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BEFORE THE PATENT TRIAL AND APPEAL BOARD

AT&T SERVICES INC., T-MOBILE USA, INC., CELLCO PARTNERSHIP
D/B/A VERIZON WIRELESS, ERICSSON INC., AND NOKIA OF AMERICA
CORPORATION,

Petitioners

v.

ASUS TECHNOLOGY LICENSING INC. AND CELERITY IP, LLC.

Patent Owner.

Case IPR2024-01121

U.S. Patent No. 10,148,402

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,148,402**

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LIST OF EXHIBITS

Ex. Number	Title
1001	U.S. Patent No. 10,148,402 to Lin et al. (“the ’402 patent”)
1002	File History of U.S. Patent No. 10,148,402
1003	Declaration of Alexander Haimovich, Ph.D.
1004	<i>Curriculum Vitae</i> of Alexander Haimovich, Ph.D.
1005	WIPO Publication No. WO2017/142573A1 (“Moon”)
1006	R1-1609515, “On network beam switching and refinement (BM P-2)”, 3GPP submission at 3GPP TSG-RAN WG1 Meeting #86bis by Intel
1007	Declaration of Craig Bishop
1008	Dahlman, E., Parkvall, S., & Sköld, J. (2016), <i>4G, LTE-Advanced Pro and the Road to 5G</i> (“Dahlman 2016”)
1009	June 21, 2022 Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings With Parallel District Court Litigation
1010	Docket Control Order
1011	Consolidation Order
1012	R1-1613206, “WF on CDM Aggregation for 32 and 24 CSI-RS Ports,” 3GPP submission at 3GPP TSG-RAN WG1 Meeting #87
1013	R1-162686, “Specification impact of aperiodic CSI-RS,” 3GPP submission at 3GPP TSG-RAN WG1 Meeting #84bis
1014	R1-166056 - Final Report of 3GPP TSG RAN WG1 #85 v1.0.0 (Nanjing, China 23 rd – 27 th May 2016)
1015	R1-165642, “WF on Beamformed CSI-RS,” 3GPP submission at 3GPP TSG-RAN WG1 Meeting #85

Petitioners AT&T Services Inc., T-Mobile USA, Inc., Cellco Partnership d/b/a Verizon Wireless, Ericsson Inc., and Nokia of America Corporation (collectively, “Petitioners”) request *Inter Partes* Review (“IPR”) of claims 1–4 and 12–15 (“the Challenged Claims”) of the ’402 patent, asserted to be owned by ASUS Technology Licensing Inc. and Celerity IP, LLC (collectively, “Patent Owner”). Petitioners respectfully request that the Challenged Claims be found unpatentable.

I. INTRODUCTION

The ’402 patent relates to control signaling for reference signals for beamforming in a wireless communication system. In 2017, at the time of the filing of the provisional that led to the ’402 patent, beamforming had long been implemented in such systems.

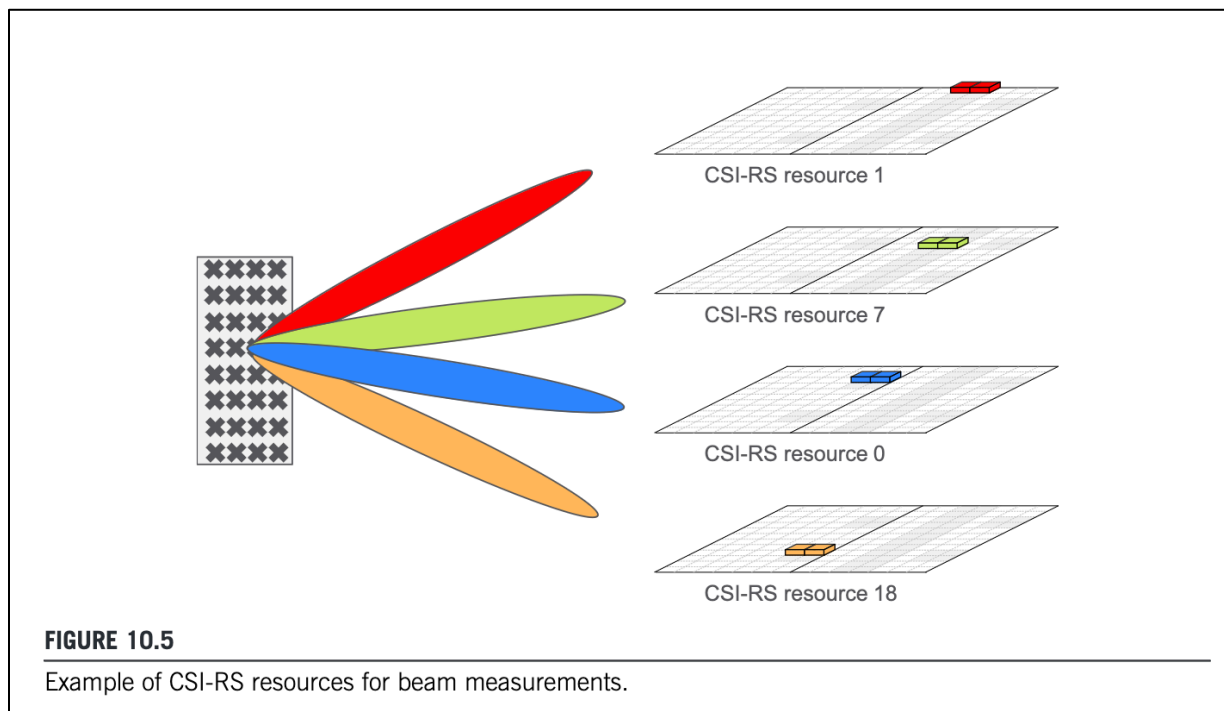
In fact, beamforming was first incorporated into modern telecommunications networks nearly a decade before, alongside the first release of LTE.¹ And LTE introduced UE-specific beamforming, as well as the associated control signaling, alongside Multiple Input Multiple Output (MIMO) technology in 2011.

¹ Beamforming was introduced as part of the first release of LTE, release 8. Ex-1003, ¶ 29. That release was frozen in December 2008. *Id.*

MIMO involves using multiple antennas at both the transmitter and receiver to improve communications performance. One way it improves performance is by controlling the phase and amplitude of the signal at each transmitter to create a pattern of constructive and destructive interference in the wavefront. When constructive interference occurs in a specific direction, it effectively ‘forms’ a beam, hence the term beamforming. This beam can be steered and focused to improve signal quality and strength at the receiver’s location.

To adapt a beam’s direction toward the appropriate receiver, LTE utilizes reference signals, including channel state information reference signals (CSI-RS), to adaptively shape the beam pattern of the antenna array. The process involves:

- 1. Transmission of Reference Signals:** The base station transmits reference signals in various directions.



Ex-1008 at 282, Figure 10.5.

2. **Feedback from the User Equipment (UE):** The UE receives these signals and measures the quality of the received signal, such as the signal-to-noise ratio (SNR).
3. **Calculation of Channel State Information (CSI):** The UE calculates the CSI based on the reference signal measurements and feeds this information back to the base station.
4. **Beamforming Optimization:** The base station uses the CSI feedback to adjust the beamforming weights (amplitude and phase) for each antenna element to focus the signal towards the UE, thereby improving signal quality and reducing interference.

With these prior LTE systems in mind, the Third Generation Partnership Project (3GPP) began the process of developing LTE release 14 and NR (5G) release 15 in 2015. By the time the applicant filed the provisional application leading to the '402 patent in 2017, substantial work had been completed related to the beamforming implementation in release 14 (LTE) and release 15 (5G). Ex-1003, ¶¶ 44–60.

Nonetheless, while prosecuting the '402 patent application, applicant purported to introduce two novel concepts for beamforming in the Challenged Claims, both using control signaling from a base station to a UE:

1. Control signaling to trigger aperiodic reference signals – i.e., reference signals sent only when necessary, rather than on a set schedule.

2. Including in the control signal an indication of the length of the reference signal in terms of the number of symbols.²

Ex-1002 ('402 patent file history) at 37–39.

Neither concept was novel. For months before the '402 patent's priority date, the *other* participants in the 3GPP standard had been discussing the use of aperiodic reference signals in the beamforming process. *See* Ex-1003, ¶¶ 46–48 (identifying numerous 3GPP contributions discussing aperiodic CSI-RS before the '402 patent's priority date). They had also agreed to expand the uniform symbol length for CSI-RSs to account for the larger antenna arrays available in newer telecommunications systems. *See* Ex-1003, ¶ 55–60.

The idea of using control signaling to trigger aperiodic reference signals and to indicate the reference signal length were also both known in the art at the time of the '402 patent's filing. In Moon (International Application No. PCT/US2016/033019 (Ex. 1005)), Intel and its employees clearly disclosed both ideas. Indeed, even the Abstract discloses control signaling to indicate “how many symbols are used to carry the reference signal for beam measurement”:

² In LTE release 13, the symbol length was constant for these reference signals – each reference signal spanned two OFDM symbols.

Techniques for configuration of a user equipment (UE) for fifth generation (5G) Channel State Information (xCSI) Reference Signals (xCSI-RS) are discussed. One example apparatus employable at a base station comprises a processor configured to schedule a fifth generation Physical Downlink Shared Channel (xPDSCH) during one or more xPDSCH symbols of a subframe n ; **schedule a final M symbols of the one or more xPDSCH symbols for fifth generation Channel State Information Reference Signals (xCSI-RS); and output one or more control messages** to transmitter circuitry for transmission to one or more User Equipments (UEs), wherein the one or more control messages comprise a xCSI-RS configuration for the one or more UEs, **wherein the xCSI-RS configuration indicates the value of M** and the final M symbols scheduled for xCSI-RS.

Ex-1005 at Abstract (emphasis added); *see also* Ex-1005 at [0039] (“[T]he number of symbols employed for xCSI-RS transmission can vary. The number of symbols for xCSI-RS can be configured by RRC or dynamic signaling (e.g., via xPDCCH, etc.).”). And Moon repeatedly describes control signaling for “triggering” of xCSI-RS transmission. *See, e.g., id.* at [0040] (“For dynamic triggering of xCSI-RS, the DCI (downlink control information) for the triggering can include any of a variety of xCSI-RS configurations, such as the example configurations shown in Table 1, below.”).

Simply put, each of the claimed points of novelty for the ’402 patent was well known in the art at the time of its filing. The patent should not have issued.

Therefore, Petitioners request *inter partes* review of the '402 patent based on the grounds below, and cancelation of the Challenged Claims as unpatentable.

II. MANDATORY NOTICES

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

The real parties in interest are AT&T Enterprises, LLC,³ AT&T Mobility LLC, AT&T Mobility II LLC, AT&T Services Inc., Cellco Partnership d/b/a Verizon Wireless, Verizon Corporate Resources Group LLC, T-Mobile USA, Inc., Ericsson Inc., Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation.⁴

³ AT&T Corp. is a named defendant in the below identified related cases. AT&T Corp. has undergone a corporate transaction and is now merged and converted into AT&T Enterprises, LLC. Out of an abundance of caution, Petitioners are identifying AT&T Enterprises, LLC as a real party in interest in this IPR.

⁴ Out of an abundance of caution, Petitioners identify all current defendants in the below identified cases as potential real parties in interest only for the purpose of this proceeding and only to the extent that Patent Owner contends that these separate legal entities should be named real parties in interest in this IPR. Petitioners do so to avoid the potential expenditure of resources to resolve such a challenge. Petitioners

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

The following are a list of related matters: *ASUS Technology Licensing Inc. et al. v. AT&T Inc. et al.*, Case No. 2-23-cv-00486-JRG-RSP (E.D. Tex. 2023) (Lead Case); *ASUS Technology Licensing Inc. et al. v. T-Mobile USA, Inc.*, Case No. 2-23-cv-00487-JRG-RSP (E.D. Tex. 2023); *ASUS Technology Licensing Inc. et al. v. Verizon Communications Inc.*, Case No. 2-23-cv-00488-JRG-RSP (E.D. Tex. 2023); *Innovative Sonic Limited et al. v. AT&T Inc., et al.*, Case No. 2-23-cv-00489-JRG-RSP (E.D. Tex. 2023); *Innovative Sonic Limited et al. v. T-Mobile USA, Inc.*, Case No. 2-23-cv-00490-JRG-RSP (E.D. Tex. 2023); *Innovative Sonic Limited et al. v. Verizon Communications, Inc. et al.*, Case No. 2-23-cv-00491-JRG-RSP (E.D. Tex. 2023).

C. Lead and Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioners provide the following designation of counsel.

also acknowledge that each Petitioner has a number of affiliates. No unnamed entity is funding, controlling, or otherwise has an opportunity to control or direct this Petition or Petitioners' participation in any resulting IPR. Petitioners are also not aware of any affiliate that would be barred from filing this Petition under 35 U.S.C. § 315(e).

Lead Counsel	Backup Counsel
Scott W. Hejny Reg. No. 45,882 shejny@McKoolSmith.com McKool Smith, P.C. 300 Crescent Court, Suite 1500 Dallas, Texas 75201 Telephone: 214-978-4000 Fax: 214-978-4044	Nicholas Mathews Reg. No. 66,067 nmathews@mckoolsmith.com McKool Smith, P.C. 300 Crescent Court, Suite 1500 Dallas, Texas 75201 Telephone: 214-978-4000 Fax: 214-978-4044 Christian J. Hurt Reg. No. 63,659 churt@mckoolsmith.com McKool Smith, P.C. 300 Crescent Court, Suite 1500 Dallas, Texas 75201 Telephone: 214-978-4000 Fax: 214-978-4044

D. Service Information Under 37 C.F.R. § 42.8(b)(4)

A copy of this entire Petition, including all Exhibits and a Power of Attorney, is being served via email and FEDERAL EXPRESS, costs prepaid, to the address of the attorney or agent of record at the USPTO:

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

Petitioners are also serving Patent Owner's litigation counsel of record, as reflected below on the Certificate of Service.

Petitioners consent to electronic service at the addresses provided above for lead and back-up counsel and at the following email address:

Celerity_IPRs@mckoolsmith.com. A Power of Attorney is filed concurrently herewith under 37 C.F.R. § 42.10(b).

III. FEES

The Office is authorized to charge a fee under 37 C.F.R. 42.15(a) to Deposit Account No. DA-505723 and any additional fees that are due.

IV. CERTIFICATION OF STANDING

Petitioners certify pursuant to 37 C.F.R. §42.104(a) that the '402 patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein.

V. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED

A. Prior Art

This challenge is based on the following references: International Application Number PCT/US2016/033019 (WIPO Publication Number 2017/142573A1) to Sungho Moon, Bishwarup Mondal, Yushu Zhang, and Jong-Kae Fwu and assigned to Intel IP Corporation ("Moon") (Ex. 1005) and "On network beam switching and refinement (BM P-2)," R1-1609515, a written contribution submitted to 3GPP before the 3GPP TSG-RAN WG1 Meeting #86bis in Lisbon, Portugal on October 10–14, 2016 by Intel ("R1-1609515").

Moon was filed on May 18, 2016, designated the United States, and is prior art to the '402 patent under at least 35 U.S.C. § 102(a)(2). MPEP 2151 ("Accordingly, a WIPO publication of a PCT application (WIPO published

application) that designates the United States, a U.S. patent, or a U.S. patent application publication that names another inventor and was effectively filed before the effective filing date of the claimed invention, is prior art under AIA 35 U.S.C. 102(a)(2).”).

R1-1609515 is, like Moon, a submission from Intel, but to the 3GPP standards body for consideration in developing the 5G cellular system. Ex-1007 (Bishop Decl.), ¶¶ 54–58; Ex-1007, Appendix 22 at 96. R1-1609515 is a printed publication prior art reference under 35 U.S.C. 102(a)(1) as it was accessible and available via 3GPP’s publicly available website on October 1, 2016, before the ’402 patent’s priority date of January 6, 2017. *Id.*

B. Relief Requested

Petitioners request institution of IPR and cancellation of the Challenged Claims based on the following Grounds, supported by the Declaration of Alexander Haimovich, Ph.D. (Ex-1003).

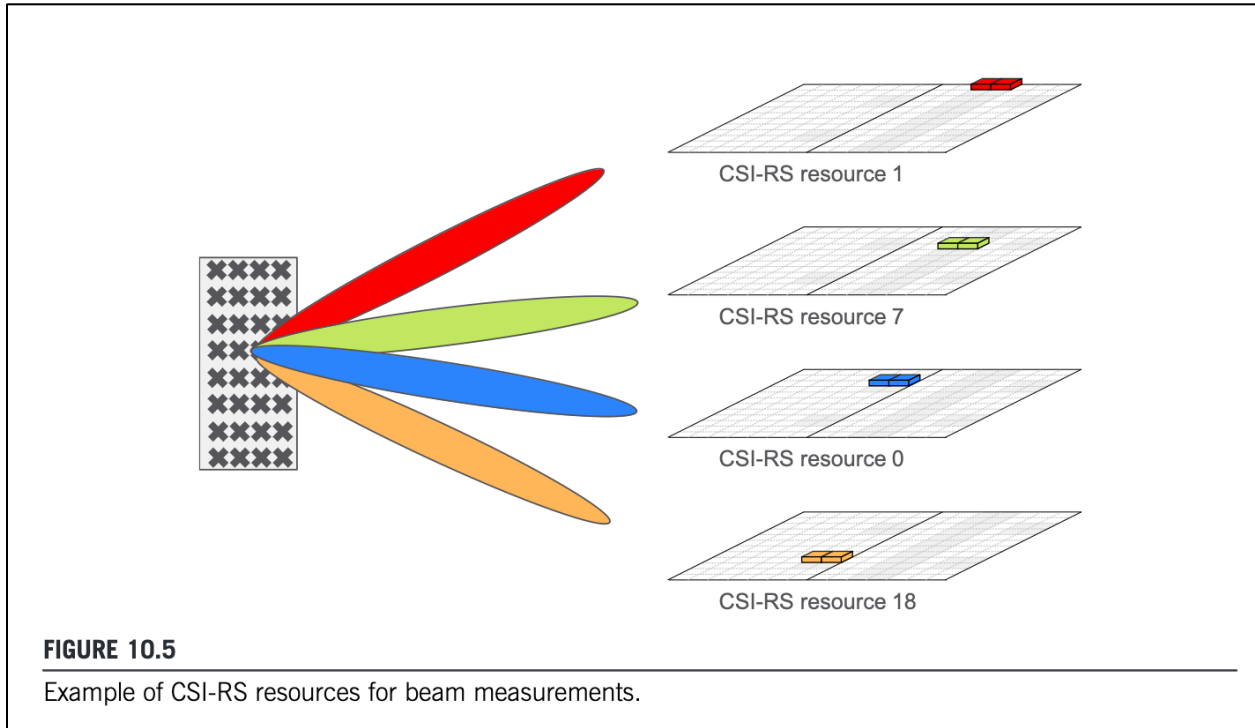
Ground	Basis	Challenged Claims	References
1	35 U.S.C. § 102 (Anticipation)	1-4, 12-15	Moon
2	35 U.S.C. § 103 (Obviousness)	1-4, 12-15	Moon
3	35 U.S.C. § 103 (Obviousness)	3 and 14	Moon in view of R1-1609515

VI. THE '402 PATENT

A. Technical Background

The technology at issue in this petition was developed by members of the Third Generation Partnership Project (“3GPP”) during the LTE and 5G standard setting process. As part of developing those standards, these members recognized the need to extend the beamforming technology from early LTE releases to effectively utilize both the larger antenna arrays available in newer base station equipment, as well as the high-frequency bandwidths (also known as millimeter-wave bands) newly available in 5G. In particular, throughout 2016, these members held detailed technical discussions related to extending the use of reference signals known as Channel State Information Reference Signals (CSI-RS) in the beamforming process for LTE release 14 and NR release 15.

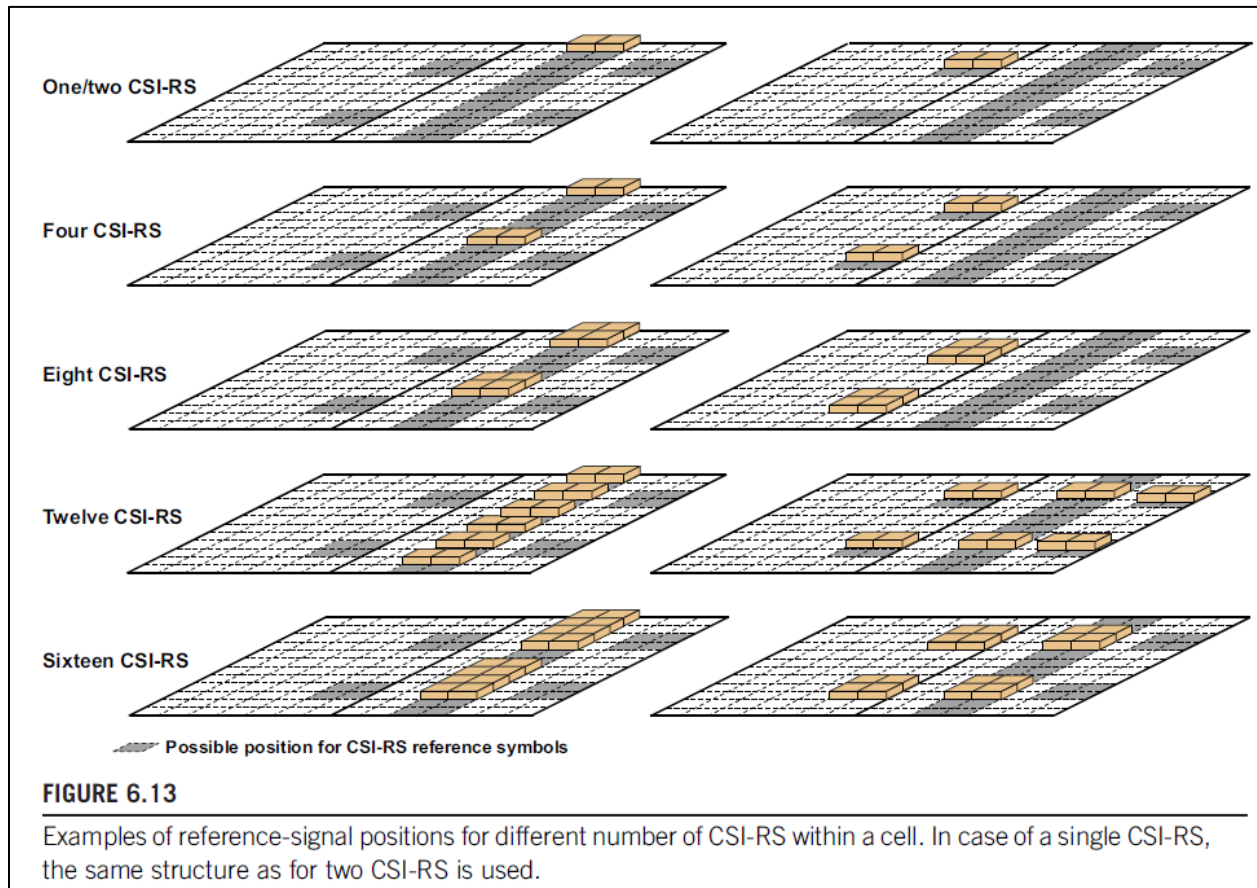
As described in the Introduction (Section I), LTE release 13 began utilizing beamformed CSI-RS:



Ex-1003, ¶ 43; Ex-1008 at 281–82, Figure 10.5. Using these reference signals, a UE “will measure on each of the CSI-RS resources and report back the recommended beam in the form of a CRI (CSI-RS resource index), along with CQI, PMI, and RI under the assumption of the preferred beam being used for transmission.” Ex-1008 at 281. “As an example, if the topmost red beam is the preferred one from a device perspective, the device will report CRI equal to one, along with preferred CQI, PMI, and RI conditioned on the topmost beam being used for transmission.” *Id.* at 282.

In release 13, base stations transmitted CSI-RS on a set schedule, at intervals of 5, 10, 20, 40, or 80 ms. Ex-1003, ¶ 45; Ex-1008 at 112 (“In the time domain, CSI-RS can be configured for transmission with different periodicity, ranging from a period of 5 ms (twice every frame) to 80 ms (every eighth frame”), 114 (“To

summarize, a CSI-RS configuration specifies . . . the CSI-RS periodicity (5, 10, 20, 40, or 80 ms)”). The CSI-RS also spanned two time-consecutive resource elements, as depicted below:



Ex-1008 at 113, Figure 6.13; Ex-1003, ¶ 55–56.

By mid-2016, 3GPP members had agreed that LTE release 14 and NR release 15, which were being developed simultaneously, would add to these implementations. Specifically, 3GPP members agreed LTE release 14 would include “[m]ore efficient resource utilization for UE-specific BF [beamformed] CSI-RS, **including aperiodic CSI-RS,**” Ex-1014 (Final Minutes Report for RAN1 Meeting

#85) at 48 (Section 6.2.3.1.2) (emphasis added), and NR release 15 would similarly “include measurement over aperiodic/periodic/semi-persistent RS,” Ex-1014 at 119. The 3GPP members even settled on the specific control signaling for implementing aperiodic CSI-RS, agreeing that an “Aperiodic CSI-RS transmission instance is indicated by UL-related DCI [Downlink Control Information] transmitted on a control channel with a CSI request field.” *Id.* at 49. In other words, the members agreed that when a base station provided a UE with an uplink-related message, the Downlink Control Information in that message from the base station to the UE could include an indication of aperiodic CSI-RS transmission and a request that the UE respond with Channel State Information (CSI). Ex-1003, ¶ 47.

Similarly, in light of the additional antenna ports available on release-14-compliant devices, 3GPP members agreed that CSI-RS would no longer be limited to spanning two consecutive resource elements on two OFDM symbols. Ex-1003, ¶¶ 59–60; Ex-1012 at 2 (“Agreements at RAND1#86bis . . . At least for 32-port CSI-RS, at least one CDM-8 pattern exists which uses REs from more than 2 OFDM symbols.”). As such, control signaling would need to indicate to the UE the length of the CSI-RS for any specific measurement occasion. Ex-1003, ¶¶ 55–60.

As explained below, these two concepts are at the heart of the ’402 patent’s claimed invention. But Patent Owner first sought patent protection for these ideas in January 2017, months after their public disclosure by others. This Petition is based

on the submissions of one of the 3GPP member companies (Intel) involved in developing the contributions described above, in the form of a PCT patent application (Moon) and a TDoc submitted at a RAN1 meeting of 3GPP (R1-1609515).

B. Overview of the '402 Patent

The '402 patent (Ex-1001) is directed to a method and apparatus for beam management in a wireless communication system. In particular, the patent claims a control signal sent from a base station to user equipment (a UE), in which the control signal is associated with a reference signal for beam measurement. The claimed control signal serves three functions in the challenged independent claims, highlighted below:

1. A method of a base station, comprising:

the base station transmits to a UE a control signal associated with a reference signal for beam measurement, wherein the control signal triggers aperiodical transmission of the reference signal for beam measurement, and wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement and indicates how many symbols are used to carry the reference signal for beam measurement; and

the base station transmits the reference signal for beam measurement to the UE.

12. A base station, comprising:
- a control circuit;
 - a processor installed in the control circuit; and
 - a memory installed in the control circuit and operatively coupled to the processor;
- wherein the processor is configured to execute a program code stored in the memory to:
- transmit to a UE a control signal associated with a reference signal for beam measurement, wherein the control signal triggers aperiodical transmission of the reference signal for beam measurement, and wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement and indicates how many symbols are used to carry the reference signal for beam measurement; and
 - transmit the reference signal for beam measurement to the UE.

First, the control signal “triggers aperiodical transmission of the reference signal for beam measurement.” Ex. 1001 (’402 patent) at 14:5-6 (claim element 1(a)(1) / 12(a)(1)). This contrasts with systems in which the reference signals for beam measurement are transmitted periodically or semi-periodically. Ex-1001 at 6:53-57 (“The reference signal for beam measurement may be sent periodically, aperiodically, or semi-persistently. For periodic beam reference signal, the base station may configure a proper periodicity for measurement occasion(s) when UE would perform measurement.”). According to the patent, “[w]hen the UE detects the

associated triggering signal (e.g., a control signal, a control channel, an uplink grant, or a downlink assignment), the UE would realize there would be a beam reference signal in an associated timing occasion, e.g., the rest of the symbol(s) in the same slot or the symbol(s) in the following slot.” Ex-1001 at 6:65-7:3. One example of aperiodic reference signals, are those reference signals requested by the UE after it “detects there is a beam quality change, UE mobility, UE rotation or any other case when beam refinement or adjustment is required.” Ex-1001 at 7:30-32. Similarly, “an aperiodic beam reference signal can be sent by the base station without request from the UE, if the base station detects that a beam refinement or adjustment is required.” Ex-1001 at 7:35-38.

Second, the claimed control signal includes “a beam-related information for transmitting the reference signal for beam measurement.” Ex-1001 at 14:7-9 (claim element 1(a)(2) / 12(a)(2)). The specification describes how such “information could indicate beam id(s) or TRP id(s).” Ex-1001 at 8:58. The challenged dependent claims expand on this concept. Challenged claims 2 and 6 provide that “the beam-related information indicates at least a beam on which the reference signal for beam measurement is transmitted.” Similarly, challenged claims 3 and 7 provide that “the beam-related information indicates a first beam, and wherein the reference signal for beam measurement is transmitted on at least a refined beam of the first beam.”

Third, the claimed control signal “**indicates how many symbols are used to carry the reference signal for beam measurement.**” Ex-1001 at 14:9-11 (claim element 1(a)(3) / 12(a)(3)). The specification does not expand on this concept, instead merely repeating it as a preferred embodiment: “In one embodiment, the trigger could indicate how many symbols are used to carry the aperiodic beam reference signal.” Ex-1001 at 9:10-12.

C. Overview of the Prosecution History

The application for the '402 patent claims priority to U.S. Provisional Patent Application Serial No. 62/443,291, filed on January 6, 2017. For the purposes of this Petition, January 6, 2017, is presumed as the priority date for the challenged claims.

The '402 patent application was filed on January 5, 2018. During prosecution, the examiner issued a single non-final office action on May 22, 2018, rejecting the pending claims as anticipated or obvious over one reference. In response, the applicant amended the pending claims to incorporate two elements from dependent claims into the independent claims: aperiodical transmission of the reference signal for beam measurement (originally filed as dependent claims 4 and 18) and the control signal indicating how many symbols are used to carry the reference signal for beam measurement (originally filed as dependent claims 6 and 20).

The examiner then allowed the claims. Ex-1002 at 14. According to the examiner's search report, he did not search for terms related to aperiodical transmission of reference signals. Ex-1002 at 28–30.

May 22, 2018, Office Action:

In the May 22, 2018, office action, the examiner rejected pending claims 1-5, 7-13, and 15-19 as anticipated by Nagaraja et al., US 2018/0103407 (Nagaraja). The examiner found that Nagaraja disclosed each of the originally filed independent claims' requirements: (1) that the base station transmit to a UE a control signal associated with a reference signal for beam measurement, (2) wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement, and (3) the base station transmits the reference signal for beam measurement to the UE. Ex-1002 at 110.

The examiner similarly found Nagaraja taught the additional requirements in the dependent claims of: (4) the beam-related information indicates at least a beam on which the reference signal for beam measurement is transmitted (claim 2); (5) the beam-related information indicates a first beam and the reference signal for beam measurement is transmitted on at least a refined beam of the first beam (claim 3); (6) that the reference signal for beam measurement is transmitted aperiodically (originally filed as dependent claim 4); and (7) that the control signal is transmitted via a control channel (originally filed as dependent claim 5). *Id.* at 110–112.

The examiner found Nagaraja lacked direct disclosure of a single element of the originally filed claims: (8) that the control signal indicates how many symbols are used to carry the reference signal for beam measurement (originally filed as dependent claims 6, 14, and 20). *Id.* at 112–113. The examiner found, however, that it “would have been obvious for one of ordinary skill in the art at the time of the invention to specifically indicate the number of symbols for carrying the reference signal since it provides necessary information for decoding the received information so that it can be utilized.” *Id.* at 113. The examiner thus rejected originally filed claims 6, 14, and 20 under 35 U.S.C. 103 as being unpatentable over Nagaraja. *Id.* at 112.

August 14, 2018, Amendments and Applicant Remarks

In response, the applicant amended the claims in two ways: (1) cancelling the dependent claims requiring “aperiodical transmission” of the reference signal for beam measurement, and adding a new requirement to the independent claims that the “control signal triggers aperiodical transmission of the reference signal for beam measurement”; and (2) moving the requirement that the control signal “indicates how many symbols are used to carry the reference signal for beam measurement” from the dependent claims to the independent claims. Ex-1002 at 41–43.

With these changes, the applicant distinguished Nagaraja on three grounds, alleging Nagaraja fails to disclose that (1) “the UE receives a control signal which

indicates how many symbols are used to carry the reference signal for beam measurement” (2) “the UE performs beam measurement based on the reference signal(s)”;⁵ and (3) “the controls signal [is] used to trigger aperiodical transmission of the reference signal.” *Id.* at 37–39.

* * *

A month later, the examiner issued a notice of allowance. Ex-1002 at 14. Despite the applicant’s focus on the claim elements relating to an indication of how many symbols are used to carry the reference signal for beam measurement and the aperiodical transmission of those reference signals, the examiner did not perform any searches relating to either element. *See* Ex-1002 at 28–30 (East Search History). For instance, the examiner did not include any searches for the term “aperiodic.”

D. Level of Ordinary Skill in the Art

As of the earliest claimed priority date, a person of ordinary skill in the art at the time of the alleged invention of the ’402 patent (“POSITA”) would have had a B.S. in Electrical Engineering or a related field with at least three years of experience

⁵ Claim 5, which is not challenged in this Petition, requires that “the UE measures the reference signal for beam measurement from the base station.” Ex-1001 at 14:32–33.

designing, developing, and/or testing telecommunication systems. Ex-1003, ¶ 73. A POSITA would also have familiarity with the wireless standards and well-known protocols for accessing wireless networks. *Id.* More education may supplement practical experience or *vice versa*. *Id.*

VII. CLAIM CONSTRUCTION

Petitioners submit that the Board does not need to expressly construe any terms to resolve the arguments presented herein. Petitioners submit that no terms need to be construed because the prior art in this Petition discloses all limitations under any plausible construction. Ex-1003, ¶ 74.

VIII. OVERVIEW OF PRIOR ART

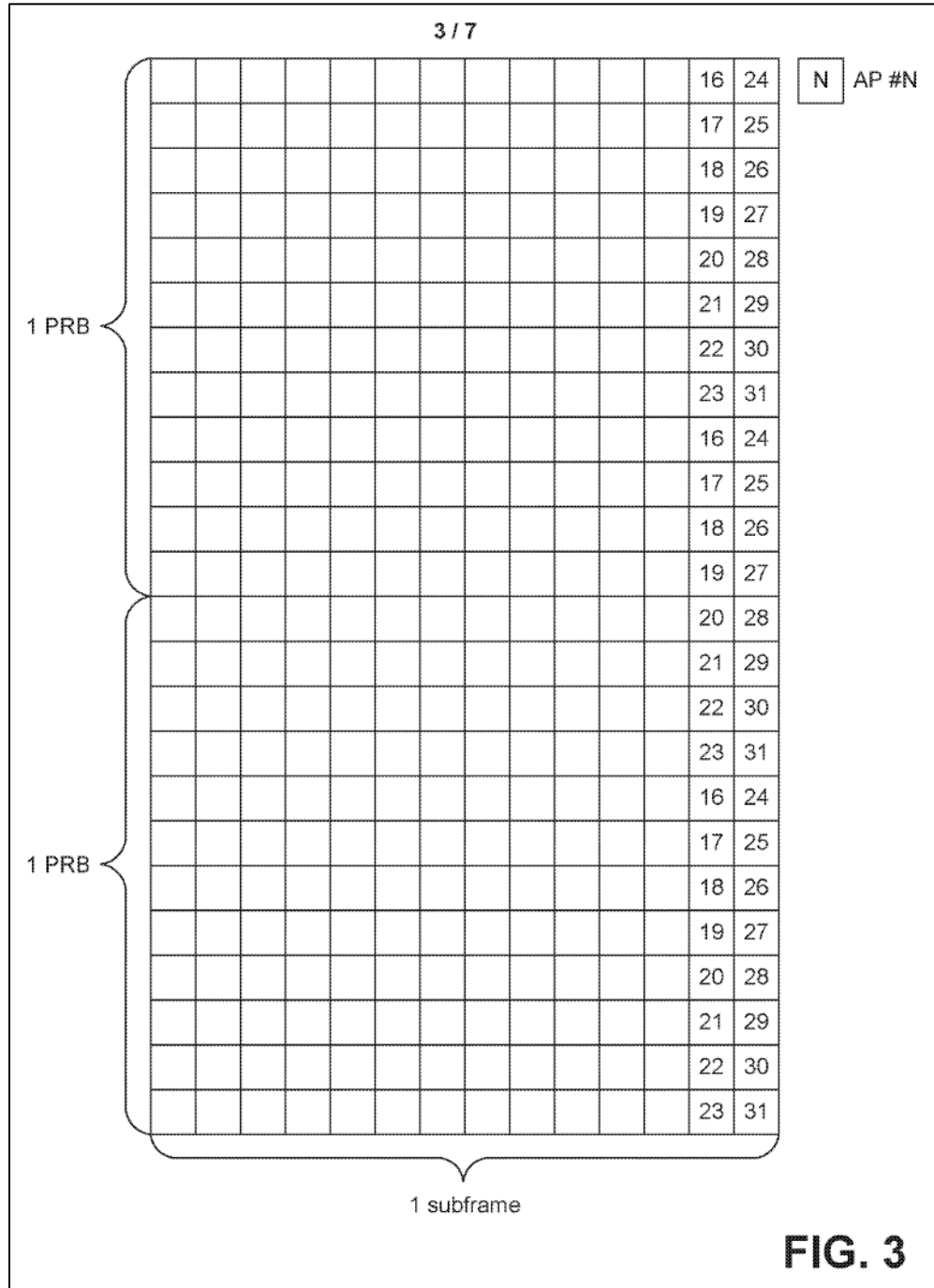
As evidenced by the prior art and explained by Dr. Haimovich in the attached expert declaration (Ex-1003), the claimed beamforming management implementation was well known before the '402 patent's priority date. In addition to the extensive background knowledge that a POSITA would have brought to bear on the subject matter discussed in the '402 patent, the following prior art demonstrates that the challenged claims would have been obvious.

A. Moon

Moon describes a technique for communicating channel state information (CSI) in 5G systems using a 5G reference signal (xCSI-RS). Ex-1005 at Abstract, [0037]. The xCSI-RS is a signal that the base station transmits to the UE in the

downlink, which the UE uses to estimate CSI and report it back to the base station in the uplink. Ex-1005 at [0003] (“Conventional LTE (Long Term Evolution) systems since LTE Release 10 (Rel. 10) have included the Channel State Information (CSI) Reference Signal (CSI-RS) among the reference signals transmitted by a base station (BS) such as an Evolved NodeB (eNB). A User Equipment (UE) can receive the CSI-RS from the eNB and estimate a channel quality information (CQI) and other parameters, which can be reported back to the eNB via a CSI Report.”), [0037] (“techniques described herein can be employed that can facilitate control signaling for fifth generation Channel State Information (xCSI) Reference Signals (xCSI-RS)”), [0038], [0041].

Moon describes various aspects of the xCSI-RS, such as how they are configured, scheduled, triggered, and transmitted by the base station, and how they are received, processed, and reported by the UE. But Moon focuses on the control signaling related to the xCSI-RS. Ex-1005 at [0037]. Figure 3 of Moon provides a diagram “of an example subframe comprising xCSI-RS”:



Ex-1005 at [0038], Fig. 3. According to Moon,

The example subframe of FIG. 3 is a DL OFDM-only subframe, where xPDCCH (5G Physical Downlink Control Channel) and xPDSCH (5G Physical Downlink

Shared Channel) is transmitted without UL (uplink) transmissions. xPDCCH is used for scheduling xPDSCH, and thus xCSI-RS can be located in the end of the xPDSCH area. In example subframe of FIG. 3, symbol indices 12 and 13 are used for xCSI-RS.

Id. at [0038]. Figure 3 is thus an example subframe with the last two symbols used for xCSI-RS transmission. But according to Moon, “the number of symbols employed for xCSI-RS transmission can vary.” *Id.* at [0039]. “The number of symbols for xCSI-RS can be configured by RRC or dynamic signaling (e.g., via PDCCH, etc.).” *Id.* “For dynamic triggering of xCSI-RS, the DCI (downlink control information) for the triggering can include any of a variety of xCSI-RS configurations, such as the example configurations shown in Table 1”:

Table 1: CSI-RS Trigger Indication	
3 bit CSI-RS Configuration	Indication
0	No xCSI-RS
1	One xCSI-RS symbol
2	Two xCSI-RS symbols from the same Tx beam (Same beam ID)
3	Two xCSI-RS symbols from different Tx beam (Different beam ID)
4	Two xCSI-RS symbols with zero powers in both symbols
5	Two xCSI-RS symbols with zero power in the second xCSI-RS symbol
6	Two xCSI-RS symbols with zero power in the first xCSI-RS symbol
7	Maintain the previous configuration

Id. at [0040], Table 1. These “DCI message(s)” can be “transmitted via xPDCCH[.]”

Id. at [0050]. Moon’s control messages can be used to “indicate an xCSI-RS configuration for subframe n, where the xCSI-RS configuration can indicate the number of xCSI-RS symbols (M), and the location of the xCSI-RS symbols (e.g., symbols (10, 11), symbols (12, 13), symbol (11), etc.), and can optionally indicate additional information.” *Id.* at [0049]. “In some aspects, information (e.g., the value of M, the location of the M symbols, etc.) can be explicitly indicated in the one or more control messages, while in other aspects, it can be implicitly indicated (e.g., via an indication to employ a previously indicated xCSI-RS configuration, etc.).” *Id.*

Moon's xCSI-RS can be transmitted by the base station using one or more beams, which can be the same or different for each symbol, and which can be associated with virtual cell identities (VCIDs), which are scrambling seeds that help the UE to identify the beams. *Id.* at [0041], [0045]–[0046]. “[T]he UE can feedback candidate Tx beam IDs for multiple xCSI-RS symbols,” such as to identify “a best and a second best Tx beams.” *Id.* at [0041].

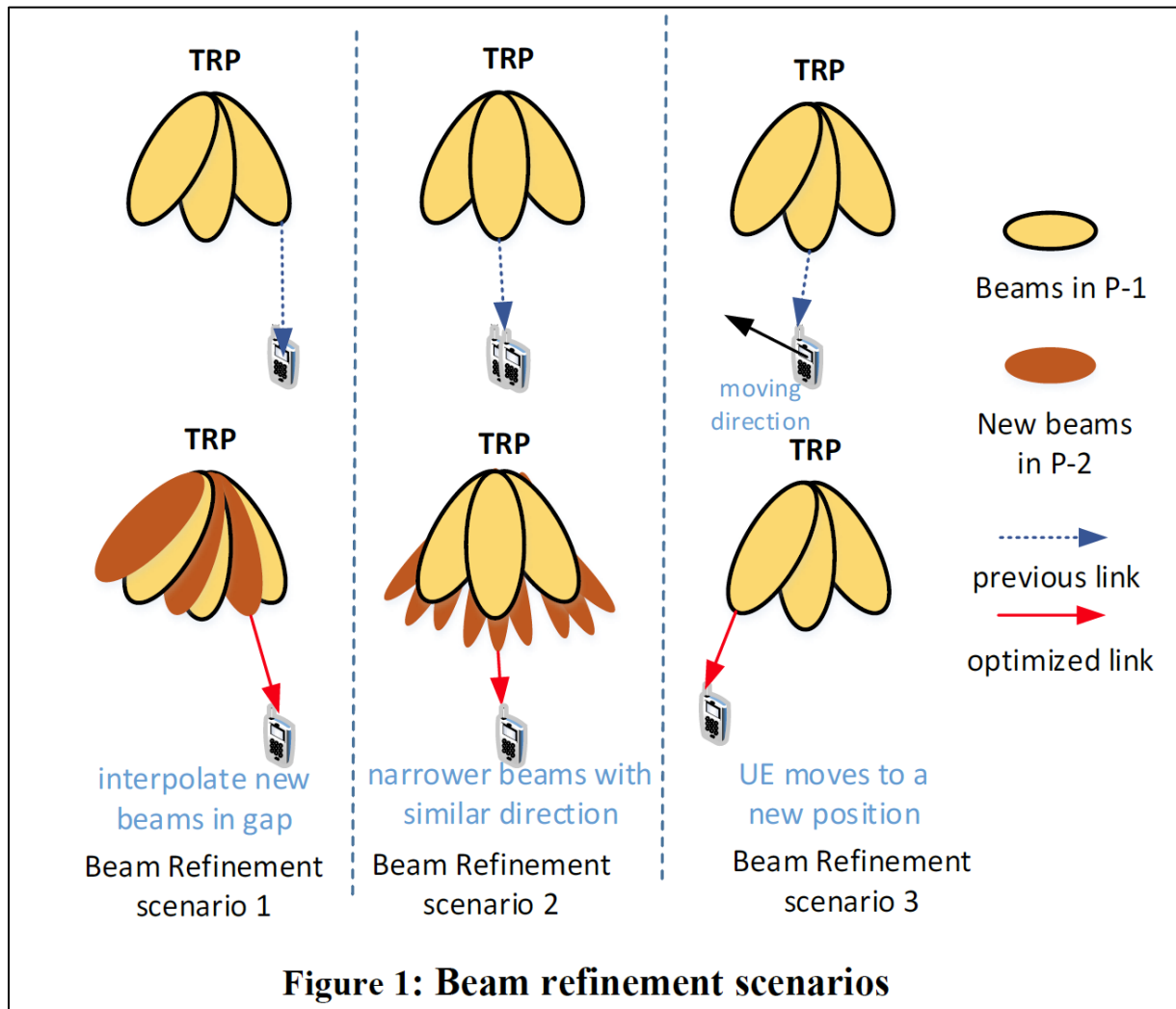
Moon explains that its proposed technique for xCSI-RS can improve the performance and efficiency of 5G systems, by enabling the base station and the UE to exchange CSI in a flexible and adaptive manner, and by supporting the use of massive MIMO technology in the millimeter wave spectrum. Ex-1005 at [0036]. Under Moon's system, the “new Channel State Information Reference Signal (CSI-RS can be designed to support the downlink (DL) Transmission (Tx) beams measurement and selection[.]” *Id.*

B. R1-1609515

“On network beam switching and refinement (BM P-2)” is a written contribution Intel submitted to 3GPP before the 3GPP TSG-RAN WG1 Meeting #86bis in Lisbon, Portugal on October 10-14, 2016 (“R1-1609515”). Intel submitted the document to the 3GPP standards body for consideration in developing the 5G cellular system. Ex-1007, ¶¶ 54-58; Ex-1007, Appendix 22 at 96. R1-1609515 is a printed publication prior art reference under at least 35 U.S.C. 102(a)(1) as it was

accessible and available via 3GPP's publicly available website on October 1, 2016, before the '402 patent's priority date of January 6, 2017. Ex-1007, ¶¶ 57-58. R1-1609515 was not considered during prosecution of the '402 patent application.

R1-1609515 discloses three potential beam-refinement processes for transmission beams from a base station (or transmission-reception point ("TRP")):



Ex-1006 (R1-1609515) at Figure 1. R1-1609515 explains that these beam refinement processes can be used after “procedure 1 (P-1) of DL beam management,

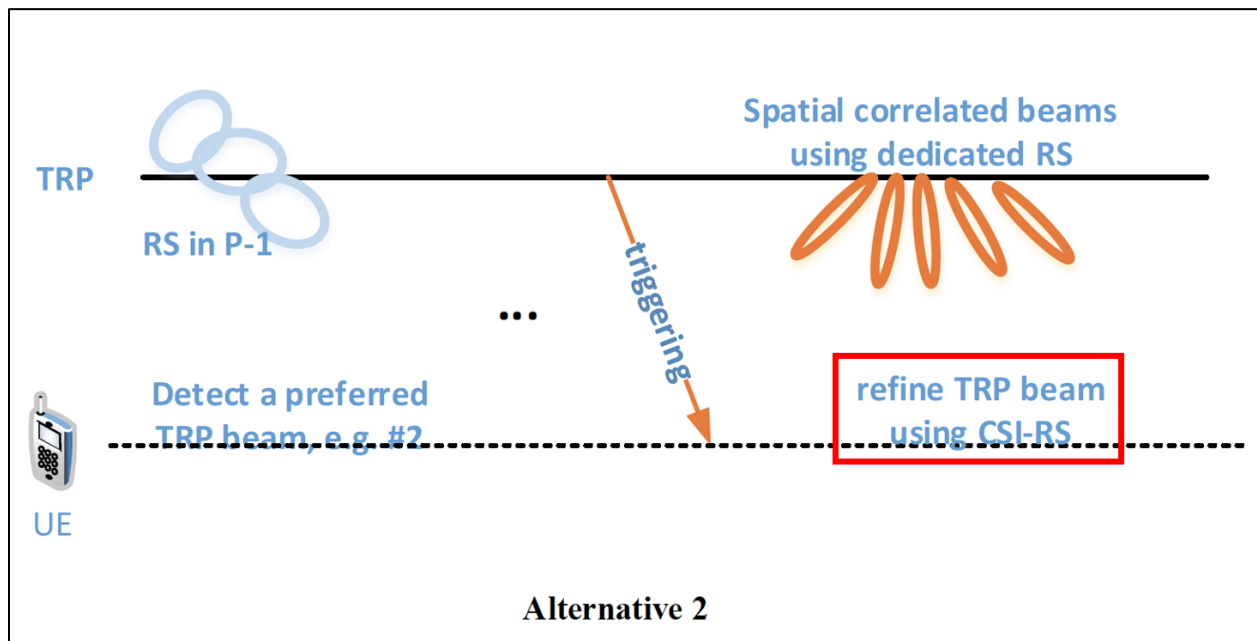
in which TRP/UE beams are acquired using beam sweeping from a full set of beams. P-1 is used to acquire the initial TRP/UE beam and to discover other candidate TRP/UE beams.” Ex-1006 at 1. After this initial TRP beam acquisition, “a dedicated [procedure 2] P-2 is beneficial to reduce the UE power consumption. It also allows more implementation flexibility to apply finer beam in P-2 than in P-1. And at the same time, UE may respond faster to movement, rotation and channel blockage using P-2 instead of P-1.” *Id.* As such, in R1-1609515, Intel provides its “views on the beam management procedure P-2.” *Id.*

As relevant to this Petition, R1-1609515 provides Intel’s views on “**beam refinement**” which allows TRP beam change between beams having strong spatial correlation.” *Id.* (emphasis in original). Before performing this beam refinement in P-2, “TRP/UE has performed procedure P-1 at least once successfully and at least one pair of TRP/UE beam has been identified.” *Id.* at 2. Then, in P-2 for beam refinement, “the TRP beam can be changed to a new beam.” *Id.* As shown in R1-1609515 Figure 1 above, Intel identifies three possible beam refinement scenarios:

- Beam Refinement Scenario-1: TRP beam refinement among beams having the same beam width as P-1 but higher spatial granularity.
- Beam Refinement Scenario-2: TRP beam refinement using narrower beam width as P-1 but similar spatial beam direction.

- Beam Refinement Scenario-3: TRP beam refinement using the same beam width and the same spatial beam granularity as P-1.

Again, as relevant to this Petition, under Beam Refinement Scenario-2, “dedicated reference signals are required since different beams are used in P-2 compared to P-1.” Ex-1006 at 2. Intel proposes that this beam refinement is performed using CSI-RS:



Ex-1006 at Figure 2 (annotated). In its “Proposal 1,” Intel further explains its desire that “Dedicated RS, e.g. UE specific CSI-RS, is used for TRP beam refinement.” Ex-1006 at 3–4 (Proposal 1).

IX. SPECIFIC GROUNDS FOR PETITION

A. Ground 1: Moon Anticipates the Challenged Claims

Moon anticipates the Challenged Claims for the reasons below.

1) **Claim 1**

a) *[Element 1Pre]: A method of a base station, comprising:*

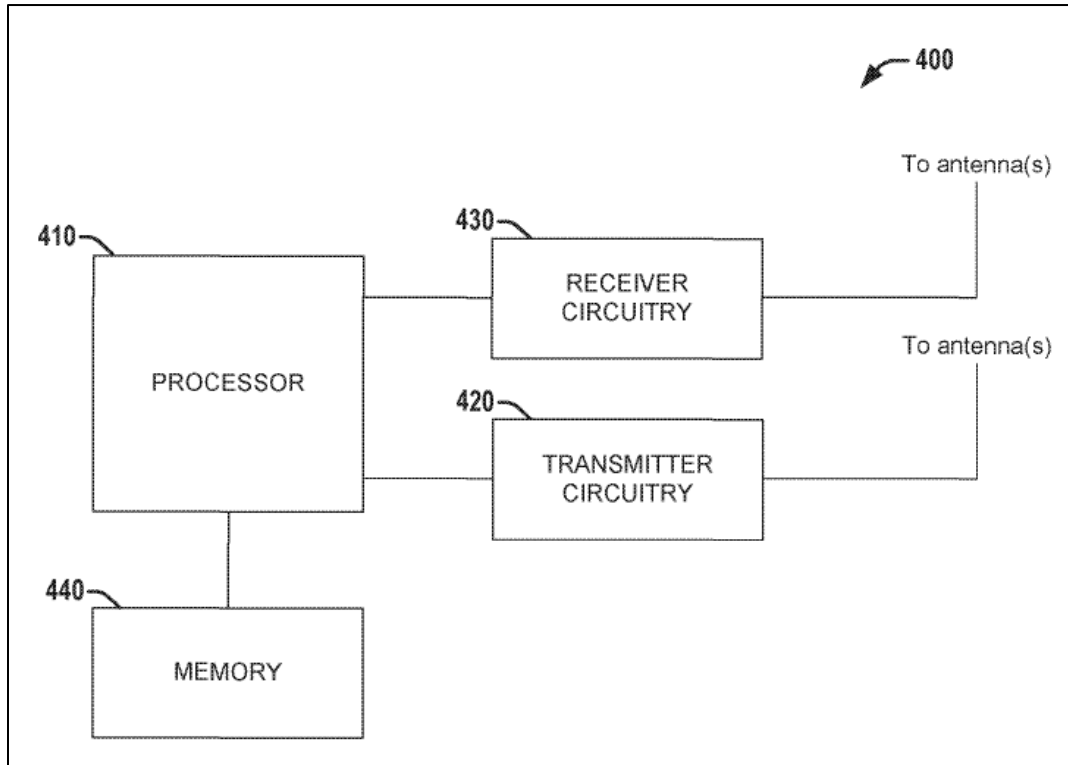
To the extent the preamble is considered limiting, Moon performs a method “of a base station”:

Techniques for configuration of a user equipment (UE) for fifth generation (5G) Channel State Information (xCSI) Reference Signals (xCSI-RS) are discussed. One example apparatus **employable at a base station** comprises a processor configured to schedule a fifth generation Physical Downlink Shared Channel (xPDSCH) during one or more xPDSCH symbols of a subframe n; schedule a final M symbols of the one or more xPDSCH symbols for fifth generation Channel State Information Reference Signals (xCSI-RS); and output one or more control messages to transmitter circuitry for transmission to one or more User Equipments (UEs), wherein the one or more control messages comprise a xCSI-RS configuration for the one or more UEs, wherein the xCSI-RS configuration indicates the value of M and the final M symbols scheduled for xCSI-RS.

Ex-1005 (Moon) at Abstract; *see also, e.g.*, Ex-1005 at [0035], [0058]. “Referring to FIG. 4, illustrated is a block diagram of a system 400 that facilitates control signaling for fifth generation (5G) Channel State Information (xCSI) Reference

Signals (xCSI-RSs) by a base station according to various aspects described herein.”

Id. at [0047].



Id. at Figure 4. “In various aspects, system 400 can be included within an Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Node B (Evolved Node B, eNodeB, or eNB) or other base station in a wireless communications network.”

Id. at [0047].

A POSITA would have understood Moon to teach this limitation. Ex-1003,

¶ 84.

- b) *[Element 1a]: the base station transmits to a UE a control signal associated with a reference signal for beam measurement;*

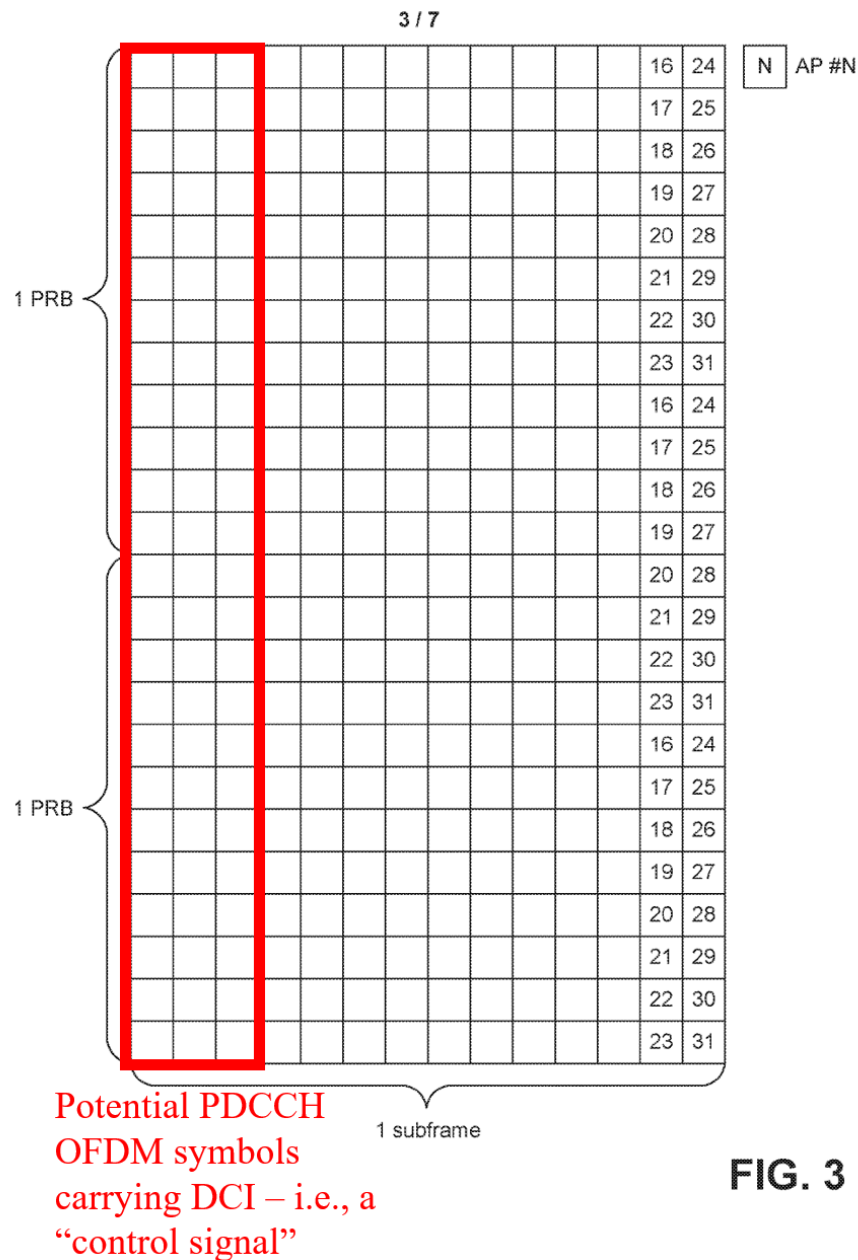
Moon teaches a base station transmitting to a UE a control signal associated with a reference signal for beam measurement. For example, Moon teaches a “new Channel State Information Reference Signal (CSI-RS) ... designed to support the downlink (DL) Transmission (Tx) beams measurement and selection”. Ex-1005 at [0036]. Moon teaches a control signal, for example, “Control Signaling for Fifth Generation Channel State Information Reference Signals (xCSI-RS)”. Ex-1005 at Title.

Further, “[i]n various embodiments, techniques described herein can be employed that can facilitate **control signaling** for fifth generation Channel State Information (xCSI) Reference Signals (xCSI-RS)”. Ex-1005 at [0037] (emphasis added).

The control signals associated with the xCSI-RSs in Moon include radio resource control (RRC) messages and downlink control information (DCI) sent via Moon’s “xPDCCH.” Specifically, Moon describes that the “5G Physical Downlink Control Channel” or “xPDCCH” is “used for scheduling xPDSCH, and thus xCSI-RS can be located at the end of the xPDSCH area.” Ex-1005 at [0038]. Moon

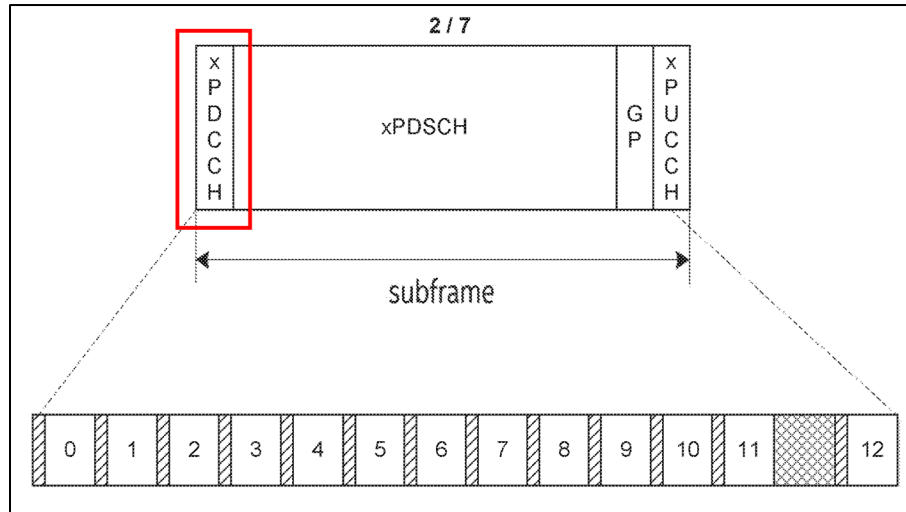
explains that the “control messages” it describes “can comprise DCI message(s) transmitted via xPDCCH of subframe n.” *Id.* at [0050];

A POSITA viewing Moon would understand that the “xPDCCH” in Moon is a control channel that carries DCI, much as the PDCCH in LTE and 5G systems carry DCI. For instance, a POSITA knows that a downlink LTE subframe comprises a control region: “In LTE, each downlink subframe . . . is normally divided into a control region, consisting of the first few OFDM symbols, and a data region, consisting of the remaining part of the subframe. . . . the control region carries L1/L2 signaling necessary to control uplink and downlink data transmissions.” Ex-1008 at 79. In addition, a POSITA viewing Moon would understand that the first few OFDM symbols in Moon Figure 3 correspond to the PDCCH:



Ex-1005 at Figure 3 (annotated) and [0038] (“The example subframe of FIG. 3 is a DL OFDM-only subframe where xPDCCH (5G Physical Downlink Control Channel) and xPDSCH (5G Physical Downlink Shared Channel) is transmitted without UL (uplink) transmissions.”); Ex-1003, ¶ 88.

According to Moon, control signaling may be mapped to a few OFDM symbols at the beginning of a downlink subframe, as shown in the figure below:



Ex-1005 at Figure 2 (annotated).

Moon discloses control information, such as the number of symbols employed for xCSI-RS transmission, can be configured by Radio Resource Control (RRC) or by a new Physical Downlink Control Channel (xPDDCH): “[t]he number of symbols for xCSI-RS can be configured by RRC or dynamic signaling (e.g., via xPDCCH, etc.)”. Ex-1005 at [0039]. Moon also explains that its various disclosures of RRC messages and DCI messages are interchangeable. Ex-1005 at [0050] (“In some aspects, the one or more control messages can comprise DCI message(s) transmitted via xPDCCH of subframe n. In the same or other aspects, the one or more control messages can comprise RRC message(s).”). In other words, where Moon describes

a system that can implement certain functionality via RRC messaging, that same functionality could be accomplished via DCI, and vice versa.

Moon teaches that these DCI and RRC messages are “associated with a reference signal for beam measurement.” For instance, Moon teaches that “[t]he number of symbols for xCSI-RS can be configured by RRC or dynamic signaling (e.g., via xPDCCH, etc.).” Ex-1005 at [0039]. Control signaling provides information on the location of xCSI-RS: “In various aspects described herein, the location of the xCSI-RS symbols can be determined dynamically based on the subframe type, and can be indicated via xPDCCH. In other aspects, the location of xCSI-RS can be configured via higher layer (e.g., RRC (radio resource control)) signaling between possible xCSI-RS locations (e.g., (10, 11) (or a subset thereof) or (12, 13) (or a subset thereof), etc.).” Ex-1005 at [0038].

Moon also teaches that DCI can trigger “any of a variety of xCSI-RS configurations, such as the example configurations shown in Table 1, below”:

Table 1: CSI-RS Trigger Indication	
3 bit CSI-RS Configuration	Indication
0	No xCSI-RS
1	One xCSI-RS symbol
2	Two xCSI-RS symbols from the same Tx beam (Same beam ID)
3	Two xCSI-RS symbols from different Tx beam (Different beam ID)
4	Two xCSI-RS symbols with zero powers in both symbols
5	Two xCSI-RS symbols with zero power in the second xCSI-RS symbol
6	Two xCSI-RS symbols with zero power in the first xCSI-RS symbol
7	Maintain the previous configuration

Id. at [0040]. The xCSI-RS trigger indications in Table 1 are from the “same Tx beam” or from “different Tx beam.” Based on these disclosures, a POSITA would recognize that the RRC and DCI “control signals” in Moon are “associated with a reference signal for beam measurement.” Ex-1003, ¶ 92.

Moon teaches that control signaling such as DCI and RRC messages are associated with a reference signal “*for* beam measurement.” For example, reference symbols xCSI-RS are for beam measurement: “These xCSI-RS configuration parameters can comprise one or more of the characteristics indicated herein as configurable for xCSI-RS, such as the number of symbols for xCSI-RS (e.g., $M = 0$,

1, 2, etc.), which symbols are configured for xCSI-RS, CRG type (e.g., candidate **beam measurement**, interference measurement, etc.), whether xCSI-RS will be received from one or more Tx beams that can be from one or more TPs, etc.” Ex-1005 at [0055].

Moon additionally describes how the xCSI-RS are used to allow a UE to feedback candidate “beam Ids for multiple xCSI-RS symbols.” *Id.* at [0041]. Moon goes into further detail, explaining how a processor in a UE

can process a set of xCSI-RS signals received via receiver circuitry 510 during subframe n (e.g., via the last M symbols of the xPDSCH of subframe n). From the processed xCSI-RS symbols, processor 520 can generate a CSI report that indicates one or more CSI parameters (e.g., CQI, PMI, RI, etc.) associated with one or more Tx beams, which processor 520 can output for transmission by transmitter circuitry 530 as part of a UCI message sent via subframe $n+k$.

Id. at [0056]. In other words, as was the case in LTE with CSI-RS, the UE in Moon uses the xCSI-RS symbols to measure candidate beams. Ex-1003, ¶ 9.

Based on these disclosures in Moon, a POSITA would have understood Moon to teach Element 1(a). Ex-1003, ¶¶ 85–95.

- c) *[Element 1(a)(1)]: wherein the control signal triggers aperiodical transmission of the reference signal for beam measurement*

The '402 patent claims a control signal that “triggers aperiodical transmission of the reference signal for beam measurement,” in contrast to the “semi-persistent” or “periodic” transmission of such reference signals described in the specification:

The reference signal for beam measurement may be sent periodically, aperiodically, or semi-persistently. For periodic beam reference signal, the base station may configure a proper periodicity for measurement occasion(s) when UE would perform measurement.

Ex-1001 at 6:53–57. In contrast:

an aperiodic beam reference signal **is transmitted when there is an associated *triggering* signal**. When the UE detects the associated triggering signal (e.g., a control signal, a control channel, an uplink grant, or a downlink assignment), the UE would realize there would be beam reference signal in an associated timing occasion, e.g., the rest of the symbol(s) in the same slot or the symbol(s) in the following slot.

Id. at 6:67–7:3 (emphasis added). A POSITA thus understands that an aperiodic reference signal is transmitted when a control signal triggers the transmission in an associated timing occasion. Ex-1003, ¶ 96. As quoted above, the '402 patent

specification details that an associated timing occasion is the rest of the symbol(s) in the same slot or the symbol(s) in the following slot. In other words, the reference signal is transmitted in the subframe in which it was triggered by the control signal. Ex-1003, ¶ 32 (explaining that a subframe is composed of two slots, with each slot spanning seven OFDM symbols in the time domain).

A POSITA would understand that this limitation is met by Moon’s disclosure of DCI that performs “triggering of xCSI-RS”:

For **dynamic *triggering of xCSI-RS***, the DCI (downlink control information) for the ***triggering*** can include any of a variety of xCSI-RS configurations, such as the example configurations shown in Table 1, below. The configuration options can include options for xCSI-RS triggering itself since there is no xCSI-RS state, and signaling of the number of xCSI-RS symbols.

Ex-1005 at [0040] (emphasis added). As depicted in Table 1, and the corresponding embodiments, Moon’s dynamic triggering initiates xCSI-RS transmission only for that subframe, by indicating between zero and two xCSI-RS symbols in the subframe. Ex-1005 at [0040], Table 1, [0044] (“In some aspects, one or more bits can be included in a DCI of **subframe n** to indicate the presence of xCSI-RS in **subframe n . . .**”) (emphasis added).

This contrasts with the concept of “periodic” reference signals in the ’402 patent in which the base station configures the UE for beam measurement based on “a proper periodicity.” Ex-1001 at 6:56; Ex-1003, ¶ 98. It also contrasts with the concept of “semi-persistent” reference signals in the ’402 patent. Ex-1001 at 7:24–28 (“Semi-persistent reference signal could be something in between (e.g., first being configured, start periodic transmission if there is an associated signal, and could modify or pause the transmission if another associated signal is detected.”); Ex-1003, ¶ 98. Under the embodiments disclosed in Moon, a UE would not know whether it was to receive xCSI-RS until receiving the DCI in the first few OFDM symbols of a subframe (the xPDCCH), such as those emphasized in annotated Figure 3 above. *See* Section IX(A)(1)(b), on Element 1(a), above. According to Table 1 of Moon and the corresponding disclosure, the DCI in those xPDCCH symbols could indicate either zero, one, or two xCSI-RS in the same subframe. Ex-1005 at [0040] and Table 1.

Thus, a POSITA would have understood Moon to teach “a control signal” *e.g.*, DCI, that “triggers aperiodical transmission of the reference signal for beam measurement.” Ex-1003, ¶¶ 96–99.

- d) [Element 1(a)(2)]: wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement*

Moon discloses a method “wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement.” For instance, dependent claim 2 of the ’402 patent discloses that the “beam-related information” can be an indication of “at least a beam on which the reference signal for beam measurement is transmitted.” Ex-1001 at 14:14-17 (claim 2). Similarly, the DCI in Moon can include the identification of a beam. Specifically, Moon discloses “an example DCI format can comprise some or all of the following for xCSI-RS: (a) CSI-RS configuration” Ex-1005 at [0046]. Moon further explains that “in the configuration, the eNB can let the UE know which beam ID, for example, for analog beam forming, is applied in each of symbols. This beam ID can correspond to xCSI-RS scrambling seed.” *Id.* at [0041]; Ex-1003, ¶¶ 100–103 (explaining concept of scrambling seed). Thus, via “the configuration,” which is transmitted via DCI control signal, the base station provides the UE a beam ID corresponding to an xCSI-RS scrambling seed. Ex-1003, ¶ 104. Moon also explicitly discloses that “at least one of the DCI message(s) and/or RRC message(s) can comprise some or all of the information indicated herein . . . number of CSI ports for each of the M symbols,

whether the M symbols are associated with a single Tx beam or more than one Tx beam, **beam index(es) of the Tx beam(s)**, etc.” Ex-1005 at [0051].

Providing a “beam ID” or “beam index” in the DCI, as Moon does, also solves the very problem that the ’402 Patent purported to solve. Ex-1003, ¶¶ 70–71, 105; Ex-1001 at 7:44–8:26

A POSITA would understand Moon’s disclosure of a beam ID or beam index within the control signal to meet claim element 1(a)(2). Ex-1003, ¶¶ 100–106.

e) [Element 1(a)(3)]: wherein the control signal . . . indicates how many symbols are used to carry the reference signal for beam measurement

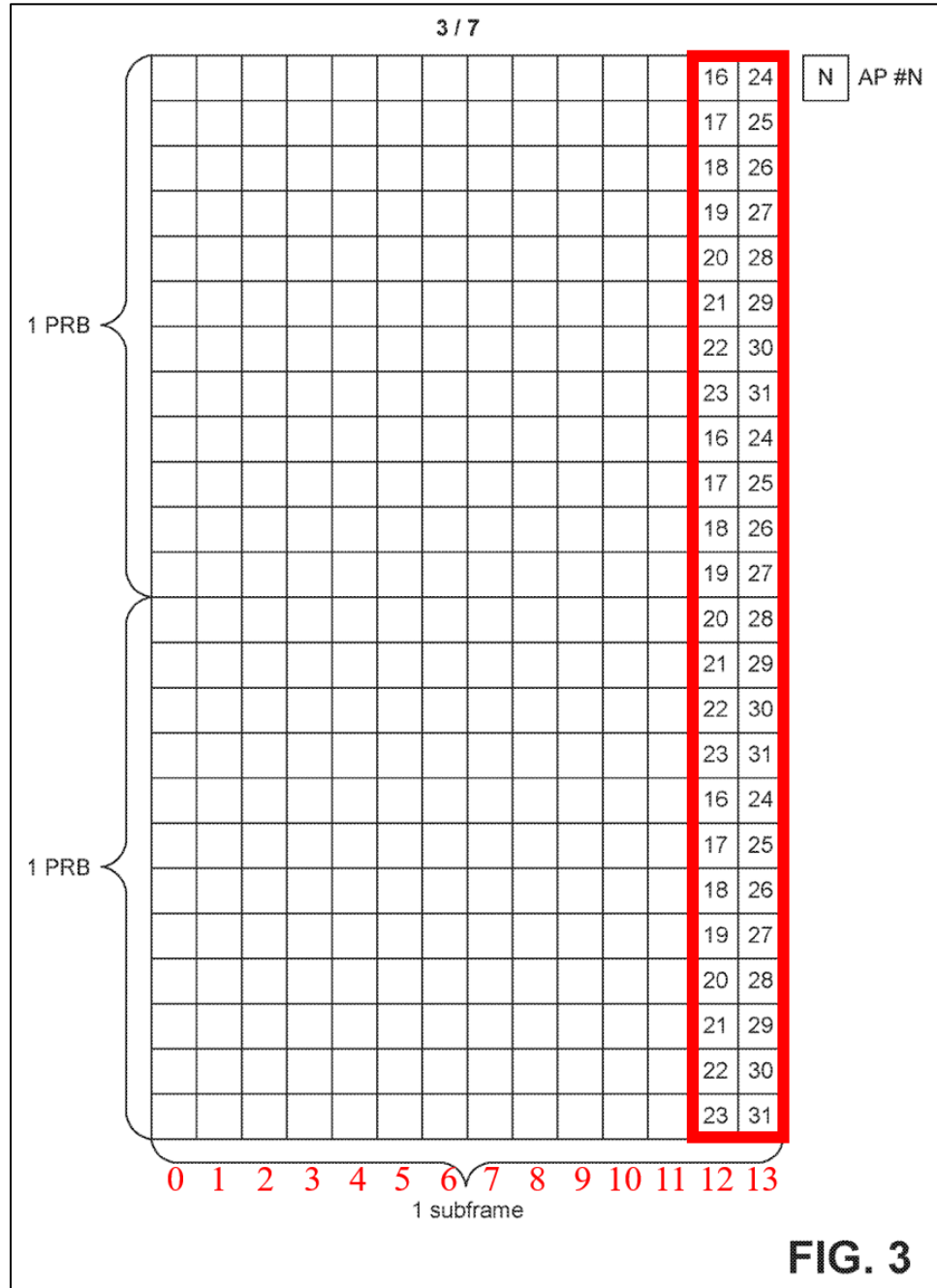
Moon discloses a method “wherein the control signal . . . indicates how many symbols are used to carry the reference signal for beam measurement”:

Additionally, in various aspects, the number of symbols employed for xCSI- RS transmission can vary. **The number of symbols for xCSI-RS can be configured by RRC or dynamic signaling (e.g., via xPDCCH, etc.)**. Depending on the number of symbols, the number of supported CSI-RS ports can be determined. In the example subframe of FIG. 3, one symbol can cover 8 antenna ports, and with two symbols, a total of 16 ports can be covered. The number of xCSI-RS ports can be configured by RRC, and the eNB can assign necessary symbols for CSI measurement, which can be done based at least in part on channel conditions.

Ex-1005 at [0039] (emphasis added). Moon provides more detail by explaining that the base station's processor can generate control messages indicating the number of xCSI-RS symbols (M) and the location of the xCSI-RS symbols:

can also generate one or more control messages that indicate an xCSI-RS configuration for subframe n, **where the xCSI-RS configuration can indicate the number of xCSI-RS symbols (M), and the location of the xCSI-RS symbols (e.g., symbols (10, 11), symbols (12, 13), symbol (11), etc.),** and can optionally indicate additional information. In some aspects, **information (e.g., the value of M, the location of the M symbols, etc.) can be explicitly indicated in the one or more control messages,** while in other aspects, it can be implicitly indicated (e.g., via an indication to employ a previously indicated xCSI-RS configuration, etc.).

Id. at [0049] (emphasis added). For instance, in Moon Figure 3, the control signal would indicate the number of xCSI-RS symbols (M) equals two, and the xCSI-RS is located in symbols 12 and 13:



Id. at Figure 3 (annotated); *Id.* at [0038] (“In the example shown in FIG. 3, the xCSI-RS is located in the last two DL OFDM (orthogonal frequency division multiplexing) symbols.”); Ex-1003, ¶ 107.

Moon explains that the “number of symbols employed for xCSI-RS transmission can vary” and that said number “can be configured by RRC or dynamic signaling (e.g., via xPDCCH, etc.).” Ex-1005 at [0039]. Table 1 of Moon provides an example of a variety of xCSI-RS configurations that can be included with the DCI for performing the dynamic signaling that indicates the number of symbols used by the xCSI-RS:

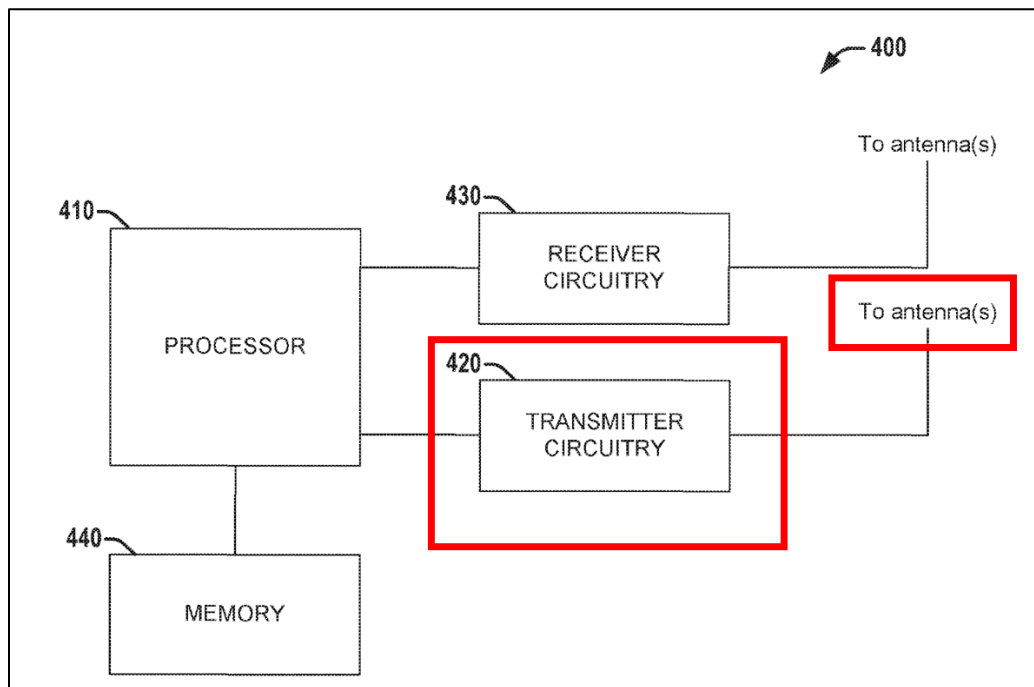
Table 1: CSI-RS Trigger Indication	
3 bit CSI-RS Configuration	Indication
0	No xCSI-RS
1	One xCSI-RS symbol
2	Two xCSI-RS symbols from the same Tx beam (Same beam ID)
3	Two xCSI-RS symbols from different Tx beam (Different beam ID)
4	Two xCSI-RS symbols with zero powers in both symbols
5	Two xCSI-RS symbols with zero power in the second xCSI-RS symbol
6	Two xCSI-RS symbols with zero power in the first xCSI-RS symbol
7	Maintain the previous configuration

Id. at [0040], Table 1.

A POSITA would thus have understood Moon to teach this limitation. Ex-1003, ¶¶ 107–109.

f) [Element 1(b)]: the base station transmits the reference signal for beam measurement to the UE.

Moon discloses a method in which “the base station transmits the reference signal for beam measurement to the UE”: “In some aspects, processor 410 can generate (and transmitter circuitry 420 can transmit) xCSI-RS for some or all of the M symbols of xCSI-RS.” Ex-1005 at [0053] (where “RS” is “reference signal”). Figure 4 of Moon depicts this transmitter circuitry and the corresponding antenna(s) for transmitting the xCSI-RS:



Id. at Figure 4 (annotated).

In addition, Moon discloses that a UE receives the xCSI-RS transmitted by the base station:

Processor 520 can process a set of one or more xCSI-RS configuration messages (e.g., DCI message(s) and/or RRC message(s)) received via receiver circuitry 510. Based on the received set of xCSI-RS configuration messages, processor 520 can determine xCSI-RS configuration parameters for a given subframe (e.g., subframe n). These xCSI-RS configuration parameters can comprise one or more of the characteristics indicated herein as configurable for xCSI-RS, such as the number of symbols for xCSI-RS (e.g., $M = 0, 1, 2$, etc.), which symbols *[sic]* are configured for xCSI-RS, CRG type (e.g., candidate beam measurement, interference measurement, etc.), whether xCSI-RS will be received from one or more Tx beams that can be from one or more TPs, etc. In some aspects, the set of xCSI-RS configuration messages can comprise a compact format DCI message that indicates that the xCSI-RS configuration parameters remain the same as previously configured.

Id. at [0055].

A POSITA would thus have understood Moon to teach this limitation. Ex-1003, ¶¶ 110–112.

2) Claim 2

a) [Element 2pre]: The method of claim 1, wherein

Moon anticipates claim 1 for the reasons above.

- b) [Element 2]: the beam-related information indicates at least a beam on which the reference signal for beam measurement is transmitted.*

For the reasons under Element 1(a)(2) (“wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement”), Moon similarly anticipates corresponding Element 2. Ex-1003, ¶ 114.

3) Claim 3

- a) [Element 3pre]: The method of claim 1, wherein*

Moon anticipates claim 1 for the reasons above. *See* Section IX(A)(1).

- b) [Element 3]: wherein the beam-related information indicates a first beam, and wherein the reference signal for beam measurement is transmitted on at least a refined beam of the first beam.*

Moon discloses a control signal that includes “beam-related information” and in which “the beam-related information indicates a first beam, and wherein the reference signal for beam measurement is transmitted on at least a refined beam of the first beam.” As explained by the ’402 patent specification, a “beam reference signal” is an example of a refined beam. Specifically, the ’402 patent describes the beam refinement process from both the perspective of the UE and the base station:

A first general concept of this invention is that when a UE requests beam refinement or adjustment, the UE would indicate which beam(s) or beam(s) from which TRP(s) would require beam refinement/adjustment associated with the request. **An example of requesting beam refinement or adjustment would be to request beam reference signal.**

A general second concept of this invention is that when a base station triggers beam refinement or adjustment for a UE, the base station would indicate that beam refinement or adjustment is performed on which beam(s) or beam(s) from which TRP(s) associated with the trigger. **An example of triggering beam refinement or adjustment for a UE would be to send an aperiodic trigger for beam reference signal to the UE.**

Ex-1001 at 8:13–26 (emphasis added). In these disclosures, the '402 patent makes clear that a beam reference signal is transmitted on a refined beam. *See* Ex-1003, ¶¶ 70–71 (describing how these two “general concepts” are directed to solving problems that arise when the base station is unaware of which beam(s) on which it needs to transmit beam reference signals in order to perform beam refinement).

As such, the same “beam index” disclosure that anticipates claim elements 1(a)(2) and 2, also anticipates claim element 3. Specifically, Moon discloses that “at least one of the DCI message(s) and/or RRC message(s) can comprise some or all

of the information indicated herein . . . number of CSI ports for each of the M symbols, whether the M symbols are associated with a single Tx beam or more than one Tx beam, beam index(es) of the Tx beam(s), etc.” Ex-1005 at [0051] (emphasis added). In other words, the M symbols of the xCSI-RS can be associated with one or more “Tx beam(s),” or transmission beams, and the DCI and/or RRC messages can indicate which beam index(es) of the transmission beam the M symbols are associated with. Ex-1003, ¶ 117. By providing that “beam index” in the DCI or RRC, Moon teaches a “beam-related information” associated with a “first beam.” It thus solves the very problem that the ’402 Patent identified in terms of beam refinement when not utilizing a “beam index”:

It is possible that a UE may detect beam refinement/adjustment is required for some beam(s) or some TRP(s) among the beams within the base station beam set of the UE while beam refinement/adjustment is not require for other beam(s) or other TRP(s) among the beams within the base station beam set of the UE. In this situation (i.e., only beam direction of some beam(s) or beam direction of some TRP(s) are changed and beam direction of other beam(s) or beam direction of other TRP(s) are unchanged), simply requesting beam reference signal for beam adjustment/refinement is inefficient as the base station has no idea beam direction of which beam(s) or of which TRP(s) is changed/unchanged. Therefore, the

base station would need to send the beam reference signal for refining/adjusting all the beams within the beam set of the UE, even if some of them does not require any adjustment.

Ex-1001 at 7:44–59; Ex-1003, ¶ 70.

Moon also teaches “massive MIMO.” Ex-1005 at [0036]. A POSITA knows massive MIMO supports beams and refined beams through the use of arrays with a large number of antennas. Ex-1003, ¶ 118. And a POSITA would understand that the xCSI-RS in Moon are transmitted on “a refined beam” of that “first beam,” in the same way that the ’402 patent specification describes that a “beam reference signal” is a refined beam. Ex-1001 at 8:13–26. A POSITA would also understand Moon’s claims to meet this limitation:

11. The apparatus of any of claims 1-6, wherein M is at least two, and wherein the one or more control messages indicate whether each of the final M symbols are beamformed from a common beam or from two or more different beams.

...

16. The machine readable medium of claim 14, wherein each of the last M symbols of the xPDSCH are scheduled for xCSI-RS signals associated with distinct transmit beams.

Ex-1005 at Claim 11, Claim 16; Ex-1003, ¶ 118.

A POSITA would have understood Moon to teach this limitation. Ex-1003, ¶¶ 116–119.

4) Claim 4

a) [Element 4pre]: The method of claim 1, wherein

Moon anticipates claim 1 for the reasons above. *See* Section IX(A)(1).

b) [Element 4]: the control signal is transmitted via a control channel.

As explained in element 1(a) above, the DCI in Moon is transmitted via the xPDCCH or 5G Physical Downlink Control Channel. Ex-1005 at [0038] and [0050]. As such, a POSITA would have understood Moon to teach this limitation. Ex-1003, ¶ 121.

5) Claim 12

a) [Element 12Pre(1)]: A base station, comprising:

To the extent element 12Pre(1) is considered limiting, Moon anticipates claim element 12Pre(1) for the reasons described above with respect to the preamble of claim 1. *See* Section IX(A)(1), above.

- b) *[Element 12pre2]: a control circuit; a processor installed in the control circuit; and a memory installed in the control circuit and operatively coupled to the processor; wherein the processor is configured to execute a program code stored in the memory to:*

To the extent element 12Pre(2) is considered limiting, Moon anticipates claim element 12Pre(2) for the reasons described above with respect to the preamble of claim 1. See Section IX(A)(1), above.

- c) *[Element 12(a)]: transmit to a UE a control signal associated with a reference signal for beam measurement*

Moon anticipates element 12(a) for the reasons above with respect to corresponding element 1(a). See Section IX(A)(1)(b), above.

- d) *[Element 12(a)(1)]: wherein the control signal triggers aperiodical transmission of the reference signal for beam measurement*

Moon anticipates element 12(a)(1) for the reasons above with respect to corresponding element 1(a)(1). See Section IX(A)(1)(c), above.

- e) *[Element 12(a)(2)]: and wherein the control signal includes a beam-related information for transmitting the reference signal for beam measurement*

Moon anticipates element 12(a)(2) for the reasons above with respect to corresponding element 1(a)(2). See Section IX(A)(1)(d), above.

- f) [Element 12(a)(3)]: and wherein the control signal . . . indicates how many symbols are used to carry the reference signal for beam measurement;*

Moon anticipates element 12(a)(3) for the reasons above with respect to corresponding element 1(a)(3). *See* Section IX(A)(1)(e), above.

- g) [Element 12(b)]: and transmit the reference signal for beam measurement to the UE.*

Moon anticipates element 12(b) for the reasons above with respect to corresponding element 1(b). *See* Section IX(A)(1)(f), above.

6) Claim 13

- a) [Element 13Pre]: The base station of claim 12, wherein*

Moon anticipates element 13Pre for the reasons above with respect to claim 12. *See* Section IX(A)(5).

- b) [Element 13]: the beam-related information indicates at least a beam on which the reference signal for beam measurement is transmitted.*

Moon anticipates element 13 for the reasons above with respect to claim 2, which is identical. *See* Section IX(A)(2).

7) Claim 14

c) [Element 14Pre]: The base station of claim 12, wherein

Moon anticipates element 14Pre for the reasons above with respect to claim 12. *See* Section IX(A)(5).

d) [Element 14]: the beam-related information indicates a first beam, and wherein the reference signal for beam measurement is transmitted on at least a refined beam of the first beam.

Moon anticipates element 14 for the reasons above with respect to claim 3, which is identical. *See* Section IX(A)(3).

8) Claim 15

e) [Element 15Pre]: The base station of claim 12, wherein

Moon anticipates element 15Pre for the reasons above with respect to claim 12. *See* Section IX(A)(5).

f) [Element 15]: the control signal is transmitted via a control channel.

Moon anticipates element 15 for the reasons above with respect to claim 4, which is identical. *See* Section IX(A)(4).

B. Ground 2: Moon Renders Obvious the Challenged Claims

Moon anticipates the Challenged Claims. To the extent Moon does not anticipate the claims, it renders the claims obvious for the reasons below.

1) Motivation to Modify Moon

a) Aperiodical transmission of the reference signal for beam measurement.

To the extent the triggering in Moon is not considered “aperiodical” triggering (elements [1(a)(1)] and [12(a)(1)]), a POSITA would have been motivated to implement aperiodical triggering. Ex-1003, ¶¶ 135–137.

Before the '402 patent, RAN Working Group 1 at 3GPP was focused on developing control signaling for “aperiodic” or “dynamic” transmission of CSI-RS. Ex-1015 (R1-165642); Ex-1003, 136; Ex-1007, ¶¶ 75–79. Before the '402 patent's priority date, 3GPP merged the two concepts, to the extent any differences ever existed. Indeed, at the time, 3GPP participants described “aperiodic CSI-RS” as “E.g., One-shot CSI-RS transmission with transmission on the same subframe as the triggering subframe.” Ex-1015 (R1-165642) at 2. Moon itself discloses triggering CSI-RS on the same subframe as the triggering subframe. Ex-1005 at [0038], [0040], Figure 3. And 3GPP participants used the terms “dynamic” and “aperiodic” interchangeably. Ex-1013 (R1-162686) at 1 (“CSI-RS resource allocation can be

performed dynamically. That is, CSI-RS is transmitted by the eNB and measured by the UE only when needed, i.e., aperiodically.”).

As such, to the extent there is any difference between aperiodic and dynamic triggering of reference signals for beam measurement (such as Moon’s xCSI-RS), a POSITA would have been motivated to adapt the system of Moon to utilize “aperiodic” triggering in order to render the system compatible with 4G and 5G telecommunication systems. Ex-1003, ¶¶ 135–137. This is a small, trivial change (if any). *Id.*

b) Refined Beam

To the extent the “beam-related information indicat[ing] a first beam,” in Moon’s control signal (e.g., DCI) does not disclose xCSI-RS “transmitted on at least a refined beam of the first beam” (elements [3] and [14]), a POSITA would have been motivated to modify Moon to implement such a system. Ex-1003, ¶¶ 138–140. As described above, the ’402 patent makes clear that transmission of a “beam reference signal for beam measurement,” such as Moon’s xCSI-RS, is an example of beam refinement. *See* Section IX(A)(3), above; Ex-1001 at 8:13–26. And Moon discloses “DCI message(s) and/or RRC message(s) can comprise some or all of the information indicated herein . . . number of CSI ports for each of the M symbols, whether the M symbols are associated with a single Tx beam or more than one

Tx beam, beam index(es) of the Tx beam(s), etc.” Ex-1005 at [0051] (emphasis added).

Nonetheless, to the extent such disclosure does not meet elements [3] and [14], it would have been obvious to modify Moon to meet those claim elements and a POSITA would have been motivated to do so. Ex-1003, ¶ 139. For example, Moon teaches “massive MIMO.” Ex-1005 at [0036]. A POSITA knows massive MIMO supports beams and refined beams through the use of arrays with a large number of antennas. Ex-1003, ¶ 139. Additionally, Moon teaches UE beam refinement. Ex-1005 at [0036]. A POSITA knows that UE beam refinement (as disclosed by Moon) may be part of a procedure that refines both transmit and receive beams: “Since the refined TRP beam is expected to be spatially correlated with the previous TRP beam, UE can receive both of the TRP beams before and after refinement with the same UE beam. And UE beam can be further refined using procedure P-3.” See RAN1 meeting of 3GPP (R1-1609515). In another example, Moon discusses the need to determine “a best and a second best Tx beams,” which the UE can then “feedback candidate Tx beam IDs for multiple xCSI-RS symbols.” Ex-1005 at [0041]. Determining a “best beam” and “second best” beam is an example of beam refinement. Ex-1003, ¶ 139. It also serves the same purpose as the beam refinement discussed in the ’402 patent’s specification: “It is possible for UE to request the beam reference signal (e.g., an aperiodic beam reference signal) if UE detects there is a

beam quality change, UE mobility, UE rotation or any other case when beam refinement or adjustment is required.” Ex-1001 at 7:29–32. A POSITA would thus have been motivated to meet elements [3] and [14] using Moon’s signaling system. Ex-1003, ¶ 139.

Lastly, as set forth in Ground 3, below, by the time of the ’402 patent’s priority date, 3GPP participants had already discussed the need to utilize CSI-RS for beam refinement in 4G and 5G telecommunications systems. Ex-1003, ¶ 140. Moon discloses that its system is compatible with such technologies, and so, to the extent Moon does not disclose elements [3] and [14], a POSITA would have been further motivated to modify Moon to meet those limitations. Ex-1005 at [0018] (“For example, in some embodiments, the baseband circuitry 104 may include a second generation (2G) baseband processor 104a, third generation (3G) baseband processor 104b, fourth generation (4G) baseband processor 104c, and/or other baseband processor(s) 104d for other existing generations, generations in development or to be developed in the future (e.g., fifth generation (5G), 6G, etc.).”); Ex-1003, ¶ 140.

2) Independent Claims

Moon renders obvious claims 1 and 12. Ex-1003, ¶ 141. Moon discloses each element of these claims. *See* Sections IX(A)(1) and (5), above. To the extent Moon does not disclose elements [1(a)(1)] and [12(a)(1)], it would have been obvious to

modify the system for the reasons above to meet those limitations. Ex-1003, ¶ 141. It would have been obvious to make the “dynamic” signaling of Moon aperiodic. *Id.*

3) Dependent Claims

Moon also renders obvious claims 2–4 and 13–15. Ex-1003, ¶ 142. Moon discloses each element of these claims. *See* Sections IX(A)(2)–(4) and (6)–(8), above. To the extent Moon does not disclose elements [3] and [14], it would have been obvious to a POSITA to modify Moon to meet those elements (*e.g.*, to transmit the reference signal on a refined beam of the first beam identified by the control signal) based on the motivations above. Ex-1003, ¶ 142.

C. Ground 3: Moon Renders Obvious Claims 3 and 14 in view of R1-1609515

As set forth in Grounds 1 and 2, Moon discloses “beam refinement” as claimed in the ’402 patent. *See, e.g.*, Ex-1001 at 8:23-26 (“An example of triggering beam refinement or adjustment for a UE would be to send an aperiodic trigger for beam reference signal to the UE.”). Nonetheless, if it is determined that Moon does not disclose the “beam refinement” claims (3 and 14), then it would have been obvious to modify Moon in view of R1-1609515 to meet claims 3 and 14. Ex-1003, ¶ 143.

1) Motivation to Combine Moon and R1-1609515.

a) Moon and R1-1609515 are From the Same Field of Endeavor and are Directly Related.

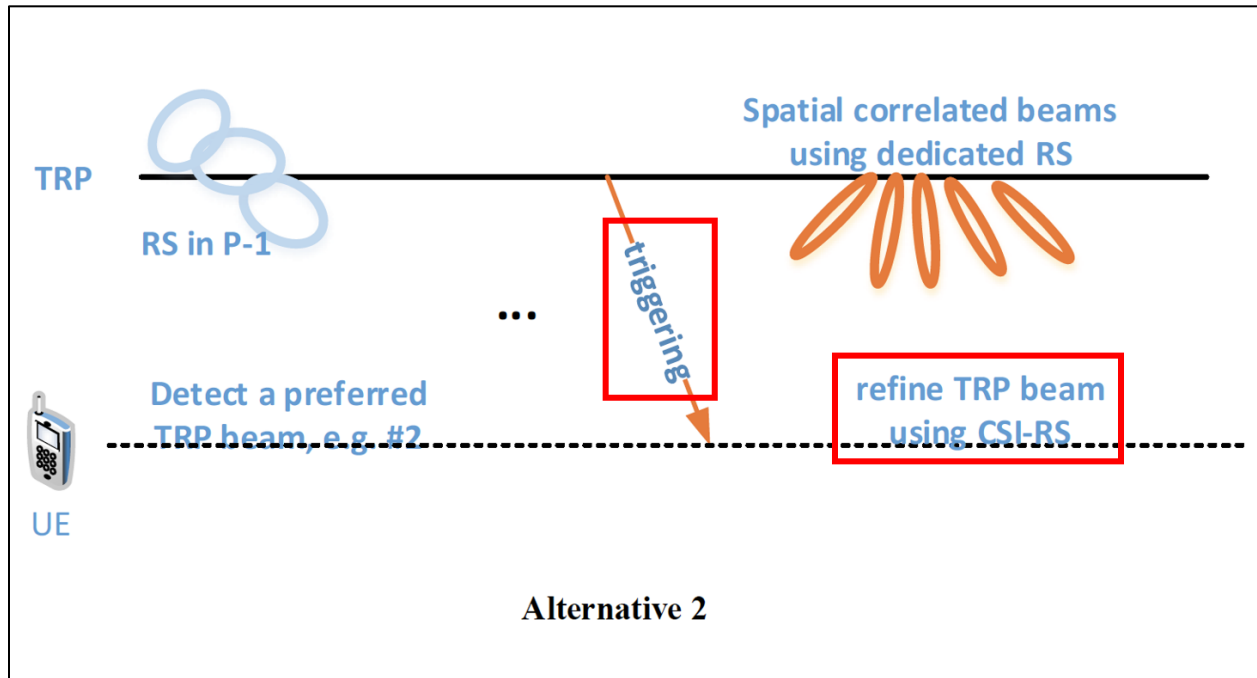
A POSITA would have been motivated to combine the teachings of Moon and R1-1609515. Both are disclosures from Intel. Both disclosures address design aspects of reference signals for beamforming in 5G new radio (NR). For example, “The present disclosure relates to wireless technology, and more specifically to techniques for communicating control signaling for Channel State Information (CSI) in fifth generation (5G) systems.” Ex. 1005 at [0002]. “FIG. 4 is a block diagram illustrating a system that facilitates control signaling for fifth generation (5G) Channel State Information (xCSI) Reference Signals (xCSI-RSs).” Id. at [0007]. “The millimeter wave can be used in 5G (Fifth Generation) systems to achieve a wider bandwidth so that user throughput can be increased.” Id. at [0036]. “In 5G systems, the downlink (DL) transmission in a self-contained subframe (e.g., those shown in FIG. 2) can comprise xCSI-RS scheduled via dynamic signaling.” Id. at [0038]. Similarly, R1-1609515 also addresses reference signals and beamforming in 5G/NR: “Since more than one antenna panel is used at UE side in NR systems, the identified top TRP beams maybe better received by either single UE panel or multiple UE panels. As such, the reference signal to enable beam switching could

be transmitted during one OFDM symbol or several OFDM symbols...” Ex. 1006 at 5.

Before the '402 Patent, it would have been obvious, beneficial, and predictable to utilize Moon's teachings regarding the use of control signaling to trigger transmission of xCSI-RS with R1-1609515's concept of beam refinement — for example, in order to effectuate the beam change discussed in R1-1609515 at “Beam Refinement Scenario 2.” Ex-1006 at 1–3. Additionally, it would have been obvious, beneficial and predictable to utilize Moon's teachings regarding the refinement of UE beams (Ex-1005 at [0036]) with R1-1609515's concept of TRP beam refinement, particularly as R1-1609515 teaches to combine TRP and UE beam refinement procedures: “Since the refined TRP beam is expected to be spatially correlated with the previous TRP beam, UE can receive both of the TRP beams before and after refinement with the same UE beam. And UE beam can be further refined using procedure P-3.” Ex-1006 at 2.

As an initial matter, one of ordinary skill in the art when considering the teachings of Moon would have also considered the teachings of R1-1609515, as they are analogous prior art pertaining to the same field of endeavor, namely, beamforming in a 5G network.

R1-1609515 explicitly discloses refining the beam from a transmission point (e.g., an eNB) using CSI-RS via a “triggering” mechanism:



Ex-1006 at Figure 2 (annotated). Given Moon's lengthy discussion of said triggering mechanism for 5G CSI-RS using control signaling such as DCI and/or RRC messages, a POSITA would have been motivated to use Moon's teachings to implement the beam refinement process disclosed in R1-1609515. Ex-1003, ¶¶ 144–147.

b) A POSITA Would Have Readily Observed that Moon and R1-1609515 Address Methods Related to Large Arrays

A POSITA would have been motivated to combine the teachings of Moon and R1-1609515. Both disclosures address design aspects related to large arrays. For example, "The new Channel State Information Reference Signal (CSI-RS) can be designed to support the downlink (DL) Transmission (Tx) beams measurement and selection in this new frame structure, by which the massive MIMO can be applied."

Ex. 1005 at [0036]. A POSITA would have understood that with “massive MIMO” it is possible to generate beams and refined beams. Similarly, R1-1609515 discloses “multiple antenna panels.” For example, “With multiple antenna panels at TRP side, this implies a FDM structure of the RS for TRP beam refinement to reduce the refinement latency.” Ex. 1006 at 2. A POSITA understands that a large array may be divided into panels, which can be used to generate beams and refined beams. Ex-1003, ¶ 148.

c) A POSITA Would Have Readily Observed that Moon and R1-1609515 Address Beam Measurements.

A POSITA would have been motivated to combine the teachings of Moon and R1-1609515. Both disclosures address design aspects related to beam measurements. For example, “The new Channel State Information Reference Signal (CSI-RS) can be designed to support the downlink (DL) Transmission (Tx) beams measurement and selection in this new frame structure, by which the massive MIMO can be applied.” Ex-1005 at [0036]. “These xCSI-RS configuration parameters can comprise one or more of the characteristics indicated herein as configurable for xCSI-RS, such as the number of symbols for xCSI-RS (e.g., $M = 0, 1, 2$, etc.), which symbols are configured for xCSI-RS, CRG type (e.g., candidate beam measurement, interference measurement, etc.), whether xCSI-RS will be received from one or more Tx beams that can be from one or more TPs, etc.” Ex-1005 at [0055]. Similarly, R1-

1609515 relates to beam measurement: “In addition, the original TRP should inform UE SS information of the target TRPs so that UE could distinguish scenario 3 from scenario 2 to perform beam measurement.” Ex-1006 at 5. A POSITA thus would have understood Moon and R1-609515 to teach methods directed toward beam measurement. Ex-1003, ¶ 149.

d) A POSITA Would Have Desired to Apply the Solutions in R1-1609515 to Moon to Perform TRP Beam Refinement

A POSITA would have been familiar with 3GPP efforts to develop methods for beam selection. For example, a POSITA would have been familiar with the technical report TR 38.802 v1.0.0 (2016-11) “Study on New Radio Access Technology” (R1-1613687) published in November 2016. Ex-1003, Appendix 10. The report utilizes the same P-1, P-2, P-3 terminology for beam management used by R1-1609515:

The following DL L1/L2 beam management procedures are supported within one or multiple TRPs:

- P-1: is used to enable UE measurement on different TRP Tx beams to support selection of TRP Tx beams. UE Rx beam(s)

For beamforming at TRP, it typically includes a intra/inter-TRP Tx beam sweep from a set of different beams. For beamforming at UE, it typically includes a UE Rx beam sweep from a set of different beams.

- P-2: is used to enable UE measurement on different TRP Tx beams to possibly change inter/intra-TRP Tx beam(s)

From a possibly smaller set of beams for beam refinement than in P-1. Note that P-2 can be a special case of P-1.

- P-3: is used to enable UE measurement on the same TRP Tx beam to change UE Rx beam in the case UE uses beamforming

At least network triggered aperiodic beam reporting is supported under P-1, P-2, and P-3 related operations.

Ex-1003, ¶ 150; Ex-1003, Appendix 10 (TR 38.802 at 10 (emphasis added)).

While Moon was published a few months earlier than the report, and does not use the P-1, P-2, P-3 terminology, it does teach methods which are in effect at least P-1 and P-3. For example, Moon discloses beam selection: “The new Channel State Information Reference Signal (CSI-RS) can be designed to support the downlink (DL) Transmission (Tx) **beams** measurement and **selection** in this new frame structure, by which the massive MIMO can be applied.” Ex-1005 at [0036] (emphasis added). A POSITA understands that beam selection is a P-1 procedure.

Moon also discloses a method to change UE Rx beam: “In addition, the new Beam Refinement Reference Signal (BRRS) can be designed to support UEs **performing reception (Rx) beam direction alignment.**” Ex-1005 at [0036] (emphasis added). A POSITA understands that this Moon disclosure is a P-3 procedure.

R1-1609515 expressly discloses how to perform beam refinement by implementing a P-2 procedure. For example, “**P-2:** is used to enable UE measurement on different TRP Tx beams to possibly change inter/intra-TRP Tx beam(s). From a possibly smaller set of beams for **beam refinement** than in P-1.” Ex-1006 at 1 (emphasis added).

In light of the fact that Moon already teaches at least P-1 and P-3 procedures, a POSITA would have desired to apply the P-2 procedure solution in R1-1609515 to Moon to perform TRP/base station beam refinement. Ex-1003, ¶ 150–154

*e) The Modification of Moon With R1-1609515 Would Have
Been Obvious to a Person of Ordinary Skill in the Art*

Given all of the above, modifying Moon using R1-1609515's teachings would have been obvious. As discussed, each reference: (1) comes from the same field of endeavor and are directly related; (2) address methods related to large antenna arrays; (3) address beam measurements; and (4) address beam refinement. A POSITA would have wanted to solve the obvious problem of beam tracking when using the narrow beams utilized in massive MIMO systems such as those disclosed by Moon. Ex-1003, ¶ 155.

Because a POSITA would have wanted to modify Moon with R1-1609515 and would have reasonably expected to succeed in doing so, the modification would have been obvious to a POSITA. Ex-1003, ¶¶ 155–156.

2) Claim 3

Moon modified by R1-1609515 renders claims 3 and 14 obvious. Ex-1003, ¶¶ 157–162.

a) [Element 3Pre]: The method of claim 1, wherein:

Moon discloses the preamble for the reasons discussed above in connection with element 3pre. See Section IX(A)(3), above.

- b) *[Element 3]: the beam-related information indicates a first beam, and wherein the reference signal for beam measurement is transmitted on at least a refined beam of the first beam;*

To the extent that Moon does not anticipate element 3, a POSITA would find it obvious to combine Moon's teachings with R1-1609515 to perform the element. As explained by Moon, "at least one of the DCI message(s) and/or RRC message(s) can comprise some or all of the information indicated herein . . . number of CSI ports for each of the M symbols, whether the M symbols are associated with a single Tx beam or more than one Tx beam, **beam index(es) of the Tx beam(s)**, etc." Moon at [0051] (emphasis added). A POSITA would understand that the "Tx beam(s)" of Moon correspond to the "TRP beams" in R1-1609515. Ex-1003, ¶ 158. For example, in Table 1, Moon teaches that two xCSI-RS symbols can come from different Tx beams with different beam ID (for example, one beam is the "first beam," while the other beam is the "refined beam"):

Table 1: CSI-RS Trigger Indication

3 bit CSI-RS Configuration	Indication
0	No xCSI-RS
1	One xCSI-RS symbol
2	Two xCSI-RS symbols from the same Tx beam (Same beam ID)
3	Two xCSI-RS symbols from different Tx beam (Different beam ID)
4	Two xCSI-RS symbols with zero powers in both symbols
5	Two xCSI-RS symbols with zero power in the second xCSI-RS symbol
6	Two xCSI-RS symbols with zero power in the first xCSI-RS symbol
7	Maintain the previous configuration

Ex-1005 at Table 1 (annotated). Similarly, claim 28 of Moon describes an apparatus in which “each of the M symbols associated with xCSI-RS in the subframe n are associated with a distinct transmit beam.”

Thus, the “beam index” included in Moon’s DCI and/or RRC control signal constitutes “beam-related information” that “indicates a first beam.” And as depicted in R1-1609515, the 5G CSI-RS are transmitted on “a refined beam of the first beam.” See annotated R1-1609515 Figure 2, above.

A POSITA would thus have understood the Moon/R1-1609515 combination to teach this limitation. Ex-1003, ¶¶ 158–160.

3) Claim 14

a) [Element 14Pre]: The base station of claim 12, wherein:

Moon discloses the preamble for the reasons discussed above in connection with element 14pre. *See* Section IX(A)(7), above.

b) [Element 14]: the beam-related information indicates a first beam, and wherein the reference signal for beam measurement is transmitted on at least a refined beam of the first beam;

For the reasons discussed above in connection with element 3, the Moon/R1-1609515 combination renders obvious corresponding element 14. *See* Section IX(C)(2), above.

X. SECONDARY CONSIDERATIONS

Petitioners are unaware of any evidence of secondary considerations that would support a finding of non-obviousness. *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311–12 (Fed. Cir. 2006). The asserted prior art cited herein demonstrates there is no evidence of failure by others and that the features recited in the Challenged Claims were readily available in the prior art. Ex-1003, ¶¶ 84–163. Even if secondary considerations did exist, they could not overcome the strong prima facie case of obviousness shown in this Petition. *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010). Should Patent Owner attempt to meet its burden to show secondary considerations, Petitioners reserve the right to respond.

XI. INSTITUTION IS PROPER UNDER SECTIONS 314 AND 325

Petitioners have shown that there is a reasonable likelihood of prevailing with respect to at least one Challenged Claim. Petitioners have not filed a civil action challenging the validity of the '402 patent that could bar review under Section 325. This is also the first and only petition challenging any of the '402 patent's claims, which weighs in favor of institution under *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 (P.T.A.B. Sept. 6, 2017). And the prior art relied upon here—Moon and R1-1609515—were not before the Patent Office during prosecution, which further weighs in favor of institution. *Advanced Bioinc, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469 (Paper No. 6) (P.T.A.B. Feb. 13, 2020) (precedential) (looking to “whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office”).

The factors set forth in *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 6 (P.T.A.B. Mar. 20, 2020) (“*Fintiv*”) (precedential) also favor institution.

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

The **second factor** (proximity) is neutral. As the Director's Interim Guidance explains, “[t]he PTAB will weigh this factor against exercising discretion to deny

institution under *Fintiv* if the median time-to trial is around the same time or after the projected statutory deadline for the PTAB’s final written decision.” Ex-1014, 9. The Interim Guidance further explains that “[w]here the parties rely on time-to-trial statistics, the PTAB will also consider additional supporting factors such as the number of cases before the judge in the parallel litigation” *Id.*

Jury selection is scheduled to begin on July 21, 2025. Ex-1015, 1. With this Petition filed in June 2024, a final written decision may be expected by December 2025, not long after the trial date (and likely before any appealable post-trial decision). The Board has granted institution in cases where the final written decision issued a few months after the scheduled trial date when other factors favor institution. *See Hulu*, IPR2021-00298, Paper 11 at 11-18; *see also NetNut Ltd. v. Bright Data Ltd.*, IPR2021-01492, Paper 12 at 9-16 (P.T.A.B. Mar. 21, 2022) (instituting review with trial date six months before final written decision). Those same factors are present here. In the litigation, moreover, there are multiple defendants, and there will be separate trials. The cases are only consolidated for pretrial. Ex-1011. It is reasonable to expect that all trials will not be complete or through post-trial orders before the final written decision. In these circumstances, the Board treats this factor as neutral. *See CrowdStrike, Inc. v. Open Text Inc.*, IPR2023-00556, Paper 9 at 8 (P.T.A.B. Sept. 12, 2023).

The **third factor** (investment) weighs against denial. The district court litigation is in its early stages. Fact discovery is in its infancy, and the parties have not engaged in expert discovery. Ex-1010, 3–5. The parties have not identified terms for claim construction. *Id.* Nor have there been any substantive orders in the case. The district court’s investment is, therefore, minimal. *See PEAG LLC v. Varta Microbattery GmbH*, IPR2020-01214, Paper 8 at 17 (P.T.A.B. Jan. 6, 2021).

Petitioners diligently filed this Petition after they received Patent Owner’s infringement contentions that confirmed Petitioners’ technology is at the center of the district court litigation. The Board has recognized that “it is often reasonable for a petitioner to wait to file its petition until it learns which claims are being asserted against it in the parallel proceeding.” *Fintiv*, IPR2020-00019, Paper 11 at 11. The Board has further found a petitioner acted diligently when filing its petition approximately four months after receiving the infringement contentions, which is the approximate timeframe here (Ex-1010, 6). *See Corning Optical Communications LLC v. Dali Wireless, Inc.*, IPR2021-00762, Paper 8 at 9-10 (P.T.A.B. Oct. 31, 2021); *see also Hulu*, IPR2021-00298, Paper 11 at 13-14; *Ericsson Inc. v. Koninklijke KPN N.V.*, IPR2022-00079, Paper 9, 10-11 (P.T.A.B. May 25, 2022) (finding petitioner “very diligent” in filing two months after receiving infringement contentions); *Ericsson Inc. v. Koninklijke KPN N.V.*, IPR2022-00069, Paper 9, 11-12 (P.T.A.B. May 25, 2022) (same).

Petitioners' diligence in filing and the district court's minimal investment tips this factor in favor of institution. *PEAG*, IPR2020-01214, Paper 8 at 17-18.

The **fourth factor** (overlap) also weighs against denial. Petitioners hereby stipulate that, if trial is instituted, Petitioners will not pursue this IPR's Grounds in the district court litigation. This stipulation eliminates any risk of overlapping effort and results. The Board has confirmed that such a stipulation "mitigates any concerns of duplicative efforts between the district court and the Board, as well as concerns of potentially conflicting decisions." *See VMWare, Inc. v. Intellectual Ventures I LLC*, IPR2020-00470, Paper 13 at 20 (P.T.A.B. Aug. 18, 2020) ("Thus, we find that this factor weighs in favor of not exercising discretion to deny institution under 35 U.S.C. § 314(a)."). "Instituting trial here serves overall system efficiency and integrity goals by not duplicating efforts and by resolving materially different patentability issues." *Apple, Inc. v. SEVEN Networks, LLC*, IPR2020-00156, Paper 10 at 19 (P.T.A.B. June 15, 2020); *see also Sand Revolution II, LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 12 (P.T.A.B. June 16, 2020). This factor, therefore, weighs against discretionary denial.

The **fifth factor** (parties) favors institution. Petitioners are either parties to the district court litigations or have sought to intervene. And if Petitioners Ericsson and Nokia's motions to intervene are granted, a "holistic view" of the factors likewise favors institution. *See Verizon Business Network Services, Inc. v. Huawei Techs. Co.*,

IPR2020-01141, Paper 12, 17 (P.T.A.B Jan. 14, 2021); *Samsung Elecs. Co Ltd., v Dynamics Inc.*, IPR2020-00505, Paper 11, 15 (P.T.A.B. Aug. 12, 2020).

Even if the Board determines that the aforementioned factors favor denial, the Board should not discretionarily deny institution, because this Petition presents compelling merits (the **sixth factor**). *See CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 at 4-5 (P.T.A.B. Feb. 27, 2023) (precedential). During prosecution Patent Owner pointed to only two points of novelty for the Challenged Claims. Ex-1002 at 37–39. Moon, both alone and in combination with R1-1609515—neither of which was before Patent Office—teaches or suggests the claimed control signaling for reference signals for beam measurement and the claimed points of novelty. This Petition thus presents compelling merits that plainly lead to the conclusion that at least one claim is unpatentable, and the Board should grant institution. *See CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 24, 75 (P.T.A.B .Mar. 17, 2023).

Due to Petitioners’ diligence, it would be premature at the time of this Petition to argue regarding the timing of respective milestones in the proceeding versus the litigation. Thus, if Patent Owner raises § 314(a) arguments in a Preliminary Response, Petitioners respectfully request the opportunity to reply before institution, to address, e.g., the expected schedules of the co-pending cases.

XII. CONCLUSION

Petitioners request institution of IPR and cancellation of the Challenged Claims.

Date: June 28, 2024

Respectfully submitted,

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CERTIFICATION OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned **PETITION FOR INTER PARTES REVIEW** specified in 37 C.F.R. § 42.24 have 13,816 words, in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24(a)(1). This word count was prepared using Microsoft Word 2010.

Respectfully submitted,

Date: June 28, 2024

/Scott W. Hejny /
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CERTIFICATION OF SERVICE

The undersigned hereby certifies that the above-captioned **PETITION FOR INTER PARTES REVIEW** is being served on counsel for patent owner via electronic mail and FEDERAL EXPRESS, costs prepaid, to the address of the attorney or agent of record at the USPTO: on June 28, 2024, in its entirety on the following counsel of record for Patent Owner:

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