duty cycle and PDSCH RE muting duty cycle: "specified by the pattern where both duty cycle values are in the set {5 ms, 10 ms, 20 ms}."

EX1004, [0040]; EX1005, 7 (§2.1, ⁋8), 14 (§3, ⁋6); EX1003, ¶101.

Accordingly, a POSITA would have understood that Chandrasekhar-I's muting patterns, which are used for designating muting regions in CSI-RS measurement/estimation qualify as the claimed "*CSI-RS muting information*," consistent with the '251 patent's disclosure that "*muting information*" is "information used for designating the [muting] region." EX1001, 13:10-16; EX1003, ¶102.

Thus, Chandrasekhar-I discloses [7.P].

2. Chandrasekhar-I discloses or at least suggests "*receiving CSI-RS muting information including a first data field that indicates a cycle and an offset of muting subframes and*" [7.a.1].

As discussed above in Section VII.B.1, Chandrasekhar-I discloses that the UE receives muting patterns ("*CSI-RS muting information*"). Chandrasekhar-I further discloses that the muting patterns include a PDSCH RE muting duty cycle (hereinafter "muting duty cycle") and subframe offset on which muting is carried out (hereinafter "muting subframe offset") ("*a cycle and an offset of muting subframes*"). *See* Section VII.A.

Chandrasekhar-I describes "signaling schemes during eNodeB configuration of the UE to receive its CSI-RS including the subframe offset and duty cycle periodicity." EX1004, [0051]; EX1005, 8 (§3, ⁋1). Specifically, Chandrasekhar-I discloses that the muting patterns specify "a subframe offset relative to the starting subframe on each frame on which intra-cell CSI-RS is transmitted, which is identical to **the subframe offset on which muting is carried out**," and that "the intra-cell CSI-RS duty cycle and **PDSCH RE muting duty cycle** is specified by the pattern." EX1004, [0040]; EX1005, 7 (§2.1, ⁋8), 14 (§3, ⁋6).

Chandrasekhar-I further defines a parameter *PDSCHmutingdutycycle* that signals ("*indicates*") the muting duty cycle ("*cycle ... of muting subframes*"): "PDSCH RE muting duty cycle is signaled by a higher-layer parameter P*DSCHmutingdutyCycle*." EX1004, [0048]; EX1005, 8 (§2.2); *see also* EX1004, [0054], [0057]; EX1005, 9 (§3.2, ⁋3), 10 (§3.2, ⁋1). For example, the parameter *PDSCHmutingdutycycle* is "signaled as a two bit value." EX1004, [0055]; EX1005, 9 (§3.2, ⁋⁋4-8).

As to the muting subframe offset ("*offset of muting subframes*"), a POSITA would have understood that the muting subframe offset is known from the parameter *CSIRSoffset*, which "is identical to the subframe offset on which muting is carried out" and "implicitly equals the subframe offset of PDSCH RE muting." EX1004, [0040], [0046]; EX1005, 7 (§2.1, ⁋8), 8 (§2.2), 14 (§3, ⁋6); EX1003, ¶105.

Chandrasekhar-I also states that the "corresponding subframe offset is determined by the parameter *CSIRSoffset*." EX1004, [0056]; EX1005, 9 (§3.2, ⁋6). For example, the parameter *CSIRSoffset* is "a three-bit message." EX1004, [0052]; EX1005, 8 (§3.1, ⁋⁋1-2).

a. Chandrasekhar-I discloses [7.a.1].

The claimed "***a*** *first data field*" in [7.a.1] refers to one or more data fields because (i) the indefinite article "*a*" means "one or more" in open-ended claims containing the transitional phrase "*comprising*" and "*including*," and (ii) neither the language of the claims themselves, the specification, nor the prosecution history necessitates a departure from the rule. *See Convolve, Inc. v. Compaq Computer Corp*., 812 F.3d 1313, 1321 (Fed. Cir. 2016); *Baldwin Graphic Sys., Inc. v. Siebert, Inc*., 512 F.3d 1338, 1342-43 (Fed. Cir. 2008). This understanding is consistent with the '251 patent, which explicitly discloses that the first data field can include two separate signaling regions. EX1001, 27:42-50, 28:1-11, FIG. 9; EX1003, ¶106; *see* Section V.A.

Therefore, Chandrasekhar-I discloses receiving the muting patterns ("*CSI-RS muting information*"), including the parameters *PDSCHmutingdutycycle* and *CSIRSoffset* (collectively "*a first data field*") that indicate the muting duty cycle and the muting subframe offset ("*a cycle and an offset of muting subframes*"). EX1003, ¶106.

To the extent that "***a*** *first data field*" in [7.a.1] means a single data field, Chandrasekhar-I discloses that the parameter *PDSCHmutingdutycycle* alone ("*a first data field*") indicates both the muting duty cycle and the muting subframe offset ("*a cycle and an offset of muting subframes*"), because the muting duty cycle is explicitly represented by the bit value, and the muting subframe offset is known to be identical to the CSI-RS subframe offset. EX1004, [0040], [0046], [0056]; EX1005, 7 (§2.1, ⁋8), 8 (§2.2), 9 (§3.2, ⁋6), 14 (§3, ⁋6); EX1003, ¶107.

This mapping is consistent with the ' 251 patent's teachings of the "*first data field*." The '251 patent discloses various ways of "generating a first data field for determining a muting duty cycle and a muting offset and indicating the muting duty cycle and the muting offset." EX1001, 13:64-67, 14:20-32. Notably, as discussed above in Section V.A, the '251 patent's Case 3—where "a muting offset is the same as a CSI-RS transmission offset of a serving cell, while the muting cycles may be different from a CSI-RS transmission cycle of the serving cell"—aligns precisely with the approach disclosed in Chandrasekhar-I. EX1001, 16:58-62; EX1003, ¶108. Like Chandrasekhar-I, in Case 3 of the '251 patent, the first data field omits explicit bits for the muting subframe offset, as the muting subframe offset is known to be the same as the CSI-RS transmission offset. EX1001, 16:58-60, 17:29-40; EX1003, ¶108; *see* Section V.A.

Similarly, in another embodiment of the '251 patent with respect to FIG. 19,

a first data field 1910 does not contain any information bits expressly representing the muting subframe offset either, as the muting subframe offset is known to be the same as the CSI-RS transmission offset. EX1001, 27:42-44, 28:17-21; EX1003, ¶109. Specifically, the '251 patent describes "a region with 4 bits of '1010' indicating an actual muting duty cycle and a muting subframe offset." EX1001, 28:10-11. Although this 4-bit value explicitly represents only the muting duty cycle, the '251 patent still treats it as indicating both the muting duty cycle and the muting subframe offset because the muting subframe offset is assumed to be "identical to CSI-RS transmission offset." EX1001, 27:42-44, 28:12-21; EX1003, ¶109.

Accordingly, a POSITA would have understood that "*a first data field that indicates a cycle and an offset of muting subframes*" encompasses Chandrasekhar-I's approach, in which the parameter *PDSCHmutingdutycycle* expressly represents the muting duty cycle ("*cycle… of muting subframes*"), while the muting subframe offset ("*offset of muting subframes*") is conveyed through the CSI-RS subframe offset—an interpretation that aligns with the '251 patent's explicit teaching that the first data field may indicate the muting subframe offset based on the condition or assumption that the muting subframe offset is identical to the CSI-RS transmission

offset.[9] EX1003, ¶¶110-111.

Therefore, Chandrasekhar-I discloses [7.a.1] even when "*a first data field*" is interpreted to mean a single data field.

b. Chandrasekhar-I at least suggests [7.a.1].

Additionally or alternatively, Chandrasekhar-I at least suggests a jointly encoded muting duty cycle and muting subframe offset ("*a cycle and an offset of muting subframes*") indicated by "*a first data field*," even if the "*first data field*" is interpreted to mean a single data field.

To the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011, *i.e.*, where Chandrasekhar-I constitutes prior art without relying on the filing date of Chandrasekhar-I-Prov, Chandrasekhar-I expressly discloses that "muting configuration includes **a jointly encoded** muting duty cycle and subframe offset." EX1004, [0084]; *see* Sections IV.B, V.B.

Moreover, Chandrasekhar-I, as supported by Chandrasekhar-I-Prov, teaches joint signaling of two parameters—*PDSCHmutingenabled* and *CSIRSpattern*—for

[9] The '251 patent's embodiments related to Case 3 and FIG. 19 are within the challenged claims' scope because the '251 patent explicitly states that "[t]his first step can be divided into 5 cases according to a relation of a muting duty cycle and a muting offset with a CSI-RS transmission cycle and a CSI-RS transmission offset of a serving cell," "the first step may be realized by differentiation in various ways," and "[a] method for configuring a muting duty cycle or a muting offset indicated by the first data field is not limited thereto." EX1011, 13:64-67, 14:20-32, 19:40-44.

"CoMP joint processing." EX1004, [0049]; EX1005, 8 (§2.2) ("Joint signaling"). It is well known in the wireless communication field that jointly encoding and/or jointly signaling two parameters would reduce signaling overhead, thereby improving communication performance. EX1021, 11:20-23, 11:49-65; EX1022, 7:47-8:28, 27:51-55; EX1023, 8:39-9:6, 10:58-11:18; EX1003, ¶113. Numerous examples show that joint encoding and/or joint signaling of duty cycle and subframe offset of reference signals, such as CSI-RS and muting, had been proposed and implemented in the industry prior to the '215 patent. *See e.g.*, EX1010, 2 (§3.1); EX1012, 1 (§2), 4 (§6); EX1013, [0020], [0022], Claims 1-2; EX1023, 8:39-9:6, 10:58-11:18; EX1003, ¶113.

The issue of signaling overhead associated with PDSCH muting had already drawn attention in the industry before the '251 patent. EX1011, 7 (Qualcomm); EX1018, 1 (§1); EX1003, ¶114. Notably, Chandrasekhar-I itself specifically contemplates and compares various ways of reducing overall signaling overhead for PDSCH muting. EX1004, [0067]-[0069]; EX1005, 13 (§2.4). A POSITA would have been motivated to apply the same joint encoding and/or signaling techniques to other parameters specified by the muting patterns for CSI-RS muting, such as the muting duty cycle and muting subframe offset, in order to further facilitate CoMP joint processing and reduce overall signaling overhead in PDSCH muting. EX1003, ¶114.

A POSITA would have understood that a jointly encoded and/or signaled muting duty cycle and muting subframe offset is indicated by a single signal ("*data field*"). EX1003, ¶115. Accordingly, even under an interpretation of "*a first data field*" as meaning a single data field, Chandrasekhar-I still at least suggests [7.a.1].

3. Chandrasekhar-I discloses or at least suggests "*receiving CSI-RS muting information including … a second data field having n-bit bitmap, the n being an integer among 12 to 28, and each bit of the n-bit bitmap indicating whether to apply muting in the muting subframes*" [7.a.2].

As discussed in Section VII.B.1, Chandrasekhar-I discloses that the UE receives muting patterns ("*CSI-RS muting information*"). Chandrasekhar-I also discloses that the muting patterns also include the parameter *PDSCHmutingenabled* ("*second data field*") for signaling a PDSCH muting pattern, which has a bitmap of length N, where N is the reuse factor ("*n-bit bitmap*"). *See* Section VII.A. Chandrasekhar-I further discloses that a bit value 1 on the k-th bit position of the bitmap indicates that PDSCH is muted on the RE corresponding to the k-th CSI-RS pattern, while a bit value 0 indicates that PDSCH is not muted (muting disabled) on the corresponding CSI-RS pattern with the muting duty cycle and muting subframe offset ("*each bit of the n-bit bitmap indicating whether to apply muting in the muting subframes*"). *See* Section VII.A.

Specifically, Chandrasekhar-I describes that the muting patterns also specify "the index set of patterns (cells) corresponds to RE locations on which PDSCH RE

muting occurs" and defines a "higher-layer parameter *PDSCHmutingenabled*" to signal "PDSCH muting whether enabled or not," *i.e.*, the PDSCH muting pattern. EX1004, [0040], [0043], [0060]; EX1005, 7 (§2.1, ⁋8, §2.2), 10 (§3.3, ⁋2).

Chandrasekhar-I explains that *PDSCHmutingenabled* is represented as "a bitmap of length N, where N is the reuse factor." EX1004, [0060]; EX1005, 10 (§3.3, ⁋2). For example, the annotated FIG. 5 (EX1003, FIG. J) below illustrates the parameter *PDSCHmutingenabled* (highlighted in the red box) with a value of "11100," where "[a] bit value 1 on the k-th bit position indicates that PDSCH is muted on the RE corresponding to the k-th CSI-RS pattern" (highlighted in blue), while "[a] bit value 0 indicates that PDSCH is not muted (muting disabled) on the corresponding CSI-RS pattern" (highlighted in purple). EX1004, [0060]; EX1005, 10 (§3.3, ⁋3); EX1003, ¶117. Chandrasekhar-I also describes that "a length N bit map indicates PDSCH muting corresponding to the N CSI-RS patterns." EX1004, [0066]; EX1005, 11 (§3.3, ⁋4).

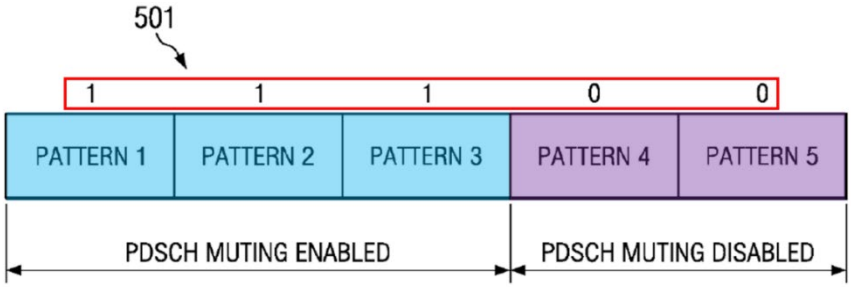


FIG. 5

EX1003 — FIG. J

Chandrasekhar-I also states that "[i]f the *PDSCHmutingenabled* parameter is

enabled for that corresponding pattern (cell), then the PDSCH REs shall be muted on the CSI-RS locations for that pattern (cell) with muting periodicity given by *PDSCHmutingdutycycle* [and] corresponding subframe offset [] determined by the parameter *CSIRSoffset*." EX1004, [0056]; EX1005, 9 (§3.2, ⁋6). A POSITA would have understood that the "*muting subframes*" are determined by the muting duty cycle and muting subframe offset indicated by the "*first data field*." EX1003, ¶118; *see* Section VIII.A, *infra*; EX1006, 4:37-46, FIG. 3; EX1007, 3 (Figure 1). Thus, Chandrasekhar-I discloses or at least suggests that each bit of the parameter *PDSCHmutingenabled* ("*the n-bit bitmap*") indicates whether to apply muting "*in the muting subframes.*"

As highlighted in the red box of the annotated TABLE 5 below, Chandrasekhar-I further discloses that the reuse factor N ("*n*") is based on the number of antenna ports, providing an exemplary possible reuse factor of **20** for 2 CSI-RS antenna ports (2Tx) in normal cyclic prefix (CP) under frame structure 1 (FS1), which falls within the claimed "*among 12 to 28*". EX1004, [0058], TABLE 5; EX1005, 6 (§1, ⁋2) ("a higher reuse factor [] **20** for 2Tx"); EX1003, ¶119. To the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011, *i.e.*, Chandrasekhar-I would nonetheless be considered prior art without relying on the filing date of Chandrasekhar-I-Prov, as highlighted in the green boxes of the annotated TABLE 5 below, Chandrasekhar-I further discloses additional reuse

factors, *e.g.*, 14, 16, and 28, which also fall into the claimed range of "*12 to 28*." EX1004, [0058], TABLE 5; EX1003, ¶119; *see* Sections IV.B, V.B.

TABLE 5

Configuration	2 CSI-RS ports	4 CSI-RS ports	8 CSI-RS ports
Normal CP (FS1)	20	10	5
Normal CP (FS2)	32	16	8
Extended CP (FS1)	16	8	4
Extended CP (FS2)	28	14	7

EX1003 — FIG. G

It is well established that when a claim recites a numerical range, the claimed range is anticipated by a prior art reference that discloses a point or an example within that range. *See Titanium Metals Corp. v. Banner*, 778 F.2d 775, 782 (Fed. Cir. 1985). Here, since [7.a.2] requires a range of "*among 12 to 28*" for the "*n bit*," disclosure of any integer within that range as the reuse factor N in Chandrasekhar-I is sufficient. Moreover, as discussed in Section V.A, the '251 patent does not enumerate every integer between "*12 to 28*"; rather, it discloses only four specific values: 12, 16, 20, and 28. EX1001, 23:18-65.

Thus, Chandrasekhar-I discloses or at least suggests [7.a.2].

4. Chandrasekhar-I discloses or at least suggests "*receiving a signal including data, mapped to resource elements using the CSI-RS muting information, the mapping process including a muting for zero power transmission*" [7.b].

Chandrasekhar-I discloses that the UE receives PDSCH ("*a signal including*

data") mapped to REs ("*resource elements*") using the muting patterns ("*CSI-RS muting information*"). *See* Section VII.A.

Chandrasekhar-I presents "signaling schemes to communicate muting patterns for intra-/inter-cell CSI estimation and for determining the RE positions around which its PDSCH is rate-matched." EX1004, [0051]; EX1005, 8 (§3, ⁋1). Chandrasekhar-I discloses that "UE needs to know the PDSCH mapping position in order to correctly interpret the code rate and decode its PDSCH," and "for UE configured in CoMP joint processing, PDSCH is rate matched around CSI-RS of all cells within the CoMP transmission/measurement set associated with the UE [such that] PDSCH on CSI-RS RE of the associated CoMP transmission/measurement set is muted." EX1004, [0031]-[0032]; EX1005, 6-7 (§2).

For instance, Chandrasekhar-I specifies that "[i]f the *PDSCHmutingenabled* parameter is enabled for that corresponding pattern (cell), then the PDSCH REs shall be muted on the CSI-RS locations for that pattern (cell) with muting periodicity given by *PDSCHmutingdutycycle* [and] corresponding subframe offset [] determined by the parameter *CSIRSoffset*." EX1004, [0056]; EX1005, 9 (§3.2, ⁋6). It is well known in the wireless communication area that PDSCH is a physical channel that carries data in downlink communication from a base station (*e.g.*, eNodeB) to a UE in LTE. EX1019, 312; EX1020, [0040]; EX1003, ¶121. Accordingly, a POSITA would have understood, or at least found it obvious, that the

muting patterns ("*CSI-RS muting information*"), including *PDSCHmutingenabled*, *PDSCHmutingdutycycle*, and *CSIRSoffset*, are used to map PDSCH ("*signal including data*") to REs ("*resource elements*"). EX1003, ¶121.

Chandrasekhar-I explains that the results of its PDSCH muting on REs include that "inter-cell CSI can be measured **free** from PDSCH interference from the serving cell" and "**no** PDSCH transmission occurs on RE corresponding to CSI-RS of serving and non-serving cells." EX1004, [0028], [0030]; EX1005, 2 (§3), 6 (§1, ⁋⁋1, 3). Moreover, it is well known in the wireless communication industry that muting implies zero power transmission without transmitting data mapped to REs. EX1006, 1:42-46; EX1007, 2 (§2, Claim 1, ⁋1); EX1016, 15:19-24; EX1017, [0112]; EX1003, ¶123. Accordingly, Chandrasekhar-I discloses or at least suggests "*the mapping process including a muting for zero power transmission.*"

Therefore, Chandrasekhar-I discloses or at least suggests [7.b].

From the foregoing, Chandrasekhar-I anticipates or otherwise renders obvious claim 7.

C. Dependent Claim 9

Claim 9 depends on claim 7 and additionally requires that "*the first data field is configured based on locations of the muting subframes to which the muting is applied* [9.a] *and a relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell* [9.b]."

1. Chandrasekhar-I discloses [9.a].

Chandrasekhar-I discloses that the muting subframe offset (indicated by "*the first data field*") is configured based on the relative positions ("*locations"*) of the muting subframes within each frame. For example, Chandrasekhar-I describes "a subframe offset **relative to the starting a subframe on each frame** on which intra-cell CSI-RS is transmitted, which is identical to the subframe offset on which muting is carried out." EX1004, [0040]; EX1005, 7 (§2.1, ⁋8); *see also* EX1004, [0054], [0057]; EX1005, 9 (§3.2, ⁋3), 10 (§3.2, ⁋1). As also discussed in Section VII.B.3, Chandrasekhar-I's muting subframe offset is used to determine the "*muting subframes*." EX1003, ¶124.

2. Chandrasekhar-I discloses or at least suggests [9.b].

Chandrasekhar-I also discloses or at least suggests that "*the first data field is configured based on … a relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell*."

The plain and ordinary meaning of "*relation*" is "an aspect or quality (as resemblance) that connects two or more things or parts as being or belonging or **working together** or as being of the same kind." EX1014, 1. A POSITA would have understood that the CSI-RS duty cycle and CSI-RS subframe offset in Chandrasekhar-I work together to define when CSI-RS are transmitted. EX1004, [0040], [0053]; EX1005, 7 (§2.1, ⁋6), 9 (§3.2, ⁋1); EX1003, ¶125. CSI-RS are

transmitted periodically, with a periodicity defined by the CSI-RS transmission/duty cycle, starting at a subframe defined by the CSI-RS subframe offset. EX1003, ¶125; *see* EX1016, 18:46-60, FIG. 13. The way in which the CSI-RS duty cycle and CSI-RS subframe offset operate together to define the CSI-RS transmission timing constitutes "an aspect … that connects" them "as being working together" and therefore satisfies the claimed "*relation*" under its plain and ordinary meaning. EX1014, 1; EX1003, ¶125.

Likewise, to define the timing when muting is applied (*i.e.*, the muting subframes), the muting duty cycle and muting subframe offset (indicated by "*the first data field*") also work together in the same manner—muting is applied to subframes periodically with a periodicity defined by the muting duty cycle, beginning at a subframe defined by the muting subframe offset—as that of the CSI-RS duty cycle and CSI-RS subframe offset. EX1003, ¶126; *see* EX1006, 4:37-46, FIG. 3; EX1007, 3 (Figure 1); *see also* Section VII.B.3. Thus, Chandrasekhar-I discloses or at least suggests that its "*first data field*" is configured in the same manner ("*based on*") in which the CSI-RS duty cycle and CSI-RS subframe offset work together to determine the CSI-RS transmission timing ("*a relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell*"). EX1003, ¶126.

Additionally or alternatively, the result or outcome of the CSI-RS duty cycle

and CSI-RS subframe offset—namely, the CSI-RS transmission itself—constitutes another "aspect … that connects" them "as being working together" and thus, also qualifies as the claimed "*relation*" under its plain and ordinary meaning. EX1014, 1; EX1003, ¶127. Since Chandrasekhar-I discloses "signaling schemes during eNodeB configuration of the UE to receive its CSI-RS including the subframe offset and duty cycle periodicity," a POSITA would have understood, or at least found it obvious, that the muting duty cycle and/or muting subframe offset (indicated by "*the first data field*") are configured based on the CSI-RS transmission ("*relation between CSI-RS transmission cycles and CSI-RS transmission offset"*). EX1004, [0051]; EX1005, 8 (§3, ⁋1); EX1003, ¶127.

As discussed above in Section V.B regarding written description for the relation limitation, to the extent that the Board finds the relation limitation (*e.g.*, [9.b]) is supported by the '251 patent specification (*e.g.*, Case 3 of the first step S1605), Chandrasekhar-I likewise discloses [9.b]. Chandrasekhar-I teaches that the muting subframe offset and muting duty cycle (indicated by "*the first data field*") are configured based on "*a relation*" wherein (i) the CSI-RS subframe offset ("*CSI-RS transmission offset*") is equal to the muting subframe offset, and (ii) the CSI-RS duty cycle ("*CSI-RS transmission cycles*") is separate from the muting duty cycle —thus satisfying the claimed "*relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell,*" according to the '251

patent. *See* Section V.A; EX1003, ¶128.

Specifically, as discussed above in Section VII.B.2, Chandrasekhar-I discloses "a subframe offset relative to the starting subframe on each frame on which intra-cell CSI-RS is transmitted, which is identical to the subframe offset on which muting is carried out" and "CSI-RS subframe offset … implicitly equals the subframe offset of PDSCH RE muting." EX1004, [0040], [0046]; EX1005, 7 (§2.1, ⁋8), 8 (§2.2), 14 (§3, ⁋6). Chandrasekhar-I also discloses that the "muting duty cycle is configured separately from the CSI-RS duty cycle." EX1004, [0038]; EX1005, 7 (§2.1, ⁋6).

This mapping in Chandrasekhar-I is consistent with the '251 patent's explanation of the "*relation*," wherein the '251 patent states that "[t]his first step can be divided into 5 cases according to a **relation** of a muting duty cycle and a muting offset with a CSI-RS transmission cycle and a CSI-RS transmission offset of a serving cell… the first step may be realized by differentiation in various ways according to a **relation** of a subframe which requires muting (that is, a muting subframe) among CSI-RS of a serving cell with a CSI-RS transmission cycle and a CSI-RS transmission offset of the serving cell or the neighboring cell." EX1001, 14:20-32. In particular, the mapping in Chandrasekhar-I aligns with at least Case 3 of the '251 patent in which the muting subframe offset is the same as the CSI-RS transmission offset of the serving cell, while the muting duty cycle is different from

the CSI-RS transmission cycle of the serving cell. EX1001, 16:58-62; EX1003, ¶129.

From the foregoing, Chandrasekhar-I anticipates or otherwise renders obvious claim 9.

D. Dependent Claim 10

Claim 10 depends on claim 7 and additionally requires that "*each bit of the n-bit bitmap indicates whether to apply muting for resource elements corresponding to a CSI-RS pattern for a specific number of antenna ports*."

As discussed above in Section VII.B.3, Chandrasekhar-I discloses that each bit of *PDSCHmutingenabled* ("*N-bit bitmap*") indicates whether PDSCH is muted on the RE corresponding to the respective CSI-RS pattern ("*whether to apply muting for resource elements corresponding to a CSI-RS pattern*"). EX1004, [0060]; EX1005, 10 (§3.3, ⁋3).

Chandrasekhar-I further describes, with respect to TABLE 5, "the available reuse factor (N) for different number[s] of eNodeB CSI-RS antenna ports." EX1004, [0058]; EX1005, 6 (§1, ⁋2). To the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011, *i.e.*, where Chandrasekhar-I constitutes prior art without relying on the filing date of Chandrasekhar-I-Prov, Chandrasekhar-I additionally discloses configuring *PDSCHmutingenabled* ("*second data field*") by "a sequence $\{T_1, T_2 \ldots T_M\}$ wherein T_i for $1 \leqq i \leqq M$ refers to the number of CSI-RS antenna ports for cell (CSI-RS pattern) i." EX1004, [0066].

Thus, Chandrasekhar-I discloses that the available reuse factor N, *i.e.*, the number of CSI-RSI patterns, is determined based, at least in part, on the specific number (*e.g.*, 2Tx, 4Tx, or 8Tx) of the CSI-RS antenna ports ("*antenna ports*").

Therefore, Chandrasekhar-I anticipates or otherwise renders obvious claim 10.

E. Dependent Claim 11

Claim 11 depends on claim 7 and additionally requires that "*the second data field is configured as a 16-bit bitmap, each bit of the 16-bit bitmap indicating a CSI-RS pattern to be muted based on a specific number of antenna ports*."

As discussed above in Sections VII.B.3 and VII.D, to the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011, *i.e.*, where Chandrasekhar-I constitutes prior art without relying on the filing date of Chandrasekhar-I-Prov, Chandrasekhar-I discloses that *PDSCHmutingenabled* ("*second data field*") is configured as a 14-bit bitmap, **16-bit bitmap**, 20-bit bitmap, or 28-bit bitmap, each bit of the 14-bit bitmap, **16-bit bitmap**, 20-bit bitmap, or 28-bit bitmap indicating a CSI-RS pattern to be muted based on the 2 or 4 CSI-RS antenna ports ("*a specific number of antenna ports*"). EX1004, [0058], TABLE 5.

Moreover, the claimed "*16-bit bitmap*" would have been obvious to a POSITA in view of Chandrasekhar-I (along with Chandrasekhar-I-Prov)'s disclosure of the 20-bit bitmap, because selecting the specific number 16 for the N-bit bitmap is merely a matter of obvious design choice. EX1004, [0058], TABLE 5;

EX1005, 6 (§1, ⁋2); EX1003, ¶¶134-135. There are a finite number of possibilities for the bitmap that would be utilized. EX1003, ¶134. The claimed "*16-bit bitmap*" constitutes an obvious design choice because the specification of the '251 patent does not describe or suggest that the value 16 is critical to the claimed invention. *See Ex parte Spangler*, Appeal No. 2018-003800 at 6 (PTAB Feb. 20, 2019) (informative). As discussed above in Section V.A, the '251 patent merely identifies a "*16-bit bitmap*" as one among several examples (*e.g.*, 12-bit, 16-bit, 20-bit, and 28-bit bitmaps) for the second data field, depending, in part, on the number of antenna ports. EX1001, 23:16-65. The selection of "*16-bit bitmap*," however, "solves no stated problem" and "presents no novel or unexpected result" over the disclosed alternatives, such as the 12-bit, 20-bit, and 28-bit bitmaps. *See In re Kuhle,* 526 F.2d 553, 555 (CCPA 1975); EX1003, ¶135.

From the foregoing, Chandrasekhar-I anticipates or otherwise renders obvious claim 11.

F. Independent Claim 12

1. Chandrasekhar-I discloses "*[a] user equipment to receive Channel State Information-Reference Signal (CSI-RS) muting information from a serving cell, the user equipment comprising*" [12.P].

As discussed above in Section VII.B.1, Chandrasekhar-I discloses a UE that performs the "*method for receiving Channel State Information-Reference Signal*

(CSI-RS) muting information from a serving cell." Thus, Chandrasekhar-I also discloses [12.P].

2. Chandrasekhar-I discloses or at least suggests "*a processor configured to receive and determine CSI-RS muting information including a first data field that indicates a cycle and an offset of muting subframes and a second data field having n-bit bitmap, the n being an integer among 12 to 28, each bit of the n-bit bitmap indicating whether to apply muting in the muting subframes*" [12.a].

As discussed above in Sections VII.B.2 and VII.B.3, Chandrasekhar-I discloses or at least suggests that the UE performs the functions recited in [12.a], which are substantially the same as [7.a.1] and [7.a.2].

To the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011, *i.e.*, where Chandrasekhar-I constitutes prior art without relying on the filing date of Chandrasekhar-I-Prov, Chandrasekhar-I discloses that the UE (*e.g.*, 1001) includes a processor 1010 "suitable for implementing this invention," which includes receiving and determining muting patterns for CSI-RS measurement. EX1004, [0023], [0088], FIG. 11; *see* Sections VII.B.2-VII.B.3. Moreover, a POSITA would have understood, or at least found it obvious, that the UE engages in processing activities typically performed by a processor, as is well known in the art. EX1005, 7 (§2) ("[p]referably for **UE configured** in CoMP joint **processing**"); EX1003, ¶139.

Thus, Chandrasekhar-I discloses or at least suggests [12.a].

3. Chandrasekhar-I discloses or at least suggests "*a receiver to receive a signal including data, mapped to resource elements using the CSI-RS muting information, the mapping process including a muting for zero power transmission*" [12.b].

As discussed above in Section VII.B.4, Chandrasekhar-I discloses or at least suggests that the UE performs the functions recited in [12.b], which are substantially the same as [7.b].

To the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011, *i.e.*, where Chandrasekhar-I constitutes prior art without relying on the filing date of Chandrasekhar-I-Prov, Chandrasekhar-I discloses that the UE (*e.g.*, 1001) includes a receiver 1022 "suitable for implementing this invention," which includes receiving PDSCH mapped to REs using the muting patterns. EX1004, [0023], [0088]-[0089], FIG. 11; *see* Section VII.B.4. Moreover, a POSITA would have understood, or at least found it obvious, that the UE engages in receiving activities typically performed by a receiver, as is well known in the art. EX1005, 8, (§3, ⁋1) ("**UE to receive** its CSI-RS including the subframe offset and duty cycle periodicity"); EX1003, ¶141.

Thus, Chandrasekhar-I discloses or at least suggests [12.b].

From the foregoing, Chandrasekhar-I anticipates or otherwise renders obvious claim 12.

G. Dependent Claim 14

Claim 14 depends on claim 12 and additionally requires that "*the first data field is configured based on locations of the muting subframes to which the muting is applied and a relation between CSI-RS transmission cycles and CSI-RS transmission offset of the serving cell or the neighboring cell*." Chandrasekhar-I discloses or at least suggests claim 14, which is substantially the same as claim 9. *See* Section VII.C.

Thus, Chandrasekhar-I anticipates or otherwise renders obvious claim 14.

H. Dependent Claim 15

Claim 15 depends on claim 12 and additionally requires that "*each bit of the n-bit bitmap indicates whether to apply muting for resource elements corresponding to a CSI-RS pattern for a specific number of antenna ports*." Chandrasekhar-I discloses claim 15, which is substantially the same as claim 10. *See* Section VII.D.

Thus, Chandrasekhar-I anticipates or otherwise renders obvious claim 15.

I. Dependent Claim 16

Claim 16 depends on claim 12 and additionally requires that "*the second data field is configured as a 16-bit bitmap, each bit of the 16-bit bitmap indicating a CSI-RS pattern to be muted based on a specific number of antenna ports*." Chandrasekhar-I discloses or at least suggests claim 16, which is substantially the same as claim 11. *See* Section VII.E.

Thus, Chandrasekhar-I anticipates or otherwise renders obvious claim 16.

VIII. GROUND 3: CHANDRASEKHAR-I IN VIEW OF CHANDRASEKHAR-II RENDERS OBVIOUS CLAIMS 7, 9-12, AND 14-16

As discussed in Section VII, Chandrasekhar-I anticipates or otherwise renders obvious claims 7, 9-12, and 14-16. To the extent further disclosures are required, Chandrasekhar-I in view of Chandrasekhar-II renders these claims obvious.

A. Overview of Chandrasekhar-II

Chandrasekhar-II is also directed to wireless communication in the CoMP environment. EX1006, 1:15-38; EX1007, 1 (§1). Similar to Chandrasekhar-I, Chandrasekhar-II discloses PDSCH RE muting schemes to perform inter-cell CSI estimation at a UE configured for CoMP reception to enable the UE to measure its CSI to the serving cell more accurately. EX1006, 1:42-58, 3:62-65; EX1007, 1 (§2).

For example, as shown in the annotated FIG. 3 of Chandrasekhar-II (EX1003, FIG. H) below, Chandrasekhar-II discloses PDSCH muting-enabled subframes, such as subframe k 301 (highlighted in yellow), which is determined by muting duty cycle (labeled in green) ("duty cycle (time domain periodicity) of PDSCH muting enabled sub-frames equals 10 ms") and muting subframe offset (labeled in red) (k from the starting subframe 0 in the frame). EX1006, 4:28-46; EX1007, 2-3 (§2, Claim 2, Figure 1); EX1003, ¶94.

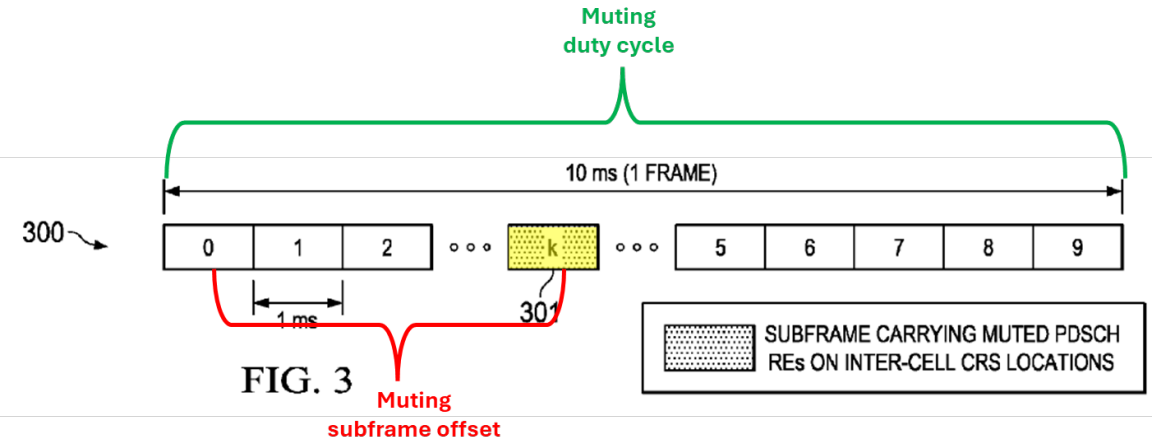


FIG. 3

EX1003 — FIG. H

Particularly, Chandrasekhar-II discloses that "the eNodeB **jointly encodes S_1 and S_2 and send[s] a single signal S** transmitting the PDSCH muting … by the sub-frame offset and time domain periodicity," where "S_1 is four bits which communicate the sub-frame offset on which PDSCH muting for inter-cell CSI estimation occurs" and "S_2 is two bits which communicate the time domain periodicity of PDSCH muting enabled sub-frames." EX1006, 4:57-5:4; EX1007, 3-4 (§2, Claims 3a-3b); EX1003, ¶95.

B. Reasons to Combine Chandrasekhar-I and Chandrasekhar-II

As discussed in Section VII.B.2, Chandrasekhar-I discloses or at least suggests "*a first data field that indicates a cycle and an offset of muting subframes*." To the extent that this limitation requires a single data field indicating both the cycle and the offset of muting subframes, a POSITA would also have been motivated to combine Chandrasekhar-I and Chandrasekhar-II to render this limitation obvious, in

addition to the discussions in Section VII.B.2.

As discussed in Section VIII.A, Chandrasekhar-II explicitly discloses jointly encoding the PDSCH muting duty cycle and muting subframe offset into a single signal. EX1006, 4:57-5:4; EX1007, 3-4 (§2, Claims 3a-3b). Thus, even if Chandrasekhar-I relies on Chandrasekhar-I-Prov's priority date as prior art, a POSITA would still have been motivated to combine Chandrasekhar-I and Chandrasekhar-II to jointly encode the muting duty cycle and muting subframe offset in Chandrasekhar-I into a single signal, such that the muting duty cycle and muting subframe offset are indicated by a single data field, even under an interpretation that requires a single data field, as explained below in detail.[10] EX1003, ¶147.

1. The teaching, suggestion, and motivation in Chandrasekhar-I and Chandrasekhar-II would have led a POSITA to jointly encode Chandrasekhar-I's muting duty cycle and muting subframe offset in its signaling schemes.

Chandrasekhar-I specifically contemplates and compares various approaches for reducing overall signaling overhead in its signaling schemes for PDSCH muting. EX1004, [0067]-[0069]; EX1005, 13 (§2.4). Chandrasekhar-I discloses one method

[10] Chandrasekhar-I alone explicitly discloses the joint encoding of muting duty cycle and muting subframe offset, to the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011. *See* Section VII.B.2.b.

to reduce signaling overhead, namely jointly signaling *PDSCHmutingenabled* and *CSIRSpattern*, which are parameters of the muting patterns. EX1004, [0049]; EX1005, 8 (§2.2) ("Joint signaling"); *see* Section VII.B.2.b. Thus, a POSITA, reviewing Chandrasekhar-I, would have been motivated to explore modifications that could further reduce the signaling overhead of the muting patterns from other parameters therein based on the similar joint processing approach disclosed by Chandrasekhar-I. EX1003, ¶¶149-151.

Naturally, Chandrasekhar-II would be an obvious candidate for a POSITA to consult for such potential modifications, as both Chandrasekhar-I and Chandrasekhar-II were invented by the same first inventor at roughly the same time and for the same assignee (Texas Instruments). *Compare* EX1004, Codes (75), (73), (22), (60) *with* EX1006, Codes (75), (73), (22), (60); EX1003, ¶152.

Like Chandrasekhar-I, Chandrasekhar-II teaches PDSCH muting at each PDSCH muting enabled sub-frame, determined by the parameters of muting duty cycle (*e.g.*, S_1) and muting subframe offset (*e.g.*, S_2), for enabling CSI-RS estimation. EX1006, 4:28-67; EX1007, 2-3 (§2, Claims 2, 3a, Figures 1-2); EX1003, ¶153; *see* Section VIII.A. Notably, Chandrasekhar-II provides a solution to further reduce signaling overhead of muting patterns: "the eNodeB **jointly encodes S_1 and S_2 and send[s] a single signal S** transmitting the PDSCH muting … by the sub-frame offset and time domain periodicity." EX1006, 5:1-4; EX1007, 4 (§2, Claim 3b).

A POSITA, upon reviewing the teachings of Chandrasekhar-I and Chandrasekhar-II, would recognize the opportunity and advantages to combine these concepts from Chandrasekhar-I and Chandrasekhar-II. EX1003. EX1003, ¶154. Specifically, by integrating the joint encoding technique from Chandrasekhar-II with the muting duty cycle and muting subframe offset parameters already disclosed in Chandrasekhar-I, the overhead associated with transmitting muting patterns in Chandrasekhar-I's signaling schemes could be further reduced. EX1003, ¶154. This would align with Chandrasekhar-I's goal of minimizing signaling overhead while enhancing system efficiency. EX1003, ¶154. By adopting this combination, a POSITA would further advance the reduction of overall signaling overhead, which is essential for improving the scalability and performance of wireless networks. EX1003, ¶155.

2. The proposed combination merely applies Chandrasekhar-II's known technique of jointly encoding muting duty cycle and muting subframe offset to improve Chandrasekhar-I's similar method and system in the same way to yield predictable results.

In fact, the wireless communication society widely recognizes that jointly encoding two signals (parameters) can save the number of bits that need to be transmitted, thereby reducing overhead and improving overall communication performance. EX1021, 11:20-23, 11:49-65; EX1023, 10:58-11:18; EX1003, ¶157. The issue of overhead in PDSCH muting had already drawn attention within the

industry before the '251 patent. EX1011, 7 (Qualcomm); EX1018, 1 (§1); EX1003, ¶157. The ability to efficiently manage and minimize signaling overhead is critical in optimizing wireless communication, especially for resource-limited systems such as those involving CoMP joint processing. EX1003, ¶157.

Moreover, numerous examples from the wireless industry, which predate the '251 patent, have demonstrated that duty cycle and subframe offset parameters—particularly those related to reference signals like CSI-RS—should be, and often were, combined (*i.e.*, jointly encoded) into a single signal to reduce overhead. *See, e.g.*, EX1006, 5:1-4; EX1007, 4 (§2, Claim 3b); EX1010, 2 (§3.1); EX1012, 1 (§2), 4 (§6); EX1013, [0020], [0022], Claims 1-2; EX1023, 8:39-9:6, 10:58-11:18; EX1003, ¶158. These examples further establish that the joint encoding of such parameters was not a novel or unexpected development at the time of the '251 patent, but rather an established and widely acknowledged technique within the industry for optimizing system performance. EX1003, ¶158. In particular, U.S. Patent No. 9,439,172 to Mazzarese *et al*. (hereinafter "Mazzarese," EX1023), submitted at about the same time as Chandrasekhar-I and Chandrasekhar-II, teaches joint encoding of CSI-RS duty cycle and offset, as well as joint encoding of muting duty cycle and offset, in order to reduce overhead. EX1023, 8:39-9:6, 10:58-11:18; EX1003, ¶159.

Therefore, a POSITA would have been motivated to apply Chandrasekhar-

II's known technique of jointly encoding the muting duty cycle and muting subframe offset to Chandrasekhar-I's similar wireless communication system, such that the PDSCH muting duty cycle and the muting subframe offset in Chandrasekhar-I are also indicated by a single signal/parameter. EX1003, ¶160.

Incorporation of the joint encoding technique from Chandrasekhar-II into Chandrasekhar-I's wireless communication system would have resulted in a predictable result of signaling overhead reduction. This reduction would address the downlink signaling from the eNodeB to the UE in Chandrasekhar-I, a well-recognized challenge in wireless communication systems. EX1003, ¶161. By jointly encoding the muting duty cycle and muting subframe offset into a single compact representation, a POSITA would expect a corresponding decrease in the number of bits required for reference signaling, thereby enhancing overall system performance—particularly in CoMP environments where signaling efficiency is essential. EX1003, ¶161.

3. A POSITA would have a reasonable expectation of success in combining Chandrasekhar-I and Chandrasekhar-II.

A POSITA would have a reasonable expectation of success in combining Chandrasekhar-I and Chandrasekhar-II, at least because the proposed combination would yield predictable results.

Both Chandrasekhar-I and Chandrasekhar-II are analogous art, within the

same field as the '251 patent, which pertains to wireless communication in a CoMP environment. EX1001, 1:26-31, 9:62-66; EX1004, [0002], [0032], [0049]; EX1005, 2-3 (§§3-4), 7 (§2), 12 (§2.3, ⁋⁋1-2); EX1006, 1:15-38; EX1007, 1 (§1). Both Chandrasekhar-I and Chandrasekhar-II also address the same problem outlined in the '251 patent, specifically interference between CoMP cells at the UE in CSI-RS measurement when performing PDSCH muting. EX1001, 1:31-35; EX1004, [0033]; EX1005, 7 (§2.1, ⁋2); EX1006, 1:42-58, 3:62-65; EX1007, 1 (§2); EX1003, ¶163.

Moreover, Chandrasekhar-II's joint encoding technique is directly applicable to Chandrasekhar-I's system and method because of the substantial similarities between the two systems. EX1003, ¶164. As discussed in Sections VII.A and VIII.A, Chandrasekhar-I and Chandrasekhar-II disclose substantially the same muting information signaling schemes and PDSCH RE muting schemes for performing CSI-RS measurement at the UE using the muting information, including muting duty cycle and muting subframe offset, as required by the challenged claims. EX1003, ¶164.

A POSITA would have found it routine, straightforward, and advantageous to apply Chandrasekhar-II's jointly encoded single signal for muting duty cycle and muting subframe offset to Chandrasekhar-I's signaling schemes. EX1003, ¶165. In particular, Chandrasekhar-I discloses a joint signaling approach in CoMP joint processing for *PDSCHmutingenabled* and *CSIRSpattern*, which are also parameters

of the muting patterns within Chandrasekhar-I's muting signaling scheme. EX1004, [0049]; EX1005, 8 (§2.2) ("Joint signaling"); *see* Section VII.B.2.b. Thus, Chandrasekhar-I's system and method are well-suited and compatible with CoMP joint processing techniques, which could also be applied to muting duty cycle and muting subframe offset. EX1003, ¶165.

Moreover, performing joint encoding of two reference signal parameters in LTE would have been well within a POSITA's common knowledge and capabilities, without undue burden, and with a reasonable expectation of success, as evidenced by numerous industry examples proposed and implemented prior to the '251 patent. *See, e.g.*, EX1010, 2 (§3.1); EX1012, 1 (§2), 4 (§6); EX1013, [0020], [0022], Claims 1-2; EX1023, 8:39-9:6, 10:58-11:18; EX1003, ¶166. The proposed combination would not impair the functionality of Chandrasekhar-I's UE, nor would it complicate the signaling schemes. EX1003, ¶166.

C. Independent Claims 7 and 12

To the extent that additional disclosures are needed to disclose or suggest "*a first data field that indicates a cycle and an offset of muting subframes*" in claims 7 and 12 under an interpretation that requires a single data field, besides Chandrasekhar-I's disclosures and suggestions explained in Section VII.B.2, Chandrasekhar-II provides explicit teaching. EX1006, 5:1-4; EX1007, 4 (§2, Claim 3b); *see* Section VIII.A. Chandrasekhar-I discloses or at least suggests other

limitations of claims 7 and 12. *See* Sections VII.B.1, VII.B.3-VII.B.4. A POSITA would have been motivated to combine Chandrasekhar-I and Chandrasekhar-II to arrive at the claimed subject matter recited in claims 7 and 12. *See* Section VIII.B.

Therefore, Chandrasekhar-I in view of Chandrasekhar-II renders obvious independent claims 7 and 12.

D. Dependent Claims 9-11 and 14-16

Claims 9-11 and 14-16 depend on independent claims 7 and 12, respectively, and additionally require limitations that, as discussed above, are disclosed or at least suggested by Chandrasekhar-I. *See* Sections VII.C-VII.E, VII.G-VII.I.

Therefore, Chandrasekhar-I in view of Chandrasekhar-II renders obvious claims 9-11 and 14-16.

IX. GROUND 4: CHANDRASEKHAR-I IN VIEW OF TI RENDERS OBVIOUS CLAIMS 7, 9-12, AND 14-16

As discussed above in Section VII, Chandrasekhar-I anticipates or otherwise renders obvious claims 7, 9-12, and 14-16. Additionally, to the extent further disclosures are required, Chandrasekhar-I in view of TI renders these claims obvious.

A. Overview of TI

TI proposes various intra-cell and inter-cell CSI-RS patterns and reuse factors achieved for different numbers of antenna ports (APs). EX1008, 1 (§1, ⁋2). Like Chandrasekhar-I, TI is also related to "muting aspects on PDSCH REs for inter-cell CSI channel estimation for DL CoMP." EX1008, 1 (§2, ⁋2). Similar to

Chandrasekhar-I, TI states that "PDSCH muting … (for 2/4 AP eNodeBs) provides compelling benefits in terms of its higher RE density within each subframe." EX1008, 1 (§2, ¶2).

Specifically, TI proposes CSI-RS patterns and corresponding reuse factors for both normal CP transmission and extended CP transmission according to different numbers of antenna ports (*e.g.*, 2Tx, 4Tx, and 8Tx). EX1008, 3-7 (§3); EX1003, ¶97.

For example, as shown in the annotated Tables 1 and 3 of TI (EX1003, FIG. I) below, TI specifies the achievable numbers of reuse factors—12, 16, and 28 (in the red boxes)—which fall within the "*among 12 to 28*" range recited in the challenged independent claims 7 and 12 for a specific number of antenna ports (*e.g.*, 2 or 4 CSI-RS ports). EX1008, 4 (Table 1), 6 (Table 3); EX1003, ¶97. TI highlights that the "achievable reuse factors [are presented] taking into account the antenna port configuration at the serving cell." EX1008, 8 (§5).

Table 1: Reuse factors for different number of CSI-RS ports and normal CP transmission

Configuration	2 CSI-RS ports	4 CSI-RS ports	8 CSI-RS ports
With Port 5	19	8	4
Without Port 5	19	8	4
Without Ports 2/3	28	12	6

Table 3: Reuse factors for different number of CSI-RS ports and extended CP transmission

Configuration	2 CSI-RS ports	4 CSI-RS ports	8 CSI-RS ports
With Port 5	12	6	3
Without Port 5	12	6	3
Without Ports 2/3	16	8	4

EX1003 — FIG. I

B. Reasons to Combine Chandrasekhar-I and TI

As discussed in Section VII.B.3, Chandrasekhar-I discloses or at least suggests "*a second data field having n-bit bitmap, the n being an integer among 12 to 28*." To the extent that the claimed "*among 12 to 28*" range requires additional values beyond 20 (which Petitioner does not concede) and for the sake of completeness, TI further explicitly discloses all remaining values disclosed by the '251 patent within that range—12, 16, and 28—in addition to what is discussed in Section VII.B.3. EX1001, 23:18-65; EX1008, 4 (Table 1), 6 (Table 3); *see* Section VII.B.3.

Thus, even if Chandrasekhar-I constitutes prior art only when it has the benefit of Chandrasekhar-I-Prov's priority date, a POSITA would have been motivated to combine Chandrasekhar-I and TI, such that the reuse factor N of Chandrasekhar-I would still include all four integers (*i.e.*, 12, 16, 20, and 28) disclosed by the '251 patent because of the "interrelated teachings" from Chandrasekhar-I and TI. *See Plantronics, Inc. v. Aliph, Inc.*, 724 F.3d 1343, 1354 (Fed. Cir. 2013).[11] EX1003, ¶170.

Chandrasekhar-I and TI are analogous art, in the same field as the '251 patent,

[11] Chandrasekhar-I alone explicitly discloses all four values to the extent that the '251 patent is not entitled to a priority date earlier than August 11, 2011. *See* Section VII.B.3.

which relates to wireless communication in a CoMP environment. EX1001, 1:26-31, 9:62-66; EX1004, [0002], [0032], [0049]; EX1005, 2-3 (§§3-4), 7 (§2), 12 (§2.3, ⁋⁋1-2); EX1008, 1 (§2, ⁋2). Both Chandrasekhar-I and TI are pertinent to the purported problem addressed by the '251 patent of interference between CoMP cells at the UE in CSI-RS measurement when performing PDSCH muting. EX1001, 1:31-35; EX1004, [0033]; EX1005, 7 (§2.1, ⁋2); EX1008, 1-2 (§2); EX1003, ¶171.

Chandrasekhar-I and TI were both submitted by the same party (Texas Instruments) around the same time (mid-2010). *Compare* EX1004, Codes (73), (60) *with* EX1008, 1. As discussed in Sections VII.A and IX.A, both Chandrasekhar-I and TI address muting aspects on PDSCH REs for inter-cell CSI channel estimation for CoMP. EX1003, ¶172.

Chandrasekhar-I outlines considerations for determining the values of CSI-RS pattern/reuse factors, including the number of CSI-RS antenna ports, normal or extended CP, and frame structures (FS). EX1004, [0058], TABLE 5; EX1005, 6 (§1, ⁋2). TI not only discloses the same considerations for determining the values of CSI-RS pattern/reuse factors, but also specifically teaches additional reuse factors disclosed by the '251 patent: 12, 16, and 28. EX1008, 4 (Table 1), 6 (Table 3). Notably, the values 12, 16, 20, and 28 disclosed in Chandrasekhar-I and TI are all based on the same number of CSI-RS antenna ports, *i.e.*, 2Tx, which also matches that of the '251 patent for its disclosed bitmap values of 12, 16, 20, and 28. EX1001,

23:16-65; EX1004, [0058], TABLE 5; EX1005, 6 (§1, ⁋2); EX1008, 4 (Table 1), 6 (Table 3); EX1003, ¶173.

Accordingly, a POSITA, reviewing Chandrasekhar-I in conjunction with TI and considering the same number of CSI-RS antenna ports (*i.e.*, 2Tx), would have understood Chandrasekhar-I to also utilize 12, 16, and 28 as achievable values for the reuse factor N in various scenarios (*e.g.*, normal or extended CP, and/or different FSs), as disclosed or suggested by TI. EX1008, 4 (Table 1), 6 (Table 3); EX1003, ¶174. This is further evidenced by Mazzarese, submitted at about the same time as Chandrasekhar-I and TI, which also discloses reuse factor values, including 12, 16, 20, and 28, considering the 2 CSI-RS antenna ports and normal and extended CPs. EX1023, 5:27-41, TABLE 1, 9:35-51; EX1003, ¶175.

Therefore, a POSITA would have been motivated to combine Chandrasekhar-I with TI's explicit teaching of reuse factors being 12, 16, and 28, which would naturally extend to Chandrasekhar-I's disclosure for a reuse factor of 20 under the same 2 CSI-RS antenna ports, thereby supplementing any alleged missing details of Chandrasekhar-I. EX1003, ¶176.

C. Independent Claims 7 and 12

To the extent that additional disclosures are needed to disclose or suggest "*a second data field having n-bit bitmap, the n being an integer among 12 to 28*" in claims 7 and 12 that requires additional values beyond 20, besides Chandrasekhar-

I's disclosures and suggestions explained in Section VII.B.3, TI provides explicit teaching. EX1008, 4 (Table 1), 6 (Table 3); *see* Section IX.A. Chandrasekhar-I discloses or at least suggests other limitations of claims 7 and 12. *See* Sections VII.B.1-VII.B.2, VII.B.4. A POSITA would have been motivated to combine Chandrasekhar-I and TI to arrive at the claimed subject matter recited in claims 7 and 12. *See* Section IX.B.

Therefore, Chandrasekhar-I in view of TI renders obvious independent claims 7 and 12.

D. Dependent Claims 9, 10, 14, and 15

Claims 9, 10, 14, and 15 depend on independent claims 7 and 12, respectively, and additionally require limitations that, as discussed above, are disclosed or at least suggested by Chandrasekhar-I. *See* Sections VII.C-VII.D, VII.G-VII.H.

Therefore, Chandrasekhar-I in view of TI renders obvious claims 9, 10, 14, and 15.

E. Dependent Claims 11 and 16

Claims 11 and 16 depend on independent claims 7 and 12, respectively, and additionally require that "*the second data field is configured as a 16-bit bitmap, each bit of the 16-bit bitmap indicating a CSI-RS pattern to be muted based on a specific number of antenna ports*."

TI teaches an achievable re-user factor of 16 ("*16-bit bitmap*"), indicating

muting of CSI-RS patterns based on 2 CSI-RS antenna ports ("*a specific number of antenna ports*"). EX1008, 6 (Table 3); *see* Section IX.A.

Therefore, Chandrasekhar-I in view of TI renders obvious claims 11 and 16.

X. GROUND 5: CHANDRASEKHAR-I IN VIEW OF CHANDRASEKHAR-II AND FURTHER IN VIEW OF TI RENDERS OBVIOUS CLAIMS 7, 9-12, AND 14-16

As discussed above in Section VIII, Chandrasekhar-I in view of Chandrasekhar-II renders obvious claims 7, 9-12, and 14-16. To the extent further disclosures are needed for claims 7, 11, 12, and/or 16, Chandrasekhar-I in view of Chandrasekhar-II and further in view of TI renders claims 7, 9-12, and 14-16 obvious.

A. Reasons to Combine Chandrasekhar-I in View of Chandrasekhar-II and TI

As discussed above in Section VIII.B, a POSITA would have been motivated to combine Chandrasekhar-I and Chandrasekhar-II because (i) the proposed combination is merely applying Chandrasekhar-II's known technique of jointly encoding muting duty cycle and muting subframe offset to improve Chandrasekhar-I's similar method and system in the same way to yield predictable results; (ii) the teaching, suggestion, and motivation in Chandrasekhar-I and Chandrasekhar-II would have led a POSITA to apply Chandrasekhar-II's joint encoding technique to Chandrasekhar-I's signaling of muting duty cycle and muting subframe offset as well; and (iii) a POSITA would have a reasonable expectation of success in

combining Chandrasekhar-I and Chandrasekhar-II. EX1003, ¶182.

As discussed above in Section IX.B, a POSITA would have been further motivated to combine Chandrasekhar-I/Chandrasekhar-II and TI, such that the reuse factor N of Chandrasekhar-I/Chandrasekhar-II includes all four possible integers (*i.e.*, 12, 16, 20, and 28) disclosed in the '251 patent due to the "interrelated teachings" from Chandrasekhar-I/Chandrasekhar-II and TI. EX1003, ¶183.

B. Independent Claims 7 and 12

To the extent that additional disclosures are needed to disclose or suggest "*a second data field having n-bit bitmap, the n being an integer among 12 to 28*" in claims 7 and 12 that requires additional values beyond 20, besides Chandrasekhar-I's disclosures and suggestions explained in Section VII.B.3, TI provides explicit teaching. EX1008, 4 (Table 1), 6 (Table 3); *see* Section IX.A. Chandrasekhar-I in view of Chandrasekhar-II discloses or at least suggests other limitations of claims 7 and 12. *See* Section VIII.C. A POSITA would have been motivated to combine Chandrasekhar-I/Chandrasekhar-II and TI to arrive at the claimed subject matter recited in claims 7 and 12. *See* Section X.A.

Therefore, Chandrasekhar-I in view of Chandrasekhar-II and further in view of TI renders obvious independent claims 7 and 12.

C. Dependent Claims 9, 10, 14, and 15

Claims 9, 10, 14, and 15 depend on independent claims 7 and 12, respectively,

and additionally require limitations that, as discussed above, are disclosed or at least suggested by Chandrasekhar-I in view of Chandrasekhar-II. *See* Section VIII.D.

Therefore, Chandrasekhar-I in view of Chandrasekhar-II and further in view of TI renders obvious claims 9, 10, 14, and 15.

D. Dependent Claims 11 and 16

Claims 11 and 16 depend on independent claims 7 and 12, respectively, and additionally require that "*the second data field is configured as a 16-bit bitmap, each bit of the 16-bit bitmap indicating a CSI-RS pattern to be muted based on a specific number of antenna ports*."

TI teaches an achievable re-user factor of 16 ("*16-bit bitmap*"), indicating muting of CSI-RS patterns based on 2 CSI-RS antenna ports ("*a specific number of antenna ports*"). EX1008, 6 (Table 3); *see* Section IX.A.

Therefore, Chandrasekhar-I in view of Chandrasekhar-II and further in view of TI renders obvious claims 11 and 16.

XI. DISCRETIONARY DENIAL

Pursuant to the Memorandum issued to all PTAB Judges by the Acting Director of the USPTO on March 26, 2025, titled "Interim Process for PTAB Workload Management," Petitioner will respond to any discretionary denial arguments Patent Owner may raise through the Board's bifurcated briefing process.

Nevertheless, to simplify the *Fintiv* analysis, and following the precedential

Sotera decision, Petitioner stipulates that, if this IPR is instituted, Petitioner will not pursue in the EDTX case any ground that Petitioner raised or reasonably could have raised against the challenged claims during the instituted IPR. *See Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 19 (PTAB Dec. 1, 2020) (precedential).

XII. CONCLUSION

Based on the grounds specified above, IPR of all challenged claims is respectfully requested.

Respectfully submitted,

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CERTIFICATION UNDER 37 C.F.R. § 42.24(d)

This Petition complies with the requirements of 37 C.F.R. § 42.24. As calculated by the word count feature of Microsoft Word, it contains 13,750 words, excluding the words contained in the following: Table of Contents, Table of Authorities, List of Exhibits, Mandatory Notices, Certification Under § 42.24(d), and Certificate of Service.

/Zhiwei Zou/
Zhiwei (Wayne) Zou
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Lead Counsel for Petitioner

CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing **Petition for *Inter Partes* Review, the associated Power of Attorney, and Exhibits 1001-1023** are being served on May 6, 2025, by U.S. Priority Express Mail at the following address of record for the subject patent.

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