

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

TOGAIL TECHNOLOGIES LTD.,
Patent Owner.

IPR2023-00644
U.S. Patent No. 11,115,165

**PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	GROUND FOR STANDING.....	4
III.	RELIEF REQUESTED AND THE REASONS FOR THE REQUESTED RELIEF	4
IV.	NOTE.....	4
V.	SUMMARY OF THE '165 PATENT	4
VI.	PROSECUTION HISTORY	7
VII.	LEVEL OF ORDINARY SKILL IN THE ART.....	9
VIII.	CLAIM CONSTRUCTION	10
IX.	TECHNOLOGY BACKGROUND – QCL ASSUMPTIONS, REFERENCE SIGNALS, ANTENNA PORTS, AND DEMODULATION.....	10
X.	IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE....	14
A.	Challenged Claims	14
B.	Statutory Grounds for Challenges	14
C.	Ground 1: Claims 1-3, 5-9, 11, 12 are obvious under 35 U.S.C. § 103 over Vilaipornsawai in view of Shin and Grant.....	15
1.	Summary of Vilaipornsawai	15
2.	Summary of Shin	21
3.	Reasons to Combine Vilaipornsawai and Shin.....	22
4.	Summary of Grant.....	26
5.	Reasons to Combine Vilaipornsawai, Shin, and Grant.....	28

6.	Claim 1	33
7.	Claim 2	53
8.	Claim 3	54
9.	Claim 5	55
10.	Claim 6	57
11.	Claim 7	58
12.	Claim 8	60
13.	Claim 9	60
14.	Claim 11	60
15.	Claim 12	60
D.	Ground 2: Claims 4 and 10 are obvious under 35 U.S.C. § 103 over Vilaipornsawai in view of Shin, Grant, and Xue	61
1.	Summary of Xue	61
2.	Reasons to Combine Grant and Xue	62
3.	Claim 4	63
4.	Claim 10	66
XI.	PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION	66
A.	The <i>Fintiv</i> Factors Favor Institution Under § 314	66
1.	No evidence regarding a stay	66
2.	Parallel proceeding trial date	67
3.	Investment in the parallel proceeding	68
4.	Overlapping issues with the parallel proceeding	68

5.	Petitioner is a defendant.....	69
6.	Other circumstances.....	69
B.	The <i>Fintiv</i> Framework Should Be Overturned.....	69
C.	The <i>Advanced Bionics</i> Test Favors Institution Under § 325(d).....	70
XII.	CONCLUSION.....	70
XIII.	MANDATORY NOTICES	71
A.	Real Party-in-Interest	71
B.	Related Matters.....	71
C.	Lead and Back-up Counsel and Service Information	71
	CERTIFICATE OF WORD COUNT.....	73
	CERTIFICATE OF SERVICE	74

PETITIONER’S EXHIBIT LIST

Exhibit	Description
Ex.1001	U.S. Patent No. 11,115,165
Ex.1002	Prosecution History of U.S. Patent No. 11,115,165
Ex.1003	Declaration of Dr. Zhi Ding under 37 C.F.R. § 1.68
Ex.1004	<i>Curriculum Vitae</i> of Dr. Zhi Ding
Ex.1005	WIPO publication WO 2018/141246 to U. Vilaipornsawai <i>et al.</i> (“Vilaipornsawai”)
Ex.1006	U.S. Patent Pub. No. 2019/0068308 to C. Shin et al. (“Shin”)
Ex.1007	U.S. Patent Pub. No. 2020/0280409 to S. Grant et al. (“Grant”)
Ex.1008	U.S. Patent No. 9,596,061
Ex.1009	U.S. Patent No. 9,788,310
Ex.1010	U.S. Patent Pub. No. 2015/0349855
Ex.1011	U.S. Patent Pub. No. 2019/0074880
Ex.1012	U.S. Patent Pub. No. 2020/0260418 to Y. Xue et al. (“Xue”)
Ex.1013	WIPO publication WO 2020/118686
Ex.1014	U.S. Patent No. 8,897,253
Ex.1015	U.S. Patent Pub. No. 2020/0015200
Ex.1016	U.S. Patent No. 8,964,632
Ex.1017	WDTX case 622-cv-00326, Plaintiff’s Preliminary Infringement Contentions (cover document), served Oct. 3, 2022
Ex.1018	WDTX case 622-cv-00326, Dkt. 33, Scheduling Order, filed Oct. 24, 2022

Ex.1019	WDTX case 622-cv-00326, Dkt. 53, Defendant Apple Sealed Reply in Support of Its Motion to Transfer Venue, filed February 9, 2023
Ex.1020	U.S. District Courts – Case Statistics, obtained at https://www.uscourts.gov/statistics-reports/analysis-reports/federal-court-management-statistics , per Director Vidal, Memorandum, “Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation” at n.4, dated June 21, 2022

LISTING OF ACRONYMS

Acronym	Description
BS	Base station
CE	Control Element
CoMP	Coordinated Multi-Point
CSI-RS	Channel State Information-Reference Signal
DCI	Downlink Control Information
DL	Downlink
DMRS	Demodulation Reference Signal
MAC	Medium Access Control
NC-JT	Non-Coherent Joint Transmission
NR	New Radio
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
QCL	“Quasi co-location” or “quasi co-located,” depending on the context. “Quasi co-located” is also sometimes abbreviated as “QCLed.”
RRC	Radio Resource Control
RS	Reference Signal
SSB	Synchronization Signal Block
TCI	Transmission Configuration Indicator
TRP	Transmitter/Receiver Point
TRS	Tracking Reference Signal

UE	User Equipment
----	----------------

I. INTRODUCTION

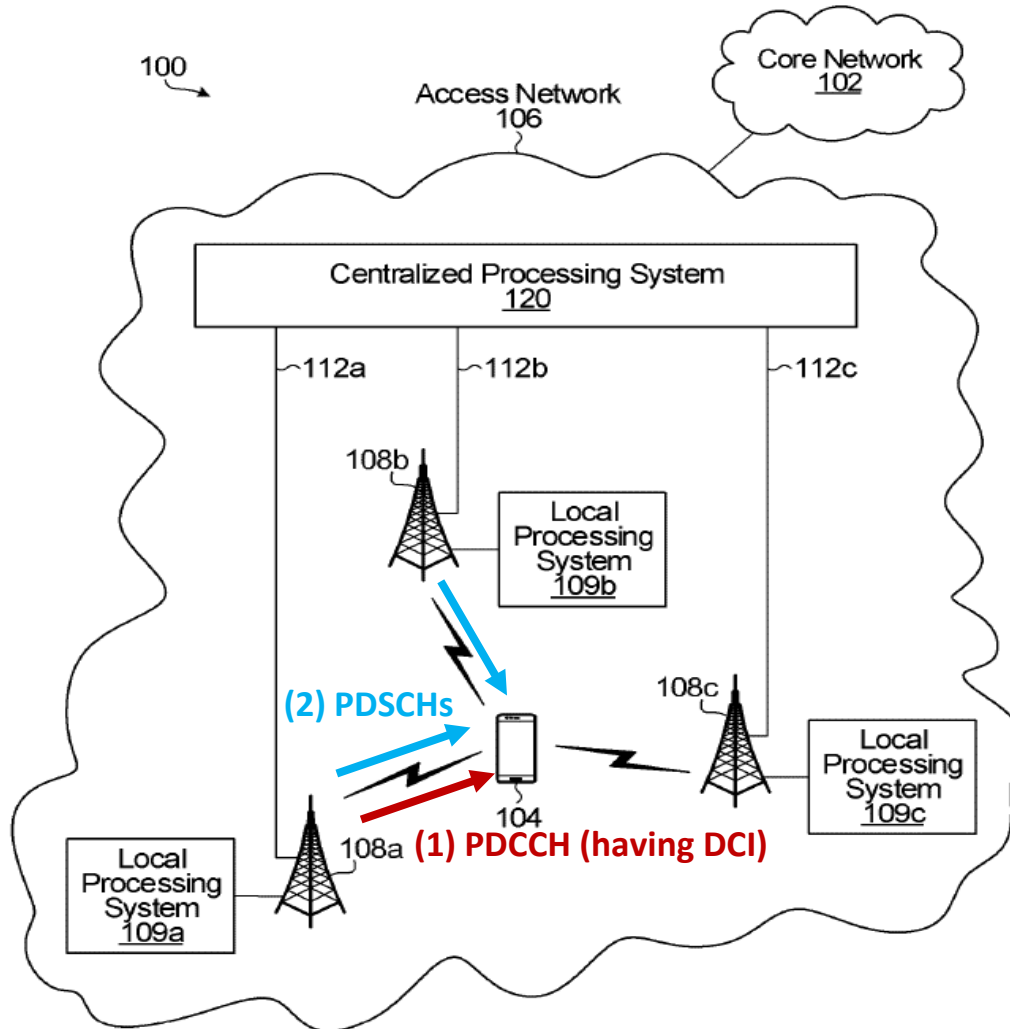
U.S. Patent No. 11,115,165 (the “’165 patent,” Ex.1001) is directed to a cellular wireless architecture that uses multiple fixed stations, known as Transmitter/Receiver Points (TRPs), to provide network connectivity to mobile stations in geographic regions. When a mobile station is within range of multiple TRPs, transmissions from those TRPs to the mobile station can be coordinated to increase data rate or enhance coverage.

More specifically, the ’165 patent is directed to a mobile station (“UE”) receiving an indicator (“TCI”) in one control channel (“PDCCH”) for determining multiple data channels (“PDSCHs”), such as in an environment in which multiple TRPs coordinate transmissions to the mobile station.¹ Based on the indicator value, the mobile station identifies various signals it needs to be able to demodulate information received on the data channels.

The techniques of the ’165 patent were not new. For example, Vilaipornsawai (Ex.1005) discloses a “single PDCCH [control channel] message corresponding to multiple PDSCHs [data channel messages] from multiple TRPs/beams/panels.” Ex.1005, [0114]. The PDCCH message includes downlink

¹ See Listing of Acronyms above for a reference description of all acronyms herein.

control information (DCI). Vilaipornsawai' s transmission of a (1) single PDCCH (having control information for multiple PDSCHs) followed by (2) joint transmission of PDSCHs from a “cooperating set of TRPs” is illustrated below in Figures 1 and 16 (the color coding is coordinated).

**FIG. 1**

Ex.1005, Figure 1; Ex.1003, ¶60

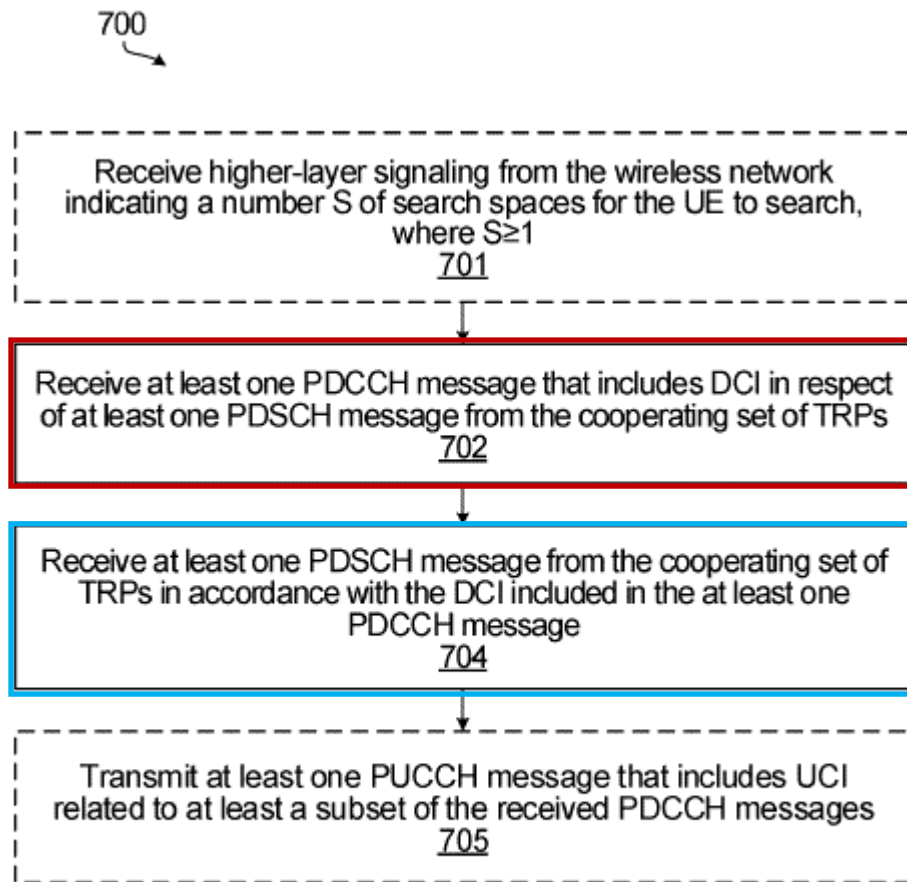


FIG. 16

Ex.1005, Figure 16; Ex.1003, ¶60

As discussed herein, Shin and Grant merely provide details regarding Vilaipornsawai's DCI and control messaging.

The claims of the '165 patent use a number of acronyms (such as PDCCH, PDSCH, QCL, DMRS), but the same acronyms are used in the prior art in the same way, as explained herein. These acronyms were understood by persons of

ordinary skill working in 4G and 5G cellular systems.

Accordingly, pursuant to 35 U.S.C. §§ 311, 314(a), and 37 C.F.R. § 42.100, Apple Inc. (“Petitioner”) respectfully requests that the Board review and cancel as unpatentable under (pre-AIA) 35 U.S.C. §103(a) claims 1-12 (hereinafter, the “Challenged Claims”) of the ’165 patent.

II. GROUNDS FOR STANDING

Petitioner certifies that the ’165 patent is eligible for IPR and that Petitioner is not barred or estopped from requesting IPR challenging the patent claims. 37 C.F.R. § 42.104(a).

III. RELIEF REQUESTED AND THE REASONS FOR THE REQUESTED RELIEF

Petitioner asks that the Board institute a trial for *inter partes* review and cancel the Challenged Claims in view of the analysis below.

IV. NOTE

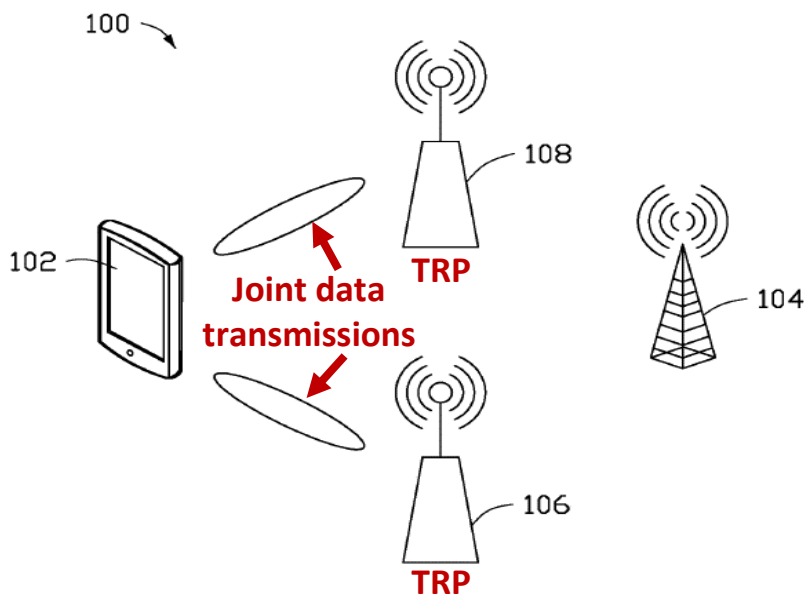
Petitioner cites to exhibits’ original page numbers. **Emphasis** in quoted material has been added. Claim terms are presented in *italics*. Color appearing in figures has been added, unless otherwise specified.

V. SUMMARY OF THE ’165 PATENT

The ’165 patent generally relates to “wireless communications, and more particularly, to methods and apparatuses for multiple Transmit/Receive Point (TRP) operations.” Ex.1001, 1:18-20. According to the ’165 patent, there was a

purported “need in the art for an improved communication mechanism for multiple TRP operations.” *Id.*, 1:40-41.

FIG. 1 presents a multi-TRP system, having multiple TRPs 106 and 108 and a base station (BS) 104. The TRPs may provide “small cells” or “pico-cells,” and a UE “may connect to the BS 104 through the TRPs 106 and 108.” *Id.*, 5:8-13.



Ex.1001, Figure 1; Ex.1003, ¶30

The TRPs 106 and 108 “may be jointly used in the data transmissions to the UE.”

Ex.1001, 5:14-18.

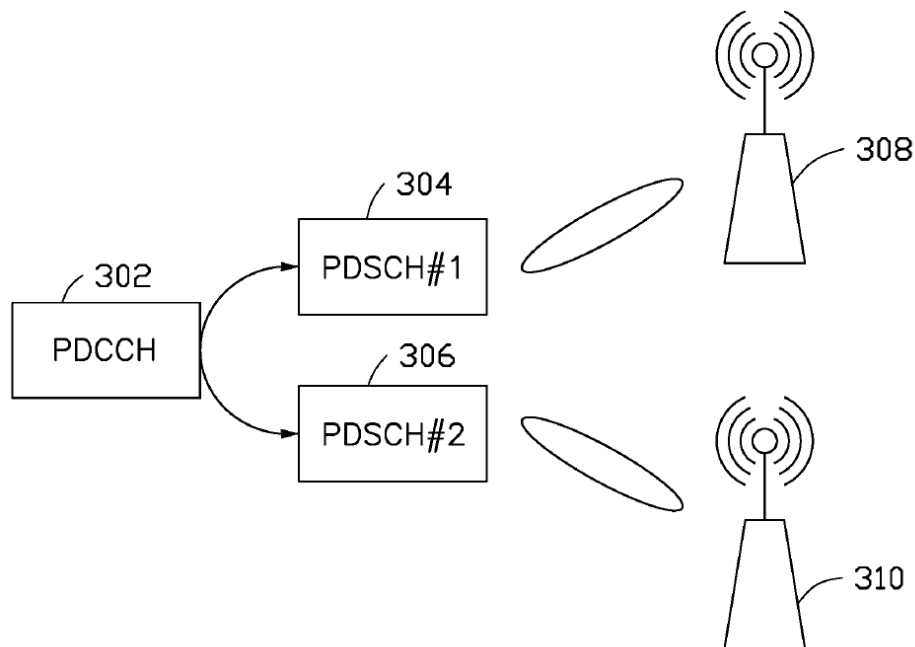
The ’165 patent uses the terms “QCL assumptions” and “DMRS port groups,” with little by way of background explanation, thus assuming that a POSITA is familiar with these concepts. *See, e.g.*, Ex.1001, 5:22-25. Briefly, there are various reference signals defined for the purpose of channel estimation,

including a demodulation reference signal (DMRS), and a “DMRS port” generally refers to an antenna port used for DMRS transmission (and also for PDSCH transmission). Ex.1003, ¶¶40-41. And Quasi Co-Location (QCL) assumptions are used to simplify and enhance channel estimation. Ex.1003, ¶47. In addition, the term “PDCCH,” as used in the context of the ’165 patent as well as the prior art herein, is a well-known acronym of “Physical Downlink Control Channel.” Ex.1003, ¶31. Similarly, the term “PDSCH” is a well-known acronym of “Physical Downlink Shared Channel.” *Id.* A POSITA’s understanding of DMRS port groups, QCL assumptions, reference signals, and other items is presented in more detail in Section IX (Technology Background).

The ’165 patent describes control messages sent to a UE in a PDCCH to facilitate data communication with a UE using multiple PDSCHs from different TRPs. A control message may include Transmission Configuration Indicator (TCI) state data that is associated with multiple DMRS port groups. Ex.1003, ¶32.

For example, “FIG. 3 is a schematic diagram illustrating multiple PDSCHs determined from a single PDCCH.” Ex.1001, 6:4-5. “As shown in FIG. 3, the UE may receive DCI that contains a TCI state data ... from the PDCCH 302.” *Id.*, 6:6-8. “For example, each TCI state may contain parameters for configuring the QCL relationship between the DL/UL RS(s) [Reference Signal(s)] and the DM-RS port(s) of a corresponding PDSCH.” *Id.*, 6:11-14. “In the example implementation,

the UE may derive multiple PDSCHs based on the DMRS port groups associated with the TCI state data in the DCI, because each DMRS port group may correspond to one PDSCH.” Ex.1001, 6:23-26. “As shown in FIG. 3, the PDSCH #1 304 and PDSCH #2 306 may be associated with TRPs 308 and 310, respectively.” *Id.*, 6:34-36; Ex.1003, ¶33.



Ex.1001, Figure 3

VI. PROSECUTION HISTORY

The application that led to the '165 patent was filed on November 4, 2019. A non-final rejection issued on April 2, 2021, in which claims 1 and 9 were rejected based on a combination of references including U.S. Patent Pub. No. 2020/0015200 to Vilaipornsawai *et al.* (**which is unrelated** to Vilaipornsawai used herein (Ex.1005)). Ex.1002, 182-184. Claims 3-6 were indicated as having

allowable subject matter. Ex.1002, 187.

In response, Applicant amended claim 1 to “incorporate the allowable subject matter in dependent claim 3” as follows. Ex.1002, 171, 176.

1. (**Currently Amended**) A user equipment (UE) comprising:

one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

receive, in a Physical Download Control Channel (PDCCH), Transmission Configuration Indicator (TCI) state data for determining a plurality of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups; and

obtain a plurality of Quasi Co-Location (QCL) assumptions for receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data,

wherein each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups.

The Notice of Allowance, received on June 16, 2021, includes an Examiner’s amendment, agreed to by the Applicant, in which claim 1 was amended to also include the subject matter of original claim 6 as follows (and independent claim 9 was similarly amended). Ex.1002, 151-152.

each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups,
the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets, and
each of the plurality of QCL RS sets corresponds to one of the plurality of DMRS port groups.

The '165 subsequently issued on September 7, 2021. Ex.1003, ¶¶34-37.

None of the references used herein as part of any ground was considered during prosecution of the '165 patent.

VII. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) in the field of the '165 patent, as of the earliest possible priority date of November 2, 2018, would have been someone knowledgeable and familiar with the cellular telecommunications arts that are pertinent to the '165 patent. That person would have had a master’s degree from an accredited program in electrical engineering, computer engineering, computer science, or a related field, and three years of relevant experience in mobile communications or wireless networks; or a Ph.D. degree in one of the disciplines listed above and one year of relevant experience. More technical education, but less experience could have also met this standard.

Ex.1003, ¶¶19-21.

VIII. CLAIM CONSTRUCTION

In an *inter partes* review, claims “shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b). The Board only construes the claims to the extent necessary to resolve the underlying controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). Petitioner submits that for the purposes of this proceeding, the terms of the challenged claims should be given their plain and ordinary meaning, and no terms require specific construction.² Ex.1003, ¶50.

IX. TECHNOLOGY BACKGROUND – QCL ASSUMPTIONS, REFERENCE SIGNALS, ANTENNA PORTS, AND DEMODULATION

The ’165 patent introduces the term “Quasi Co-Location (QCL) assumptions” in the Detailed Description with little additional context, assuming that a POSITA is familiar with the term. *See, e.g.*, Ex.1001, 5:24-35 (“In action 204, the UE may obtain multiple **QCL assumptions** for receiving the

² Petitioner does not concede that any term in the challenged claims meets the statutory requirements of 35 U.S.C. § 112, or that the challenged claims recite patentable subject matter under 35 U.S.C. § 101.

PDSCHs based on the DMRS port groups associated with the TCI state data.”).

Ex.1003, ¶38.

A POSITA would have been familiar with the concept of QCL assumptions in the context of well-known Long-Term Evolution (LTE or 4G) and 5G wireless systems. The concept of Quasi Co-Location (QCL) assumptions was introduced in LTE to simplify and enhance channel estimation used for demodulation. Thus, before discussing QCL assumptions further, demodulation and channel estimation are discussed. Ex.1003, ¶39.

Fundamentally, “[d]emodulation of sent data requires estimation of the radio channel, which is done by using transmitted reference symbols (RS), i.e., symbols known a priori by the receiver.” Ex.1010, [0007]. There are various reference signals defined for the purpose of channel estimation, including a demodulation reference signal (DMRS) and a Channel State Information Reference Signal (CSI-RS). *Id.* A DMRS is “UE-specific,” or specifically intended for a certain UE, and a CSI-RS is “cell-specific,” or intended for all UEs sharing a cell. (citing Ex.1010, [0007]). CSI-RS and DMRS signals were well-known signals that were a pre-existing part of wireless cellular systems, such as LTE systems. Ex.1003, ¶40.

A “DMRS port” generally refers to an antenna port used for DMRS transmission (and also for PDSCH transmission). For example, the prior art refers to an “antenna port mapping” for DMRS reference signals, and illustrates the

mapping in the figure below, where each square is a time-frequency resource element. Ex.1003, ¶41 (citing Ex.1008).

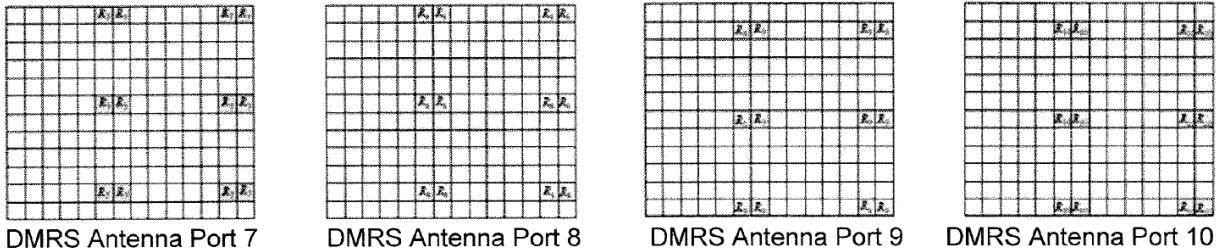


FIG. 4B

Ex.1008, Figure 4B

An “antenna port” was a well-known concept, and it was known that reference signals may be mapped to antenna ports. Ex.1003, ¶¶42-43 (citing Ex.1008). For example, an antenna port may represent a logical antenna and may map to one or more physical antennas. Ex.1008, 5:53-59. In 4G and 5G cellular systems, transmitters and receivers could be equipped with multiple antennas to increase reliability and/or throughput. Ex.1003, ¶42 (citing Ex.1010). Moreover, a “transmission/reception point,” or TRP, is also a term of art used in LTE and 5G, referring to a set of antenna ports covering a geographic area. Ex.1003, ¶45 (citing Exs.1010 and 1011).

Returning to QCL assumptions, QCL assumptions are used to simplify and enhance channel estimation. For example, different antenna ports may be said to be quasi co-located with respect to certain channel properties if they share these same

properties. Also, the network may recognize that certain repeating/recurring cell-specific reference signals, such as CSI-RS, are QCL with certain UE-specific reference signals, such as DMRS, that are transmitted less often. Ex.1003, ¶47 (citing Ex.1010).

Different reference signals also may be said to be quasi co-located with respect to certain channel properties if they share the same properties, such as the same frequency shift, Doppler spread, received timing, and/or delay spread. Ex.1003, ¶48 (citing Ex.1009). An important and known advantage of QCL assumptions among antenna ports is “the possibility of extracting channel properties from certain ports which allow accurate estimation and applying them to other QCLeD ports that do not allow equally good estimation.” Ex.1010, [0013]-[0014]; Ex.1003, ¶47. And, “[s]ince estimation of long term channel properties from DMRS is challenging,” an advantage of QCL assumptions between DMRS signals and other reference signals (e.g., CSI-RS) is allowing “estimating selected long term channel properties from a signaled CSI-RS resource and applying them to DMRS, to aid DMRS estimation.” Ex.1010, [0014]; Ex.1003, ¶47.

In summary, antenna ports may be recognized by the network as being quasi co-located (QCL/QCLeD), such that the ports form a group, and different reference signals may also be recognized by the network as being quasi co-located. Examples of “QCL assumptions” are assumptions that a UE could use regarding

antenna ports, reference signals, and/or associated channel estimation parameters to perform channel estimation more efficiently and accurately, e.g., by applying an estimation from one antenna port to another and/or applying an estimation from one reference signal to another. And channel estimates are subsequently used to receive data, such as in a PDSCH. Ex.1003, ¶49.

X. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

A. Challenged Claims

Petitioner challenges all claims of the '165 patent (i.e., claims 1-12), which of course includes all claims asserted in the plaintiff's infringement contentions in the co-pending litigation.

B. Statutory Grounds for Challenges

Grounds	Claim(s)	Basis
#1	1-3, 5-9, 11, 12	35 U.S.C. § 103 obvious over Vilaipornsawai in view of Shin and Grant
#2	4, 10	35 U.S.C. § 103 obvious over Vilaipornsawai in view of Shin , Grant , and Xue

The earliest possible priority date of the '165 patent is November 2, 2018, which is the filing date of the provisional application on which the '165 patent relies. All prior art used herein is prior art as of November 2, 2018.

Vilaipornsawai is a WIPO publication with publication date of August 9, 2018, so Vilaipornsawai is prior art under 35 U.S.C. § 102(a)(1). Shin is a U.S.

patent publication that was effectively filed no later than August 24, 2018 (the filing date of the non-provisional application), so Shin is prior art under 35 U.S.C. § 102(a)(2). Grant is a U.S. national stage application of a PCT application filed on September 10, 2018, so Grant is prior art under 35 U.S.C. § 102(a)(2). Xue is a U.S. national stage application of a PCT application filed on August 8, 2017, so Grant is prior art under 35 U.S.C. § 102(a)(2).

Petitioner’s analysis also cites additional prior art to demonstrate the background knowledge of a POSITA and to provide contemporaneous context to support Petitioner’s assertions regarding what a POSITA would have understood from the prior art. *See Yeda Research v. Mylan Pharm. Inc.*, 906 F.3d 1031, 1041-1042 (Fed. Cir. 2018) (affirming the use of “supporting evidence relied upon to support the challenge”); 37 C.F.R. § 42.104(b); *see also K/S HIMPP v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365-66 (Fed. Cir. 2014); *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363 (Fed. Cir. 2016).

C. Ground 1: Claims 1-3, 5-9, 11, 12 are obvious under 35 U.S.C. § 103 over Vilaipornsawai in view of Shin and Grant

1. Summary of Vilaipornsawai

Vilaipornsawai recognizes that many wireless networks include “data channels” and “control channels.” Ex.1005, [0050]. For example, LTE networks include “data channels such as Physical Downlink Shared Channel (PDSCH) ... and control channels such as PDCCH (Physical Downlink Control Channel).”

Ex.1005, [0050]; Ex.1003, ¶54.

Figure 1 illustrates a “communication system 100” that “includes a core network 102 and an access network 106.” Ex.1005, [0054]. Furthermore, “the network elements 108a-c may be configured to serve UE 104 in accordance with one or more CoMP [Coordinated Multi-Point] transmission schemes, such as Dynamic Point Selection (DPS) or Non-Coherent Joint Transmission. In these network coordination schemes, the same or different downlink PDSCH data stream(s) can be transmitted to a UE from multiple TRPs.” *Id.*, [0061]; Ex.1003, ¶55.

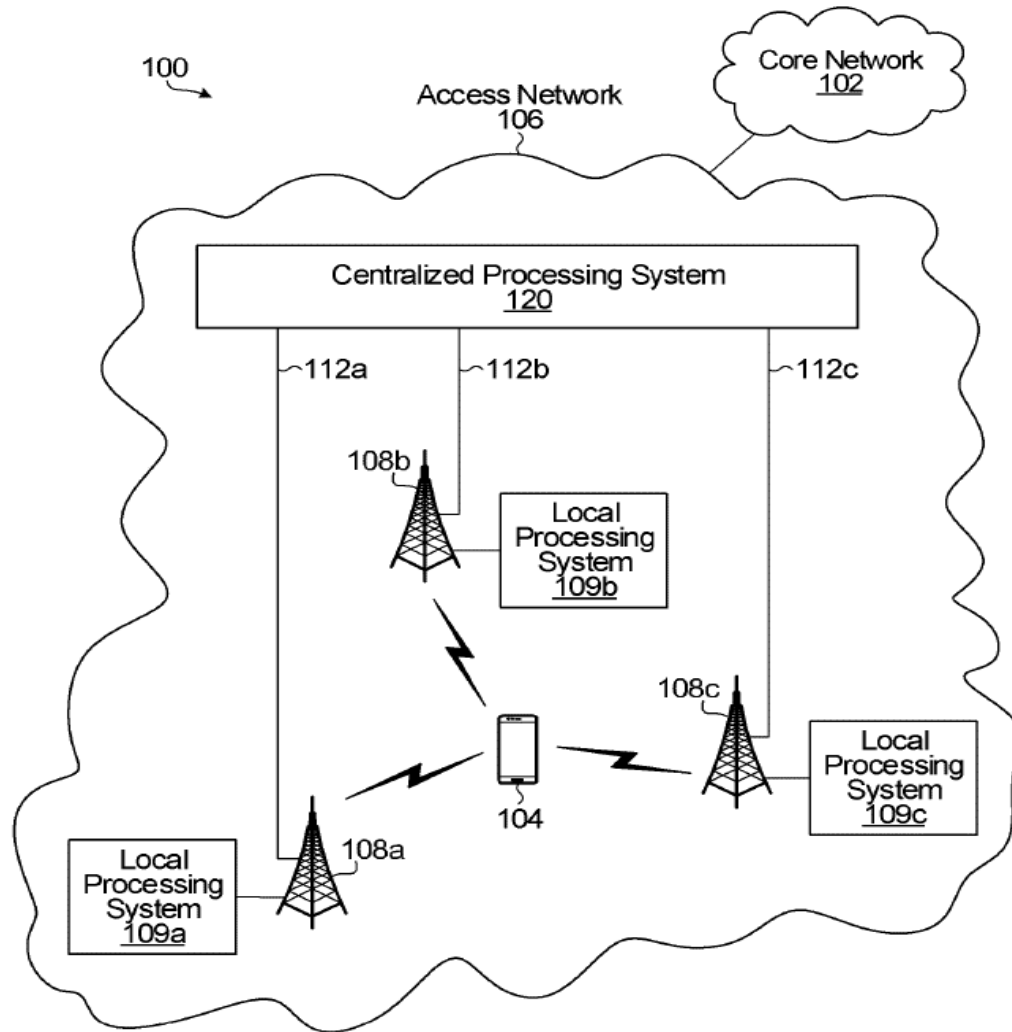


FIG. 1

Ex.1005, Figure 1

Vilaipornsawai provides “mechanisms to support one or more PDCCH(s) for network coordination schemes such as those being contemplated for NR [New Radio/5G] to support the delivery of the same or different PDSCH data stream(s) to a UE from multiple TRPs.” Ex.1005, [0052]; *see also* [0005]. Vilaipornsawai addresses a scenario in which a UE receives different PDSCHs from multiple

transmission-reception points (TRPs):

For the NC-JT [Non-Coherent Joint Transmission] scenario in which multiple PDSCHs, e.g. multiple TBs are transmitted from multiple TRPs, either single or multiple PDDCH [*sic*]³ messages are required to convey the DCI for the multiple PDSCHs from the multiple TRPs.

Ex.1005, [0067]; *see also* [0068], [0114], [0116], [0159], [0166], [0170], [0188] (Example Embodiments 1 and 2); Ex.1003, ¶¶56-57.

In a section about Downlink Control Information (DCI) content, Vilaipornsawai discloses “a single PDCCH message” that has one or more “resource assignment fields” for scheduling “multiple PDSCHs.” Ex.1005, [0116]. Vilaipornsawai also discloses that the DCI of a PDCCH carries “DMRS information” for UEs to use to perform channel estimation and receive multiple PDSCH(s). Ex.1005, [0113]-[0114] (“**[T]he content of the DCI carried in PDCCH messages may include**, in addition to the LTE DCI content for different DCI formats, **additional content such as one or more of DMRS information for PDSCH(s).**”); Ex.1003, ¶¶58-59.

Thus, Vilaipornsawai describes a system in which different TRPs (transmission-reception points) transmit different PDSCHs to a UE in a joint

³ “PDDCH” is a typo and should instead be “PDCCH.”

transmission (JT) scenario, and a single TRP transmits downlink control information (DCI) information in a PDCCH for scheduling the multiple PDSCHs, with the DCI also including “DMRS information” for the transmissions.

Vilaipornsawai’s transmission of a (1) PDCCH (having DCI including scheduling information for multiple PDSCHs and also DMRS information) followed by (2) joint transmission of PDSCHs from different TRPs is illustrated below in Figures 1 and 16. Ex.1003, ¶60.

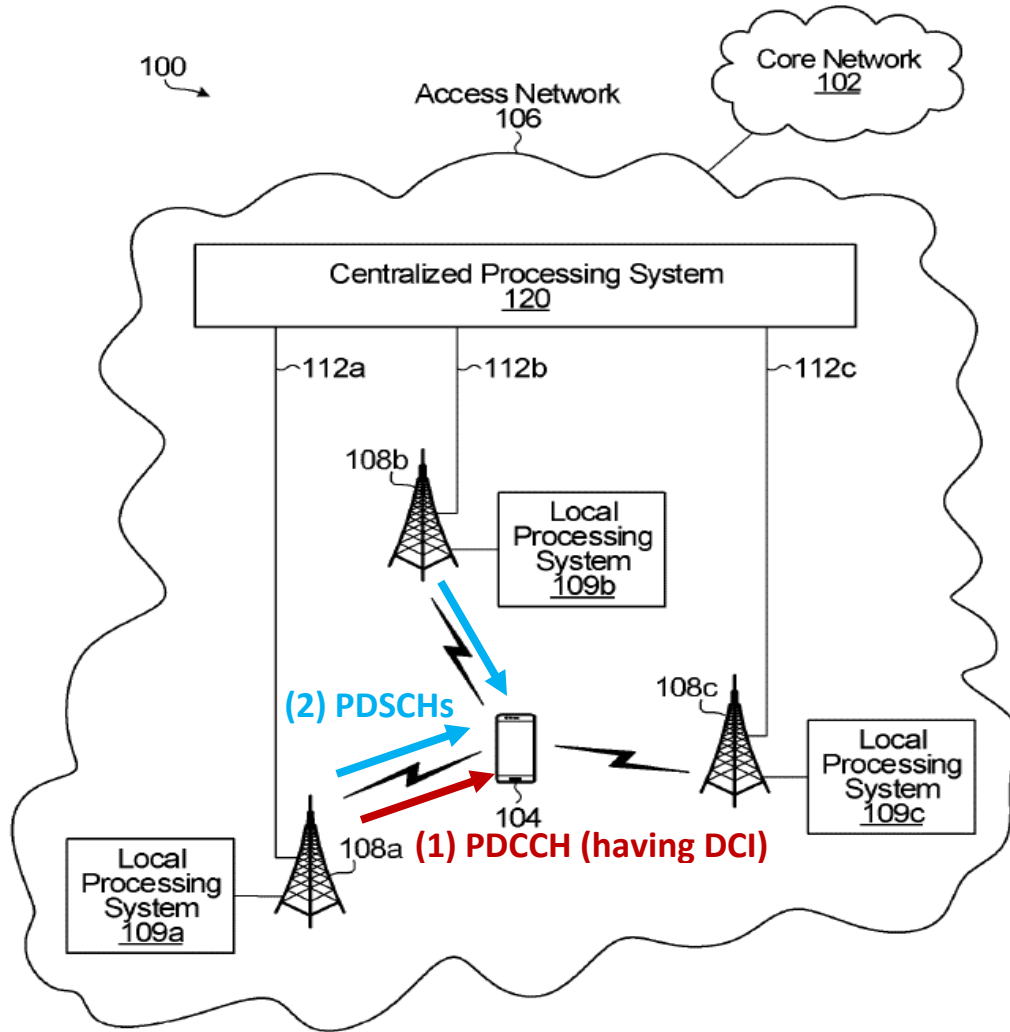


FIG. 1

Ex.1005, Figure 1; Ex.1003, ¶60

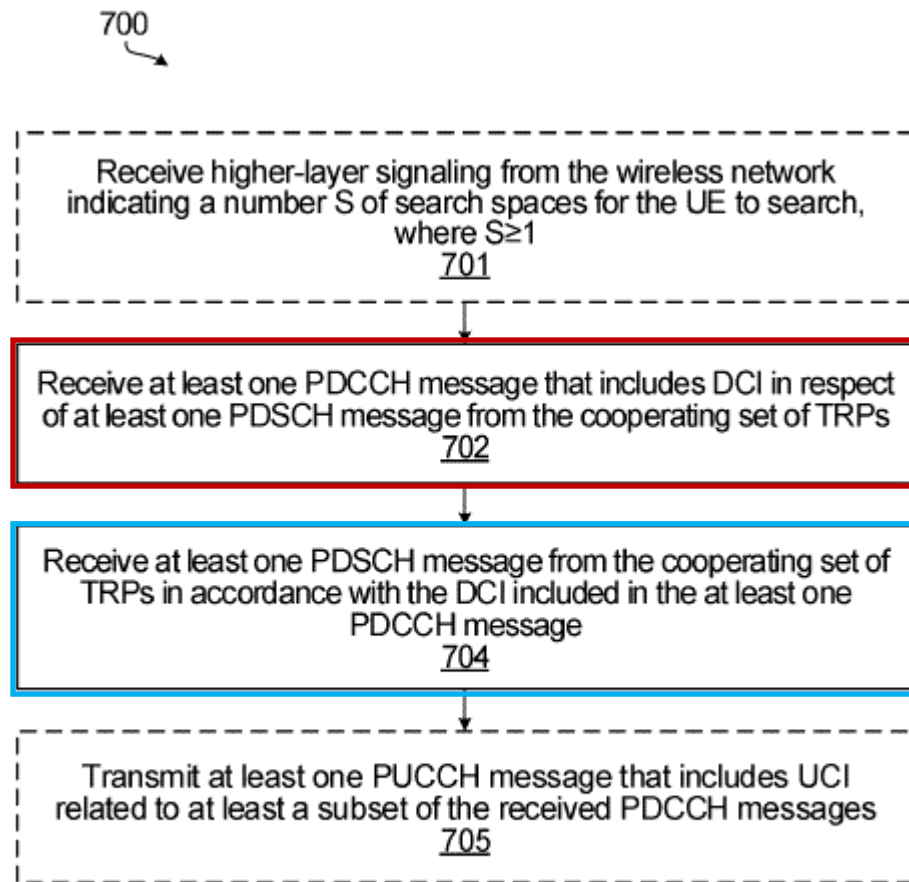


FIG. 16

Ex.1005, Figure 16; Ex.1003, ¶60

2. Summary of Shin

Shin is directed to cellular wireless communications, such as LTE and 5G/NR systems. Ex.1006, [0008] (“An aspect of the disclosure provides a DMRS port grouping and signaling method in a 5G wireless communication system supporting non-coherent joint transmission (NC-JT).”). The communication system

may support joint transmission from multiple TRPs to a single UE. *Id.*, [0008], [0200], Figure 11 (illustrating transmission from multiple transmission points to a UE). Furthermore, the “radio resources are allocated for transmitting different signals,” including “DMRS ... PDSCH [and] control channels [such as] PDCCH.” *Id.*, [0050]-[0052]; Ex.1003, ¶61.

Shin provides examples of DMRS information, such as DMRS port groups, that would have been beneficial to include in the DCI of a PDCCH in systems such as Vilaipornsawai. Shin provides detailed examples of “DMRS information” communicated to a UE in NR (New Radio)/5G systems. Ex.1006, [0062] (“**In the NR system, the DMRS information may include information as follows ... DMRS port grouping information.**”); [0200] (“The DMRS port grouping may be performed for NC-JT [Non-Coherent Joint Transmission].”); Ex.1003, ¶62.

3. Reasons to Combine Vilaipornsawai and Shin

As a threshold matter, Vilaipornsawai and Shin are analogous art to the ’165 patent, as all three documents are directed to cellular wireless communications, such as LTE and 5G/NR systems. Ex.1001, 3:37-48 (describing a “radio communication network architecture,” such as a “Long Term Evolution (LTE)” system or a “5G New Radio (NR)” system); Ex.1005, [0003] (“Coordinated MultiPoint (CoMP) or Joint Transmission (JT) CoMP” has been considered for “5G”/“NR” “wireless networks”); Ex.1006, [0008] (“An aspect of the disclosure

provides a DMRS port grouping and signaling method in a 5G wireless communication system supporting non-coherent joint transmission (NC-JT).”); Ex.1003, ¶63.

In addition, all three documents relate to methods and apparatuses relating to cellular communication involving multiple TRPs. *See, e.g.*, Ex.1001, 1:18-20 and Figure 1; Ex.1005, [0005] (“Aspects of this disclosure provide mechanisms to support one or more PDCCH (s) for network coordination schemes such as those being contemplated for NR to support the delivery of the same or different PDSCH data stream(s) to a UE from multiple TRPs.”); Ex.1006, [0200] (“The DMRS port grouping may be performed for various purposes. The DMRS port grouping may be performed for NC-JT.”); Ex.1003, ¶64.

It would have been obvious for a POSITA to combine Vilaipornsawai and Shin to provide the obvious, beneficial, and predictable result of including Shin’s DMRS port grouping information in Vilaipornsawai’s “DMRS information” in Vilaipornsawai’s multi-TRP system, in which each TRP can beneficially have multiple antennas. Ex.1003, ¶65 (citing Ex.1005, [0164]).

Vilaipornsawai does not specify the details of its “DMRS information,” beyond that “the same or different DMRSs” can be used by the network and this “DMRS information” is specified in the DCI. Ex.1005, [0114]. A POSITA implementing Vilaipornsawai’s system for joint transmission from multiple TRPs,

each having multiple antennas, would have been motivated to specify “DMRS information” in such a way to provide the flexibility to group antenna ports together into port groups (and indicate those groups to a UE) for the purpose of simplifying and improving channel estimation and also to be able to associate various reference signals, such as DMRS signals, with those grouped ports, to form DMRS port groups, as taught in Shin, also to simplify and improve channel estimation. Ex.1003, ¶¶43-44, 66.

Shin provides detailed examples of “DMRS information” communicated to a UE, in such a joint transmission (JT) scenario, as DMRS port grouping information:

When supporting the downlink/uplink common DMRS structure, it is important to consider DMRS information signaling efficiency. **In the NR system, the DMRS information may include information as follows:**

...

DMRS port grouping information

Ex.1006, [0062]; [0071] (“The DMRS port grouping information is used for the NC-JT...”); Ex.1003, ¶67.

For multi-TRP scenarios (e.g., NC-JT), according to Shin, it is “necessary to transmit the DMRS port grouping information to the UE for NC-JT.” Ex.1006, [0200]. For example, there may be different DMRS port groups for different TPs (Shin uses the term “TP” or transmission point, whereas Vilaipornsawai uses the

term TRP, and, nonetheless, the teachings relevant to the '165 claims relate only to transmission to and reception by a UE). Ex.1003, ¶68 (citing Shin, [0204]). And, as discussed previously (see Section IX, Technology Background), it was well-known that QCL assumptions among different DMRS ports in a DMRS port group (and different DMRS port groups, each having different QCL assumptions, for different TPs) can beneficially be used to improve channel estimation. Ex.1003, ¶¶42-44, 47, 68 (citing Exs.1008, 1010, 1016). For example, a UE provided information about groupings of reference signal ports “**allows the UE to jointly estimate channel properties and to achieve increased estimation accuracy for the corresponding channels estimates.**” Ex.1016, 6:56-7:10; Ex.1003, ¶68; *see also* Ex.1010, [0013]-[0014] (Describing an advantage of QCL assumptions among antenna ports is “the possibility of extracting channel properties from certain ports which allow accurate estimation and applying them to other QCLeD ports that do not allow equally good estimation.”); Ex.1003, ¶47.

There would have been a reasonable expectation of success in combining Vilaipornsawai and Shin. Vilaipornsawai contemplates the use of multiple antennas at each TRP, referring to TRPs having “beams” and “panels,” which was well-known circuitry referring to multiple antennas per panel. Ex.1005, [0068], [0164]. Thus, Vilaipornsawai discloses TRPs having multiple antennas and therefore multiple antenna ports. As explained in Section IX (Technology

Background), a POSITA would have understood that “[a]ntenna ports may represent logical antennas. An antenna port may map to one or more physical antenna[s].” Ex.1008, 5:53-59. And a POSITA would have understood that a “DMRS port” generally refers to an antenna port used for DMRS transmission. Thus, Shin further specifies the type of “DMRS information” that a UE would have found useful to receive information from TRPs having multiple antennas, such as in Vilaipornsawai. Ex.1003, ¶69.

Combining Vilaipornsawai with Shin represents combining prior art elements, namely, further specifying the DMRS information carried by bits or fields in Vilaipornsawai’s DCI as Shin’s DMRS port groups, according to known methods (using bits to represent and signal DMRS port groups) to yield the predictable result of Vilaipornsawai’s DCI communicating or indicating DMRS port group information to a UE in a multi-TRP system in which each TRP employs multiple antennas. Ex.1003, ¶70.

4. Summary of Grant

Grant is directed to cellular wireless communications, such as LTE and 5G/NR systems. Ex.1007, [0092]. The communication system may support joint transmission from multiple TRPs to a single UE. *Id.*, [0006] (describing “[d]ifferent [indicator] states [that] may correspond to different TRP pairs, supporting, e.g., non-coherent joint transmission (NC-JT) from a pair of TRPs to

the UE.”). Grant also involves “transmission of a channel (e.g., ... PDSCH, PDCCH) or reference signal,” such as “DMRS.” *Id.*, [0157], [0007], [0181]; Ex.1003, ¶71.

Grant uses the term “Transmission Configuration Indicator (TCI)” to refer to an N-bit indicator in the DCI (of a PDCCH). The TCI value indicates two reference signal (RS) sets and a QCL relationship for a DMRS port group per RS set, wherein each RS set refers to one or more RSs which are QCLeD with DMRS ports within corresponding DMRS group. Ex.1003, ¶72.

Consistent with Shin’s techniques, the signaling of DMRS port groups in DCI is confirmed by Grant, which describes the use of an “N-bit indicator” transmitted via “DCI signaling.” Ex.1007, [0005]. Grant refers to an “agreement” at a 3GPP standards meeting that “establishes that an N-bit indicator field in DCI provides at least a spatial QCL reference to a downlink reference signal (DL RS) (either CSI-RS or SSB) to aid in the demodulation of PDSCH.” Ex.1007, [0004]. Furthermore, Grant explains that in the “same 3GPP meeting, an agreement for facilitating “multi-TRP operation” was reached about the “N-bit indicator,” in which

each indicator state [i.e., TCI state] is associated with one or two RS [reference signal] sets, where each RS set refers to one or two downlink DMRS port groups, respectively. This facilitates QCL indication in the case of that multi-TRP operation (DL CoMP) is configured. Different

states may correspond to different TRP pairs supporting, e.g., non-coherent joint transmission (NC-JT) from a pair of TRPs to the UE. *Id.*, [0006]. Furthermore, “[e]ach [indicator] state refers to one or two RS sets, which indicates a QCL relationship for one or two DMRS port group(s), respectively,” and “[e]ach RS set refers to one or more RS(s) which are QCLeD with DM-RS ports within corresponding DM-RS group.” *Id.*, [0005]; *see also* [0269]. Finally, Grant specifies a name for its N-bit indicator transmitted in DCI: **“Transmission Configuration Indicator (TCI).”** *Id.*, [0008], [0271]; Ex.1003, ¶73.

5. Reasons to Combine Vilaipornsawai, Shin, and Grant

As a threshold matter, Grant is analogous art to the ’165 patent, as both documents are directed to cellular wireless communications, such as LTE and 5G/NR systems. Ex.1001, 3:37-48; Ex.1007, [0092] (“[P]articular embodiments of the wireless network may implement communication standards, such as Global System for Mobile Communications (GSM), Universal Mobile Telecommunications System (UMTS), Long Term Evolution (LTE), and/or other suitable 2G, 3G, 4G, or 5G standards.”); Ex.1003, ¶74.

In addition, all documents are related to methods and apparatuses relating to cellular communication involving multiple TRPs. *See, e.g.*, Ex.1001, 1:18-20 and Figure 1; Ex.1005, [0005]; Ex.1006, [0200]; Ex.1007, [0006] (describing “[d]ifferent [indicator] states [that] may correspond to different TRP pairs,

supporting, e.g., non-coherent joint transmission (NC-JT) from a pair of TRPs to the UE.”); Ex.1003, ¶75.

It would have been obvious to a POSITA to combine Grant with the previously-discussed teachings of Vilaipornsawai and Shin to provide the obvious, beneficial, and predictable result of including Grant’s TCI in the DCI of Vilaipornsawai and Shin to indicate QCL relationships among DMRS port groups (e.g., Shin’s DMRS port groups) and other, cell-specific, reference signals to improve channel estimation and the reception of DMRS signals, thereby improving reception of the corresponding PDSCH messages in a multi-TRP system. Ex.1003, ¶76.

Grant uses the term “Transmission Configuration Indicator (TCI)” to refer to an N-bit indicator in the DCI (of a PDCCH). The TCI value indicates two reference signal (RS) sets and a QCL relationship for a DMRS port group per RS set, wherein each RS set refers to one or more RSs which are QCLeD with DMRS ports within corresponding DMRS group. Ex.1003, ¶77.

Consistent with Shin’s techniques, the signaling of DMRS port groups in DCI is confirmed by Grant, which describes the use of an “N-bit indicator” transmitted via “DCI signaling.” Ex.1007, [0005]. Grant refers to an “agreement” at a 3GPP meeting that **“establishes that an N-bit indicator field in DCI provides at least a spatial QCL reference to a downlink reference signal (DL**

RS) (either CSI-RS or SSB) to aid in the demodulation of PDSCH.” Ex.1007, [0004]. Furthermore, Grant explains that in the “same 3GPP meeting, an agreement for facilitating “multi-TRP operation” was reached about the “N-bit indicator,” in which the different TCI states “may correspond to different TRP pairs supporting, e.g., non-coherent joint transmission (NC-JT) from a pair of TRPs to the UE.” Ex.1007, [0005]-[0006]. Furthermore, “[e]ach [indicator] state refers to one or two RS sets, which indicates a QCL relationship for one or two DMRS port group(s),” and “[e]ach RS set refers to one or more RS(s) which are QCLed with DM-RS ports within corresponding DM-RS group.” *Id.*, [0005]; *see also* Grant, [0269]. Finally, Grant specifies a name for its N-bit indicator transmitted in DCI: “**Transmission Configuration Indicator (TCI).**” *Id.*, [0008], [0271]; Ex.1003, ¶78.

A RS, such as a CSI-RS, can be a cell-specific reference signal as was understood in the art. By contrast, it was known that a DMRS is a UE-specific reference signal. CSI-RS and DMRS signals were well-known signals that were (and are) a pre-existing part of wireless cellular systems, such as LTE systems. By indicating a QCL relationship between an “RS set” (e.g., indicating CSI-RS) and a “DMRS port group(s),” long term channel properties gleaned by the UE from receiving CSI-RS can be used in conjunction with information gleaned from receiving DMRS signals on DMRS ports to aid DMRS-based channel estimation.

Ex.1003, ¶79 (citing Ex.1010). Thus, it would have been obvious to a POSITA to combine Grant with Vilaipornsawai and Shin to yield the obvious, predictable, and beneficial result of including Grant's TCI in the DCI of Vilaipornsawai and Shin (combining of prior art elements) to indicate QCL relationships among DMRS port groups (e.g., Shin's DMRS port groups) and other, cell-specific, reference signals to improve channel estimation and the reception of DMRS signals in the case of multi-TRP operation. *Id.*

As explained in Section IX (Technology Background), an advantage of QCL assumptions among antenna ports is the possibility of extracting channel properties from certain ports which allow accurate channel estimation and applying them to other QCLed ports that do not allow equally good estimation. Ex.1003, ¶80 (citing Ex.1010). And an advantage of QCL assumptions between DMRS signals and other reference signals (e.g., CSI-RS) is allowing estimating selected long term channel properties from a signaled CSI-RS resource and applying them to DMRS, to aid DMRS estimation. *Id.*

Different reference signals also may be said to be quasi co-located (QCL or QCLed) with respect to certain channel properties if they share the same properties, such as frequency shift, Doppler spread, received timing, and/or delay spread. Ex.1003, ¶81 (citing Ex.1009). And Grant further clarifies the different QCL connections that may exist between reference signals, in that the PDSCH

DMRS could be configured to be QCL with CSI-RS/SSB with respect to spatial parameters, but QCL with Tracking Reference Signal (TRS) with respect to non-spatial (time/frequency) parameters. *Id.*, [0007]; Ex.1003, ¶82.

Due to the advantages provided by the use of TCI that includes RS sets and QCL information as applied to a UE receiving PDSCH messages in a multi-TRP scenario, and the fact that Vilaipornsawai, Shin, and Grant all involve similar multi-TRP (or multi-TP) wireless communication systems communicating PDSCH messages based on 5G/NR concepts, a POSITA would have had a reasonable expectation of success in including Grant's TCI (indicating RS sets and QCL information) in the DCI of Vilaipornsawai-Shin. Ex.1003, ¶83.

In summary:

- **Vilaipornsawai** discloses a UE receiving DCI (in a single PDCCH) (claimed "*PDCCH*") that carries resource assignment fields for scheduling multiple PDSCHs ("*plurality of PDSCHs*") from different TRPs and also carries "DMRS information" for performing channel estimation and receiving/determining the different PDSCHs;
- **Shin** discloses exemplary "DMRS information" received in DCI (of a PDCCH) in a multi-TRP scenario, wherein the DMRS information represents different DMRS port groups for different TRPs ("*plurality of DMRS port groups*"); and

- **Grant** discloses the use of an N-bit indicator, referred to as a TCI (“*TCI state data*”), received in the DCI (of a PDCCH) for indicating QCL information between RS sets and DMRS port groups, where “each RS set refers to one or two downlink DMRS port groups,” to support multi-TRP operation. Grant’s TCI provides a connection (QCL assumptions) between DMRS port groups and RS sets, used for channel estimation in PDSCH reception.

Ex.1003, ¶112.

6. Claim 1

[1.0] *A user equipment (UE) comprising:*

Vilapornasawai discloses a UE: “Figure 14 is a block diagram of a UE according to an embodiment of the present disclosure.” Ex.1005, [0041].

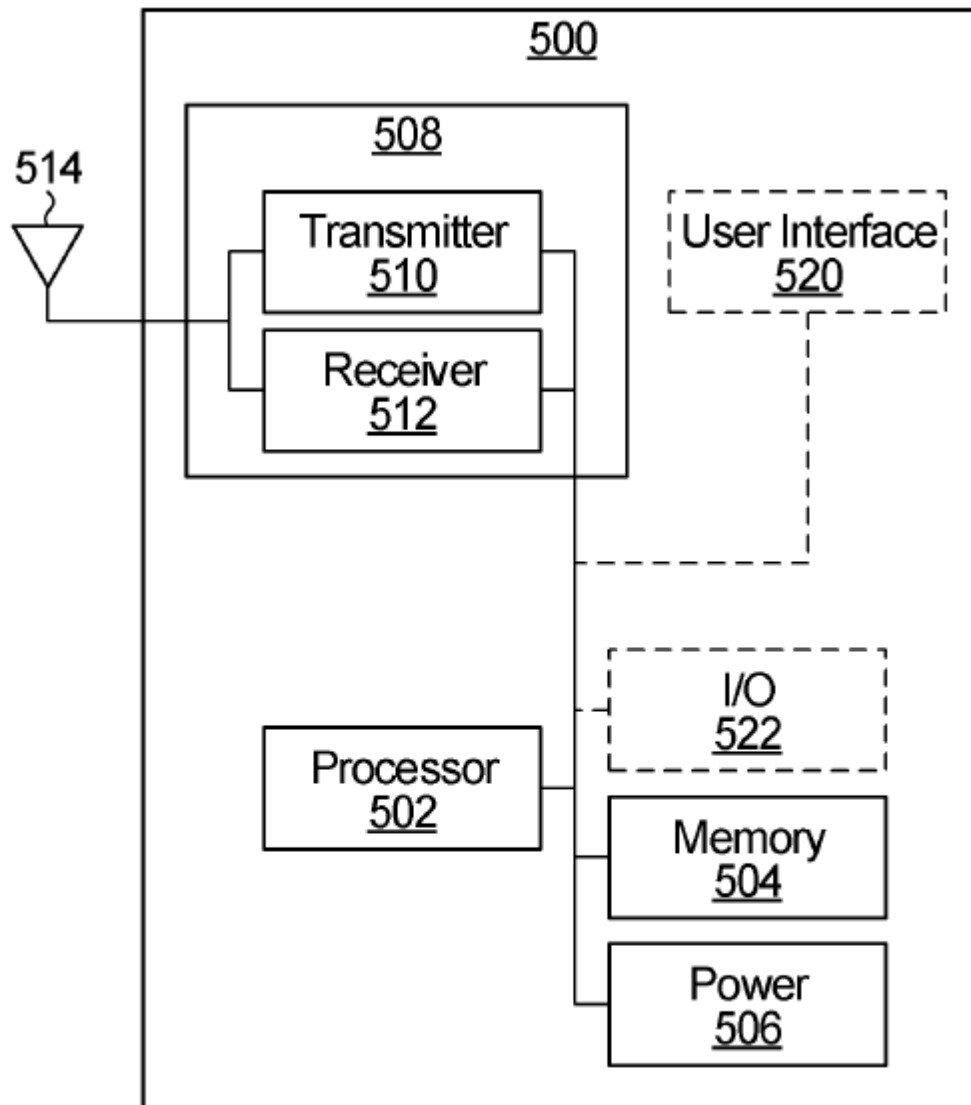


FIG. 14

Ex.1001, Figure 14

Thus, Vilaipornsawai discloses “*user equipment (UE)*.” Ex.1003, ¶84.

[1.1] *one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and*

Vilaipornsawai discloses or renders obvious claim element [1.1].

Vilaipornsawai's UE in Figure 14 includes a "memory 504." Ex.1005, [0160]. Furthermore, "[t]he memory 504 may store programming and/or instructions for the processor 502 including instructions for sending, receiving, processing and supporting different services and types of data, such as but not limited to video, VoIP calls, web browsing data, email and other text communications," and the memory 504 is an example of claim element [1.1]. *Id.*, [0160]; *see also* [0047] ("Moreover, it will be appreciated that any module, component, or device disclosed herein that executes instructions may include or otherwise have access to a **non-transitory computer/processor readable storage medium or media for storage of information**, such as computer/processor readable instructions, data structures, program modules, and/or other data."); Ex.1003, ¶85.

Thus, Vilaipornsawai's disclosure of a UE having a memory storing instructions, with such a memory understood as an example of a "*non-transitory computer-readable media*," discloses or renders obvious [1.2]. Ex.1003, ¶86.

[1.2] at least one processor coupled to the one or more non-transitory computer-readable media, and configured to execute the computer-executable instructions to:

Vilaipornsawai discloses or renders obvious claim element [1.2].

Vilaipornsawai's UE in Figure 14 (see figure reproduced above) includes a "processor 502" ("*processor*") coupled to a "memory 504" ("*non-transitory*

computer-readable media”) for processing instructions, thereby disclosing [1.2].

Ex.1005, [0160] (“The memory 504 may store programming and/or instructions for the **processor 502** including instructions for sending, receiving, processing and supporting different services and types of data, such as but not limited to video, VoIP calls, web browsing data, email and other text communications.”); Ex.1003, ¶88.

[1.3] receive, in a Physical Download Control Channel (PDCCH), Transmission Configuration Indicator (TCI) state data for determining a plurality of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups; and

Vilaipornsawai combined with Shin renders obvious claim element [1.3].

Vilaipornsawai combined with Shin and Grant also renders obvious claim element [1.3]. Ex.1003, ¶89.

Vilaipornsawai combined with Shin renders obvious [1.3]⁴

First, Vilaipornsawai describes a system in which multiple TRPs transmit different PDSCHs to a UE in a joint transmission (JT) scenario, and a single TRP transmits downlink control information (DCI) information in a PDCCH for scheduling the multiple PDSCHs, with the DCI including “DMRS information” for the transmissions. Ex.1003, ¶90.

Vilaipornsawai recognizes that many wireless networks include “data

⁴ Reasons to combine references are provided in Sections X.C.3 and X.C.5.

channels,” such as “PDSCH,” and “control channels,” such as “PDCCH.” Ex.1005, [0050]. “The PDCCH carries control information that is referred to as Downlink Control Information (DCI).” *Id.*, [0051]; Ex.1003, ¶¶91-92.

Vilaipornsawai contemplates a joint transmission (JT) scheme in which a single PDCCH message is used to convey the DCI for multiple PDSCHs:

NC-JT [noncoherent-joint transmission] schemes may involve transmitting the same or **different data/codewords from different TRPs** and the resource allocation on different TRPs may be the same or different. For example, in one scenario, different data/codewords are transmitted to a UE from different TRPs, with each TRP performing adaptive precoding independently.

...

For the NC-JT scenario in which **multiple PDSCHs, e.g. multiple TBs [transport blocks] are transmitted from multiple TRPs**, either **single or multiple PDDCH messages are required to convey the DCI for the multiple PDSCHs from the multiple TRPs.**

Ex.1005, [0065]-[0067]; Ex.1003, ¶93.

In a section called “DCI content,” Vilaipornsawai discloses “a single PDCCH message” that has one or more resource assignment fields for scheduling multiple PDSCHs. Ex.1005, [0116] (“For transmission of a **single PDCCH message for multiple PDSCHs**, DCI carried by a PDCCH message can have either a single resource assignment field or multiple resource assignment fields.”).

Vilaipornsawai addresses a scenario in which a UE receives different PDSCHs

from multiple transmission-reception points (TRPs). *Id.*, [0067] (“For the NC-JT scenario in which multiple PDSCHs, e.g. multiple TBs are transmitted from multiple TRPs, either single or multiple PDDCH messages are required to convey the DCI for the multiple PDSCHs from the multiple TRPs.”); *see also* [0068], [0114], [0116], [0159], [0166], [0188]; Ex.1003, ¶¶94-95.

Thus, Vilaipornsawai discloses that the DCI in a PDCCH from a single TRP informs a UE about the resource assignments (time/frequency resources) so that the UE can know when and where (in time and frequency) to receive different PDSCHs from different TRPs. Ex.1003, ¶96.

As was understood in the art, because of dynamic wireless channel distortions on PDSCH signals, UEs would have to perform channel estimation for a PDSCH in order to successfully or more accurately receive the PDSCH data. A demodulation reference signal (DMRS) is a UE-specific reference signal used by the UE for demodulating the associated channel (e.g., used with PDSCH). Ex.1003, ¶97 (citing Ex.1010).

Vilaipornsawai also discloses that the DCI of a PDCCH carries “DMRS information” for UEs to use to perform channel estimation for, and receive, multiple PDSCH(s). Ex.1005, [0113]-[0114] (“[T]he content of the DCI carried in PDCCH messages may include ... one or more of DMRS information for PDSCH(s),” and there may “be different DMRSs for different PDSCHs.”);

Ex.1003, ¶98. Further, each TRP in Vilaipornsawai’ s system can beneficially have multiple antennas for transmission and reception. Ex.1003, ¶65 (citing Ex.1005, [0164]).

Thus, Vilaipornsawai describes a system in which different multi-antenna TRPs transmit different PDSCHs to a UE in a joint transmission (JT) scenario, and a single TRP transmits downlink control information (DCI) information in a PDCCH for scheduling the multiple PDSCHs, with the DCI including “DMRS information” for the transmissions. Ex.1003, ¶99.

Vilaipornsawai’s transmission of a (1) PDCCH (having DCI, including scheduling information for multiple PDSCHs and also DMRS information) followed by (2) joint transmission of PDSCHs from different TRPs is illustrated below in Figures 1 and 16. Ex.1003, ¶100.

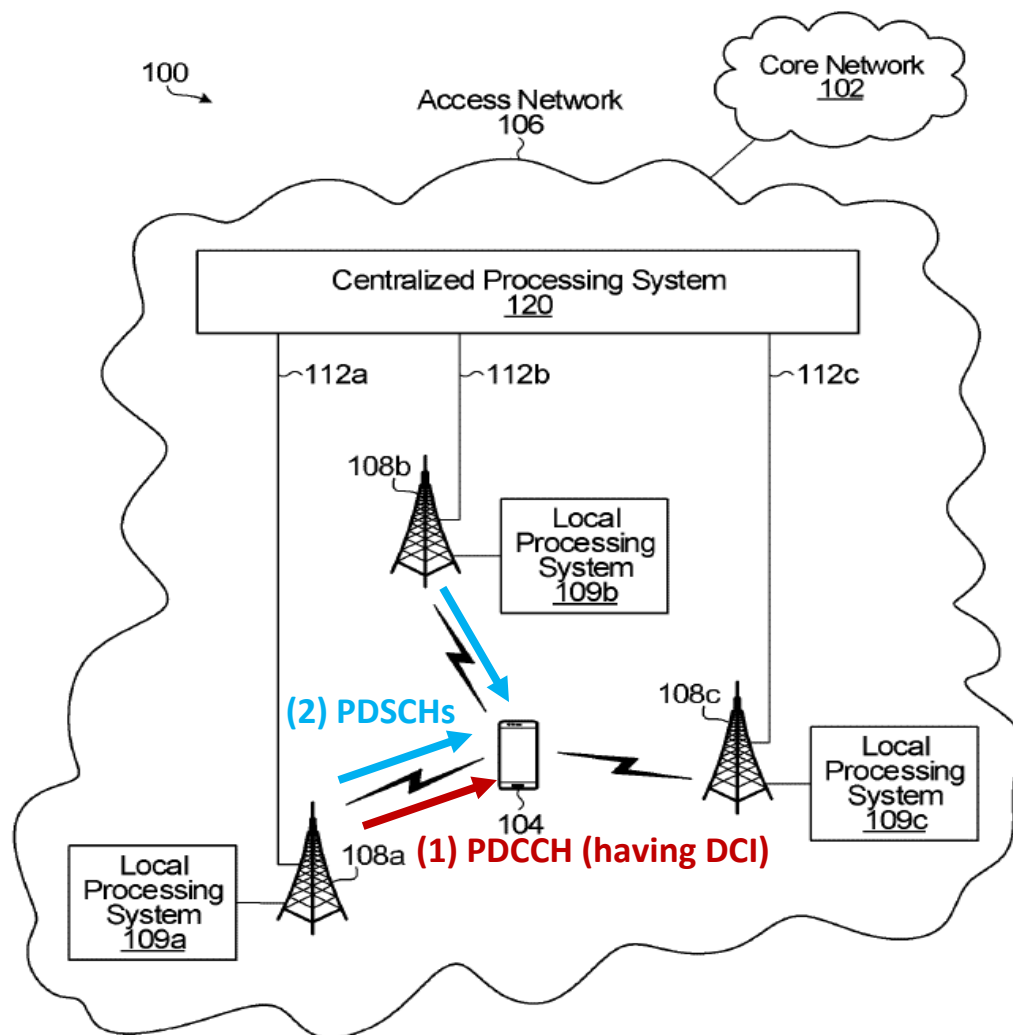


FIG. 1

Ex.1005, Figure 1; Ex.1003, ¶100

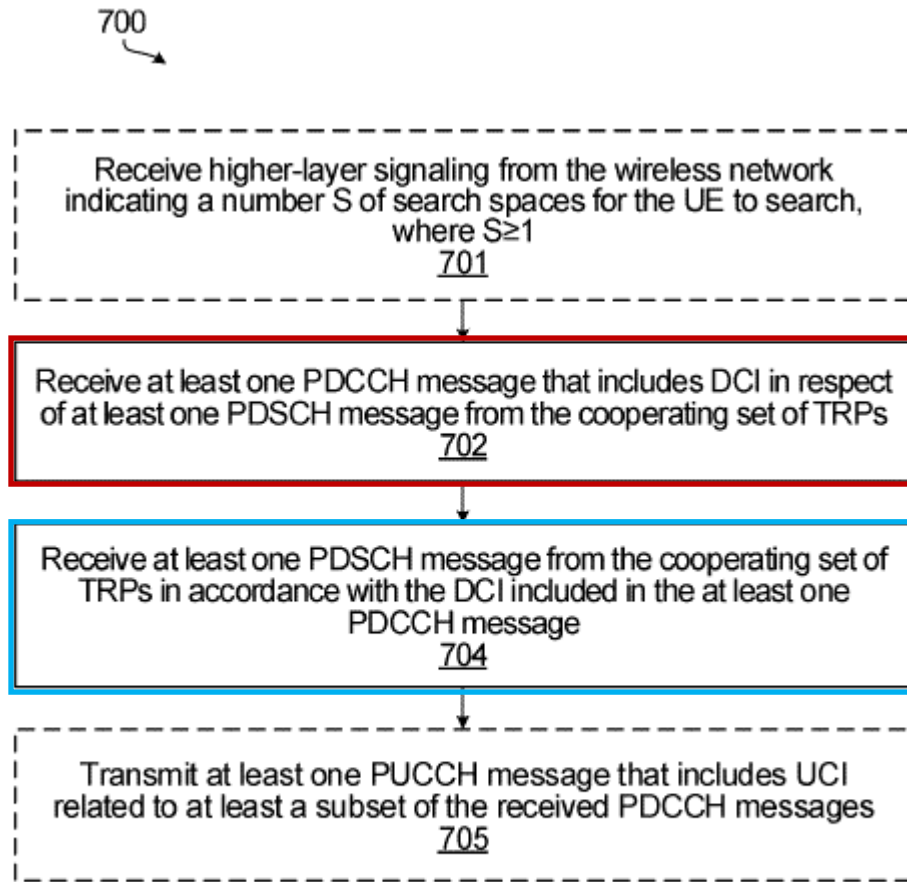


FIG. 16

Ex.1005, Figure 16; Ex.1003, ¶100

Second, Shin provides examples of Vilaipornsawai’s “DMRS information,” such as DMRS port groups, that would have been beneficially included in the DCI of a PDCCH. Vilaipornsawai does not specify the detailed structure of its “DMRS information,” beyond that “the same or different DMRS’s can be used by different TRPs” and this “DMRS information” is specified in the DCI. A POSITA

implementing Vilaipornsawai's system for joint transmission from multiple TRPs, each having multiple antennas, would have been motivated to specify the details of this "DMRS information" communicated to a UE. Ex.1003, ¶66. Shin provides detailed examples of "DMRS information" communicated to a UE in such a scenario:

When supporting the downlink/uplink common DMRS structure, it is important to consider DMRS information signaling efficiency. **In the NR system, the DMRS information may include information as follows:**

...

DMRS port grouping information

Ex.1006, [0062].

The DMRS port grouping information is used for the NC-JT or phase tracking reference signal (PTRS) transmission, and the signaling method thereof is described with respect to a fourth embodiment of the disclosure.

Id., [0071]; [0194]-[0200]; Ex.1003, ¶¶67, 101-103.

For scenarios employing coordinated transmission from multiple TRPs (e.g., NC-JT), according to Shin, it is "necessary to transmit the DMRS port grouping information to the UE for NC-JT." Ex.1006, [0200]. For example, there may be different DMRS port groups for different TPs (e.g., TRPs). As an example, "[f]or 3-layer NC-JT with 1-layer transmission from TP1 and 2-layer transmission from TP2, it may be possible to select **DMRS port 0 for TP1 and DMRS ports 2 and**

3 for TP2.” Ex.1006, [0204]. The QCL assumptions among different DMRS ports in a DMRS port group (and different DMRS port groups, each having different QCL assumptions, for different TPs) may be used to assist with UE channel estimation. Ex.1003, ¶104.

Without explicitly using the term “Transmission Configuration Indicator (TCI),” Vilaipornsawai combined with Shin discloses a UE receiving DCI (in a single PDCCH) that carries resource assignment fields for scheduling multiple PDSCHs from different TRPs and also carries “DMRS information” for the different PDSCHs (Vilaipornsawai), and discloses “DMRS information” as representing different DMRS port groups (Shin), thereby rendering obvious claim element [1.3]. Ex.1003, ¶105.

Vilaipornsawai combined with Shin and Grant renders obvious [1.3]

Vilaipornsawai combined with Shin and Grant also renders obvious claim element [1.3], as shown below.

Grant uses the term “Transmission Configuration Indicator (TCI)” to refer to an N-bit indicator within the DCI (of a PDCCH). The received TCI value indicates one or two reference signal (RS) sets and a QCL relationship for a DMRS port group per RS set, wherein each RS set refers to one or more RSs which are QCLed with DMRS ports within corresponding DMRS group. Ex.1003, ¶¶106-107.

Consistent with Shin’s techniques, the signaling of DMRS port groups in

DCI is confirmed by Grant, which describes the use of an “N-bit indicator” transmitted via “DCI signaling,” referred to as “Transmission Configuration Indicator (TCI).” Ex.1007, [0005], [0008], [0271]. Furthermore, “[e]ach [indicator] state refers to one or two RS sets, which indicates a QCL relationship for one or two DMRS port group(s),” and “[e]ach RS set refers to one or more RS(s) which are QCLed with DM-RS ports within corresponding DM-RS group.” *Id.*, [0005]; Ex.1003, ¶108.

A RS, such as a CSI-RS, can be a cell-specific reference signal as was understood in the art. By contrast, it was known that DMRS is a UE-specific reference signal. Ex.1003, ¶109; *see also* Section IX (Technology Overview). By indicating a QCL relationship between an “RS set” (e.g., indicating CSI-RS) and a “DMRS port group(s),” long term channel properties gleaned from receiving CSI-RS by the UE can be used in conjunction with information gleaned from receiving DMRS signals on DMRS ports to aid DMRS based channel estimation. Ex.1003, ¶109 (citing Ex.1010). Thus, it would have been beneficial to include Grant’s TCI in the DCI of Vilaipornsawai and Shin in order to indicate QCL relationships among DMRS port groups (e.g., Shin’s DMRS port groups) and other, cell-specific, reference signals to improve channel estimation and the reception of DMRS signals, thereby providing a motivation to combine the teachings of Vilaipornsawai and Shin regarding DCI and multiple PDSCHs and Grant’s

teachings regarding an N-bit TCI indicator in DCI. Ex.1003, ¶109.

Because Vilaipornsawai explicitly relates to different PDSCH transmissions from different TRPs in a joint transmission scenario, it would have been obvious to a POSITA that the application of different DMRS port groups of Grant to Vilaipornsawai's teachings regarding different PDSCH transmissions from different TRPs would have implied that the network can assign different DMRS port groups to different PDSCH transmissions. For example, Vilaipornsawai provides an example with "different DMRSs for different PDSCHs." Ex.1005, [0114]; Ex.1003, ¶110.

Grant provides an example in which an RS set "could contain, for example, an index to either CSI-RS or SSB [synchronization signal block] and a configured TRS [tracking RS]. In this case, the PDSCH DMRS could be configured [e.g., by the network] to be QCL with CSI-RS/SSB with respect to spatial parameters, but QCL with TRS with respect to non-spatial (time/frequency) parameters." Ex.1007, [0007]; Ex.1003, ¶111.

In summary:

- **Vilaipornsawai** discloses a UE receiving DCI (in a single PDCCH) (claimed "*PDCCH*") that carries resource assignment fields for scheduling multiple PDSCHs ("*plurality of PDSCHs*") from different TRPs and also carries "DMRS information" for performing channel estimation and

receiving/determining the different PDSCHs;

- **Shin** discloses exemplary “DMRS information” received in DCI (of a PDCCH) in a multi-TRP scenario, wherein the DMRS information represents different DMRS port groups for different TRPs (“*plurality of DMRS port groups*”); and
- **Grant** discloses the use of an N-bit indicator, referred to as a TCI (“*TCI state data*”), received in the DCI (of a PDCCH) for indicating QCL information between RS sets and DMRS port groups, where “each RS set refers to one or two downlink DMRS port groups,” to support multi-TRP operation. Grant’s TCI provides a connection (QCL assumptions) between DMRS port groups and RS sets, used for channel estimation in PDSCH reception.

Ex.1003, ¶112.

In combination, Grant’s TCI (“*TCI state data*”), received in a PDCCH (“*PDCCH*”), would have been associated with Vilaipornsawai-Shin’s “*plurality of DMRS port groups*,” by the UE, so that QCL assumptions indicated by the TCI could be used in channel estimation needed for receiving Vilaipornsawai’s multiple PDSCHs (“*for determining a plurality of PDSCHs*”), thereby rendering obvious “*receive, in a Physical Downlink Control Channel (PDCCH), Transmission Configuration Indicator (TCI) state data for determining a plurality*

of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups,” as claimed. Ex.1003, ¶113.

The ’165 patent specification confirms that these teachings of Vilaipornsawai, Shin, and Grant disclose claim element [1.3]. For example, the ’165 patent explains that “if the TCI state data is associated with DMRS port group #1 and DMRS port group #2 ... the UE may then determine the QCL assumptions for PDSCH #1 304 and PDSCH #2 306 based on the DMRS port group #1 and DMRS port group #2, respectively.” Ex.1001, 6:26-32; *see also* claim element [1.4] (“*receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data.*”). Ex.1003, ¶114.

[1.4] *obtain a plurality of Quasi Co-Location (QCL) assumptions for receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data, wherein:*

As an initial matter, the ’165 patent uses the term “Quasi Co-Location (QCL) assumptions” with little by way of context or background explanation, assuming that a POSITA is familiar with the term. As discussed in Section IX (Technology Background), antenna ports may be recognized by the network as being quasi co-located (QCL), and different reference signals may also be recognized by the network as being QCL. Examples of “QCL assumptions” are assumptions that a UE should consider with respect to antenna ports, reference

signals, and/or associated channel estimation parameters in performing channel estimation, which is subsequently used to receive data, such as in a PDSCH.

Ex.1003, ¶115.

Turning to the prior art, Vilaipornsawai combined with Shin and Grant renders obvious claim element [1.4].

As discussed in the analysis of claim element [1.3], Grant’s “TCI” state value (or data) received by a UE in DCI can refer to “**two RS sets**, wherein “[e]ach **RS set refers to one or more RS(s) which are QCLeD with DM-RS ports within corresponding DM-RS group.**” Ex.1007, [0005]. Therefore, Grant’s disclosure of multiple RS sets, in which each RS set refers to a corresponding DMRS port group of DMRS ports that are QCLeD, discloses a “*plurality of Quasi Co-Location (QCL) assumptions.*” Similarly, Shin discloses a “*plurality of Quasi Co-Location (QCL) assumptions.*” Ex.1006, [0194]-[0195] (“DMRS ports within one DMRS port group are QCL-ed, and DMRS ports in different groups are non-QCL-ed.”). Ex.1003, ¶¶116-118.

It would have been understood or obvious that when Grant’s TCI is used in the context of Vilaipornsawai and Shin, the different PDSCHs of Vilaipornsawai and Shin may use different DMRS port groups (“*receiving the plurality of PDSCHs based on the plurality of DMRS port groups*”), with Grant’s TCI indicator value providing QCL assumptions for receiving the different data in

different PDSCHs from different TRPs (“*plurality of PDSCHs*”) (“*obtain a plurality of QCL assumptions*” for “*the plurality of DMRS port groups associated with the TCI state data*”), thereby rendering obvious claim element [1.4]. Ex.1003, ¶118.

[1.5] *each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups,*

First, as discussed in [1.3], Vilaipornsawai’s UE receives “DMRS information” for performing channel estimation and receiving/determining different PDSCHs from different TRPs, and Shin discloses exemplary “DMRS information” for Vilaipornsawai’s UE as different DMRS port groups for different TRPs (“*plurality of DMRS port groups*”). And as discussed in [1.3] and [1.4], Grant’s TCI received by a UE associates QCL assumptions with DMRS port groups, yielding “*a plurality of QCL assumptions.*” Ex.1003, ¶119.

Second, as shown below, Grand and Shin each disclose a one-to-one correspondence between QCL assumptions and DMRS port groups.

As discussed in the analysis of claim element [1.3], Grant’s “TCI” state received by a UE in DCI can refer to “two RS sets, which indicates a QCL relationship for...two DMRS port group(s)” wherein “[e]ach RS set refers to one or more RS(s) which are QCLed with DM-RS ports within corresponding DM-RS group.” Ex.1007, [0005]. Therefore, Grant discloses a “*plurality of Quasi Co-Location (QCL) assumptions,*” and each of the QCL assumptions refers to a

corresponding DMRS port group. Ex.1003, ¶¶120-121.

Shin also discloses a one-to-one correspondence between DMRS port groups and QCL assumptions, thereby disclosing “*each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups.*” Ex.1006, [0194]-[0195] (“DMRS ports within one DMRS port group are QCL-ed, and DMRS ports in different groups are non-QCL-ed.”); Ex.1003, ¶122.

Thus, Shin’s disclosure of exemplary DMRS information for Vilaipornsawai’s UE as DMRS port groups, in view of Grant and Shin’s disclosure of a one-to-one correspondence between QCL assumptions and DMRS port groups, renders obvious claim element [1.5]. Ex.1003, ¶123.

[1.6] the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets, and

First, the ’165 Patent uses the terms “RS set” only three times in the specification (and only in the context of a “QCL RS set”). Ex.1001, 5:63-6:3. There is no further explanation of a “QCL RS set” in the ’165 Patent. A POSITA would have understood that the terms “RS set” and “QCL RS set” were used synonymously in the art, as confirmed by other contemporaneous references. *See, e.g.,* Ex.1013, [0054] (“RS set (also referred to as ... ‘QCL RS set’)”); Ex.1003, ¶¶124-125.

Second, as discussed in [1.3], Grant discloses the use of an N-bit indicator, referred to as a TCI (“*TCI state data*”), received in control information for

indicating QCL information between RS sets and DMRS port groups. Ex.1003, ¶126.

Third, Grant refers to “two RS sets” in the context of indicating QCL relationships, such as in the following disclosure, an example of “*a plurality of QCL RS sets*,” as claimed:

Each [TCI] state refers to one or two RS sets, which indicates a QCL relationship for one or two DMRS port group(s), respectively

Each RS set refers to one or more RS(s) which are QCLED with DM-RS ports within corresponding DM-RS group

Ex.1007, [0005]. In fact, Grant’s disclosure is substantively the same as the ’165 Patent’s specification. *See* Ex.1001, 5:63-6:3 (“the TCI state data may correspond to a TCI state configuration that includes multiple QCL RS sets, and each of the QCL RS sets may correspond to one of the DMRS port groups associated with the TCI state data.”); Ex.1003, ¶127.

Grant’s Table 3 (below) shows various TCI state values (“*TCI state data*”) corresponding to TCI state configurations (“*a TCI state configuration*”) having two RS sets (“*a plurality of QCL Reference Signal (RS) sets*”), such as TCI State values of 3 and higher.

TABLE 3

a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets

TCI states used for QCL indication for PDSCH and PDCCH			
TCI State	RS Set(s)	Used for PDCCH QCL Indication	Used for PDSCH QCL Indication
0 (default state)	{Set1 ₀ }	Y	Y
1	{Set1 ₀ }	Y	Y
2	{Set1 ₀ }	Y	Y
3	{Set1 ₃ , Set2 ₃ }		Y
⋮	⋮		⋮
⋮	⋮		⋮
⋮	⋮		⋮
2 ^N -1	{Set1 _{2^N-1} , Set2 _{2^N-1} }		Y

Ex.1007, [0009]; Ex.1003, ¶128

Thus, Grant discloses an N-bit TCI state indicator transmitted in DCI to a UE, wherein the TCI state refers to two RS sets and indicates a QCL relationship between each RS set and DMRS ports in a corresponding DMRS port group (two RS sets and two DMRS port groups), thereby disclosing or rendering obvious “*the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets.*” Ex.1003, ¶129.

[1.7] each of the plurality of QCL RS sets corresponds to one of the plurality of DMRS port groups.

First, as discussed in the analysis of claim element [1.6], Grant discloses that a TCI state value refers to two RS sets (*see, e.g.,* Table 3, TCI State greater than or equal to three), wherein “each [TCI] state refers to one or two RS sets, which indicates a QCL relationship for one or two DMRS port group(s), respectively”

(“*plurality of QCL RS sets*”). Ex.1007, [0005]. Second, as discussed in the analysis of claim element [1.3], Vilaipornsawai-Shin discloses exemplary DMRS information for Vilaipornsawai’s UE as different DMRS port groups for different TRPs (“*plurality of DMRS port groups*”). Third, “[e]ach RS set refers to one or more RS(s) which are QCLed with DM-RS ports within corresponding DM-RS group,” Ex.1007, [0005]. In other words, Grant discloses a one-to-one correspondence between two RS sets and two DMRS port groups, which, in view of Vilaipornsawai-Shin’s teachings, discloses or renders obvious claim element [1.7]. Ex.1003, ¶130.

7. Claim 2

The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

[2.1] identify a plurality of Transmit/Receive Points (TRPs) based on the plurality of QCL assumptions.

First, as discussed in [1.4], both Grant and Shin disclose multiple DMRS port groups, each having associated QCL assumptions (“*plurality of QCL assumptions*”). Ex.1003, ¶131.

Second, Grant discloses associating QCL assumptions with TRP pairs. For example, Grant recites:

With this extension, each indicator state is associated with one or two RS sets, where each RS set refers to one or two downlink DMRS port groups, respectively. **This facilitates QCL indication in the case of**

that multi-TRP operation (DL CoMP) is configured. Different states may correspond to different TRP pairs supporting, e.g., non-coherent joint transmission (NC-JT) from a pair of TRPs to the UE.

Ex.1007, [0006]. As recited above, TCI indicator states associated with two RS sets may “correspond to different TRP pairs.” The QCL assumptions associated with a particular TCI state are used by a UE to receive information transmitted from a specific pair of TRPs. Associating a TCI indicator state, which has a plurality of QCL assumptions (per Shin and Grant in the analysis of [1.4])), with a TRP pair/two TRPs (per the teachings of Grant), renders obvious “*identify a plurality of Transmit/Receive Points (TRPs) based on the plurality of QCL assumptions.*” Ex.1003, ¶132.

8. Claim 3

The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

[3.1] receive an instruction for indicating a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups via Medium Access Control (MAC) Control Element (CE) signaling.

As discussed in [1.3], Vilaipornsawai’s UE receives “DMRS information” for performing channel estimation and receiving/determining different PDSCHs from different TRPs, and Shin discloses exemplary “DMRS information” for Vilaipornsawai’s UE as different DMRS port groups for different TRPs (“*plurality of DMRS port groups*”). And as discussed in [1.3] and [1.4], Grant’s TCI received by a UE indicates QCL assumptions connecting DMRS port groups and other

reference signals (RSs), yielding “a plurality of QCL assumptions.” Ex.1003, ¶133.

Furthermore, Grant addresses how the information in a table of TCI configurations (corresponding to TCI state values) is established or communicated from the network. Ex.1003, ¶134. For example, Grant discloses that the “[c]onfiguration of RS set for each state can be done via higher layer signaling,” such as “MAC CE.” Ex.1007, [0005]. Grant’s mention of “each state” is a reference to each TCI state in a table of TCI state values. And Grant explains that “different TCI states may be used for QCL indication referring to different RS types.” *Id.*, [0009]. By changing the “[c]onfiguration of RS set” for each TCI state, the QCL relationships between RS sets and DMRS port groups are changed. Ex.1003, ¶135.

Thus, Vilaipornsawai-Shin’s disclosure of a UE receiving a plurality of DMRS port groups, in view of Grant’s disclosure of TCI received by a UE indicates QCL assumptions connecting DMRS port groups and RSs and that the “[c]onfiguration of each RS set” for each TCI state can be indicated via “MAC CE” signaling,” renders obvious [3.1] . Ex.1003, ¶¶136-137.

9. Claim 5

The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

[5.1] receive the plurality of DMRS port groups via Radio Resource Control (RRC) signaling, wherein the plurality of DMRS port groups is associated with the plurality of PDSCHs.

Vilaipornsawai combined with Shin renders obvious claim element [5.1].

As explained in the analysis of claim element [1.3], Vilaipornsawai provides an example in which a UE receives “DMRS information” via DCI in a PDCCH for UEs to be able to receive multiple PDSCHs. *See, e.g.*, Ex.1005, [0113] (“the content of the DCI carried in PDCCH messages may include...one or more of DMRS information for PDSCH(s)”; Ex.1003, ¶139.

As further explained in the analysis of [1.3], Shin describes example DMRS information as DMRS port groups. Shin explains that DMRS port grouping may be configured via RRC signaling. Ex.1006, [0198] (“DMRS port grouping information may be configured in a semi-static manner via RRC signaling.”). Ex.1003, ¶140.

In summary, Vilaipornsawai discloses communicating DMRS information to a UE for receiving a plurality of PDSCHs, and Shin discloses communicating DMRS information (namely, DMRS port group information) via RRC signaling, thereby rendering obvious [5.1]. Ex.1003, ¶141.

Additional Reasons to Combine Vilaipornsawai and Shin

Reasons to combine Vilaipornsawai and Shin are provided previously in Section X.C.3. Additional reasons to combine are presented here. It is not necessary to indicate DMRS port grouping information in DCI messages, which are transmitted via PDCCH as taught in Vilaipornsawai. Instead, DMRS port group

information may be conveyed to a UE “in a semi-static manner via RRC signaling,” as taught in Shin (at [0198]). A POSITA would have understood that Shin’s description of a “semi-static manner via RRC signaling” refers to signaling that does not take place as often as DCI messages. Ex.1003, ¶142 (discussing Shin and Ex.1014). Thus, the use of RRC signaling instead of DCI signaling represents a well-known tradeoff between reducing the number of times and the amount of resource used with which control and/or configuration parameters are conveyed to a UE (a benefit, because fewer resources are dedicated to control signaling) at the expense of not being able to update the DMRS port group information as often (a drawback). Ex.1003, ¶142.

10. Claim 6

The UE of claim 1,
[6.1] *wherein each of the plurality of QCL assumptions includes at least one of a time-domain QCL parameter, a frequency-domain QCL parameter, and a spatial-domain QCL parameter.*

As discussed in the analysis of claim element [1.4], Grant discloses a “*plurality of QCL assumptions.*” For example, Grant’s “TCI” state received by a UE in DCI can refer to “**two RS sets, wherein “[e]ach RS set refers to one or more RS(s) which are QCLed with DM-RS ports within corresponding DM-RS group.”** Ex.1007, [0005]; Ex.1003, ¶143.

Turning to the contents of the QCL assumptions, Grant discloses each of the different claimed QCL parameters: “**the PDSCH DMRS could be configured to**

be **QCL** with CSI-RS/SSB with respect to **spatial parameters**, but **QCL** with TRS with respect to **non-spatial (time/frequency) parameters**.” *Id.*, [0007].

Thus, each of the plurality of Grant’s QCL assumptions (corresponding to different RS sets, each of which may have multiple RSs) may include “spatial parameters” (*a spatial-domain QCL parameter*) and “non-spatial (time/frequency) parameters” (*a time-domain QCL parameter [and] a frequency-domain QCL parameter*), thereby disclosing [6.1].⁵ Ex.1003, ¶144.

11. Claim 7

[7.0] *A method of wireless communications by a user equipment (UE), the method comprising:*

As discussed in the analysis of claim elements [1.0]-[1.2], Vilaipornsawai discloses a UE having a memory and a processor for storing and processing instructions, respectively. *See* Ex.1005, [0160] and Figure 14. And Vilaipornsawai “relates generally to wireless communication.” *Id.*, [0002]. Further, Vilaipornsawai discloses wireless communication of a PDCCH and PDSCHs to a UE. Ex.1005, [0052]. Thus, Vilaipornsawai discloses [7.0]. Ex.1003, ¶146.

⁵ The ’165 patent defines the expression “at least one of A, B, and C” as disjunctive, such that only one of A, B, or C (or any combination thereof) is required. Ex.1001, 2:61-64. Regardless, Grant discloses all three parameters of [6.1]. Ex.1003, ¶145.

[7.1] receiving, in a Physical Downlink Control Channel (PDCCH) Transmission Configuration Indicator (TCI) state data for determining a plurality of Physical Downlink Shared Channels (PDSCHs), the TCI state data being associated with a plurality of Demodulation Reference Signal (DMRS) port groups

Claim element [7.1] is substantively the same as claim element [1.3].

Therefore, see the analysis of [1.3]. Ex.1003, ¶147.

[7.2] obtaining a plurality of Quasi Co-Location (QCL) assumptions for receiving the plurality of PDSCHs based on the plurality of DMRS port groups associated with the TCI state data, wherein:

Claim element [7.2] is substantively the same as claim element [1.4].

Therefore, see the analysis of [1.4]. Ex.1003, ¶148.

[7.3] each of the plurality of QCL assumptions corresponds to one of the plurality of DMRS port groups,

Claim element [7.3] is substantively the same as claim element [1.5].

Therefore, see the analysis of [1.5]. Ex.1003, ¶149.

[7.4] the TCI state data corresponds to a TCI state configuration that includes a plurality of QCL Reference Signal (RS) sets

Claim element [7.4] is substantively the same as claim element [1.6].

Therefore, see the analysis of [1.6]. Ex.1003, ¶150.

[7.5] each of the plurality of QCL RS sets corresponds to one of the plurality of DMRS port groups.

Claim element [7.5] is substantively the same as claim element [1.7].

Therefore, see the analysis of [1.7]. Ex.1003, ¶151.

12. Claim 8

The method of claim 7, further comprising:

[8.1] identifying a plurality of Transmit/Receive Points (TRPs) based on the plurality of QCL assumptions.

Claim element [8.1] is substantively the same as claim element [2.1].

Therefore, see the analysis of [2.1]. Ex.1003, ¶152.

13. Claim 9

The method of claim 7, further comprising:

[9.1] receiving an instruction for indicating a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups via Medium Access Control (MAC) Control Element (CE) signaling.

Claim element [9.1] is substantively the same as claim element [3.1].

Therefore, the analysis of [3.1]. Ex.1003, ¶153.

14. Claim 11

The method of claim 7, further comprising:

[11.1] receiving the plurality of DMRS port groups via Radio Resource Control (RRC) signaling, wherein the plurality of DMRS port groups is associated with the plurality of PDSCHs.

Claim element [11.1] is substantively the same as claim element [5.1].

Therefore, see the analysis of [5.1]. Ex.1003, ¶154.

15. Claim 12

The method of claim 7,

[12.1] wherein each of the plurality of QCL assumptions includes at least one of a time-domain QCL parameter, a frequency-domain QCL parameter, and a spatial-domain QCL parameter.

Claim element [12.1] is substantively the same as claim element [6.1].

Therefore, see the analysis of [6.1]. Ex.1003, ¶155.

D. Ground 2: Claims 4 and 10 are obvious under 35 U.S.C. § 103 over Vilaipornsawai in view of Shin, Grant, and Xue

1. Summary of Xue

Xue describes a UE that uses a timer to keep track of time periods in which it “monitors and receives a PDCCH” and when the UE “does not receive the PDCCH.” Ex.1012, [0002]. For example, Xue describes a “DRX [discontinuous reception] deactivation timer” that keeps track of “a plurality of consecutive subframes.” *Id.*, [0003]; Ex.1003, ¶156.

More generally, Xue describes a method in which “[a] terminal monitors downlink control information in a first time resource unit range according to a first rule.” Ex.1012, [0108]. The “time resource unit range” may be a certain number of slots. *Id.*, [0112]; Ex.1003, ¶157.

Further, “[i]n a possible design, the first time resource unit range is determined by using a first timer.” Ex.1012, [0148]. For example, “the 1st time resource unit range is implemented by a timer 1,” “[a] start moment of the timer 1 is the same as a start moment of the 1st time resource unit range, and an effective period of the timer 1 is the same as a time length of the 1st time resource unit range,” and a time resource unit range may “include[] four consecutive slots.” *Id.*, [0159]-[160]; Ex.1003, ¶¶158-159.

2. Reasons to Combine Grant and Xue

As a threshold matter, Xue is analogous art to the '165 patent, as both documents are directed to cellular wireless communication systems, such as LTE and 5G/NR systems. Ex.1001, 1:18-19 and 3:37-48. Xue, [0095] (“This application is mainly applied to a long term evolution (Long Term Evolution, LTE for short)/5G new radio access technology (New RAT. NR for short) system.”); Ex.1003, ¶160.

As explained in Section X.C.4 (Summary of Grant), Grant uses the term “Transmission Configuration Indicator (TCI)” to refer to an N-bit indicator in the DCI (of a PDCCH). The TCI value indicates two reference signal (RS) sets and a QCL relationship for a DMRS port group per RS set, wherein each RS set refers to one or more RSs which are QCLeD with DM-RS ports within corresponding DM-RS group. Ex.1003, ¶161.

In Grant’s Table 6, entitled “Proposal for Procedures for defining/updating TCI States,” Grant describes “[e]xplicit update[s] of a TCI state,” in which “[t]he UE receives a signalling message.” Ex.1007, [0289]. Furthermore, “[i]f the UE receives the signalling message in slot n, the first time that the UE may apply the updated QCL assumption for demodulation of PDSCH ... is in slot $n+d_1$.” *Id.*, [0289]. Grant does not provide implementation detail for how its UE keeps track of time between “slot n” and “slot $n+d_1$.” Thus, a POSITA seeking to implement

Grant's teachings would have been motivated to specify this implementation detail to implement Grant's teachings. It would have been obvious that a timer is one way for a UE to keep track of whether the amount of time that has passed is equal to some integer (e.g., d_1) number of slots. Xue confirms this understanding of a POSITA, presenting use of such a timer in the context of wireless communications (see "Summary of Xue" above). Ex.1003, ¶162.

Thus, Xue discloses the use of a timer to keep track of the expiry of a certain number of slots, thereby confirming that a POSITA would have understood that a timer is a way keep track of the expiry of a certain number (d_1) of slots to implement Grant's teaching of "[i]f the UE receives the signalling message in slot n , the first time that the UE may apply the updated QCL assumption for demodulation of PDSCH ... is in slot $n+d_1$." Ex.1007, [0289]; Ex.1003, ¶162.

Combining Xue and Grant represents combining prior art elements (Xue's timer in Grant's UE) according to known methods to yield the obvious and predictable result of a timer keeping track of the expiry of a certain number of slots to implement Grant's teaching regarding the timing of applying updated QCL assumptions. Ex.1003, ¶163.

3. Claim 4

The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to:

[4.1] indicate a relationship between the plurality of QCL assumptions and the plurality of DMRS port groups when a timer configured for the UE expires.

As discussed in [1.3], Vilaipornsawai's UE receives "DMRS information" for performing channel estimation and receiving/determining different PDSCHs from different TRPs, and Shin discloses exemplary "DMRS information" for Vilaipornsawai's UE as different DMRS port groups for different TRPs ("*plurality of DMRS port groups*"). And as discussed in [1.3] and [1.4], Grant's TCI received by a UE indicates QCL assumptions connecting DMRS port groups and other reference signals (RSs), yielding "*a plurality of QCL assumptions.*" Ex.1003, ¶164.

Furthermore, in Grant's Table 6, entitled "Proposal for Procedures for defining/updating TCI States," Grant describes "[e]xplicit update[s] of a TCI state," in which "[t]he UE receives a signalling message." Ex.1007, [0289]. Moreover, "the signalling can simultaneously update more than one TCI state." *Id.* Finally, "[i]f the UE receives the signalling message in slot n, the first time that the UE may apply the updated QCL assumption for demodulation of PDSCH ... is in slot $n+d_1$." *Id.*; Ex.1003, ¶165.

It would have been obvious to a POSITA that a timer is one way for a UE to keep track of whether the amount of time that has passed is equal to some integer (e.g., d_1) number of slots. A "slot" would have been understood as a term of art referring to a time slot. For example, a "slot" in LTE was understood as spanning a fixed amount of time. Ex.1003, ¶166 (citing Ex.1006).

As described previously (Section X.D.1), Xue confirms that it was common

to determine the passage of a fixed number of slots using a timer. More generally, Xue describes a method in which “[a] terminal monitors downlink control information in a first time resource unit range according to a first rule.” Ex.1012, [0108]. The “time resource unit range” may be a certain number of slots. *Id.*, [0112] (“The time resource unit is ... a slot.”); Ex.1003, ¶167.

Further, “[i]n a possible design, the first time resource unit range is determined by using a first timer.” Ex.1012, [0148]. For example, “the 1st time resource unit range is implemented by a timer 1,” “[a] start moment of the timer 1 is the same as a start moment of the 1st time resource unit range, and an effective period of the timer 1 is the same as a time length of the 1st time resource unit range,” and a time resource unit range may “include[] four consecutive slots.” Ex.1012, [0159]-[160]. Thus, Xue discloses or renders obvious the use of a timer to keep track of the expiry of a certain number of slots, thereby confirming that a timer is one way keep track of the expiry of a certain number (d_1) of slots to implement Grant’s teaching of “[i]f the UE receives the signalling message in slot n , the first time that the UE may apply the updated QCL assumption for demodulation of PDSCH ... is in slot $n+d_1$.” Ex.1007, [0289]; Ex.1003, ¶168. In view of Vilaipornsawai-Shin’s teachings regarding “*plurality of DMRS port groups*,” Grant’s TCI values that provide QCL assumptions for the DMRS port groups and that are updated based on the expiration of Xue’s timer, renders

obvious [4.1]. Ex.1003, ¶169.

4. Claim 10

***The method of claim 7, further comprising:
[10.1] indicating a relationship between the plurality of QCL assumptions and
the plurality of DMRS port groups when a timer configured for the UE expires.***

Claim element [10.1] is substantively the same as claim element [4.1].

Therefore, see the analysis of [4.1]. Ex.1003, ¶170.

XI. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

A. The *Fintiv* Factors Favor Institution Under § 314

The six *Fintiv* factors considered for § 314 denial strongly favor institution. See *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential); *Memorandum: Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation* (June 21, 2022) (memo from Director applying the *Fintiv* factors). Not only is the parallel WDTX case at an early stage, but both Apple and Togail have asked to transfer the case to a California district. Ex.1019, 3. The likely transfer of the district court case will vacate the current scheduling order.

1. No evidence regarding a stay

No motion to stay has been filed, so the Board should not infer the outcome of such a motion. *Sand Revolution II LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) (informative)

(“*Sand*”); *see also Dish Network L.L.C. v. Broadband iTV, Inc.*, IPR2020-01359, Paper 15 at 11 (Feb. 12, 2021) (“It would be improper to speculate, at this stage, what the Texas court might do regarding a motion to stay...”). Thus, this factor is neutral on discretionary denial.

2. Parallel proceeding trial date

According to the current WDTX Scheduling Order, the *Markman* Hearing will not take place until March 30, 2023; fact discovery will not open until March 31, 2023; and trial will not commence until April 1, 2024. Ex.1018, 2-3. This trial schedule, however, is likely to be vacated because Apple and Togail agree that the case should be transferred to a California district. Ex.1018, 1. Apple filed a motion seeking transfer to NDCA, and Togail opposes only to the extent that it believes the case should instead be transferred to SDCA. Ex.1019, 1-3. This uncertainty weighs in favor of institution. *See Sand* at 8-10, 14.

Moreover, even if the case was not transferred, the projected WDTX trial date based on median time-to-trial statistics is not until September of 2024, the same month the Board is expected to issue its Final Written Decision. *See* Ex.1020, 37 (showing median time-to-trial of 28.9 months). This factor heavily favors institution.

3. Investment in the parallel proceeding

The investment in the co-pending litigation has been minimal. As mentioned above, a claim construction hearing has not yet occurred; fact discovery has not yet commenced and will not close until October 18, 2023; and expert discovery has not commenced and will not close until December 21, 2023. Ex.1018, 2-3; *see PEAG LLC v. Varta Microbattery GmbH*, IPR2020-01214, Paper 8 at 17 (Jan. 6, 2021). This lack of investment favors institution.

Since Petitioner learned which claims were being asserted in October 2022, Petitioner has worked expeditiously to file this petition. Ex.1017, 1. And, as of this filing, Patent Owner has not yet served its final infringement contentions. Under *Fintiv*, Petitioner’s prompt filing “weigh[s] against exercising the authority to deny institution.” *Fintiv*, Paper 11 at 11.

4. Overlapping issues with the parallel proceeding

Because the co-pending litigation is in its early stages, Petitioner’s invalidity positions have not yet been fully developed—only the preliminary invalidity contentions have been served. Final invalidity contentions are not due until May 25, 2023. Ex.1018, 3. The extent of overlap is thus speculative at this point in time. Additionally, Petitioner challenges two claims (4 and 10) that are not asserted in the plaintiff’s preliminary infringement contentions, Ex.1017, 2, thereby reducing overlap. .

5. Petitioner is a defendant

Petitioner is a defendant in the co-pending litigation. That is true of most Petitioners in IPR proceedings, making this factor neutral. *See HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9 (PTAB Jan. 14, 2021) (having the “same parties as parallel proceeding” makes factor 5 “neutral”).

6. Other circumstances

The prior art presented in this Petition renders the Challenged Claims unpatentable as obvious. The merits of Petitioner’s arguments are compelling. Additionally, Patent Owner has engaged in a campaign of asserting the ’165 patent against multiple defendants across the industry, including Samsung Electronics Co., Motorola Mobility LLC, Google LLC, TCL Technologies, and TCT Mobile, among other TCL/TCT entities. *See infra* Section XIII.B. There is thus a strong public interest in the Office adjudicating the validity of the claims here. This factor weighs against discretionary denial.

As such, because the *Fintiv* factors are either neutral or weigh against discretionary denial, and because this Petition was filed well before the statutory bar date, institution should not be denied on discretionary factors.

B. The *Fintiv* Framework Should Be Overturned

Apart from Petitioner’s showing that the *Fintiv* factors favor institution, the *Fintiv* framework should be overturned because it (1) exceeds the Director’s

authority, (2) is arbitrary and capricious, and (3) was adopted without notice-and-comment rulemaking.

C. The *Advanced Bionics* Test Favors Institution Under § 325(d)

Denial under § 325(d) is not warranted because the challenges presented in this petition are neither cumulative nor redundant to the prosecution of the '165 patent. The Examiner did not consider any of the references relied upon in this petition. Moreover, the challenges in this petition are non-cumulative because the art relied upon here teaches the claim elements that the Examiner deemed allowable. *See supra*, Section VI.

XII. CONCLUSION

Petitioner has established a reasonable likelihood that the Challenged Claims are unpatentable.

Respectfully submitted,

Dated: March 7, 2023
HAYNES AND BOONE, LLP
2323 Victory Avenue, Suite 700
Dallas, Texas 75219
Customer No. 27683

/Scott T. Jarratt/
Scott T. Jarratt
Lead Counsel for Petitioner
Registration No. 70,297

XIII. MANDATORY NOTICES

A. Real Party-in-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner certifies that the real party-in-interest is Apple Inc.

B. Related Matters

Pursuant to 37 C.F.R. § 42.8(b)(2), to the best knowledge of the Petitioner, the '165 patent is or was involved in the following cases:

Case Heading	Number	Court	Filed
<i>Togail Technologies Ltd. v. Apple Inc.</i>	6-22-cv-00326	WDTX	Mar. 28, 2022
<i>Togail Technologies Ltd. v. Samsung Electronics Co., Ltd. et al.</i>	6-22-cv-00328	WDTX	Mar. 28, 2022
<i>Togail Technologies Ltd. v. Motorola Mobility LLC</i>	1-22-cv-02176	NDIL	Apr. 26, 2022
<i>Togail Technologies Ltd. v. Google LLC</i>	6-22-cv-00327	WDTX	Mar. 28, 2022
<i>Togail Technologies Ltd. v. TCL Technology Group Corp., TCT Mobile Intl. Ltd., et al.</i>	2-23-cv-00039	EDTX	Feb. 1, 2023

C. Lead and Back-up Counsel and Service Information

Lead Counsel

Scott T. Jarratt
HAYNES AND BOONE, LLP
2323 Victory Ave. Suite 700
Dallas, TX 75219

Phone: (972) 739-8663
Fax: (214) 200-0853
scott.jarratt.ipr@haynesboone.com
USPTO Reg. No. 70,297

Back-up Counsel

Andrew S. Ehmke
HAYNES AND BOONE, LLP
2323 Victory Ave. Suite 700
Dallas, TX 75219

Phone: (214) 651-5116
Fax: (214) 200-0853
andy.ehmke.ipr@haynesboone.com
USPTO Reg. No. 50,271

Samuel Drezdron
HAYNES AND BOONE, LLP
2323 Victory Ave. Suite 700
Dallas, TX 75219

Phone: (972) 739-6918
Fax: (214) 200-0853
samuel.drezdron.ipr@haynesboone.com
USPTO Reg. No. 67,085

Clint Wilkins
HAYNES AND BOONE, LLP
2323 Victory Ave. Suite 700
Dallas, TX 75219

Phone: (972) 739-6927
Fax: (214) 200-0853
clint.wilkins.ipr@haynesboone.com
USPTO Reg. No. 62,448

Please address all correspondence in this proceeding to lead and back-up counsel. Petitioner consents to service in this proceeding by email at the addresses above.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), Petitioner hereby certifies, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 12,580 Pursuant to 37 C.F.R. § 42.24(d), this word count excludes the table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing.

Dated: March 7, 2023

/Scott T. Jarratt /

Scott T. Jarratt
Lead Counsel for Petitioner
Registration No. 70,297

CERTIFICATE OF SERVICE

The undersigned certifies that, in accordance with 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105, service was made on Patent Owner as detailed below.

Date of service March 7, 2023

Manner of service FEDERAL EXPRESS

Documents served Petition for *Inter Partes* Review Under 35 U.S.C. § 312 and 37 C.F.R. § 42.104 of U.S. 11,115,165; Petitioner's Exhibit List; Exhibits 1001-1020.

Persons served ScienBiziP, PC
550 South Hope Street
Suite 2825
Los Angeles, CA 90071

/Scott T. Jarratt/

Scott T. Jarratt
Lead Counsel for Petitioner
Registration No. 70,297