



(51) International Patent Classification:  
H04L 5/00 (2006.01)

(21) International Application Number:  
PCT/US2022/023344

(22) International Filing Date:  
04 April 2022 (04.04.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
63/171,009 05 April 2021 (05.04.2021) US

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(81) Designated States (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,  
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,  
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,  
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,

HR, HU, ID, IL, IN, IR, IS, IT, JM, JO, JP, KE, KG, KH,  
KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA,  
MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,  
NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU,  
RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM,  
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM,  
ZW.

(84) Designated States (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,  
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,  
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,  
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,  
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,  
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

**Published:**  
— with international search report (Art. 21(3))  
— before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments (Rule 48.2(h))  
— upon request of the applicant, before the expiration of the  
time limit referred to in Article 21(2)(a)

(88) Date of publication of the international search report:  
15 September 2022 (15.09.2022)

(54) Title: METHOD OF REFERENCE SIGNAL DESIGN FOR NR-U BEYOND 52.6GHZ

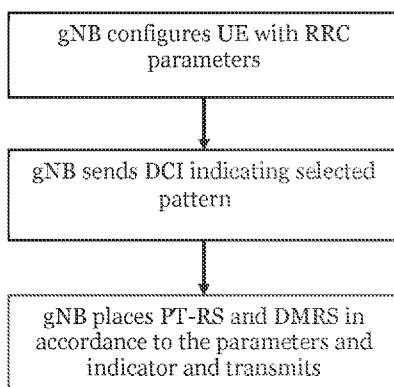


FIG. 18

(57) Abstract: A method of wireless communication includes a next generation Node B (gNB) configuring a user equipment (UE) with radio resource control (RRC) parameters, selecting a pattern of signal allocation and distribution symmetric in time, frequency, and space, the pattern indicating orthogonal frequency division multiplexing (OFDM) symbol tones and subcarrier of a reference signal (RS), transmitting, to the UE, downlink control information (DCI) indicating the selected pattern, and transmitting at least one or more phase tracking reference signal (PT-RS) and demodulation reference signal (DMRS) in accordance with the RRC parameters and selected pattern.



# INTERNATIONAL SEARCH REPORT

International application No  
**PCT/US2022/023344**

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> <b>INV. H04L5/00</b> <b>ADD.</b>				
According to International Patent Classification (IPC) or to both national classification and IPC				
<b>B. FIELDS SEARCHED</b>				
Minimum documentation searched (classification system followed by classification symbols) <b>H04L</b>				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) <b>EPO-Internal, COMPENDEX, INSPEC, WPI Data</b>				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
<b>X</b>	<p><b>NATIONAL INSTRUMENTS: "Discussion on explicit and implicit signaling for PT-RS", 3GPP DRAFT; R1-1708272 DISCUSSION ON EXPLICIT AND IMPLICIT SIGNALING FOR PT-RS_FINAL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANT</b></p> <p><b>, vol. RAN WG1, no. Hangzhou; 20170515 - 20170519 5 May 2017 (2017-05-05), XP051261400, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_89/Docs/[retrieved on 2017-05-05] sections 2.1, 3.1, 3.2, 3.2.3 and 3.2.4; table 2</b></p> <p style="text-align: right;">-/--</p>	<b>1-11, 19-29</b>		
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.                 </td> <td style="width: 50%; border: none;"> <input checked="" type="checkbox"/> See patent family annex.                 </td> </tr> </table>			<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.			
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">                 * Special categories of cited documents :                   "A" document defining the general state of the art which is not considered to be of particular relevance                  "E" earlier application or patent but published on or after the international filing date                  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)                  "O" document referring to an oral disclosure, use, exhibition or other means                  "P" document published prior to the international filing date but later than the priority date claimed             </td> <td style="width: 50%; border: none;">                 "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                   "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art                   "&amp;" document member of the same patent family             </td> </tr> </table>			* Special categories of cited documents :  "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  "&" document member of the same patent family
* Special categories of cited documents :  "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  "&" document member of the same patent family			
Date of the actual completion of the international search  <p style="text-align: center;"><b>10 June 2022</b></p>		Date of mailing of the international search report  <p style="text-align: center;"><b>18/08/2022</b></p>		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer  <p style="text-align: center;"><b>May, David</b></p>		

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2022/023344

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p style="text-align: center;">-----</p> <p>US 2020/295979 A1 (SAITO KEISUKE [JP] ET AL) 17 September 2020 (2020-09-17)</p> <p>paragraphs [0104], [0157]; figures 5A,12</p>	2, 3, 7, 8, 20, 21, 25, 26
A	<p style="text-align: center;">-----</p> <p>US 2019/149295 A1 (WANG ZHAO [SE] ET AL) 16 May 2019 (2019-05-16)</p> <p>paragraph [0079]; figures 14,17</p>	3, 8, 21, 26
A	<p style="text-align: center;">-----</p> <p>US 2019/305908 A1 (LEE KILBOM [KR] ET AL) 3 October 2019 (2019-10-03)</p> <p>paragraph [0208]; figure 18; table 10</p> <p style="text-align: center;">-----</p>	5, 9, 10, 22, 23, 27, 28

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2022/023344

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

**see additional sheet**

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:  
**1-11, 19-29**

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11, 19-29

Joint PTRS and DMRS pattern configuration

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2. claims: 12-14, 30-32

flexible PTRS frequency configuration for single slot and multi-slot transmissions

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3. claims: 15-18, 33-36

DMRS Allocations for Multi-PDSCH/PUSCH

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

**PCT/US2022/023344**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date		
<b>US 2020295979 A1</b>	<b>17-09-2020</b>	<b>AU 2017433792 A1</b>	<b>14-05-2020</b>		
		<b>BR 112020006170 A2</b>	<b>06-10-2020</b>		
		<b>CN 111386737 A</b>	<b>07-07-2020</b>		
		<b>EP 3691365 A1</b>	<b>05-08-2020</b>		
		<b>JP 2021145384 A</b>	<b>24-09-2021</b>		
		<b>JP WO2019064602 A1</b>	<b>22-10-2020</b>		
		<b>PH 12020550137 A1</b>	<b>08-02-2021</b>		
		<b>US 2020295979 A1</b>	<b>17-09-2020</b>		
		<b>US 2022070038 A1</b>	<b>03-03-2022</b>		
		<b>WO 2019064602 A1</b>	<b>04-04-2019</b>		
		<b>ZA 202002153 B</b>	<b>29-06-2022</b>		
		-----			
		<b>US 2019149295 A1</b>	<b>16-05-2019</b>	<b>BR 112019024298 A2</b>	<b>16-06-2020</b>
<b>CN 110870240 A</b>	<b>06-03-2020</b>				
<b>CO 2019012622 A2</b>	<b>17-01-2020</b>				
<b>DK 3459201 T3</b>	<b>23-03-2020</b>				
<b>DK 3624388 T3</b>	<b>03-01-2022</b>				
<b>EP 3459201 A1</b>	<b>27-03-2019</b>				
<b>EP 3624388 A1</b>	<b>18-03-2020</b>				
<b>EP 3926885 A1</b>	<b>22-12-2021</b>				
<b>ES 2779959 T3</b>	<b>20-08-2020</b>				
<b>ES 2905000 T3</b>	<b>06-04-2022</b>				
<b>JP 6983257 B2</b>	<b>17-12-2021</b>				
<b>JP 2020523816 A</b>	<b>06-08-2020</b>				
<b>KR 20200007940 A</b>	<b>22-01-2020</b>				
<b>MA 47559 A1</b>	<b>30-04-2020</b>				
<b>PL 3459201 T3</b>	<b>15-06-2020</b>				
<b>PT 3459201 T</b>	<b>20-02-2020</b>				
<b>RU 2729041 C1</b>	<b>04-08-2020</b>				
<b>US 2019149295 A1</b>	<b>16-05-2019</b>				
<b>US 2021211257 A1</b>	<b>08-07-2021</b>				
<b>WO 2018231140 A1</b>	<b>20-12-2018</b>				
<b>ZA 201907794 B</b>	<b>28-04-2021</b>				
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<b>US 2019305908 A1</b>	<b>03-10-2019</b>			<b>CN 110537343 A</b>	<b>03-12-2019</b>
		<b>EP 3618336 A1</b>	<b>04-03-2020</b>		
		<b>KR 20180135850 A</b>	<b>21-12-2018</b>		
		<b>KR 20190134587 A</b>	<b>04-12-2019</b>		
		<b>US 2019305908 A1</b>	<b>03-10-2019</b>		
		<b>US 2021167921 A1</b>	<b>03-06-2021</b>		
<b>WO 2018199584 A1</b>	<b>01-11-2018</b>				
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