

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ericsson Inc.

Petitioner,

v.

Motorola Mobility LLC

Patent Owner.

Patent No. 11,184,130 B2

Filing Date: June 26, 2017

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Title: DEMODULATION REFERENCE SIGNAL CONFIGURATION

Inter Partes Review No. IPR2025-00174

DECLARATION OF DR. J. NICHOLAS LANEMAN

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Cited Exhibits

Exhibit No.	Description
EX-1001	U.S. Patent No. 11,184,130 (“the ’130 Patent”)
EX-1002	File History of U.S. Patent No. 11,184,130 (U.S. Patent Application No. 16/626,279 (“the ’279 Application”))
EX-1003	3GPP TR 38.912 v14.0.0
EX-1004	R1-1710789
EX-1005	R1-1710294
EX-1006	<i>Telefonaktiebolaget LM Ericsson v. Lenovo (US) Inc.</i> , No. 5:23-cv-00569, Dkt. 29, Am. Answer and Countercl. (E.D.N.C. Dec. 15, 2023)
EX-1007	Excerpts from Dahlman, 4G, LTE-Advanced Pro and The Road to 5G (2016)
EX-1008	Declaration of Craig Bishop and appendices
EX-1009	In The Matter Of Certain Cellular Base Station Communication Equipment, Components Thereof, And Products Containing Same, Inv. No. 337-TA-1388, Updated Joint Claim Construction Chart (I.T.C. Jul. 15, 2024).
EX-1010	3GPP TS 36.300 V14.3.0 (2017-06)
EX-1011	3GPP TS 36.211 V14.3.0 (2017-06)
EX-1012	3GPP TS 36.331 V14.2.2 (2017-04)
EX-1200	Declaration of Dr. J. Nicholas Laneman
EX-1201	CV of Dr. J. Nicholas Laneman

Listing of Challenged Claims

Claim	Lim.	Claim Text
11	11pre	An apparatus comprising:
	11a	a processor that determines a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information,
	11b	wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and
	11c	a transmitter that transmits the demodulation reference signal based on the demodulation reference signal configuration.
12		The apparatus of claim 11, wherein the remaining minimum system information channel is a remaining minimum system information downlink channel.
13		The apparatus of claim 11, wherein the remaining minimum system information channel is a remaining minimum system information physical downlink shared channel.
14		The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.
15		The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is predefined.
16		The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration.
17		The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.
18	18pre	A method comprising:

Claim	Lim.	Claim Text
	18a	determining a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information,
	18b	wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and
	18c	transmitting the demodulation reference signal based on the demodulation reference signal configuration.
19		The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.
20		The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.

I. INTRODUCTION

1. My name is J. Nicholas Laneman. I have been retained to testify as an expert in this action on behalf of Ericsson Inc. (“Ericsson” or “Petitioner”). For this declaration, I have been asked to offer an expert opinions on the invalidity of Claims 11-20 of U.S. Patent Nos. 11,184,130 (“’130 Patent”) (collectively, the “Challenged Claims”). The ’130 Patent is owned by Motorola Mobility LLC (“Motorola” or “Patent Owner”), and has been the subject of related litigation between the parties, including International Trade Commission Investigation (“ITC”) Investigation No. 337-TA-1388. My conclusion is that each of the Challenged Claims are not patentable, instead reciting features of wireless communication systems that were well known in the prior art.

2. I am being compensated for my work on this case at my standard consulting rate of \$600 per hour. I am also being reimbursed for expenses that I incur. My compensation is not contingent upon the results of my analysis or the substance of my testimony.

II. QUALIFICATIONS AND EXPERIENCE

3. I provide a brief summary of my qualifications as an expert in this Investigation below. My qualifications are set out more fully in my curriculum vitae (“CV”), in Ex-1201.

4. I am the Founding Director and currently Co-Director of the Wireless Institute in the College of Engineering and a Professor of Electrical Engineering at the University of Notre Dame.

5. I joined the faculty of Notre Dame in 2002, and I conduct research projects and teach students in the area of communication systems engineering—blending information theory, signal processing, and prototyping and experimental validation of communication protocols—with an emphasis on wireless systems and networks.

6. I supervise a laboratory in which students have utilized advanced software-defined radios to prototype our research algorithms in the context of either the WiFi (IEEE 802.11 family) or 3GPP (LTE family) standards. We have extensively studied and modified implementations of the time and frequency synchronization and channel access mechanisms in the context of both standard families. Specifically, we have prototyped dynamic spectrum access in the context of the LTE standard, and published the results at Asilomar 2015 and SDR WinnComm 2016. We have also prototyped time and frequency alignment for uplink multiuser MIMO transmission in the context of the IEEE 802.11ax standard amendment, and we demonstrated real-time, over-the-air transmissions of this prototype at IEEE GLOBECOM 2016.

7. I am author or co-author on over 144 publications, including 47 journal articles and invited book chapters, and I have been recognized by Thomson Reuters as an ISI Highly Cited Researcher (2010, 2015). I am co-inventor on eight U.S. patents.

8. In over twenty years on the faculty at the University of Notre Dame, I have taught a multi-disciplinary survey course on wireless technology, economics, and policy as well as electrical engineering courses, both graduate and undergraduate, in signals and systems, communication systems, multi-user communications, information theory, probability and stochastic processes, and detection and estimation theory.

9. I have been a member of the Institute of Electrical and Electronics Engineers (IEEE) for over twenty years, as well as a member of the IEEE Information Theory Society, the IEEE Communications Society, and the IEEE Signal Processing Society. In 2014, I was elected to the rank of IEEE Fellow, which is conferred on a person with an extraordinary record of accomplishments in any of the IEEE fields of interest, the total number selected in any one year not exceeding one-tenth of one percent of the total voting IEEE membership. I was also named the recipient of the 2018 IEEE Kiyo Tomiyasu Award, which honors outstanding contributions toward technologies holding the promise of innovative applications made by researchers in early to mid-career.

10. I received Ph.D. and S.M. degrees in electrical engineering and computer science from the Massachusetts Institute of Technology (MIT) in Cambridge, MA, in 2002 and 1997, respectively.

11. I also earned two B.S. degrees, both *summa cum laude*, in electrical engineering and in computer science, from Washington University in St. Louis, MO, in 1995.

III. SUMMARY OF OPINIONS

12. Upon review of the prior art, the Challenged Claims, corresponding specifications and file history of the '130 Patent, it is my opinion that the Challenged Claims are invalid in view of the prior art. My invalidity analysis has taken into account the claim constructions as discussed in the Claim Construction section. My opinions take into account the knowledge of a person of ordinary skill in the art ("POSITA") at the relevant time as well as my own experience and education.

13. Based on the work described herein, it is my opinion that Claims 11-20 of the '130 Patent are not patentable. In my opinion:

- Ground 1: TR 38.912 anticipates and/or renders obvious Claims 11-20 of the '130 Patent
- Ground 2: TR 38.912, in view of R1-1710789, renders obvious Claims 15-16 of the '130 Patent
-

- Ground 3: TR 38.912, in view of R1-1710294, renders obvious Claims 15, 17, and 20 of the '130 Patent
- Ground 4: R1-1710294 anticipates and/or renders obvious Claims 11-20 of the '130 Patent
- Ground 5: R1-1710294, in view of R1-1710789, renders obvious Claims 15-16 of the '130 Patent

IV. RELEVANT LEGAL STANDARDS

14. As a technical expert, I am not offering any legal opinions. I am offering technical assessments and opinions. In rendering my analysis, I have been informed by counsel regarding various legal standards for determining patentability. I have applied those standards in forming my technical opinions expressed in this report.

15. The patent claims describe the invention made by the inventors and describe what the patent owner owns and what the owner may prevent others from using. I understand that an independent claim sets forth all the requirements that must be met to be covered by that claim. I further understand that a dependent claim does not itself recite all of the requirements of the claim but refers to another claim and incorporates all of the requirements of the claim to which it refers.

16. It is my understanding that a claimed invention is unpatentable if a prior art reference discloses every limitation of a patent claim. My understanding is that this concept is referred to as anticipation.

17. It is also my understanding that a claimed invention is unpatentable if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA to which the subject matter pertains. Obviousness, as I understand it, is based on the scope and content of the prior art, the differences between the prior art and the claim, and the level of ordinary skill in the art.

18. I understand that when evaluating obviousness, I must not consider whether the claimed invention would have been obvious to a layman or to an expert; not use hindsight when comparing the prior art to the claimed invention; and not consider what was learned from the teachings of the patent. In particular, I understand that it is improper to use the patent claims as a road map for selecting and combining items of prior art. In other words, one should avoid using the challenged patent as a guide through the prior art references, combining the right references in the right way so as to achieve the result of the claims at issue. Instead, one must put oneself in the place of a POSITA at the time the invention was made and consider only what was known before the invention.

19. I understand that the obviousness analysis takes into account factual inquiries, including the level of ordinary skill in the art, the scope and content of the prior art, the differences between the prior art and the claimed subject matter, and any secondary considerations, to the extent they exist, such as commercial success,

long felt but unsolved needs in the prior art that was satisfied by the claimed invention, unexpected results achieved by the invention, and praise of the invention by others skilled in the art. I understand that there must be a relationship between any such secondary considerations/indicia and the claimed invention.

20. I have been informed and understand that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device or method in the same way; (d) applying a known technique to a known device or method ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success when there is a design need or market pressure to solve a problem; and (f) some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

21. Also, I have been informed and understand that obviousness does not require physical combination or bodily incorporation but rather consideration of

what the combined teachings of prior art references would have suggested to a POSITA at the time of the alleged invention.

22. In addition, I understand that the law requires a “common sense” approach when determining whether a claimed invention would have been obvious to a POSITA. For example, combining familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. This is especially true in instances where there are limited numbers of possible solutions to technical problems or challenges.

V. TECHNOLOGY BACKGROUND

23. The purpose of this section is to provide a background on wireless mobile cellular telecommunication systems and global standards development relevant to the '130 Patent and the Prior Art References.

A. Demodulation Reference Signals (“DMRS” or “DM-RS”)

24. Cellular systems such as LTE and 5G use a modulation technique called Orthogonal Frequency Division Multiplexing, or “OFDM.” Ex-1007, 75. In OFDM, transmissions are made across multiple subcarriers on different frequencies, and across multiple symbols at different times. These frequencies and times can be represented by a grid:

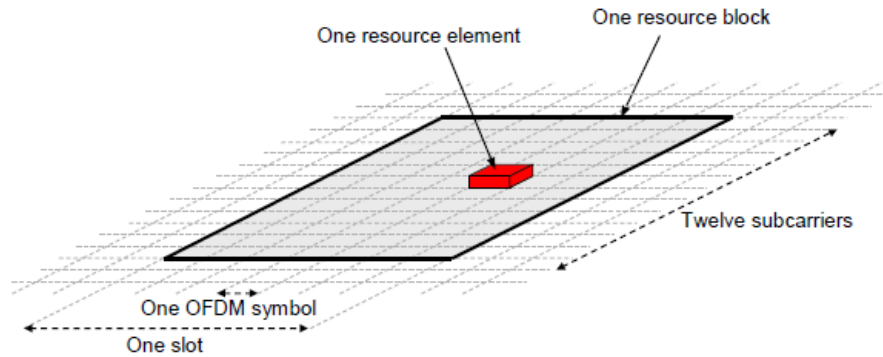


FIGURE 5.2
The LTE physical time–frequency resource.

Ex-1007, 78.

25. A “resource block” comprising a set of symbols and subcarriers is made of individual “resource elements” that correspond to a specific symbol time and subcarrier frequency. Ex-1007, 78. In order to allow receivers to demodulate the signals, reference signals—predefined signals occupying specific resource elements within the time/frequency grid—are transmitted in the resource block by the transmitter. *Id.*, 103. Demodulation reference signals (“DM-RS” or “DMRS”) are used for channel estimation so that the data can be correctly demodulated by the receiver. *Id.*, 103-104.

26. Because demodulation reference signals are predefined signals occupying specific resource elements within the time/frequency grid, there are a variety of ways that demodulation reference signals can be configured. Ex-1007, 103. For example, demodulation reference signals can be placed at various different positions in the time and frequency domains; they can be configured to use different

sequences; and they can be configured to repeat with different periodicity or to use a different number of symbols.

27. The LTE standard, for example, summarizes reference signals that it uses (including demodulation reference signals) as follows:

5.1.4 Downlink Reference signal and synchronization signals

The downlink cell-specific reference signals consist of known reference symbols inserted in the first and third last OFDM symbol of each slot for antenna port 0 and 1. There is one cell-specific reference signal transmitted per downlink antenna port. The number of downlink antenna ports for the transmission of cell-specific reference signals equals 1, 2, or 4.

Physical layer provides 504 unique cell identities using Synchronization signals.

The downlink MBSFN reference signals consist of known reference symbols inserted every other sub-carrier in the 3rd, 7th and 11th OFDM symbol of sub-frame in case of 15kHz sub-carrier spacing and extended cyclic prefix.

In addition to cell-specific reference signals and MBSFN reference signals, the physical layer supports UE-specific reference signals, positioning reference signals, CSI reference signals, and discovery signals.

A UE may assume presence of the discovery signals consisting of cell-specific reference signals, primary and secondary synchronization signals, and configurable CSI reference signals.

Ex-1010, 3GPP TS 36.300 V14.3.0 (2017-06), p. 58.

6.10 Reference signals

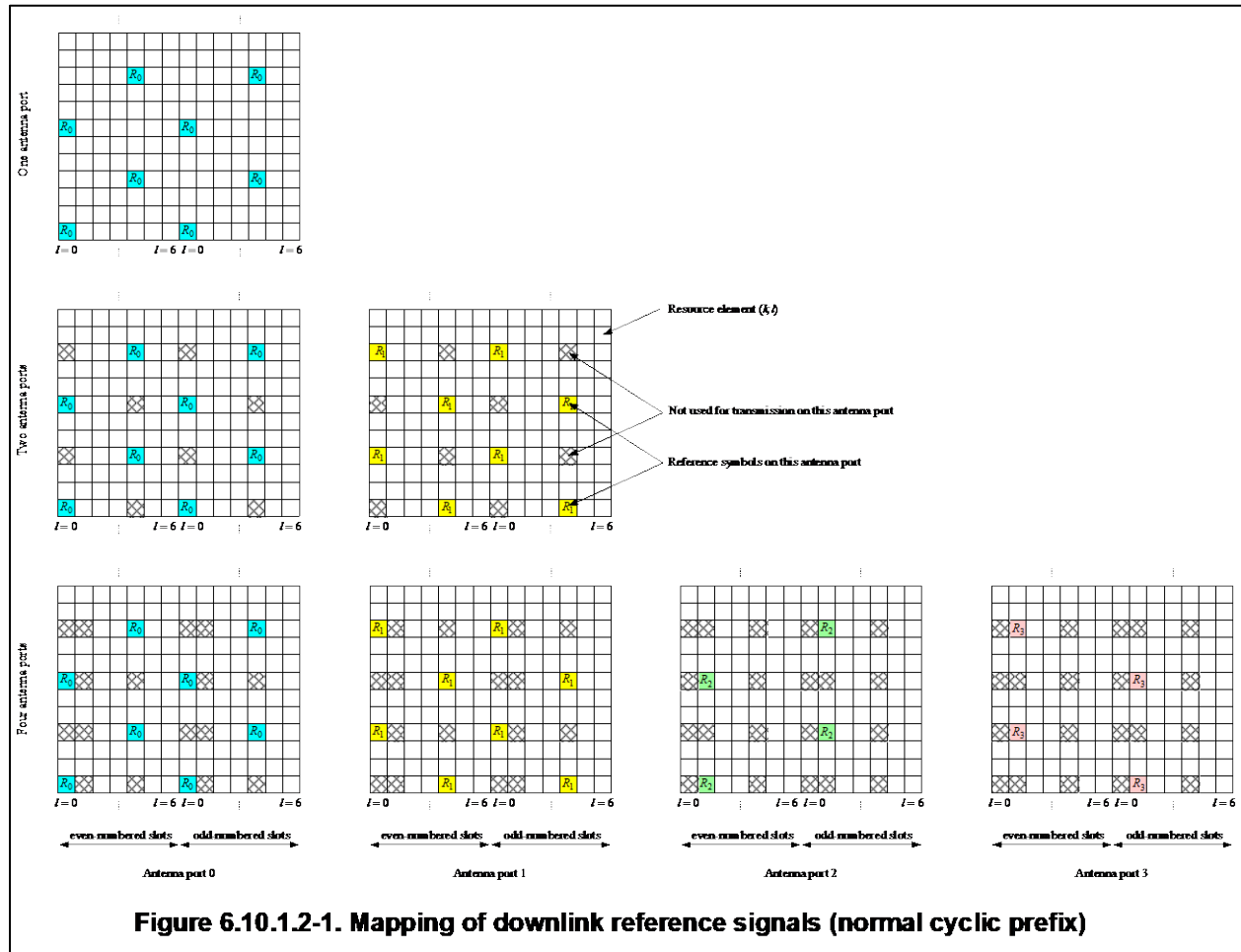
Six types of downlink reference signals are defined:

- Cell-specific Reference Signal (CRS)
- MBSFN reference signal
- UE-specific Reference Signal (DM-RS) associated with PDSCH
- DeModulation Reference Signal (DM-RS) associated with EPDCCH or MPDCCH
- Positioning Reference Signal (PRS)
- CSI Reference Signal (CSI-RS)

There is one reference signal transmitted per downlink antenna port.

Ex-1011, 3GPP TS 36.211 V14.3.0 (2017-06), pp. 114-115.

28. The LTE standard illustrates how reference signals, shown as colored squares, are mapped to resource elements in an OFDM transmission.



Ex-1011, 3GPP TS 36.211 V14.3.0 (2017-06), p. 116.

B. System Information

29. In cellular systems such as LTE and 5G, the network provides devices with “system information,” which is “information that is repeatedly broadcast by the network and which needs to be acquired by devices in order for them to be able to access and, in general, operate properly within the network and within a specific

cell.” Ex-1007, 289. In LTE, this system information is delivered by two different mechanisms relying on two different transport channels. *Id.* A limited amount of system information is transmitted in the master information block, or MIB, on the broadcast channel. *Id.* The remaining parts of the system information, corresponding to different so-called system information blocks (SIBs), is transmitted using the downlink shared channel. *Id.*

30. When a mobile device is turned on, it executes certain procedures to search for a cellular network, associate to and communicate with at least a primary base station in the radio access network, authenticate to the core network, and provide wireless connectivity to applications on the device. A key outcome in this process is conveying adequate *System Information* (“SI”) from the cellular network to the mobile device. SI is also monitored and updated by the mobile device for multiple base stations, and potentially multiple radio access networks, in order to support mobility throughout the coverage area and handover at cell boundaries.

31. It is therefore critical for the information elements, transmission formats, and procedures associated with SI to be standardized so that mobile devices from different manufacturers can operate with network devices from different vendors.

32. This section summarizes what a POSITA would have known about SI and related procedures from the prevailing 3GPP TS and TR documents, specifically

what information was conveyed by cellular base stations, how such information is transmitted by the base stations, and how mobile devices receive and process the system information to gain full access to the cellular network.

33. SI in the 4G LTE standard is divided into the *MasterInformationBlock* (“*MIB*”) and a number of *SystemInformationBlocks* (“*SIBs*”). See, e.g., Section 7.4 of Ex-1010, 3GPP TS 36.300 V14.3.0 (2017-06) and Section 5.2 of Ex-1012, 3GPP TS 36.331 V14.2.2 (2017-04). In particular:

“*MasterInformationBlock* defines the most essential physical layer information of the cell required to receive further system information;

SystemInformationBlockType1 ... contain[s] information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information blocks;

SystemInformationBlockType2 contains common and shared channel information;

....”

See, e.g., Ex-1010, Section 7.4 of 3GPP TS 36.300 V14.3.0 (2017-06).

34. Furthermore:

The MIB includes a limited number of most essential and most frequently transmitted parameters that are needed to acquire other information from the cell, and is transmitted on BCH. SIBs other than *SystemInformationBlockType1* are carried in *SystemInformation* (SI) messages and mapping of SIBs to SI messages is flexibly configurable by *schedulingInfoList* included in *SystemInformationBlockType1*, with

restrictions that: each SIB is contained only in a single SI message, and at most once in that message; only SIBs having the same scheduling requirement (periodicity) can be mapped to the same SI message; *SystemInformationBlockType2* is always mapped to the SI message that corresponds to the first entry in the list of SI messages in *schedulingInfoList*. There may be multiple SI messages transmitted with the same periodicity. *SystemInformationBlockType1* and all SI messages are transmitted on DL-SCH.

Section 5.2.1.1 of Ex-1012, 3GPP TS 36.331 V14.2.2 (2017-04).

35. The relevant 5G NR study items document terminology and characteristics of the SI. Specifically:

System information is divided into minimum SI and other SI. Minimum SI is periodically broadcast. The minimum SI comprises basic information required for initial access to a cell and information for acquiring any other SI broadcast periodically or provisioned via on-demand basis, i.e. scheduling information. The other SI encompasses everything not broadcast in the minimum SI.

Ex-1003, Section 9.8.3 of 3GPP TR 38.912 V14.0.0 (2017-03), p. 45.

36. Part of the minimum system information is broadcasted using the NR-PBCH, and the “remaining” minimum system information is transmitted in the shared downlink channel via NR-PDSCH. *See, e.g.*, Section 8.2.2.3.1 of Ex-1003, 3GPP TR 38.912 V14.0.0 (2017-03), pp. 30-31.

VI. OVERVIEW OF THE '130 PATENT

37. The '130 Patent is directed to “[a]pparatuses, methods, and systems...for demodulation reference signal configuration.” '130 Patent at Abstract. The patent describes “a processor that determines a remaining minimum system information channel demodulation reference signal configuration” and an

“apparatus [that] includes a receiver that receives the demodulation reference signal based on the demodulation reference signal configuration.” *Id.* at 2:16-22.

38. The '130 Patent discloses that the demodulation reference signal (“DMRS”) configuration may be transmitted on a remaining minimum system information (“RMSI”) channel or on a physical downlink shared channel (“PDSCH”) carrying remaining minimum system information. *See* '130 Patent, Fig. 4, 2:7-10, 9:64-65.

39. The DMRS configuration may comprise or include the following: a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level order, a frequency domain density, a time domain density, or some combination thereof. *See* '130 Patent, 2:28-33.

40. The '130 Patent has 20 claims. Claims 1, 8, 11, and 18 are independent claims.

A. Prosecution History

41. The '130 Patent issued from U.S. Patent App. No. 16/626,279 (“'279 App.”), filed on Dec. 23, 2019. The '279 App. is a National Stage application of and claims priority to PCT App. No. PCT/CN2017/090033, filed June 26, 2017.

42. During prosecution of the '279 App., the examiner rejected pending Claims 1, 5, 6, 8, 12, 16, 15, 19, 20, 22, 26, and 27 under 35 U.S.C. § 102 as being

anticipated by Sun (U.S. Patent App. Pub. 2018/0206247). Ex-1002 at 35. The examiner also rejected pending Claims 1, 8, 15, and 22 under 35 U.S.C. § 102 as being anticipated by Abedini. *Id.* at 36-37. The examiner further rejected pending Claims 1-3, 5, 8-10, 12, 15-17, 19, 22-24 under 35 U.S.C. § 102 as being anticipated by Park (U.S. Patent App. Pub. 2018/0324732). *Id.* at 37-38. The examiner also rejected pending Claims 1, 5-8, 12-15, 19-22, and 26-28 under 35 U.S.C. § 102 as being anticipated by Lee (U.S. Patent App. Pub. 2018/0324843). *Id.* at 38-39.

43. In response to these rejections, applicant requested an interview with the examiner. *Id.* at 32. The applicant's summary of the interview does not disclose any details of the interview. *Id.* at 27. Shortly after this interview, pending Claims 9-10, 12-13, 23-24, and 26-27 were cancelled, and pending Claims 1, 8, 15, and 22 were amended as follows:

1. (Currently Amended) An apparatus comprising:
 - a processor that determines a demodulation reference signal configuration for a physical downlink shared channel carrying [[a]] remaining minimum system information ~~channel demodulation reference signal configuration~~, wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and
 - a receiver that receives the demodulation reference signal based on the demodulation reference signal configuration.

8. (Currently Amended) A method comprising:
determining a demodulation reference signal configuration for a physical downlink shared channel carrying [[a]] remaining minimum system information
channel demodulation reference signal configuration, wherein the
demodulation reference signal configuration comprises a first configuration,
a second configuration, a mapping order, a frequency domain density, a time
domain subframe level density, a time domain symbol level density, or some
combination thereof; and
receiving the demodulation reference signal based on the demodulation reference
signal configuration.

15. (Currently Amended) An apparatus comprising:
a processor that determines a demodulation reference signal configuration for a
physical downlink shared channel carrying [[a]] remaining minimum system
information channel demodulation reference signal configuration, wherein
the demodulation reference signal configuration comprises a first
configuration, a second configuration, a mapping order, a frequency domain
density, a time domain subframe level density, a time domain symbol level
density, or some combination thereof; and
a transmitter that transmits the demodulation reference signal based on the
demodulation reference signal configuration.

22. (Currently Amended) A method comprising:
determining a demodulation reference signal configuration for a physical downlink shared channel carrying [[a]] remaining minimum system information
~~channel demodulation reference signal configuration,~~ wherein the
demodulation reference signal configuration comprises a first configuration,
a second configuration, a mapping order, a frequency domain density, a time
domain subframe level density, a time domain symbol level density, or some
combination thereof; and
transmitting the demodulation reference signal based on the demodulation reference
signal configuration.

Id. at 22-26.

44. The applicant provided no narrative response to the aforementioned 35 U.S.C. § 102 rejections, instead relying exclusively on its claim amendments. *Id.* at 28-29.

45. The PTO issued a Notice of Allowance on July 23, 2021, which does not identify any particular limitation(s) as being novel or other reason for allowance. *Id.* at 7-12.

VII. THE LEVEL OF ORDINARY SKILL

46. In my opinion, with respect to the '130 Patent, a POSITA would have had a master's degree in electrical engineering, computer engineering, or computer science, or equivalent and at least three years of experience in the field of telecommunications or wireless systems. Additional education might compensate for less experience, and vice-versa. In either case, it is my expectation that someone

with such experiences would have awareness of the 3GPP standards body and its working procedures.

47. I understand that in other proceedings, Patent Owner has contended a POSITA with respect to the '130 Patent would have at least a bachelor's degree in electrical engineering or computer science or a related degree, and at least two years of experience designing, developing, or researching cellular communication technology and that additional education might compensate for less experience, and vice-versa.

48. Although I disagree with Patent Owner's proposed POSITA standard, my opinions herein would be the same (and I would still conclude the Challenged Claims of the '130 Patent are obvious) even if I were to apply Patent Owner's standard.

VIII. CLAIM CONSTRUCTION

49. I understand the parties dispute the proper construction of several terms in the '130 Patent, and whether other terms are indefinite.

50. I understand the parties in other litigation¹ have agreed to the following constructions, and I concur that these constructions are appropriate here. I therefore apply these constructions in my analysis.

<u>Term</u>	<u>Prior Agreed Construction</u>
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¹ For example, International Trade Commission (ITC) Investigation No. 337-TA-1388.

“a first configuration” (Claims 11, 18)	Plain and ordinary meaning, that is, a first configuration that is different from a second configuration
“a second configuration” (Claims 11, 18)	Plain and ordinary meaning, that is, a second configuration that is different from a first configuration
“the demodulation reference signal” (Claims 11, 18)	“a demodulation reference signal”

Ex-1009 at 3.

51. In that same litigation, I understand that Ericsson has contended that the term “the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof” is indefinite. Patent Owner, in contrast, took the position that this term means “the demodulation reference signal configuration comprises at least two of: a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, or a time domain symbol level density.” Although I agree with Ericsson that this claim is indefinite, for purposes of this analysis, I apply Patent Owner’s proposal.

52. Finally, each of the asserted dependent claims refers to “the remaining minimum system information channel,” but independent Claims 11 and 18 do not provide the antecedent basis for this channel. I understand that to resolve this ambiguity, Patent Owner proposed the following construction in that same litigation, which replaces the “the remaining minimum system information channel” recited in

the dependent claims with the “physical downlink shared channel carrying remaining minimum system information” discussed in independent Claims 11 and 18:

“the remaining minimum system information channel demodulation reference signal configuration” Claims 5-7, 15-17	the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information
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Ex-1009, 4.

53. Accordingly, for purposes of this proceeding, I apply the constructions detailed below, which correspond to the proposal Patent Owner made in the ITC - 1388 litigation:

<u>Term</u>	<u>Construction For Purposes of <i>Inter Partes</i> Review</u>
“the remaining minimum system information channel” (Claims 12, 13)	“the physical downlink shared channel carrying remaining minimum system information”
“the remaining minimum system information channel demodulation reference signal configuration” (Claims 14-17, 19-20)	“the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information”

54. I apply these only for the purposes of this proceeding and reserve the right to argue in other forums that these claims are indefinite due to a lack of antecedent basis.

55. I understand all other claim terms should be given their ordinary and customary meanings, as would have been understood by a POSITA at the time of the alleged invention. In considering the meaning of the claims, however, I understand that one must consider the language of the claims, the specification, and the prosecution history of record. I have done so in support of my opinions concerning the '130 Patent and the prior art discussed herein.

IX. OVERVIEW OF THE PRIOR ART TO THE '130 PATENT

A. TR 38.912 v14.0.0 (Ex-1003)

56. TR 38.912 is a 3GPP Technical Report entitled “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on New Radio (NR) access technology (Release 14).” Ex-1003. As explained in detail by Craig Bishop (Ex-1008), 3GPP technical reports, including TR 38.912 (Ex-1003), are publicly accessible as of the date they were uploaded to the 3GPP FTP server. Ex-1008, ¶¶29-36, 59-62. Such documents can be located by the public based on the website’s indexing scheme. Ex-1008, ¶¶42, 44, 49. TR 38.912 was uploaded to 3GPP’s file server on March 24, 2017. Ex-1008, ¶¶63-66. It is therefore my understanding that TR 38.912 qualifies as prior art, as it was published before June 26, 2017, the earliest claimed priority date of the '130 Patent.

57. TR 38.912 describes a variety of technical aspects of 3GPP Next Generation New Radio (NR) Access Technology, one of the initial studies in

creating the NR standard, and “covers all RAN aspects” of “technology components to be considered for new radio access technologies.” In essence, it describes the understanding in March 2017 of how the NR radio access network (RAN) would be built. Ex-1003 at 10, 73.

58. Section 8, “Physical layer for next generation radio,” discusses how the physical layer would be developed. Ex-1003 at 15-39. This section describes an OFDM-based system where a number of subcarriers are used to send symbols over slots. Ex-1003 at 15-16. TR 38.912 also explains that demodulation reference signals (DM-RS) are used. Ex-1003 at 16-18, 27, 28. TR 38.912 discloses that a DM-RS can be a “[r]eference signal with main functionalities of data and control demodulation.” Ex-1003 at 27.

59. Section 8.2.1.6.4.2 of TR 38.912, “DM-RS,” explains how “[v]ariable/configurable DM-RS patterns for data demodulation are supported,” providing details about numerous aspects of DM-RS that can be configured. Ex-1003 at 28.

60. Section 8.2.2.3.1 of TR 38.912, “Synchronization signal and DL broadcast signal/channel structure,” discusses how system information is transmitted over the physical layer in multiple parts. “For the minimum system information delivery, part of minimum system information is transmitted in NR-PBCH.” Ex-

1003 at 31. “The remaining minimum system information is transmitted in shared downlink channel via NR-PDSCH.” *Id.*

B. R1-1710789 (Ex-1004)

61. R1-1710789, entitled “RS structures for NR-PDCCH,” is a technical contribution by MediaTek Inc. to 3GPP TSG RAN Working Group 1. Ex-1004. As explained in detail by Craig Bishop (Ex-1008), 3GPP technical documents, including R1-1710789 (Ex-1004), are publicly accessible as of the date they were uploaded to the 3GPP FTP server. Ex-1008, ¶¶37-40, 70-76. Such documents can be located by the public based on the website’s indexing scheme. Ex-1008, ¶¶42, 44, 49. R1-1710789 was uploaded to 3GPP’s file server on June 17, 2017. Ex-1008, ¶¶70-76. It is therefore my understanding that R1-1710789 qualifies as prior art, as it was published before June 26, 2017, the earliest claimed priority date of the ’130 Patent.

62. R1-1710789 provides simulation results for a variety of different DM-RS structures. Ex-1004 at 1. It explains that different DM-RS configurations would be appropriate in different circumstances. Ex-1004 at 2-3. It explains that a control resource set, or CORESET, configuration may be used to indicate how DM-RS is transmitted: “[t]he network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed.” Ex-1004 at 3.

C. R1-1710294 (Ex-1005)

63. R1-1710294, entitled “On DL DMRS Design,” is a technical contribution by LG Electronics to 3GPP TSG RAN Working Group 1. Ex-1005. As explained in detail by Craig Bishop (Ex-1008), 3GPP technical documents, including R1-1710294 (Ex-1005), are publicly accessible as of the date they were uploaded to the 3GPP FTP server. Ex-1008, ¶¶37-40, 77-83. Such documents can be located by the public based on the website’s indexing scheme. Ex-1008, ¶¶42, 44, 49. R1-1710294 was uploaded to 3GPP’s file server on June 17, 2017. Ex-1008, ¶¶77-83. It is therefore my understanding that R1-1710294 qualifies as prior art, as it was published before June 26, 2017, the earliest claimed priority date of the ’130 Patent.

64. R1-1710294 relates to the design of the downlink (DL) demodulation reference signal (DMRS) for New Radio (NR), *i.e.*, 5G. Ex-1005. Specifically, the section starting at the bottom of page 6, titled “DMRS for broadcast PDSCH” relates to the DMRS configuration for broadcast PDSCH transmission, e.g. for transmission of system information (p. 7, line 1: “For the case of broadcast PDSCH transmission, e.g. SIB [...]”). “SIB” is well understood in the art and within the 3GPP standards to stand for “system information block,” and “PDSCH” is well understood to stand for “physical downlink shared channel,” *i.e.*, the physical channel used for downlink data. Ex-1001 at 1:41-42, 1:58.

X. INVALIDITY OF CHALLENGED CLAIMS OF THE '130 PATENT

65. In my opinion, each of the Challenged Claims 11-20 of the '130 Patent are invalid, based on each of the seven grounds set forth by Petitioner as indicated below.

B. Ground 1: TR 38.912 Anticipates And/Or Renders Obvious Claims 11-20 of the '130 Patent

1. TR 38.912 Discloses Claim 11

[11a] An apparatus comprising: a processor that determines a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information;

66. In my opinion, TR 38.912 discloses a processor that determines a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information, as explained below.

67. In my opinion, TR 38.912 discloses a processor. For example, TR 38.912 shows that a “gNB” (gNodeB) serves as the base station, and communicates with the user equipment (UE):

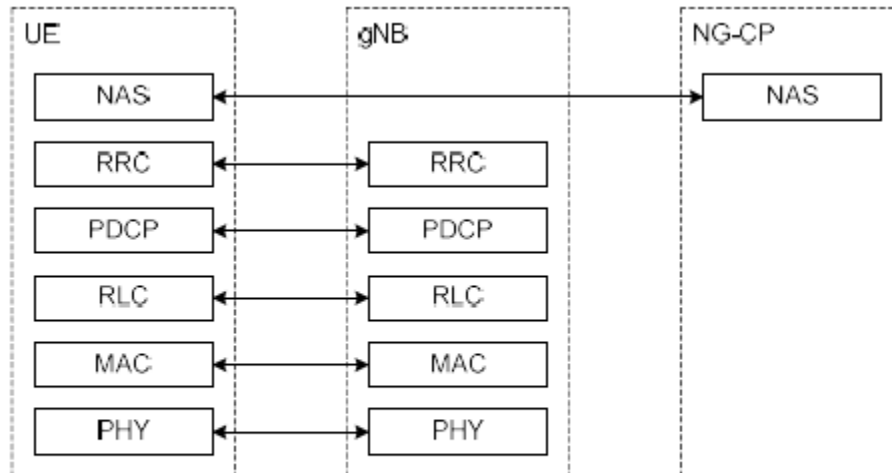


Figure 7.2.1-1: Control plane protocol stack

Ex-1003 at 13. TR 38.912 discloses that the RRC, RLC, MAC, and physical layers are “terminated in gNB on the network side;” in order to implement each of these protocols, the gNB inherently would have a processor. *See* Ex-1003 at 12-13. Based on my experience, every cellular base station contains one or more processors.

68. In my opinion, TR 38.912 discloses that a physical downlink shared channel, or PDSCH, is used to send downlink data from the gNodeB to the UE. The use of a PDSCH is referred to throughout TR 38.912. *See, e.g.,* Ex-1003 at 23, 29, 31. A POSITA would understand that in the context of 3GPP standards, the PDSCH is the main physical channel used for unicast downlink data transmission—a basic concept maintained from prior generations of 3GPP standards such as LTE, and illustrated in any basic text on 3GPP standards such as the Dahlman textbook:

The following physical-channel types are defined for LTE:

- The *physical downlink shared channel (PDSCH)* is the main physical channel used for unicast data transmission, but also for transmission of paging information.

Ex-1007 (Dahlman) at 70. As I explained above regarding the level of ordinary skill, a POSITA in this field would be familiar with the 3GPP standards body.

69. TR 38.912 further discloses: “The remaining minimum system information is transmitted in shared downlink channel via NR-PDSCH.” Ex-1003 at 31. In my opinion, this shows that the NR-PDSCH is a physical downlink shared channel carrying remaining minimum system information.

70. In my opinion, TR 38.912 discloses that demodulation reference signals are used to transmit NR-PDSCH. For example, section 8.2.1.2 describes the “Physical layer channel[s]” used, and more specifically, section 8.2.1.2.2 describes the physical layer “Data channel,” *i.e.*, the NR-PDSCH, and section 8.2.1.2.3 describes the physical layer “Control channel,” *i.e.*, the NR-PDCCH. Ex-1003 at 18. TR 38.912 explains that both of these channels use DM-RS. Ex-1003 at 17-18. For the data channel (NR-PDSCH), TR 38.912 explains that “NR supports at least functionality where for DL data scheduled for a slot, the DL data DM-RS location in time is not dynamically varying relative to the start of slot.” Ex-1003 at 17. In other words, there is a “DL data DM-RS” (downlink data demodulation reference signal) used to transmit a physical downlink shared channel. *Id.*

71. In my opinion, TR 38.912 discloses a configuration for the demodulation reference signal that is part of this data channel. For example, it discloses a “DM-RS format/structure/configuration for slot-level data channel.” Ex-

1003 at 16. Further, TR 38.912 discloses various ways that the demodulation reference signal may be configured, for example:

- “Variable/configurable DM-RS patterns for data demodulation are supported.”
- “Front-loaded DM-RS is mapped over 1 or 2 adjacent OFDM symbols.”
- “Additional DM-RS can be configured for the later part of the slot.”
- “DM-RS configuration can be up to the maximum number of DM-RS ports.”
- “the exact DM-RS location, DM-RS pattern, and scrambling sequence can be the same or different”
- “DM-RS for same or different links can be configured to be orthogonal to each other.”

Ex-1003 at 28. In my opinion, these configurations are examples of the claimed “demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.”

72. In my opinion, the processor in the gNodeB would determine this demodulation reference signal configuration. Because TR 38.912 discloses a demodulation reference signal that is on the physical downlink shared channel and therefore sent by the gNodeB, the processor in the gNodeB inherently must determine the demodulation reference signal configuration in order to transmit the demodulation reference signal. Any base station that has different configurations to transmit demodulation reference signal would inherently use a processor to determine the configuration, as a processor would be necessary to determine the

correct configuration and to send the corresponding demodulation reference signal. Further, it would be obvious to a POSITA to use a processor for this purpose, as a POSITA would know that processors are typically used in mobile communications equipment to manage configurations and to process signals. Further, given TR 38.912's disclosure that a demodulation reference signal is sent on the downlink, it would be obvious to a POSITA for the processor in the gNodeB to determine the demodulation reference signal configuration.

[11b] wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and

73. In my opinion, TR 38.912 discloses that the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof. In performing this analysis, I apply Patent Owner's construction that "the demodulation reference signal configuration comprises **at least two of**: a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, or a time domain symbol level density."

74. In my opinion, TR 38.912 discloses a first configuration and a second configuration. Section 8.2.1.6.4.2 of TR 38.912 discloses that "[v]ariable/configurable DM-RS patterns for data demodulation are supported." Ex-

1003 at 28. “At least, one configuration supports front-loaded DM-RS pattern,” and “[a]dditional DM-RS can be configured for the later part of the slot.” *Id.* Thus, at least one configuration indicates the presence of a front-loaded DM-RS, and at least a second configuration indicates the presence of additional DM-RS in the later part of the slot.

75. Section 8.2.1.6.4.2 of TR 38.912 explains that the DM-RS configuration can indicate whether “[f]ront-loaded DM-RS is mapped over 1 or 2 adjacent OFDM symbols.” *Id.* In my opinion, this is another example of a “first configuration”/“second configuration” under the claim language. Further, an indication of whether the DM-RS is mapped over 1 or 2 adjacent symbols is a “time domain density” according to the claim language. Mapping a DM-RS to only one adjacent symbol is a different time domain density than mapping a DM-RS to two adjacent symbols. TR 38.912 teaches that each symbol lasts for a duration in time. Ex-1003 at 28, 32 (referring to “symbol duration”). The number of symbols to which a DM-RS is mapped therefore affects the time domain density.

76. Section 8.2.1.6.4.2 indicates that “the exact DM-RS location, DM-RS pattern, and scrambling sequence can be the same or different” and are therefore configurable. Ex-1003 at 28. Not only are these further examples of configurations that meet the claim language (“first configuration” and/or “second configuration”), but these also meet the claimed “frequency domain density” and a “time domain

density.” The ’130 Patent explains that a “frequency domain . . . offset” is an example of the claimed “frequency domain density,” and that a “time domain . . . offset” is an example of the claimed “time domain density.” Ex-1001 at 9:67-10:11. Thus, in my opinion, TR 38.912’s disclosure that the demodulation reference signal’s location and/or pattern are configurable meets the claimed “frequency domain density” and “time domain subframe level density” elements.

77. In my opinion, the claimed “density” limitations would be inherent in any orthogonal frequency division multiplexing (OFDM) system that transmits a demodulation reference signal, such as the 5G RAN that is the subject of TR 38.912. No matter how many demodulation reference signal symbols are placed on a time/frequency grid, and no matter where such symbol(s) are placed on the grid, the result will necessarily have a density in both the frequency domain and time domain. Any configuration would therefore affect densities in the time domain and / or frequency domain.

78. Thus, in my opinion, location or pattern information meet the claimed “frequency domain density” and “time domain subframe level density” elements.

79. In my opinion, this is consistent with the claim construction of “a first configuration” and “a second configuration” discussed in the claim construction section above. That construction clarifies that under the plain and ordinary meaning of those terms, the first configuration “is different from a second configuration” and

vice versa. Because there are many different types of configurations discussed by TR 38.912, and because these different configurations are types of configurations that could be used together, the configurations can comprise “a first configuration” and “a second configuration” consistent with the claim construction.

80. In my opinion, given that TR 38.912 discloses that so many aspects are configurable, there can be little doubt that at least “a first configuration” and “a second configuration” are disclosed by TR 38.912. Further, some of the configurable aspects meet the claimed “frequency domain density” and “time domain subframe level density” as well. The claim requires only “some combination thereof,” and under Patent Owner’s own construction only two need to be shown (i.e. just “a first configuration” and “a second configuration” would be sufficient). TR 38.912 discloses—and it would be obvious to a POSITA—to have a demodulation reference signal configuration with at least two of the listed items (for example, “a first configuration” and “a second configuration”) in light of the teachings of TR 38.912.

[11c] a transmitter that transmits the demodulation reference signal based on the demodulation reference signal configuration.

81. In my opinion, TR 38.912 discloses a transmitter that transmits the demodulation reference signal based on the demodulation reference signal configuration. As discussed above for claim element [11b], TR 38.912 discloses that a demodulation reference signal configuration configures several aspects of the

demodulation reference signal. TR 38.912 discloses that the base station transmits the physical downlink shared channel. *See* Ex-1003 at 31 (referring to data “transmitted in shared downlink channel via NR-PDSCH”). TR 38.912 further discloses that the DM-RS is a “reference signal” that aids in data and control demodulation. Ex-1003 at 35. TR 38.912 explains that the DM-RS has a “location in time . . . relative to the start of slot” where “DL data [is] scheduled for a slot.” Ex-1003 at 17. As a POSITA would readily understand, this means that the DM-RS is transmitted, based on the demodulation reference signal configuration, by the base station. The UE, upon receiving the demodulation reference signal, can then use it “for data demodulation.” Ex-1003 at 28.

82. TR 38.912 explains the use of an architecture where downlink data is transmitted from a gNB to a UE.

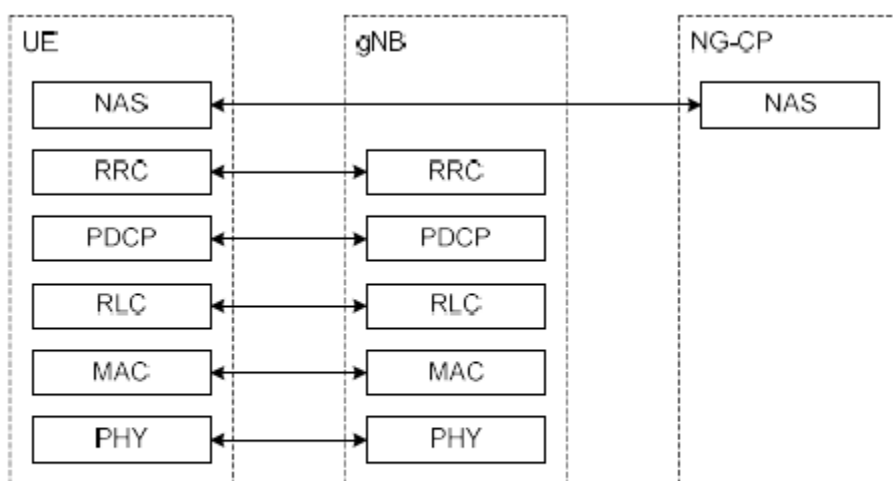


Figure 7.2.1-1: Control plane protocol stack

Ex-1003 at 13. The gNB therefore must have a transmitter to transmit data to the UE. As a POSITA would understand, the purpose of a demodulation reference signal is to transmit a reference signal along with the data “with main functionalities of data and control demodulation” so that the receiver can find and demodulate the data to be received. *See* Ex-1003 at 27. According to the disclosure in TR 38.912, therefore, the demodulation reference signal would be transmitted along with the data. Further, it is my opinion that it would be evident to a POSITA that a demodulation reference signal must be transmitted along with the data signal in order to be useful in demodulating that signal.

2. TR 38.912 Discloses Claim 12

83. Claim 12 of the ’130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel is a remaining minimum system information downlink channel.” EX-1001, Claim 12.

84. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel” is “the physical downlink shared channel carrying remaining minimum system information.”

85. TR 38.912 discloses: “The remaining minimum system information is transmitted in shared downlink channel via NR-PDSCH.” Ex-1003 at 31. Under any construction, this shows that the NR-PDSCH is a physical downlink shared

channel carrying remaining minimum system information. In my opinion, such a channel would be a remaining minimum system information downlink channel, and a POSITA would share this understanding.

3. TR 38.912 Discloses Claim 13

86. Claim 13 of the '130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel is a remaining minimum system information physical downlink shared channel.” EX-1001, Claim 13.

87. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel” is “the physical downlink shared channel carrying remaining minimum system information.”

88. TR 38.912 discloses: “The remaining minimum system information is transmitted in shared downlink channel via NR-PDSCH.” Ex-1003 at 31. Under any construction, this shows that the NR-PDSCH is a physical downlink shared channel carrying remaining minimum system information. In my opinion, such a channel would be a remaining minimum system information downlink shared channel, and a POSITA would share this understanding.

4. TR 38.912 Discloses Claim 14

89. Claim 14 of the '130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal

configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.” EX-1001, Claim 14.

90. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how TR 38.912 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

91. TR 38.912 discloses: “The remaining minimum system information is transmitted in shared downlink channel via NR-PDSCH.” Ex-1003 at 31. In my opinion, this shows that there is a physical downlink shared channel carrying remaining minimum system information. Further, as explained above for element [11b], TR 38.912 discloses a demodulation reference signal configuration for the PDSCH that comprises “a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.” For example, a variety of aspects of the DM-RS disclosed by TR 38.912, such as the number of symbols over which a DM-RS is mapped, configuration of additional DM-RS for the later

part of the slot, and the DM-RS location, pattern, scrambling sequence, or number of ports, are examples of first or second configurations disclosed by TR 38.912.

5. TR 38.912 Discloses Claim 15

92. Claim 15 of the '130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is predefined.” EX-1001, Claim 15.

93. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” As I explained above with respect to Claim 11[a], TR 38.912 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

94. In my opinion, TR 38.912 discloses predefined demodulation reference signal configurations for the DM-RS for PDSCH. For example, TR 38.912 teaches that “[a]t least, one configuration supports frontloaded DM-RS pattern,” whereas “[a]dditional DM-RS” can optionally be configured. Ex-1003 at 28. The existence of one frontloaded DM-RS pattern that does not need to be configured is an example of a predefined demodulation reference signal configuration.

95. Further, TR 38.912 teaches that “NR supports a **common DM-RS structure** for DL and UL where the exact DM-RS location, DM-RS pattern, and scrambling sequence can be **the same** or different.” Ex-1003 at 28. This teaches the use of a predefined configuration that does not need to be explicitly indicated for downlink and uplink.

96. For example, TR 38.912 teaches that for the downlink data channel (i.e., PDSCH), “NR supports at least functionality where for DL data scheduled for a slot, the DL data DM-RS location in time is not dynamically varying relative to the start of slot.” This fixed timing value is an example of a predefined configuration.

6. TR 38.912 Discloses Claim 16

97. Claim 16 of the ’130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration.” EX-1001, Claim 16.

98. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how

TR 38.912 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

99. TR 38.912 teaches the use of a control resource set and explains that it is “a set of REGs within which the UE attempts to blindly decode downlink control information.” Ex-1003 at 18.

100. In my opinion, it would have been obvious to a POSITA to consider using the control resource set configuration disclosed in TR 38.912 to indicate the claimed DMRS configuration to the mobile device. As a POSITA would understand, the very purpose of TR 38.912’s CORESET is to configure the link between the base station and the mobile device. Based on this purpose, a POSITA would immediately recognize that the DMRS configuration for the PDSCH is among the aspects of the link that needs to be configured and communicated to the mobile device before the mobile device can start receiving data transmissions on the PDSCH. Therefore, in my opinion, in light of TR 38.912, a POSITA would have looked to the control resource set configuration and considered using it to indicate a DMRS configuration.

7. TR 38.912 Discloses Claim 17

101. Claim 17 of the ’130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.” EX-1001, Claim 17.

102. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how TR 38.912 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

103. Downlink control information, or DCI, is a well-known concept in 3GPP standards that any POSITA would be familiar with. Dahlman’s 2016 overview of the physical layer in 3GPP standards such as LTE explained:

*A physical channel corresponds to the set of time–frequency resources used for transmission of a particular transport channel and each transport channel is mapped to a corresponding physical channel, as shown in Figures 4.7 and 4.8 for the downlink and uplink (the sidelink is covered in Chapter 21). In addition to the physical channels with a corresponding transport channel, there are also physical channels without a corresponding transport channel. These channels, known as L1/L2 control channels, are used for *downlink control information* (DCI), providing the device with the necessary information for proper reception and decoding of the downlink data transmission, *uplink control information* (UCI) used for providing the scheduler and the hybrid-ARQ protocol with information about the situation at the device, and *sidelink control information* (SCI) for handling sidelink transmissions.*

Ex-1007 at 70. As I explained above regarding the level of ordinary skill, a POSITA in this field would be familiar with the 3GPP standards body. As Dahlman explains, DCI “provid[es] the device with necessary information for proper reception and decoding of the downlink transmission;” a demodulation reference signal

configuration, which is information needed to decode the downlink transmission, is just the sort of information that would be communicated through DCI.

104. TR 38.912 teaches that downlink control information, or DCI, is used for a wide variety of purposes. For example, in the physical layer, “Timing between DL assignment and corresponding DL data transmission is indicated by a field in the DCI.” Ex-1003 at 29. TR 38.912 teaches that “a UE monitors for downlink control information in one or more control resource sets.” Ex-1003 at 19.

105. Based on this, a POSITA would understand that DM-RS configurations taught by TR 38.912 could be transmitted using DCI. For example, the timing of DM-RS for downlink data is determined based on the timing of the data transmission itself, and TR 38.912 teaches that the timing of that data transmission is configured via DCI. Ex-1003 at 29. Therefore, a POSITA would have found it obvious to combine these to use the DCI to convey DM-RS configuration.

106. Accordingly, TR 38.912 teaches (and renders obvious) that “the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.”

8. TR 38.912 Discloses Claim 18

107. Claim 18 is a method claim counterpart to Claim 11, an apparatus claim. It is unpatentable for the same reasons explained above for Claim 11.

[18a] A method comprising: determining a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information,

108. TR 38.912 discloses determining a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information. *See* Claim [11a] above.

[18b] wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and

109. TR 38.912 discloses that the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof. *See* Claim [11b] above.

[18c] transmitting the demodulation reference signal based on the demodulation reference signal configuration.

110. TR 38.912 discloses transmitting the demodulation reference signal based on the demodulation reference signal configuration. *See* Claim [11c] above.

9. TR 38.912 Discloses Claim 19

111. Claim 19 of the '130 Patent recites “The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.” EX-1001, Claim 19.

112. TR 38.912 discloses this limitation. *See* discussion of dependent Claim 14, which recites the same additional limitation with respect to independent Claim 11, above.

10. TR 38.912 Discloses Claim 20

113. Claim 20 of the '130 Patent recites “The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.” EX-1001, Claim 20.

114. TR 38.912 discloses this limitation. *See* discussion of dependent Claim 17, which recites the same additional limitation with respect to independent Claim 11, above.

C. Ground 2: TR 38.912, In View Of R1-1710789, Renders Obvious Claims 15-16 of the '130 Patent

115. As noted above, TR 38.912 by itself anticipates/renderers obvious many claims of the '130 patent, including Claims 15 and 16. However, to the extent that Patent Owner contends that TR 38.912 does not explicitly disclose “the remaining minimum system information channel demodulation reference signal configuration is predefined” or “the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration,” the combination of TR 38.912 and R1-1710789 renders those claim elements obvious to a POSITA. The following discussion details how the

TR 38.912/R1-1710789 combination further renders at least Claims 15 and 16 obvious to a POSITA.

1. A POSITA Would Have Been Motivated to Combine the Disclosures in TR 38.912 With The Teachings Of R1-1710789

116. Both TR 38.912 and R1-1710789 are design documents from the mid-2017 timeframe, with TR 38.912 a 3GPP technical report published in March 2017, and R1-1710789 a Tdoc published for a subsequent 3GPP meeting in June 2017. Both deal with the physical layer of the NR standard and how demodulation reference signals are configured. Although TR 38.912 provides some description of demodulation reference signals (for example, Section 8.2.1.6.4.2, Ex-1003 at 28), this description is relatively short, and in particular for the physical downlink shared (data) channel (Section 8.2.1.2.2, Ex-1003 at 17), the discussion is quite short. Thus, a POSITA would have looked to other 3GPP contributions like R1-1710789 for further details of how demodulation reference signals would be configured and how that configuration would be sent to the UE.

117. A POSITA would have looked to R1-1710789 in particular because it is specifically about configuring DMRS structure and density in a 3GPP system:

1 Introduction

In this paper, the following aspects about the DMRS for NR-PDCCH are discussed.

- DMRS structure
 - DMRS density
-

Ex-1004 at 1.

118. Although some of the discussion in R1-1710789 relates to the downlink control channel NR-PDCCH rather than the downlink data channel NR-PDSCH, TR 38.912 makes clear that there are commonalities between the demodulation reference signals for both data and control channels. For example, TR 38.912 teaches that a DM-RS is a “[r]eference signal with main functionalities of **data and control** demodulation.” Ex-1003 at 27 (emphasis added). TR 38.912 teaches that the configurable elements of the DM-RS can be the same throughout all the downlink channels (both control and data): “NR supports a **common DM-RS structure** for DL and UL where the exact DM-RS location, DM-RS pattern, and scrambling sequence can be **the same** or different.” Ex-1003 at 28 (emphasis added). TR 38.912 also teaches that DM-RS formats, structures, and configurations can be reused across different channels: “At least one of DM-RS format/structure/configuration for slot-level data channel is re-used for mini-slot-level data channel.” Ex-1003 at 16. A POSITA would fully expect configurable

parameters of DM-RS signals to be reusable across control and data channels, and uplink and downlink channels, in the NR specifications because of the common OFDM transmission format that underlies all of these channels. Based on these teachings, a POSITA would take the configuration techniques described in R1-1710789 for the DM-RS for the PDCCH and understand that they are applicable for the DM-RS for other downlink channels (e.g., NR-PDSCH) as well.

119. Both references are using similar techniques to solve similar problems. R1-1710789 acknowledges that it is building on the evolving NR standard, and that it is intended to address an “open issue in the RS structure” at the time it was submitted. Ex-1004 at 1. Accordingly, a POSITA would be motivated to combine both and have a reasonable expectation of success that R1-1710789 would be compatible with and effectively address open issues in TR 38.912.

120. The references use similar techniques to solve the same problem of configuring demodulation reference signals in an effective way. The combination would have produced *predictable results*, particularly considering that both references were designed to work within the same system. There are a limited number of ways in which configuration information can be sent in the evolving NR standard, and the combination of TR 38.912 and R1-1710789 would have been an obvious way to use demodulation reference signal configuration to improve performance of the NR communication system.

2. The TR 38.912/R1-1710789 Combination Renders Claim 15 Obvious

121. As discussed in Ground 1 above, TR 38.912 teaches each element of Claim 15, and therefore anticipates Claim 15 and renders it obvious. R1-1710789 provides additional reasons to find Claim 15 obvious. For example, even if TR 38.912 did not teach that “the remaining minimum system information channel demodulation reference signal configuration is predefined,” R1-1710789 would, in combination with TR 38.912, render Claim 15 obvious.

122. R1-1710789 provides a proposal where there is a pre-defined “[f]ront-loaded DMRS structure” that “is supported in default”:

Considering the observations in 2-symbol and 3-symbol CORESETs, we propose:

Proposal 1#: Front-loaded DMRS structure is supported in default. The network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed.

Ex-1004 at 3.

123. This proposal could easily be applied to TR 38.912 to provide a DMRS structure with predefined configurations by default. For example, Front-Loaded DMRS Configuration 1 includes an IFDM (Interleaved Frequency Division Multiplexing) based pattern, and Front-Loaded DMRS Configuration 2 includes an FD-OCC (Frequency Domain Orthogonal Cover Codes) pattern; both can have one- or two-symbol DMRS options. Ex-1005 at 1. A POSITA would be motivated to make such a combination to provide simplicity to the DMRS structure defined in TR 38.912. This would allow at least one DMRS structure to be provided all the

time, and additional DMRS could be provided only if needed. Because R1-1710789 teaches a predefined DMRS configuration, the teachings of TR 38.912 in view of R1-1710789 render obvious Claim 15 of the '130 Patent.

3. The TR 38.912/R1-1710789 Combination Renders Claim 16 Obvious

124. As discussed in Ground 1 above, TR 38.912 teaches each element of Claim 16, and therefore anticipates Claim 16 and renders it obvious. R1-1710789 provides additional reasons to find Claim 16 obvious. For example, even if TR 38.912 did not teach that “the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration,” R1-1710789 would, in combination with TR 38.912, render Claim 16 obvious.

125. R1-1710789 provides a proposal where “[t]he network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed”:

Considering the observations in 2-symbol and 3-symbol CORESETs, we propose:

Proposal 1#: Front-loaded DMRS structure is supported in default. The network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed.

Ex-1004 at 3.

126. The R1-1710789 proposal could easily be applied to TR 38.912 to use a control resource set (“CORESET”) configuration to configure additional DMRS in the downlink. TR 38.912 describes the use of both control resource sets and

demodulation reference signals. *E.g.* Ex-1003, 18, 28. A POSITA would be motivated to make such a combination to provide flexibility to the DMRS structure defined in TR 38.912 and to allow the DMRS structure to be efficiently configured on both the PDCCH and the PDSCH. For example, if the additional DMRS symbol is added in the last symbol of the PDCCH in the CORESET via the CORESET configuration, then it would be natural for a POSITA to at least consider adding a DMRS to the last symbol of the corresponding PDSCH transmission via the same CORESET configuration. This would allow additional DMRS to be provided only if needed. Because R1-1710789 teaches that the DMRS configuration can be indicated via a control resource set configuration, the teachings of TR 38.912 in view of R1-1710789 render obvious Claim 16 of the '130 Patent.

D. Ground 3: TR 38.912, In View Of R1-1710294, Renders Obvious Claims 15, 17, and 20 of the '130 Patent

127. As noted above, TR 38.912 by itself anticipates/renderers obvious many claims of the '130 patent, including Claims 15, 17, and 20. However, to the extent that Patent Owner contends that TR 38.912 does not explicitly disclose “the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information,” the combination of TR 38.912 and R1-1710294 renders that claim element obvious to a POSITA. The following discussion details how the TR 38.912/R1-1710294 combination further renders at least Claims 15, 17, and 20 obvious to a POSITA.

2. A POSITA Would Have Been Motivated to Combine the Disclosures in TR 38.912 With R1-1710294's DCI Disclosures

128. Both TR 38.912 and R1-1710294 are design documents from the mid-2017 timeframe, with TR 38.912 a 3GPP technical report published in March 2017, and R1-1710294 a Tdoc published for a subsequent 3GPP meeting in June 2017. Both deal with the physical layer of the NR standard and how configuration is sent to the UE. Although TR 38.912 provides some description of downlink control information (DCI) (for example, Ex-1003 at 17-18, 22), this description is relatively short. Thus, a POSITA would have looked to other 3GPP contributions like R1-1710294 for further details of how DCI could be used for configuration.

129. A POSITA would have looked to R1-1710294 because it summarizes technical decisions that were made as part of the same 3GPP standardization process in the May 2017 Hangzhou meeting (RAN1#89) subsequent to the March 2017 publication of TR 38.912. *See* Ex-1005 at 1 (“Working assumption” box).

130. Furthermore, a POSITA would have looked to R1-1710294 because it provides specific options and details to build upon the disclosure of DMRS in TR 38.912:

- Option 1: Additional DMRS is always on and the number of additional DMRS is fixed as maximum number for high speed UEs.

- Option 2: Presence of and the number of additional DMRS are configured by gNB.

Option 1 ensures channel estimation performance for all UEs in the coverage of gNB regardless of UE speed and SINR at the cost of large DMRS overhead. On the other hands, option 2 can configure the number of additional DMRS, so that it can prevent unnecessary transmission of additional DMRS if specific scenarios such as indoor cell guarantees DMRS performance without additional DMRS or with low density DMRS. In this case, the presence and the number of additional DMRS can be configured through MIB in PBCH or DCI that is CRC masked by SI RNTI or P (paging) RNTI. In order to reduce control overhead, it does not need to support all possible DMRS configuration designed for unicast PDSCH. Taking into account the robust DMRS performance for broadcast PDSCH and no signaling overhead using PBCH or common DCI, we slightly more prefer Option 1.

Ex-1005 at 7.

131. Both references use similar techniques to solve similar problems. R1-1710294 acknowledges that it is building on the evolving NR standard and provides proposals to extend that standard. Ex-1006 at 1. Accordingly, a POSITA would be motivated to combine both and have a reasonable expectation of success that R1-1710294 would be compatible with and effectively improve the performance of the system disclosed in TR 38.912.

132. The references use similar techniques to solve the same problem of configuring demodulation reference signals in an effective way. The combination would have produced *predictable results*, particularly considering that both references were designed to work within the same system. There are a limited number of ways in which configuration information can be sent in the evolving NR standard, and the combination of TR 38.912 and R1-1710294 would have been an

obvious way to use demodulation reference signal configuration through downlink control information.

3. The TR 38.912/R1-1710294 Combination Renders Claim 15 Obvious

133. As discussed in Ground 1 above, TR 38.912 teaches each element of Claim 15, and therefore anticipates Claim 15 and renders it obvious. R1-1710294 provides additional reasons to find Claim 15 obvious. For example, even if TR 38.912 did not teach that “the remaining minimum system information channel demodulation reference signal configuration is predefined,” R1-1710294 would, in combination with TR 38.912, render Claim 15 obvious.

134. R1-1710294 summarizes agreements from the RAN1#89 meeting in May 2017. This provides an array of pre-defined DMRS configurations, such as various versions of “Front-load DMRS Configuration 1” and “Front-load DMRS Configuration 2.”

In the previous RAN1 #89 meeting, we discussed front-load DMRS design for NR and two DMRS configurations for UL/DL CP-OFDM were defined in working assumption as follows [1]:

Working assumption:

- UEs in a cell are higher layer configured with 2 DMRS configurations for the front-load DMRS for UL/DL CP-OFDM
 - Front-load DMRS Configuration 1: Supports up to 8 ports
 - IFDM based pattern with Comb [2] and/or [4] w cyclic shifts (CS)
 - One OFDM symbol:
 - To be down selected to 1 Alt:
 - Alt 1: Comb 2 + 2 CS, up to 4 ports
 - Alt 2: Comb 4 + 2 CS, up to 8 ports
 - Two OFDM symbols:
 - To be down selected to 2 Alts:
 - Alt. 1: Comb 2 + 2 CS + TD-OCC ($\{1\ 1\}$ and $\{1\ -1\}$), up to 8 ports
 - Alt. 2: Comb 2 + 4 CS + TD-OCC ($\{1\ 1\}$), up to 8 ports
 - Alt. 3: Comb 4 + 2 CS + TD-OCC ($\{1\ 1\}$), up to 8 ports
 - Front-load DMRS Configuration 2: Supports up to 12 ports
 - FD-OCC pattern with adjacent REs in the frequency domain
 - One OFDM symbol:
 - To be down selected to 1 Alt:
 - Alt. 1: 2-FD-OCC across adjacent REs in the frequency domain up to 6 ports
 - Alt. 2: 2-FD-OCC across adjacent REs in the frequency domain up to 4 ports
 - Alt. 3: 2-FD-OCC across adjacent REs in the frequency domain up to 2 ports
 - Two OFDM symbols:
 - 2-FD-OCC across adjacent REs in the frequency domain + TDM up to 12 ports
 - 2-FD-OCC across adjacent REs in the frequency domain + TD-OCC (both $\{1,1\}$ and $\{1,-1\}$) up to 12 ports
 - FFS: DMRS pattern before configuration, e.g., SIB1

Ex-1005 at 1.

135. This proposal could easily be applied to TR 38.912 to provide a predefined DMRS structure by default. A POSITA would be motivated to make such a combination to provide simplicity to the DMRS structure defined in TR 38.912. This would allow the use of predefined DMRS structures and reduce the amount of configuration information that would need to be transmitted. Because R1-1710294 teaches a predefined DMRS configuration, the teachings of TR 38.912 in view of R1-1710294 render obvious Claim 15 of the '130 Patent.

4. The TR 38.912/R1-1710294 Combination Renders Claim 17 Obvious

136. As discussed in Ground 1 above, TR 38.912 teaches each element of Claim 17, and therefore anticipates Claim 17 and renders it obvious. R1-1710294 provides additional reasons to find Claim 17 obvious. For example, even if TR 38.912 did not teach that “the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information,” R1-1710294 would, in combination with TR 38.912, render Claim 17 obvious.

137. R1-1710294 summarizes a proposal where “presence of and the number of additional DMRS are configured by gNB,” and that it can be configured through “DCI,” or downlink control information:

- Option 1: Additional DMRS is always on and the number of additional DMRS is fixed as maximum number for high speed UEs.

- Option 2: Presence of and the number of additional DMRS are configured by gNB.

Option 1 ensures channel estimation performance for all UEs in the coverage of gNB regardless of UE speed and SINR at the cost of large DMRS overhead. On the other hands, option 2 can configure the number of additional DMRS, so that it can prevent unnecessary transmission of additional DMRS if specific scenarios such as indoor cell guarantees DMRS performance without additional DMRS or with low density DMRS. In this case, the presence and the number of additional DMRS can be configured through MIB in PBCH or DCI that is CRC masked by SI RNTI or P (paging) RNTI. In order to reduce control overhead, it does not need to support all possible DMRS configuration designed for unicast PDSCH. Taking into account the robust DMRS performance for broadcast PDSCH and no signaling overhead using PBCH or common DCI, we slightly more prefer Option 1.

Ex-1005 at 7.

138. This proposal could easily be applied to TR 38.912 to use downlink control information to configure DMRS. As discussed in Ground 1 above,

TR 38.912 teaches a variety of aspects of DMRS that need to be configured. *E.g.* Ex-1003 at 28. TR 38.912 further teaches that downlink control information, or DCI, is used for a wide variety of purposes. For example, in the physical layer, “Timing between DL assignment and corresponding DL data transmission is indicated by a field in the DCI.” Ex-1003 at 29. TR 38.912 teaches that “a UE monitors for downlink control information in one or more control resource sets.” Ex-1003 at 19.

139. A POSITA would be motivated to combine these teachings with R1-1710294’s indication that DCI is used to configure demodulation reference signals. At minimum, the DCI conveys the resource allocation for the PDSCH transmission, and therefore indicates the range of time-frequency resource elements in which the DMRS and data symbols are placed. This would allow simple configuration of DMRS using a “common” DCI format. Ex-1005 at 7. Because the combination teaches that configuration for an RMSI channel such as PDSCH can be indicated via downlink control information, TR 38.912 in view of the teachings of R1-1710294 renders obvious Claim 17 of the ’130 Patent.

5. The TR 38.912/R1-1710294 Combination Renders Claim 20 Obvious

140. Claim 20 of the ’130 Patent recites “The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.” EX-1001, Claim 20.

141. As explained above for Ground 1, TR 38.912 anticipates and renders obvious Claim 18 for the same reasons it anticipates and renders obvious Claim 11. Claim 20 adds the same additional limitation to claim 18 that claim 17 adds to claim 11.

142. The combination of TR 38.912 and R1-1710294 renders obvious this limitation. *See* discussion of dependent Claim 17, which recites the same additional limitation with respect to independent Claim 11, above.

E. Ground 4: R1-1710294 Anticipates And/Or Renders Obvious Claims 11-20 of the '130 Patent

1. R1-1710294 Discloses Claim 11

[11a] An apparatus comprising: a processor that determines a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information;

143. R1-1710294 discloses a processor that determines a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

144. R1-1710294 discloses a processor. For example, R1-1710294 teaches that a “gNB” (gNodeB) is capable of determining and configuring the presence of and number of additional DMRS. Such a determination would inherently be performed by a processor, and a POSITA would find it obvious to use a processor to perform this type of configuration.

- Option 2: Presence of and the number of additional DMRS are configured by gNB.

Ex-1005 at 7.

145. Similarly, sending a DMRS by the gNB would require the gNB to have a processor.

146. R1-1710294 discloses that a physical downlink shared channel, or PDSCH, is used to send downlink data from the gNodeB to the UE, as shown in the following excerpts:

For the case of broadcast PDSCH transmission, e.g. SIB and paging, only single port is used. So, one OFDM symbol is sufficient for front-load DMRS in this case. And considering robustness to frequency selectivity, Alt. 1 of one OFDM symbol in front-load DMRS Configuration 1 should be preferred because of its high RS density in frequency domain.

Ex-1005 at 7.

Option 1 ensures channel estimation performance for all UEs in the coverage of gNB regardless of UE speed and SINR at the cost of large DMRS overhead. On the other hands, option 2 can configure the number of additional DMRS, so that it can prevent unnecessary transmission of additional DMRS if specific scenarios such as indoor cell guarantees DMRS performance without additional DMRS or with low density DMRS. In this case, the presence and the number of additional DMRS can be configured through MIB in PBCH or DCI that is CRC masked by SI RNTI or P (paging) RNTI. In order to reduce control overhead, it does not need to support all possible DMRS configuration designed for unicast PDSCH. Taking into account the robust DMRS performance for broadcast PDSCH and no signaling overhead using PBCH or common DCI, we slightly more prefer Option 1.

Ex-1005 at 7.

147. R1-1710294 further discloses that the PDSCH carries remaining minimum system information. In the context of the '130 Patent, remaining minimum system information, or RMSI, is explained as follows: "In some embodiments, system information may be divided into several parts: master information block ('MIB'), RMSI, and other system information ('OSI'). In some

embodiments, MIB may be carried in PBCH together with an SS block in a beam sweeping manner. In certain embodiments, RMSI may be carried by PDCCH+PDSCH.” Ex-1001 at 9:53-58.

148. R1-1710294 teaches that some system information is “configured through MIB in PBCH.” Ex-1005 at 7. R1-1710294 teaches that other system information is communicated through “broadcast PDSCH transmission, e.g. SIB and paging.” *Id.* This use of a system information block (SIB) in PDSCH to carry remaining information beyond what was in the MIB constitutes “remaining minimum system information” as the term is described in the ’130 specification. Further, as a POSITA would understand, both MIB and SIB are required in the 3GPP 4G LTE standards for initial access, so the “minimum” system information includes the system information in SIB. Thus, SIB would be understood to be “remaining minimum system information” beyond the system information in MIB.

149. R1-1710294 discloses that demodulation reference signals (“DMRS”) are used to transmit PDSCH, and that their configuration is configured by a gNodeB:

- Option 2: Presence of and the number of additional DMRS are configured by gNB.

Option 1 ensures channel estimation performance for all UEs in the coverage of gNB regardless of UE speed and SINR at the cost of large DMRS overhead. On the other hands, option 2 can configure the number of additional DMRS, so that it can prevent unnecessary transmission of additional DMRS if specific scenarios such as indoor cell guarantees DMRS performance without additional DMRS or with low density DMRS. In this case, the presence and the number of additional DMRS can be configured through MIB in PBCH or DCI that is CRC masked by SI RNTI or P (paging) RNTI. In order to reduce control overhead, it does not need to support all possible DMRS configuration designed for unicast PDSCH. Taking into account the robust DMRS performance for broadcast PDSCH and no signaling overhead using PBCH or common DCI, we slightly more prefer Option 1.

Ex-1005 at 7.

150. Finally, the processor in the gNodeB determines this demodulation reference signal configuration. Because R1-1710294 discloses a demodulation reference signal that is on the physical downlink shared channel and therefore sent by the gNodeB, the processor in the gNodeB inherently must determine the demodulation reference signal configuration in order to transmit the demodulation reference signal, and it would be obvious to a POSITA to use a processor for this purpose. Further, given R1-1710294's disclosure that a demodulation reference signal is sent on the PDSCH downlink channel, it would be obvious to a POSITA for the processor in the gNodeB to determine the demodulation reference signal configuration.

[11b] wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and

151. R1-1710294 discloses that the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof. For this declaration, I apply Patent Owner's construction that "the demodulation reference signal configuration comprises **at least two of**: a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, or a time domain symbol level density."

152. For example, R1-1710294 discloses at least a first configuration and a second configuration. R1-1710294 discloses that the “[p]resence of and the number of additional DMRS are configured by gNB” and that “[...] option 2 can configure the number of additional DMRS [...]”. Ex-1005 at 7. This means that the DMRS configuration comprises at least:

- (i) a configuration with a front-loaded DMRS (in a first symbol) without any additional DMRS (i.e., additional DMRS not present) Ex-1005 at 6. This anticipates a first configuration;
- (ii) a further configuration with a first number of additional DMRS. This anticipates a second configuration; and
- (iii) yet a further configuration with a second number of additional DMRS. Ex-1005 at 7.

153. These alone constitute a “first configuration” and “second configuration.” Further, R1-1710294 teaches additional configurations summarized next that would meet the “first configuration”/“second configuration” language as well as other elements listed in the “configuration comprises . . .” claim language.

154. This is consistent with the claim construction of “a first configuration” and “a second configuration” discussed in section V above. That construction clarifies that under the plain and ordinary meaning of those terms, the first

configuration “is different from a second configuration” and vice versa. *See supra* section V.

155. R1-1710294 teaches a “mapping order.” For the DMRS broadcast PDSCH front-load DMRS configuration, R1-1710294 discloses that “Alt. 1 of one OFDM symbol in front-load DMRS Configuration 1 should be preferred” Ex-1005 at 7. This alternative called “Alt. 1” is defined in the box on page 1—“Alt 1: Comb 2 + 2 CS, up to 4 ports”—and it refers to a specific way of arranging and mapping the DMRS. Ex-1005 at 1. This necessarily implies a mapping order because it specifies how the DMRS signals are distributed across the subcarriers and antenna ports (“Comb 2” indicates the use of a comb-based pattern where the reference signals are on every other subcarrier; and “2 CS” means that two cyclic shifts are used to create orthogonal reference signals).

156. R1-1710294 teaches a frequency domain density: See Ex-1005 at 7 (“its high RS density in frequency domain”).

157. R1-1710294 teaches a time domain subframe level density. Using a front-load DMRS configuration (Ex-1005 at 6) means a specific location (front-load, i.e. in front of the slot – Ex-1005 at 5) and also defines a number of DMRS per subframe (Ex-1005 at 7: “one OFDM symbol”). See also Ex-1005 at 5, section “Issues on additional DMRS”, first sentence: “When slot contains 14 OFDM symbol [...]”.

158. Given that R1-1710294 discloses that so many aspects are configurable, there can be little doubt that at least “a first configuration” and “a second configuration” are disclosed by R1-1710294 and also rendered obvious. Further, some of the configurable aspects meet other claim elements as well. The claim requires only “some combination thereof,” and under Patent Owner’s own construction only two need to be shown (e.g., just “a first configuration” and “a second configuration” would be sufficient). It is disclosed by R1-1710294—and would be obvious to a POSITA—to have a demodulation reference signal configuration with at least two of the listed items (for example, “a first configuration” and “a second configuration”) in light of the teachings of R1-1710294.

[11c] a transmitter that transmits the demodulation reference signal based on the demodulation reference signal configuration.

159. R1-1710294 discloses a transmitter that transmits the demodulation reference signal based on the demodulation reference signal configuration. As discussed above for Claim [11b], R1-1710294 discloses that a demodulation reference signal configuration configures several aspects of the demodulation reference signal. The gNB inherently must have a transmitter to transmit the DMRS to the UE. For example, R1-1710294 explains that in a certain configuration, “that front-loaded DMRS is transmitted using 2 OFDM symbols.” Ex-1005 at 6. As a further example, R1-1710294 explains that “Alt. 1 of one OFDM symbol in front-

load DMRS Configuration 1 is used for the broadcast PDSCH transmission.” Ex-1005 at 7. To transmit these demodulation reference signals, the base station must have a transmitter that transmits them based on the DMRS configuration.

2. R1-1710294 Discloses Claim 12

160. Claim 12 of the ’130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel is a remaining minimum system information downlink channel.” Ex-1001, Claim 12.

161. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel” is “the physical downlink shared channel carrying remaining minimum system information.”

162. As explained in my analysis of R1-1710294 with respect to Claim [11a] above, the PDSCH is a physical downlink shared channel carrying remaining minimum system information. It therefore meets the claim requirement to be “a remaining minimum system information downlink channel.”

3. R1-1710294 Discloses Claim 13

163. Claim 13 of the ’130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel is a remaining minimum system information physical downlink shared channel.” Ex-1001, Claim 13.

164. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel” is “the physical downlink shared channel carrying remaining minimum system information.”

165. As explained in my analysis of R1-1710294 with respect to Claim [11a] above, the PDSCH is a physical downlink shared channel carrying remaining minimum system information. It therefore meets the claim requirement to be “a remaining minimum system information physical downlink shared channel.”

4. R1-1710294 Discloses Claim 14

166. Claim 14 of the '130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.” EX-1001, Claim 14.

167. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how

R1-1710294 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

168. As explained above for element [11b], R1-1710294 discloses a demodulation reference signal configuration for PDSCH that comprises “a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.” For example, a variety of aspects of the DM-RS configuration disclosed by R1-1710294, are examples of first or second configurations (or other claim elements) recited by Claim 14.

5. R1-1710294 Discloses Claim 15

169. Claim 15 of the '130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is predefined.” EX-1001, Claim 15.

170. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how R1-1710294 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

171. R1-1710294 discloses predefined demodulation reference signal configurations for the DM-RS for PDSCH. For example, on the first page R1-1710294 summarizes agreements from the RAN1#89 meeting in May 2017. This summary provides an array of pre-defined DMRS configurations, such as various versions of “Front-load DMRS Configuration 1” and “Front-load DMRS Configuration 2.”

In the previous RAN1 #89 meeting, we discussed front-load DMRS design for NR and two DMRS configurations for UL/DL CP-OFDM were defined in working assumption as follows [1]:

- Working assumption:**
- UEs in a cell are higher layer configured with 2 DMRS configurations for the front-load DMRS for UL/DL CP-OFDM
 - Front-load DMRS Configuration 1: Supports up to 8 ports
 - IFDM based pattern with Comb [2] and/or [4] w cyclic shifts (CS)
 - One OFDM symbol:
 - To be down selected to 1 Alt:
 - Alt 1: Comb 2 + 2 CS, up to 4 ports
 - Alt 2: Comb 4 + 2 CS, up to 8 ports
 - Two OFDM symbols:
 - To be down selected to 2 Alts:
 - Alt. 1: Comb 2 + 2 CS + TD-OCC ($\{1\ 1\}$ and $\{1\ -1\}$), up to 8 ports
 - Alt. 2: Comb 2 + 4 CS + TD-OCC ($\{1\ 1\}$), up to 8 ports
 - Alt. 3: Comb 4 + 2 CS + TD-OCC ($\{1\ 1\}$), up to 8 ports
 - Front-load DMRS Configuration 2: Supports up to 12 ports
 - FD-OCC pattern with adjacent REs in the frequency domain
 - One OFDM symbol:
 - To be down selected to 1 Alt:
 - Alt. 1: 2-FD-OCC across adjacent REs in the frequency domain up to 6 ports
 - Alt. 2: 2-FD-OCC across adjacent REs in the frequency domain up to 4 ports
 - Alt. 3: 2-FD-OCC across adjacent REs in the frequency domain up to 2 ports
 - Two OFDM symbols:
 - 2-FD-OCC across adjacent REs in the frequency domain + TDM up to 12 ports
 - 2-FD-OCC across adjacent REs in the frequency domain + TD-OCC (both $\{1,1\}$ and $\{1,-1\}$) up to 12 ports
 - FFS: DMRS pattern before configuration, e.g., SIB1

Ex-1005 at 1.

172. In addition, R1-1710294 teaches an “Option 1” where “Additional DMRS is always on and the number of additional DMRS is fixed as maximum number for high speed UEs.” Ex-1005 at 7. This option is an example of a predefined DMRS configuration.

6. R1-1710294 Discloses Claim 16

173. Claim 16 of the ’130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration.” EX-1001, Claim 16.

174. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how R1-1710294 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

175. R1-1710294 teaches that the DMRS configuration can be configured in various ways: “the presence and the number of additional DMRS can be configured through MIB in PBCH or DCI that is CRC masked by SI RNTI or P (paging) RNTI.” Ex-1005 at 7.

176. The '130 Patent specification explains that “the remote unit 102 may get information about the RMSI PDSCH DMRS configuration implicitly by RMSI control resource set (‘CORESET’) configuration in MIB” and “[i]n such configurations, MIB may be carried by PBCH.” Ex-1001, 10:46-50. Thus, at least according to how the term is used in the specification, the configuration through MIB in PBCH disclosed by R1-1710294 would include a control resource set configuration. R1-1710294 renders obvious the use of a control resource set configuration for this purpose because it discloses putting the DMRS configuration in the MIB, and there are only a limited number of portions of the MIB where the DMRS configuration could go. *See* Ex-1005 at 7. It would therefore have been obvious to a POSITA to consider using the control resource set configuration portion of the MIB disclosed in R1-1710294 to indicate the DMRS configuration to the mobile device.

7. R1-1710294 Discloses Claim 17

177. Claim 17 of the '130 Patent recites “The apparatus of claim 11, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.” EX-1001, Claim 17.

178. As discussed in the claim construction section above, the claim construction I apply for “the remaining minimum system information channel demodulation reference signal configuration” is “the demodulation reference signal

configuration for the physical downlink shared channel carrying remaining minimum system information.” The discussion of Claim 11[a] above explains how R1-1710294 teaches a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information.

179. R1-1710294 teaches that the DMRS configuration can be indicated by downlink control information, or DCI: “the presence and the number of additional DMRS can be configured through MIB in PBCH or DCI that is CRC masked by SI RNTI or P (paging) RNTI.” Ex-1005 at 7. This satisfies (and renders obvious) the additional requirement of Claim 17.

8. R1-1710294 Discloses Claim 18

180. Claim 18 is a method claim counterpart to Claim 11, an apparatus claim. It is unpatentable for the same reasons explained above for Claim 11.

[18a] A method comprising: determining a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information,

181. R1-1710294 discloses determining a demodulation reference signal configuration for a physical downlink shared channel carrying remaining minimum system information. See my analysis of R1-1710294 with respect to Claim [11a] above.

[18b] wherein the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof; and

182. R1-1710294 discloses that the demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof. *See* my analysis of R1-1710294 with respect to Claim [11b] above.

[18c] transmitting the demodulation reference signal based on the demodulation reference signal configuration.

183. R1-1710294 discloses transmitting the demodulation reference signal based on the demodulation reference signal configuration. *See* my analysis of R1-1710294 with respect to Claim [11c] above.

9. R1-1710294 Discloses Claim 19

184. Claim 19 of the '130 Patent recites “The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration comprises a first configuration, a second configuration, a mapping order, a frequency domain density, a time domain subframe level density, a time domain symbol level density, or some combination thereof.” EX-1001, Claim 19.

185. R1-1710294 discloses this limitation. *See* discussion of R1-1710294 with respect to dependent Claim 14, which recites the same additional limitation with respect to independent Claim 11, above.

10. R1-1710294 Discloses Claim 20

186. Claim 20 of the '130 Patent recites “The method of claim 18, wherein the remaining minimum system information channel demodulation reference signal configuration is indicated by downlink control information.” EX-1001, Claim 20.

187. R1-1710294 discloses this limitation. *See* discussion of R1-1710294 with respect to dependent Claim 17, which recites the same additional limitation with respect to independent Claim 11, above.

F. Ground 5: R1-1710294, In View Of R1-1710789, Renders Obvious Claims 15-16 of the '130 Patent

188. As noted above, R1-1710294 by itself anticipates/renders obvious many claims of the '130 patent, including Claims 15 and 16. However, to the extent that Patent Owner contends that R1-1710294 does not explicitly disclose “the remaining minimum system information channel demodulation reference signal configuration is predefined” or “the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration,” the combination of R1-1710294 and R1-1710789 renders that claim element obvious to a POSITA. The following discussion details how the R1-1710294/R1-1710789 combination further renders at least Claims 15 and 16 obvious to a POSITA.

1. A POSITA Would Have Been Motivated to Combine the Disclosures in R1-1710294 With The Teachings Of R1-1710789

189. Both R1-1710294 and R1-1710789 are 3GPP Tdocs submitted in June 2017 for the same 3GPP meeting. Both deal with the physical layer of the NR standard and how demodulation reference signals are configured. While R1-1710294 provides some description of demodulation reference signals, there is relatively little discussion about how the configurations of those demodulation reference signals are determined and communicated. Thus, a POSITA would have looked to other contemporaneous 3GPP contributions like R1-1710789 for further details of how demodulation reference signals would be configured and how that configuration would be sent to the UE.

190. A POSITA would have looked to R1-1710789 because it is specifically about configuring DMRS structure and density in a 3GPP system:

Source: MediaTek Inc.
Title: RS structures for NR-PDCCH
Document for: Discussion

1 Introduction

In this paper, the following aspects about the DMRS for NR-PDCCH are discussed.

- DMRS structure
 - DMRS density
-

Ex-1004 at 1.

191. Although some of the discussion in R1-1710789 relates to the control channel NR-PDCCH rather than the data channel NR-PDSCH, R1-1710294 indicates that it defines “DMRS configurations for the front-load DMRS for UL/DL CP-OFDM” as a whole, and does not suggest that its DMRS system is any less relevant to the PDSCH.

192. Based on these teachings, a POSITA would take the configuration techniques described in R1-1710789 for the DM-RS for the PDCCH and understand that they are applicable for the DM-RS for other downlink channels (PDSCH) as well.

193. Both references are using similar techniques to solve similar problems. R1-1710789 acknowledges that it is building on the evolving NR standard, and that it is intended to address an “open issue in the RS structure” at the time it was submitted. Ex-1004 at 1. Accordingly, a POSITA would be motivated to combine both and have a reasonable expectation of success that R1-1710789 would be compatible with the contemporaneous contributions of R1-1710294.

194. The references use similar techniques to solve the same problem of configuring demodulation reference signals in an effective way. The combination would have produced *predictable results*, particularly considering that both references were designed to work within the same system. There are a limited number of ways in which configuration information can be sent in the evolving NR

standard, and the combination of R1-1710294 and R1-1710789 would have been an obvious way to use demodulation reference signal configuration to improve performance of the 5G communication system.

2. The R1-1710294/R1-1710789 Combination Renders Claim 15 Obvious

195. As discussed in Ground 4 above, R1-1710294 teaches each element of Claim 15, and therefore anticipates Claim 15 and renders it obvious. R1-1710789 provides additional reasons to find Claim 15 obvious. For example, even if R1-1710294 did not teach that “the remaining minimum system information channel demodulation reference signal configuration is predefined,” R1-1710789 would, in combination with R1-1710294, render Claim 15 obvious.

196. R1-1710789 provides a proposal where there is a pre-defined “[f]ront-loaded DMRS structure” that “is supported in default”:

Considering the observations in 2-symbol and 3-symbol CORESETs, we propose:

Proposal 1#: Front-loaded DMRS structure is supported in default. The network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed.

Ex-1004 at 3.

197. This proposal could easily be applied to R1-1710294 to provide a predefined DMRS structure by default. A POSITA would be motivated to make such a combination to provide simplicity to the DMRS structure defined in R1-1710294. This would allow at least one DMRS structure to be provided all the time, and additional DMRS could be provided only if needed. Because R1-1710789

teaches a predefined DMRS configuration, the teachings of R1-1710294 in view of R1-1710789 render obvious Claim 15 of the '130 Patent.

3. The R1-1710294/R1-1710789 Combination Renders Claim 16 Obvious

198. As discussed in Ground 4 above, R1-1710294 teaches each element of Claim 16, and therefore anticipates Claim 16 and renders it obvious. R1-1710789 provides additional reasons to find Claim 16 obvious. For example, even if R1-1710294 did not teach that “the remaining minimum system information channel demodulation reference signal configuration is indicated by a control resource set configuration,” R1-1710789 would, in combination with R1-1710294, render Claim 16 obvious.

199. R1-1710789 provides a proposal where “[t]he network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed”:

Considering the observations in 2-symbol and 3-symbol CORESETs, we propose:

Proposal 1#: Front-loaded DMRS structure is supported in default. The network can indicate additional DMRS on the last symbol of the CORESET via the CORESET configuration if needed.

Ex-1004 at 3.

200. This proposal could easily be applied to R1-1710294 to use a control resource set (“CORESET”) configuration to configure additional DMRS in the downlink. A POSITA would be motivated to make such a combination to provide flexibility to the DMRS structure defined in R1-1710294 and to allow the DMRS

structure to be efficiently configured on both the PDCCH and the PDSCH. For example, if the additional DMRS symbol is added in the last symbol of the CORESET via the CORESET configuration, then it would be natural for a POSITA to at least consider adding a DMRS to the last symbol of the corresponding PDSCH transmission via the same CORESET configuration. Such an approach would reduce downlink signaling. This would allow additional DMRS to be provided only if needed. Because R1-1710789 teaches that the DMRS configuration can be indicated via a control resource set configuration, the teachings of R1-1710294 in view of R1-1710789 render obvious Claim 16 of the '130 Patent.

XI. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

201. I have reviewed the alleged secondary considerations of non-obviousness argued by Patent Owner in related proceedings². In my opinion, Patent Owner has failed to connect any alleged secondary considerations to the Challenged Claims of the '130 Patent, and the secondary considerations previously argued by Patent Owner do not affect my conclusion that the Challenged Claims are obvious. To the extent Patent Owner or its experts attempt to argue that secondary considerations of non-obviousness are present here, I reserve the right to respond.

² For example, International Trade Commission (ITC) Investigation No. 337-TA-1388.

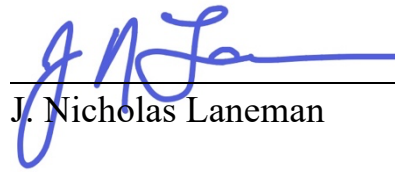
XII. CONCLUSION

202. In my opinion, the Challenged Claims are unpatentable in light of the prior art combinations described herein.

203. I hereby declare under the laws of the United States of America that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this proceeding.

Respectfully submitted,

Dated: November 11, 2024



J. Nicholas Laneman

Location: Granger, IN