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(54) **Title:** HANDOVER OPERATIONS IN NON-TERRESTRIAL NETWORKS

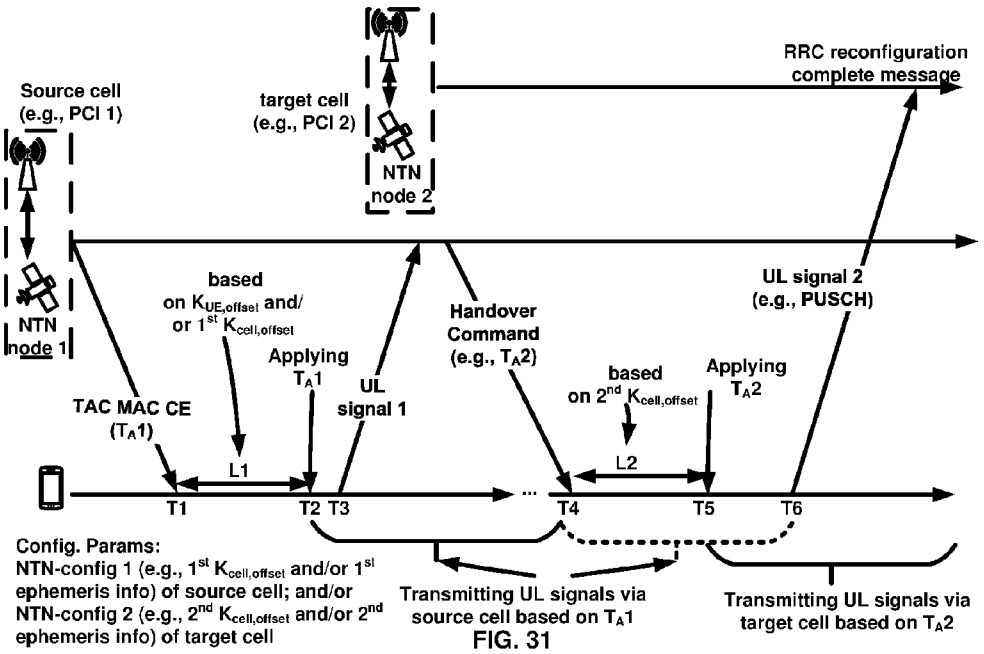


FIG. 31

(57) **Abstract:** A method may include receiving, by a wireless device, a radio resource control (RRC) message indicating a first cell-specific scheduling offset. The method may also include receiving, via a first cell of a non-terrestrial network (NTN), a medium access control (MAC) control element (CE) indicating a differential offset. The method may further include transmitting, via the first cell, a first uplink signal using the differential offset and the first cell-specific scheduling offset. The method may additionally include receiving an RRC reconfiguration message comprising reconfiguration with synchronization configuration parameters. The RRC reconfiguration message may include a second cell-specific scheduling offset. Based on the RRC reconfiguration message, the method may include discarding or deleting the differential offset. The method may also include transmitting, via a second cell, a second uplink signal using the second cell-specific scheduling offset.

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[Continued on next page]

KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, 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.

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Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B H04W

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2023/013997 A1 (HYUNDAI MOTOR CO LTD [KR]; KIA CORP [KR] ET AL.) 9 February 2023 (2023-02-09) abstract & US 2024/179592 A1 (SUH YOUNG KIL [KR] ET AL) 30 May 2024 (2024-05-30) figures 9, 12 paragraph [0089] paragraph [0107] - paragraph [0119] paragraph [0121] paragraph [0124] - paragraph [0135] -----	1-42, 46-50
A	EP 4 131 800 A2 (APPLE INC [US]) 8 February 2023 (2023-02-08) paragraph [0027] - paragraph [0074] -----	1-42, 46-50

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* 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

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"P" document published prior to the international filing date but later than the priority date claimed

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"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	Date of mailing of the international search report
25 October 2024	11/11/2024

Name and mailing address of the ISA/	Authorized officer
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/022343

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.:

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.

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	MODERATOR (ERICSSON): "Feature lead summary#1 on timing relationship enhancements", 3GPP DRAFT; R1-2112507, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. e-Meeting; 20211111 - 20211119 11 November 2021 (2021-11-11), XP052075769, Retrieved from the Internet: URL:https://ftp.3gpp.org/tsg_ran/WG1_RL1/TSGR1_107-e/Inbox/R1-2112507.zip R1-2112507 FL summary#1 on NTN timing relationships.docx [retrieved on 2021-11-11] section 1 -----	1-42, 46-50
A	IGNACIO PASCUAL PELAYO ET AL: "Handover enhancements", 3GPP DRAFT; R2-2301867; TYPE DISCUSSION; NR_NTN_ENH, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Athens, GR; 20230227 - 20230303 17 February 2023 (2023-02-17), XP052246493, Retrieved from the Internet: URL:https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_121/Docs/R2-2301867.zip R2-2301867 - Handover enhancements.docx [retrieved on 2023-02-17] section 2 ----- -/--	43-45

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	XIANGDONG ZHANG ET AL: "Discussion on PCI unchanged scenario", 3GPP DRAFT; R2-2300209; TYPE DISCUSSION; NR_NTN_ENH-CORE, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Athens, GR; 20230227 - 20230303 17 February 2023 (2023-02-17), XP052244859, Retrieved from the Internet: URL:https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_121/Docs/R2-2300209.zip R2-2300209 Discussion on PCI unchanged scenario.docx [retrieved on 2023-02-17] section 2 -----	43-45
A	ERICSSON: "R18 NR NTN Mobility enhancements", 3GPP DRAFT; R2-2210732, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Electronic meeting ;20221010 - 20221019 30 September 2022 (2022-09-30), XP052264044, Retrieved from the Internet: URL:https://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210732.zip R2-2210732 - R18 NR NTN Mobility enhancements.docx [retrieved on 2022-09-30] section 2.1 ----- -/--	43-45

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KATSUNARI UEMURA ET AL: "Discussion on Handover enhancements for NTN", 3GPP DRAFT; R2-2301504; TYPE DISCUSSION; NR_NTN_ENH-CORE, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Athens, GR; 20230227 - 20230303 17 February 2023 (2023-02-17), XP052246138, Retrieved from the Internet: URL:https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_121/Docs/R2-2301504.zip R2-2301504_NTN_HO-enh_FJ.docx [retrieved on 2023-02-17] section 2 -----	43-45

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2023013997 A1	09-02-2023	KR 20230020356 A	10-02-2023
		US 2024179592 A1	30-05-2024
		WO 2023013997 A1	09-02-2023
EP 4131800 A2	08-02-2023	CN 115707087 A	17-02-2023
		EP 4131800 A2	08-02-2023
		EP 4325951 A2	21-02-2024
		KR 20230021578 A	14-02-2023
		US 2023039715 A1	09-02-2023

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-42, 46-50

Reducing the possibility of handover failure in NTN

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2. claims: 43-45

Synchronizing uplink transmissions in NTN handover
