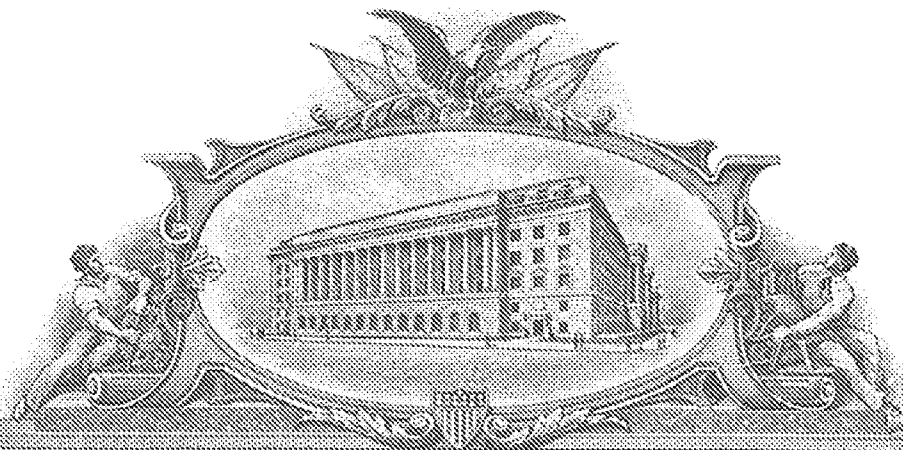


DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:	PCT/US2018/035987
International filing date:	05 June 2018 (05.06.2018)
Document type:	Certified copy of priority document
Document details:	Country/Office: US
	Number: 62/516,586
	Filing date: 07 June 2017 (07.06.2017)
Date of receipt at the International Bureau:	21 June 2018 (21.06.2018)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)

932804



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

June 20, 2018

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE.

APPLICATION NUMBER: 62/516,586

FILING DATE: *June 07, 2017*

RELATED PCT APPLICATION NUMBER: *PCT/US18/35987*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US62/516,586*



Certified by

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Atsushi		SHII			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						
City	Vancouver	State/Province	WA	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	8611 NW 18th Avenue					
Address 2						
City	Vancouver	State/Province	WA			
Postal Code	98665	Country	US			
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.						Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence information of this application.			
Customer Number	126613		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	Area Update Procedure(s) for Radio System		
Attorney Docket Number	SLA3747P_6112-99	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	14	Suggested Figure for Publication (if any)	

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	126613		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button. Add			

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)	Remove

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1	Remove
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section. Clear		
☒ Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
Name of the Deceased or Legally Incapacitated Inventor:		
If the Applicant is an Organization check here. ☒		
Organization Name	SHARP Laboratories of America, Inc.	
Mailing Address Information For Applicant:		
Address 1	5750 NW Pacific Rim Boulevard	
Address 2		
City	Camas	State/Province
Country	US	Postal Code
Phone Number		Fax Number
Email Address		
Additional Applicant Data may be generated within this form by selecting the Add button. Add		

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		

Assignee	1
-----------------	---

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	Given Name	Middle Name	Family Name	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/H. Warren Burnam, Jr./		Date (YYYY-MM-DD)	2017-06-07
First Name	H. Warren	Last Name	Burnam, Jr.	Registration Number
			29366	

Additional Signature may be generated within this form by selecting the Add button.

Add

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	SLA3747P_6112-99
		Application Number	
Title of Invention	Area Update Procedure(s) for Radio System		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

Inventor 1

[Remove](#)

Given Name

Middle Name

Family Name

City

State

Country i

Atsushi

SHII

Vancouver

WA

US

All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

[Add](#)

Title of Invention

Area Update Procedure(s) for Radio System

Attorney Docket Number (if applicable)

SLA3747P_6112-99

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number

☐ Firm or Individual Name

Customer Number

126613

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

Entity Status**Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29**

- ☐ Applicant asserts small entity status under 37 CFR 1.27
- ☐ Applicant certifies micro entity status under 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
- ☒ No

Warning

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	H. Warren Burnam, Jr./		Date (YYYY-MM-DD)	2017-06-07
First Name	H. Warren	Last Name	Burnam, Jr.	Registration Number (If appropriate) 29366

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that : (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

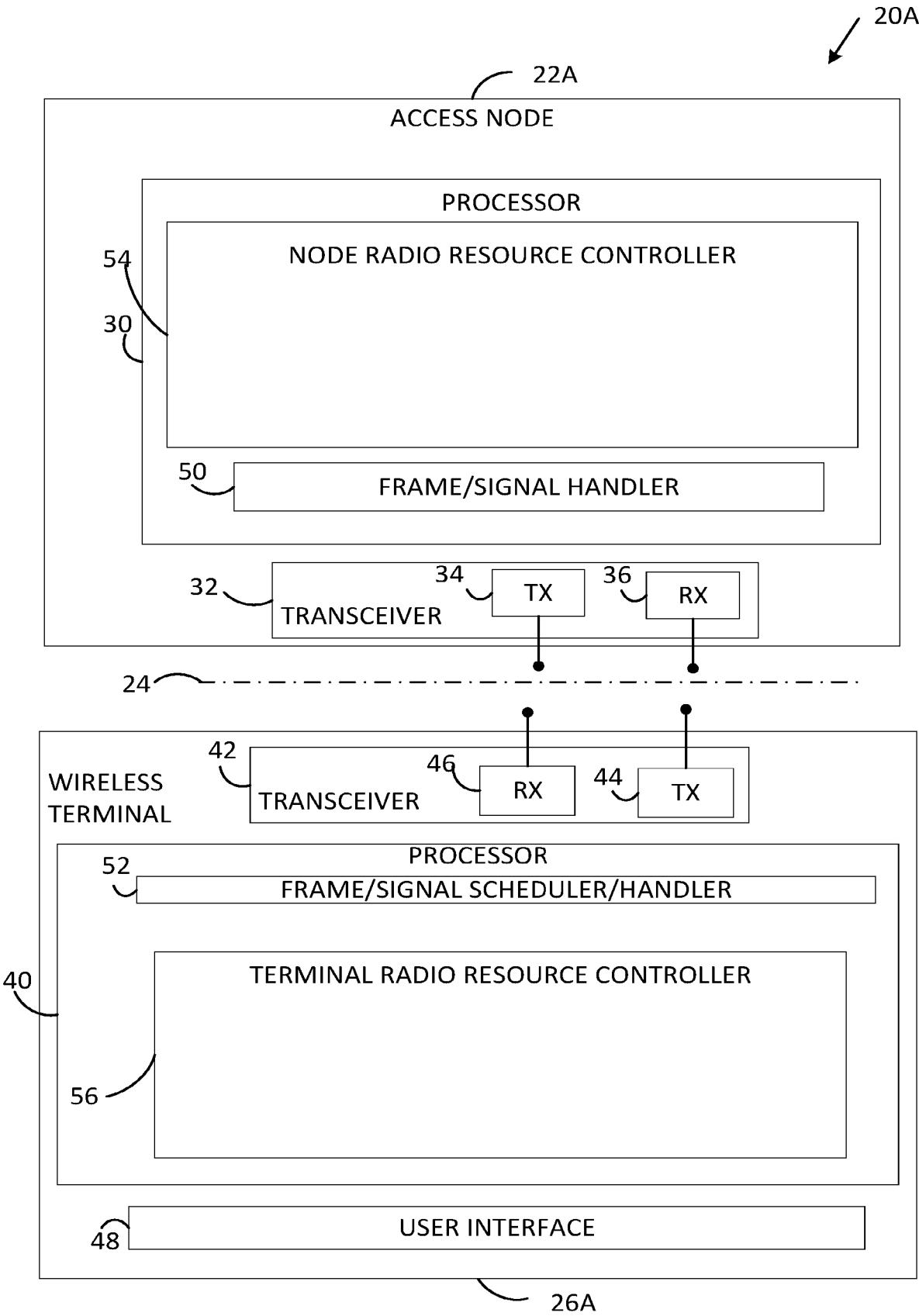


Fig. 1A

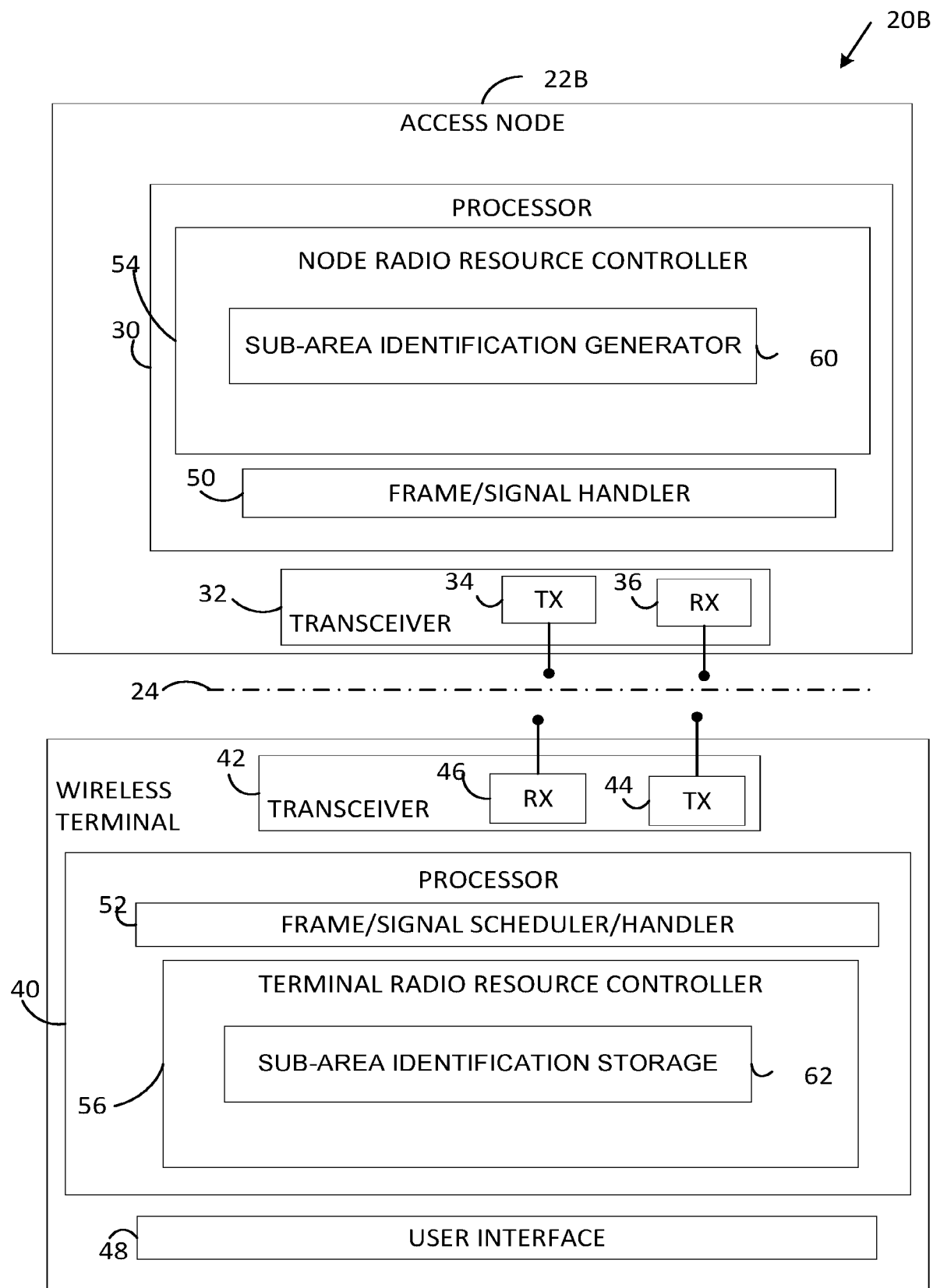


Fig. 1B

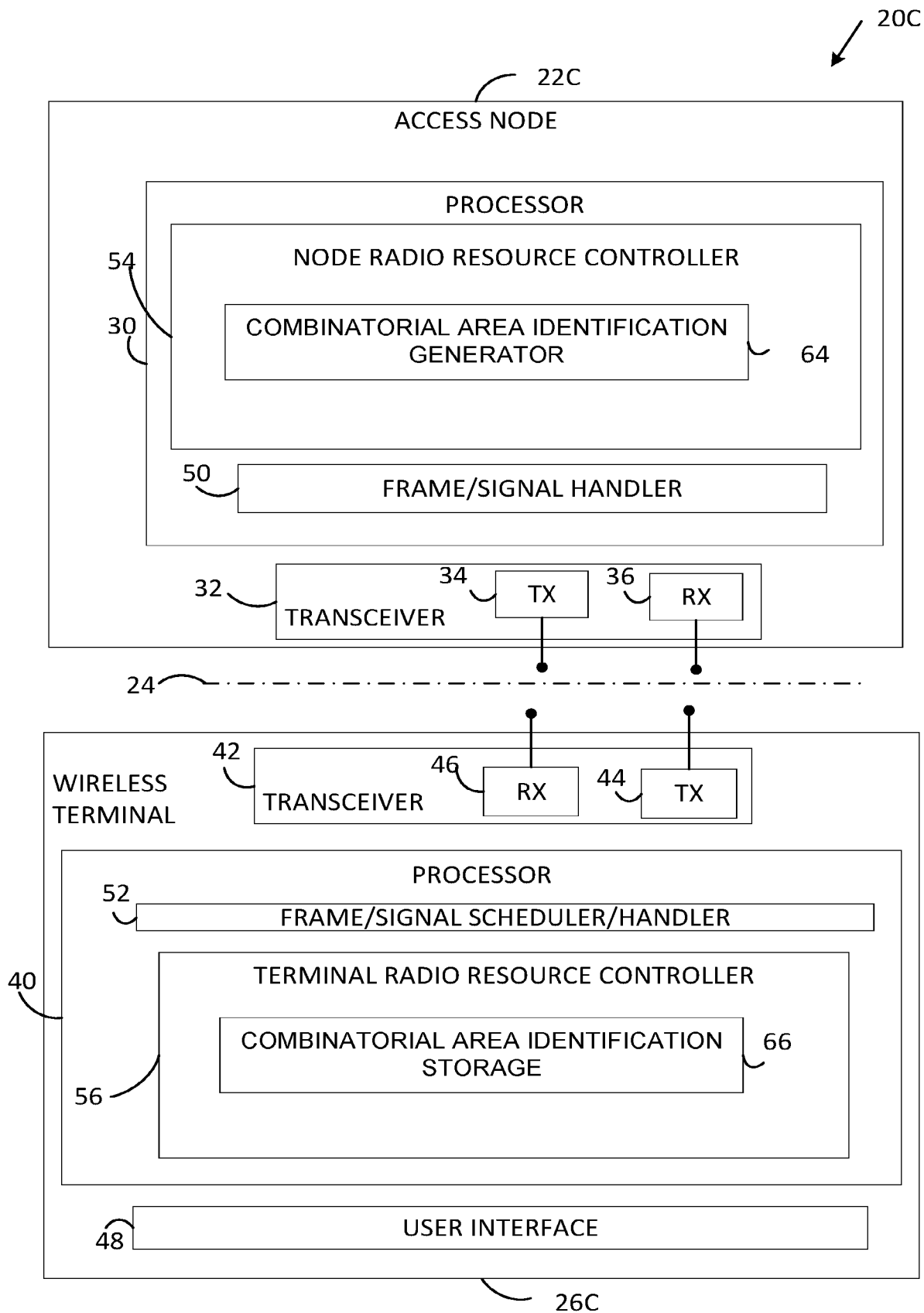


Fig. 1C

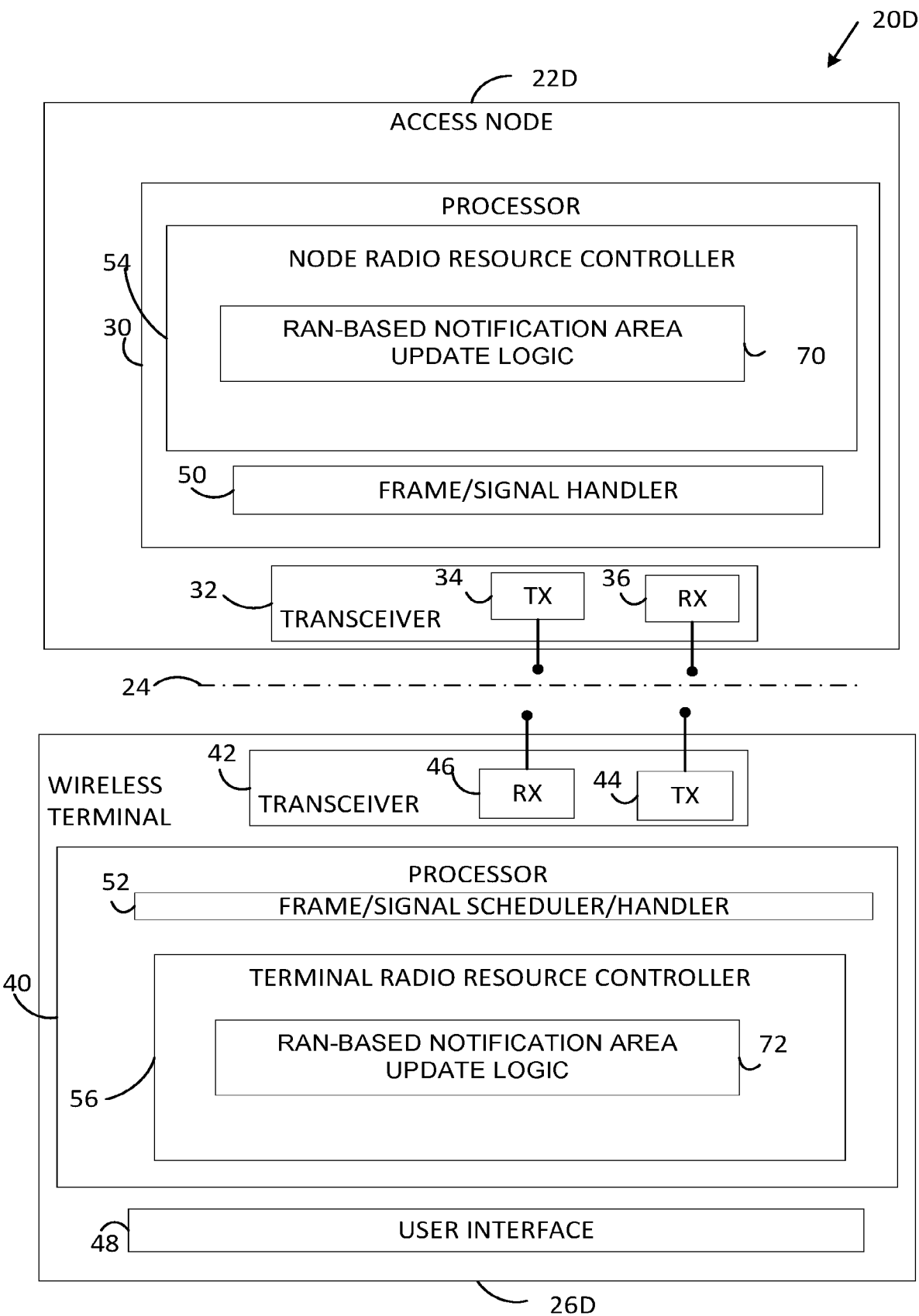


Fig. 1D

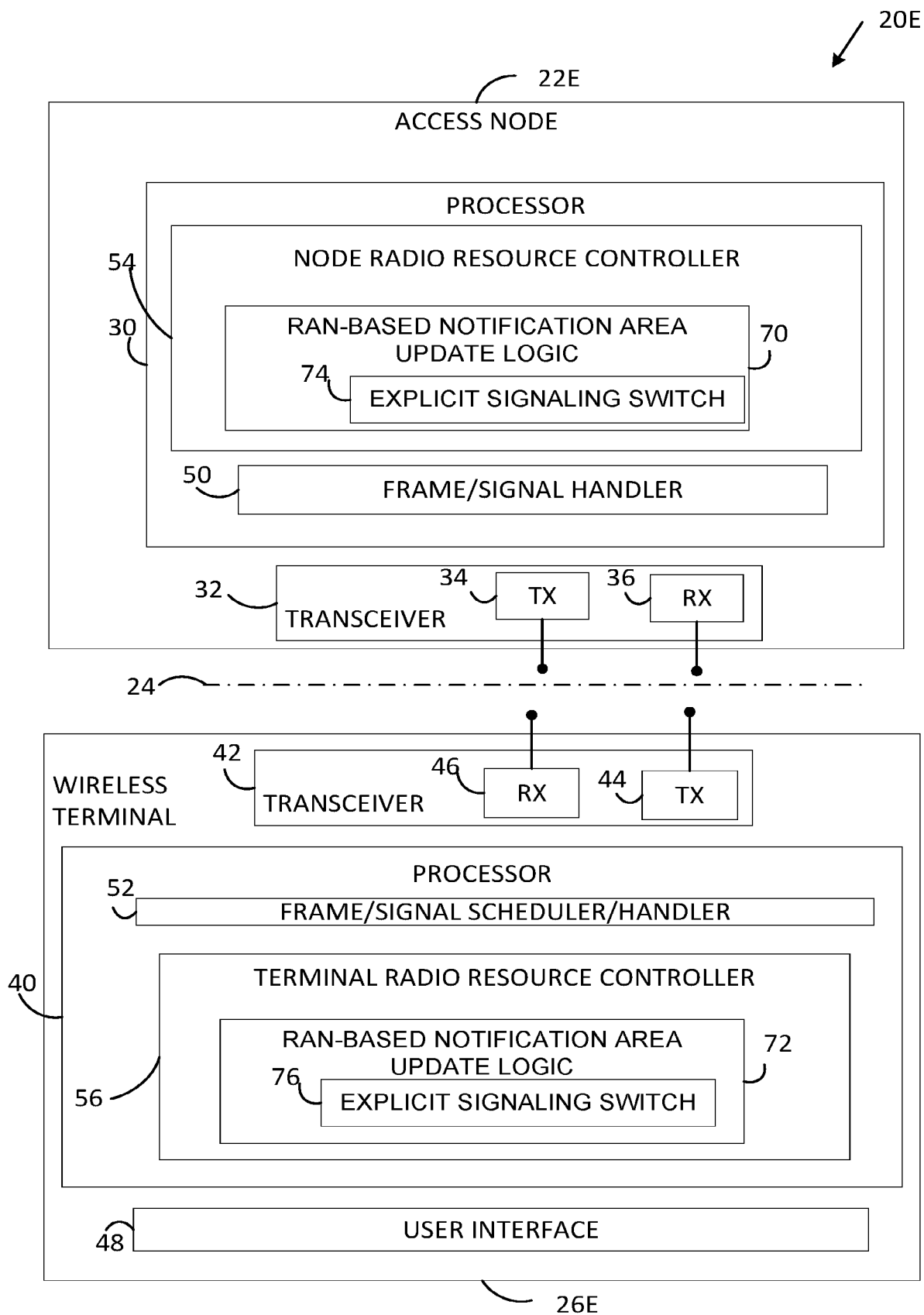
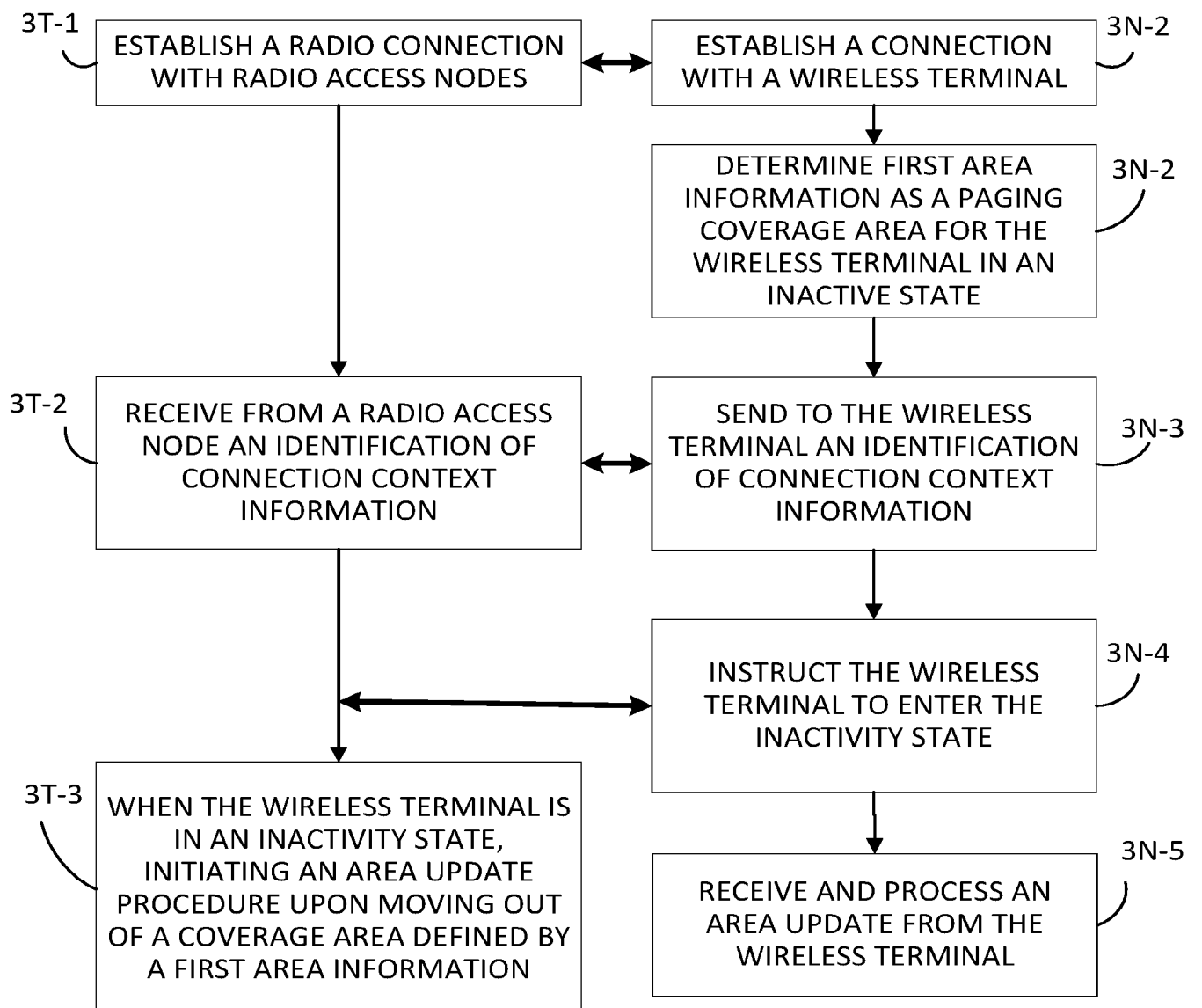
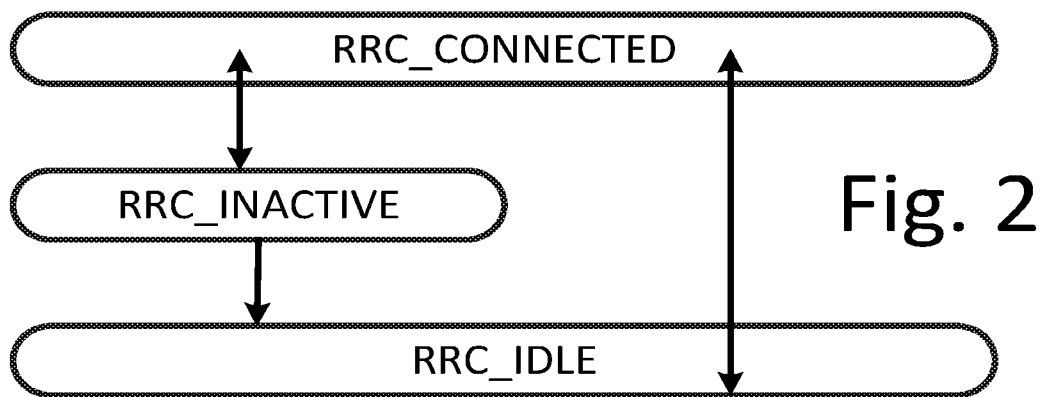


Fig. 1E

**Fig. 3**

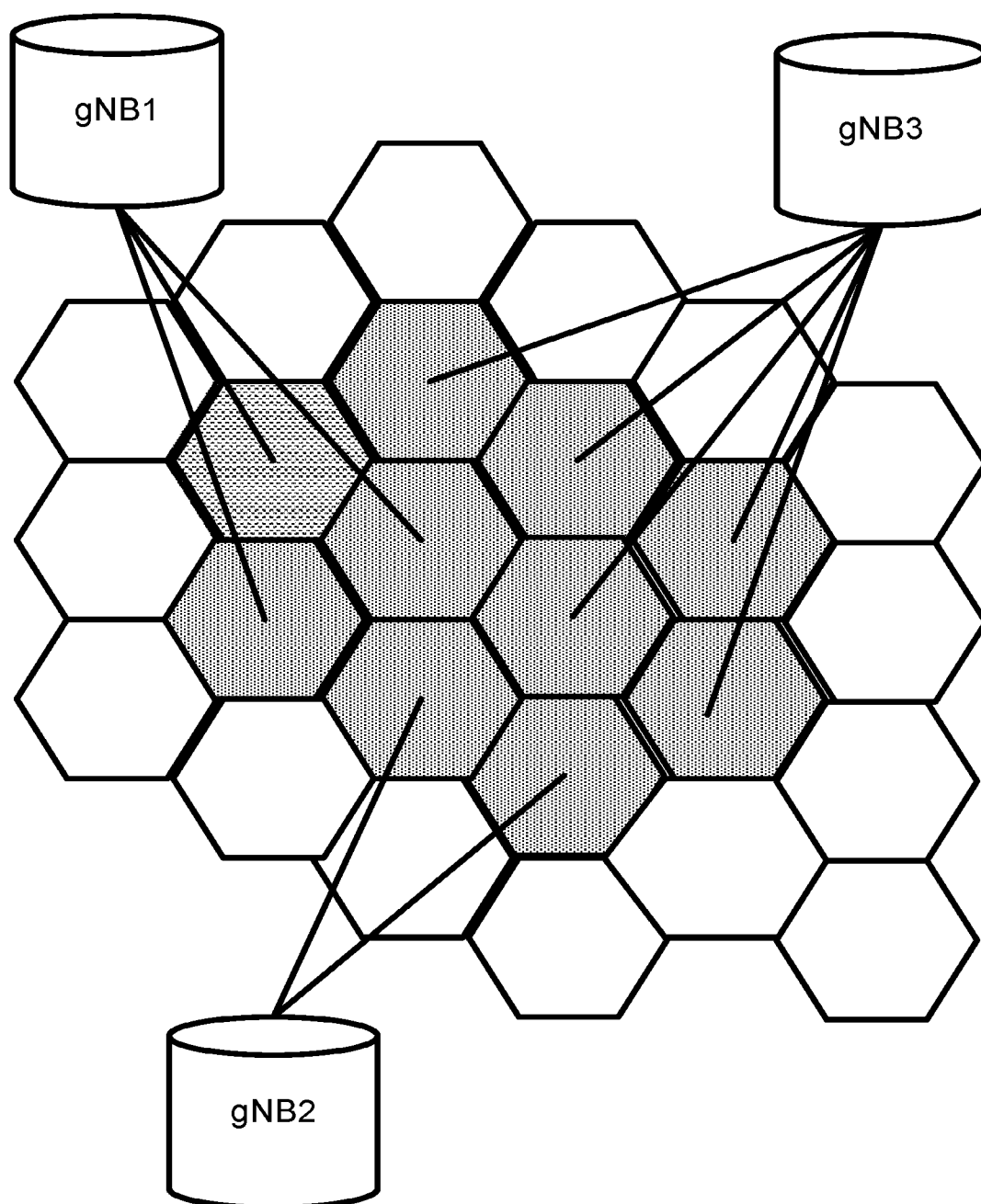


Fig. 5

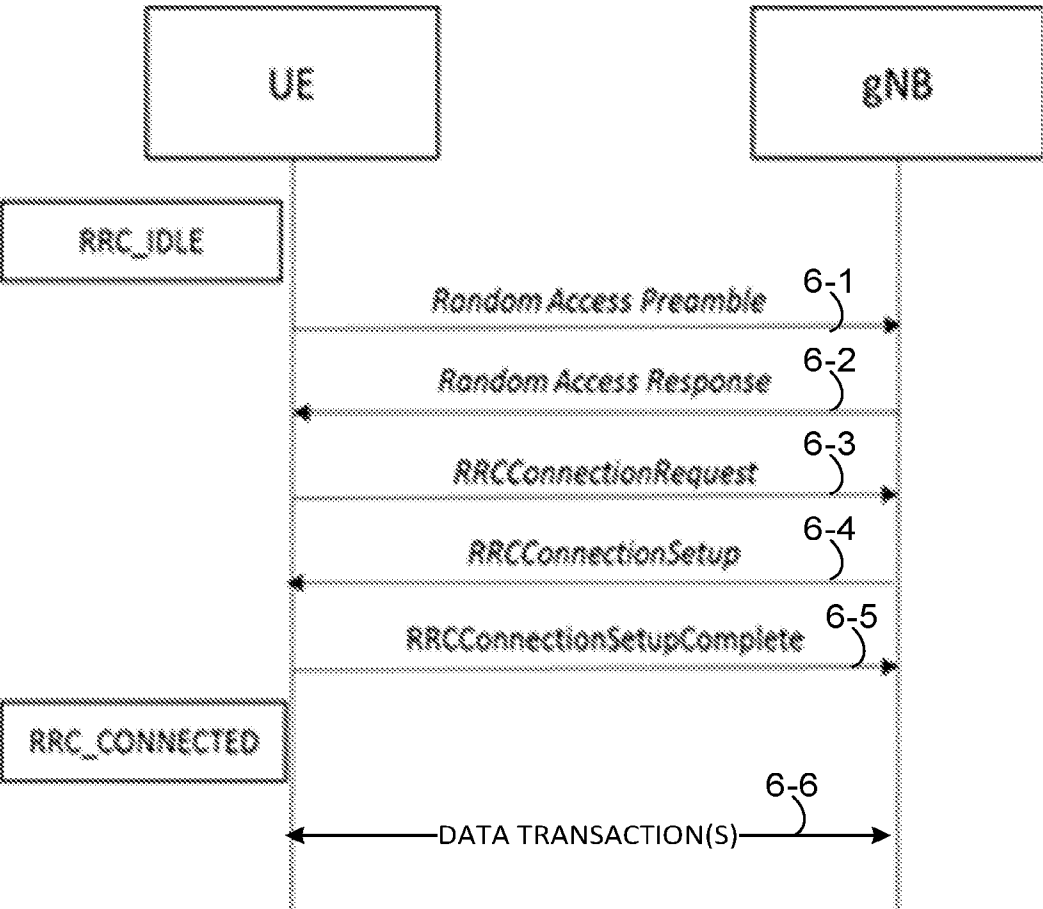


Fig. 6

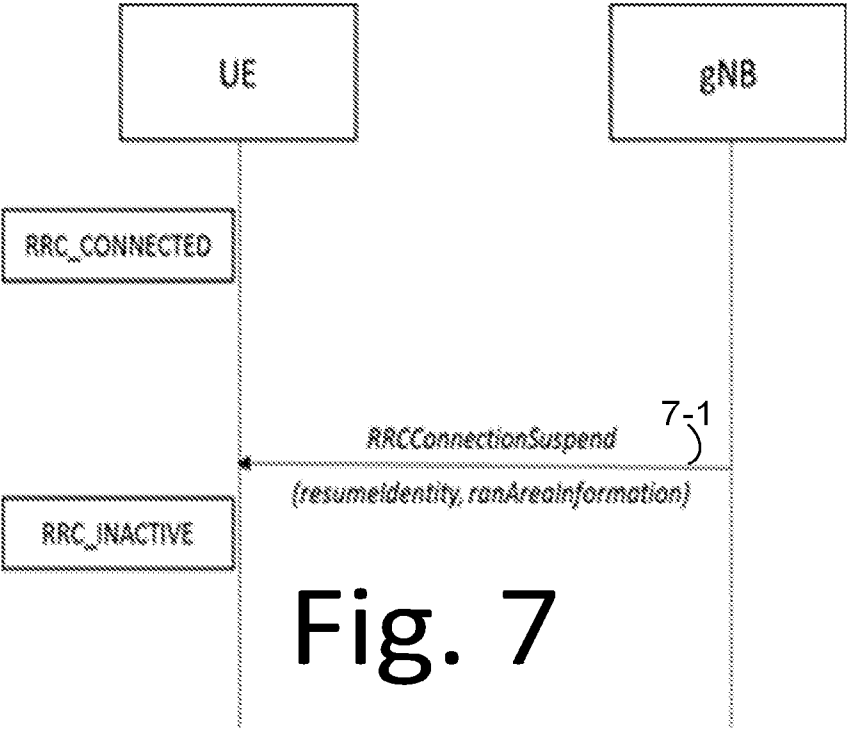


Fig. 7

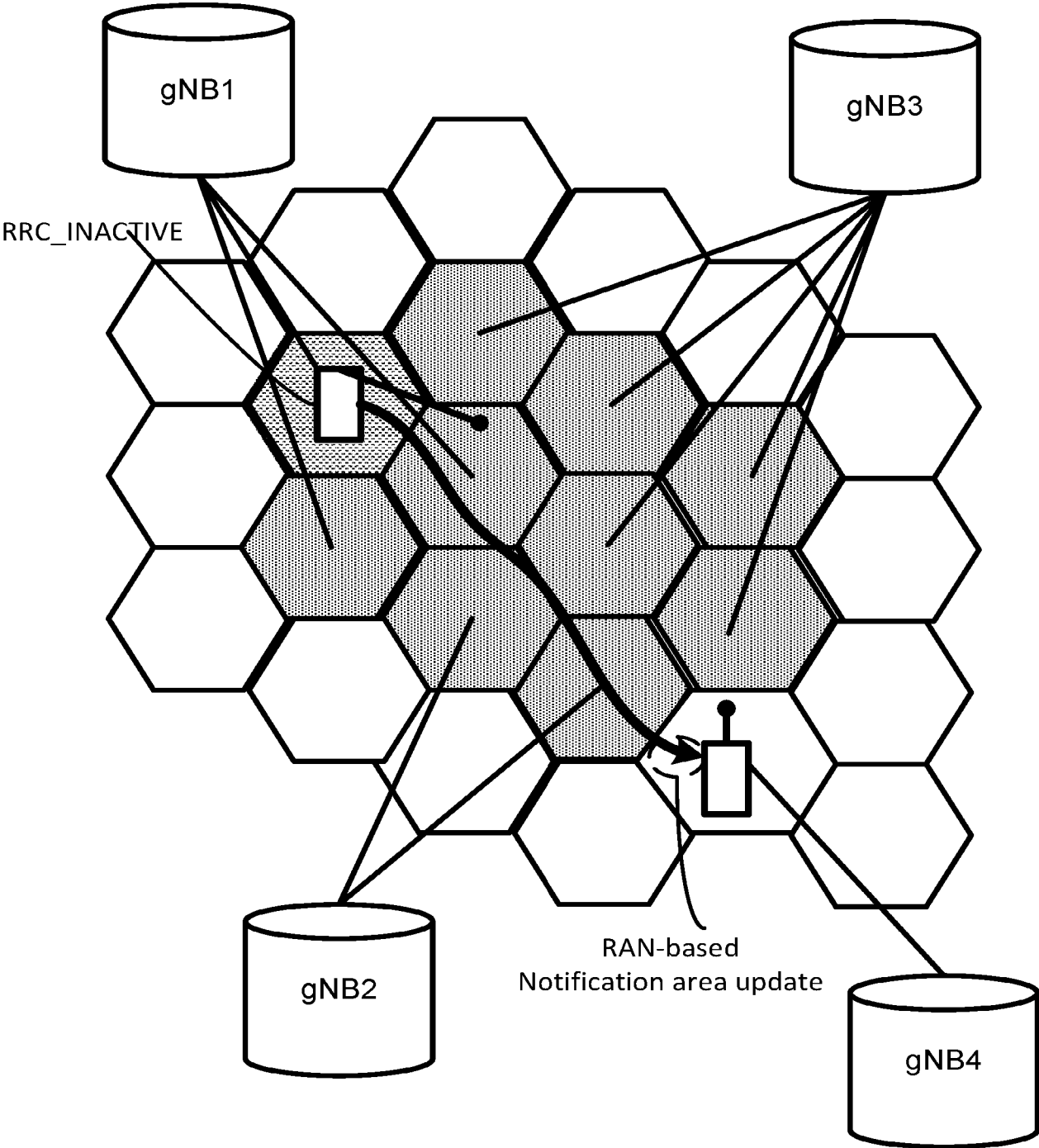


Fig. 8

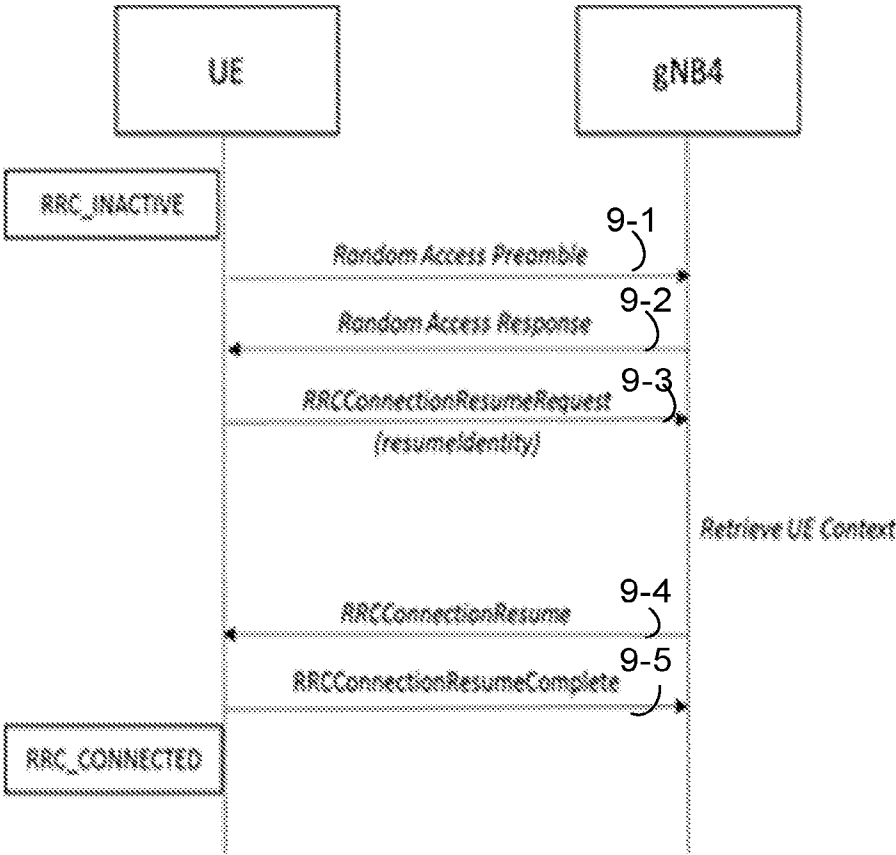
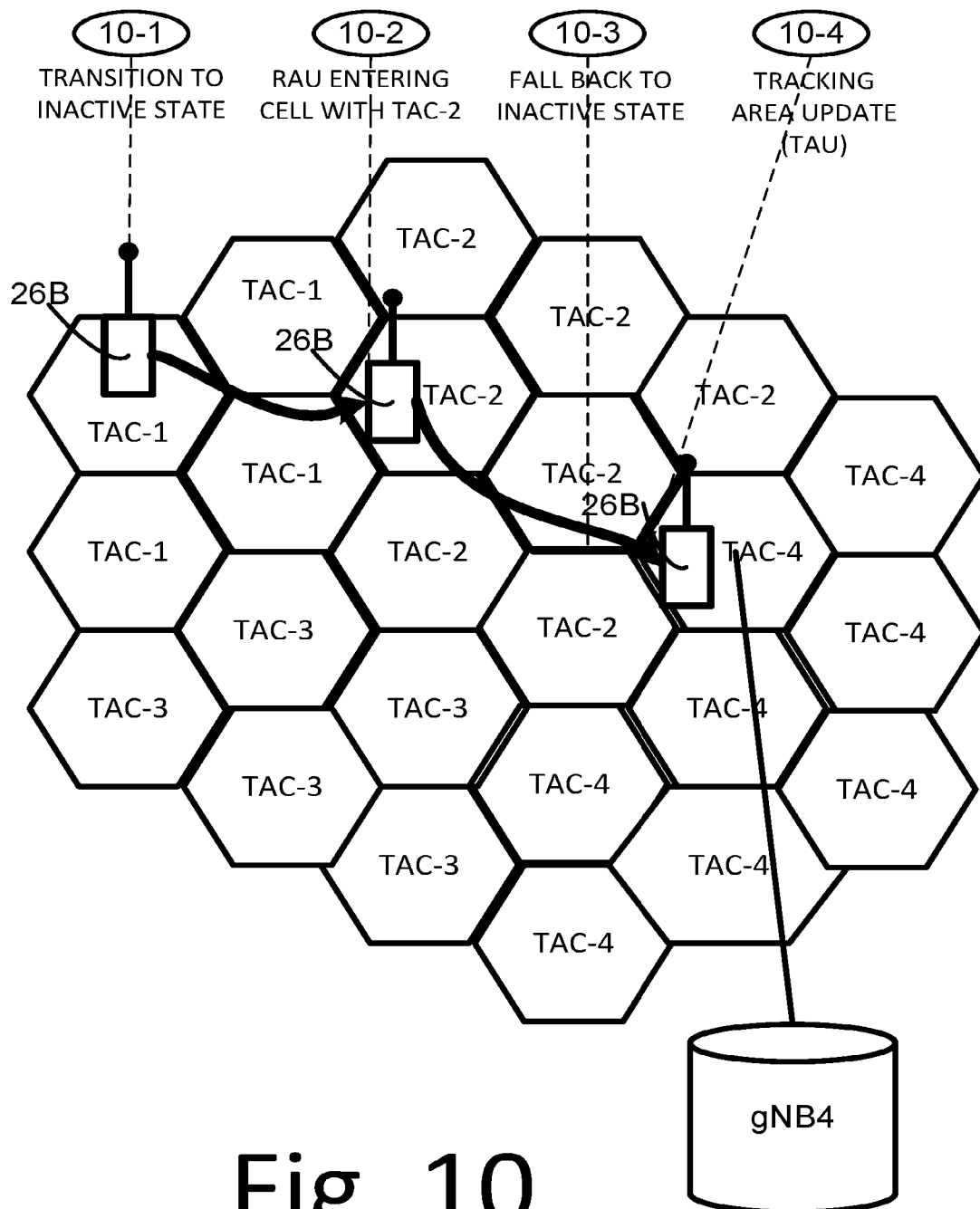
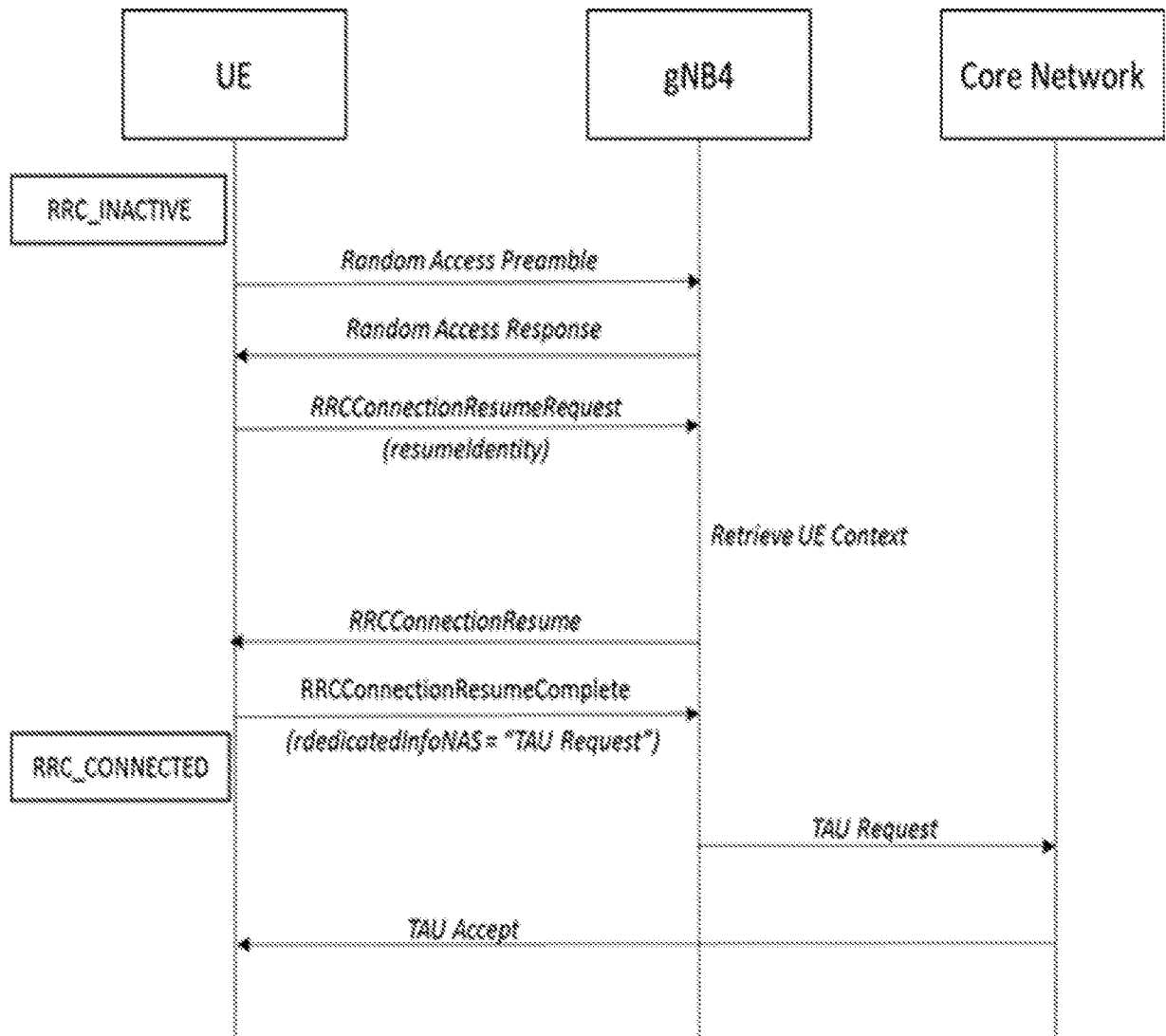
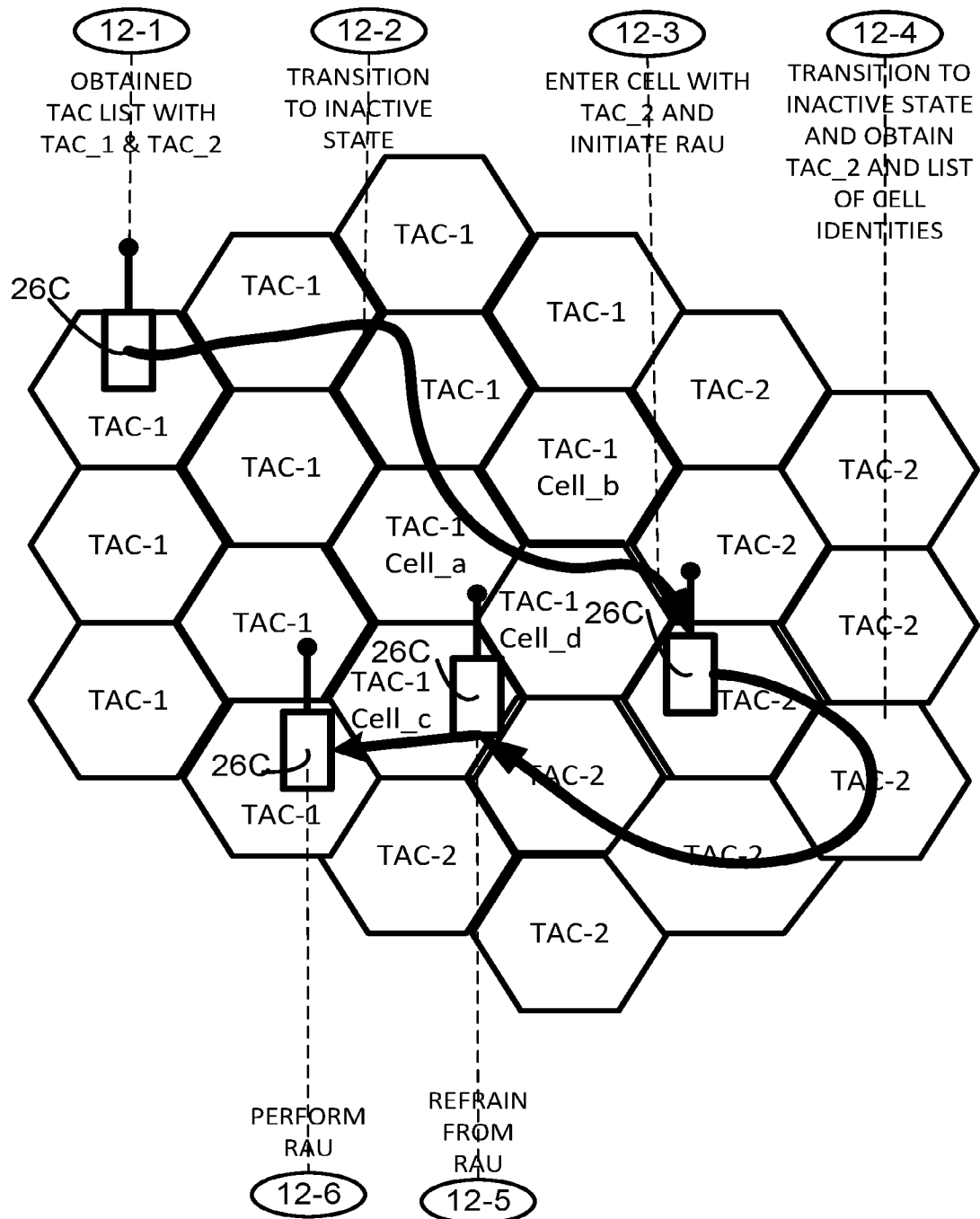


Fig. 9

**Fig. 10**

**Fig. 11**

**Fig. 12**

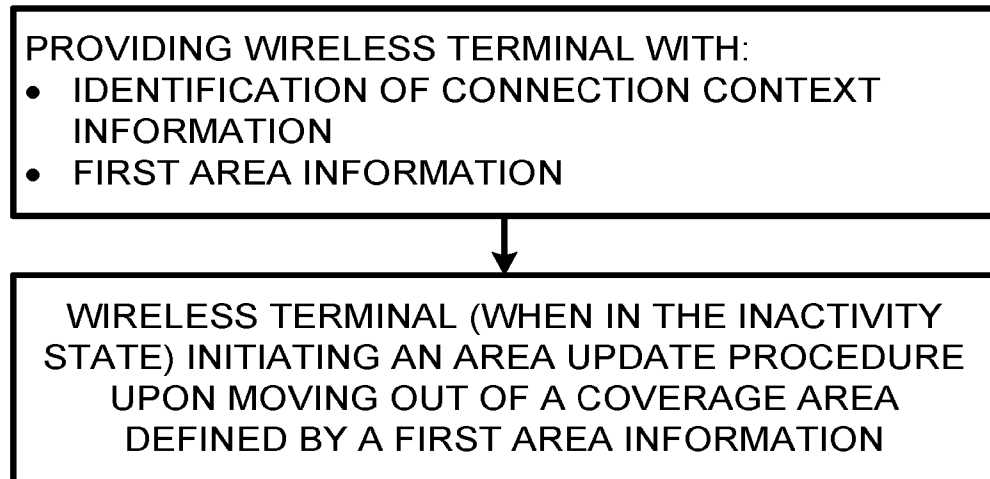


Fig. 4

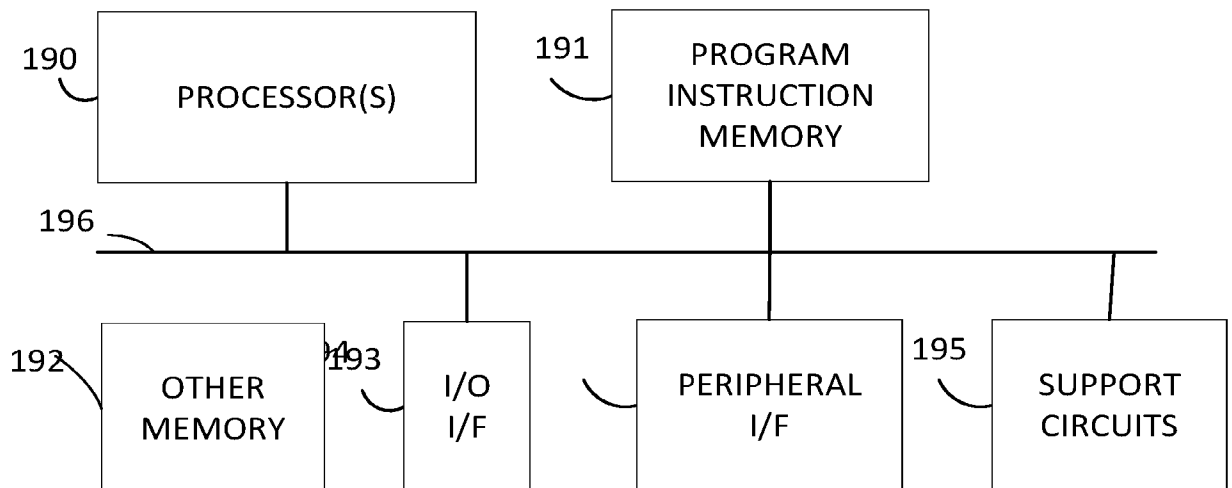


Fig. 13

AREA UPDATE PROCEDURE(S) FOR RADIO SYSTEM TECHNICAL FIELD

[0001] The technology relates to wireless communications, and particularly to methods and apparatus for performing area update procedures in wireless communications.

5

BACKGROUND

[0002] In wireless communication systems, a radio access network generally comprises one or more access nodes (such as a base station) which communicate on radio channels over a radio or air interface with plural wireless terminals. In some technologies such a wireless terminal is also called a User Equipment (UE). A group known as the 3rd Generation
10 Partnership Project (“3GPP”) has undertaken to define globally applicable technical specifications and technical reports for present and future generation wireless communication systems. The 3GPP Long Term Evolution (“LTE”) and 3GPP LTE Advanced (LTE-A) are projects to improve an earlier Universal Mobile Telecommunications System (“UMTS”) mobile phone or device standard in a manner to cope with future requirements.

15 **[0003]** In LTE telecommunications a mobile station (UE) may be in one of several Radio Resource Control (RRC) states, such as IDLE state or RRC-connected state, for example. In typical cellular mobile communication systems, the reachability by the network of a mobile station (UE) in the IDLE state, i.e. the ability of the network to reach the UE by paging, is achieved by the mobile station occasionally reporting its location. The coverage of the system
20 is divided into several geographic areas, each of which consists of multiple cells. The mobile station reporting takes place when the mobile station moves across the boundary of an area. When the network receives incoming data which should be sent to the mobile station, the network broadcasts a paging message to all of the cells in the area that the mobile station is supposed to be located.

25 **[0004]** In Long-Term Evolution (LTE) and LTE Advanced (LTE-A), such a geographic area is called a “tracking area” (TA). When first registering with the core network (CN), the user equipment (UE) is given a TA or a list of TAs. Subsequently, when moving out of the coverage of the initially specified TA(s), the UE reports its presence by sending a Tracking

Area Update (TAU) message to the core network via a currently camped base station, e.g., an evolved Node B (eNB). As a response, the network then provides the mobile station with an updated TA or a list of TAs.

5 **[0005]** When a mobile-terminated event (such as an incoming call) occurs, the network attempts to page the UE by broadcasting a Paging message. This Paging message is transmitted from all the eNBs in the TA or TAs in the list where the UE is supposed to be located.

[0006] In general, paging is radio resource intensive, since paging uses downlink radio resources on all the cells in the area. A smaller area size might reduce the resource usage, but conversely would increase the number of TAUs that the mobile station needs to perform.

10 **[0007]** 3GPP is currently discussing introduction of “INACTIVE” state for 5G, where the Radio Access Network (RAN) manages the mobility of the UEs in the state, in order to hide mobility and state transitions from the core network.

15 **[0008]** What is needed, therefore, and example object(s) of the technology disclosed herein, are methods, apparatus, and techniques to provide area update procedures that are suitable for a 5G system.

SUMMARY

20 **[0009]** In one of its example aspects, the technology disclosed herein concerns a wireless terminal comprising receiver circuitry and transmitter circuitry and processor circuitry. The receiver circuitry and transmitter circuitry are configured to communicate across a radio interface with a radio access node. The processor circuitry is configured to establish a radio connection with radio access nodes; to receive from a radio access node an identification of connection context information; and, in an inactivity state, to initiate an area update procedure upon moving out of a coverage area defined by a first area information.

25 **[00010]** In another of its example aspects, the technology disclosed herein concerns an access node of a radio access network which comprises receiver circuitry and transmitter circuitry and processor circuitry. The receiver circuitry and transmitter circuitry are configured

to communicate across a radio interface with a wireless terminal. The processor circuitry is configured to establish a connection with a wireless terminal; to determine first area information as a paging coverage area for the wireless terminal in an inactive state; to send to the wireless terminal an identification of connection context information; to instruct the
5 wireless terminal to enter the inactivity state; and, to receive and process an area update from the wireless terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

[00011] The foregoing and other objects, features, and advantages of the technology disclosed herein will be apparent from the following more particular description of preferred
10 embodiments as illustrated in the accompanying drawings in which reference characters refer to the same parts throughout the various views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the technology disclosed herein.

[00012] Fig. 1A – Fig. 1E are schematic views showing an example communications
15 system comprising differing configurations of radio access nodes and a wireless terminal which perform random access procedures according to differing example embodiment and modes of the technology disclosed herein.

[00013] Fig. 2 is a diagrammatic view of radio resource control (RRC) states of a New Radio (NR) system.

[00014] Fig. 3 is a flowchart showing example, non-limiting, representative acts or steps
20 performed by the wireless terminals of the systems of Fig. 1A – Fig. 1E

[00015] Fig. 4 is a diagrammatic view showing example features of a generic example embodiment and mode.

[00016] Fig. 5 is a diagrammatic view depicting an exemplary deployment of the RAN-
25 based notification area comprising multiple cells.

[00017] Fig. 6 is signaling diagram showing an example procedure of a state transition from the RRC_IDLE state to the RRC_CONNECTED state.

[00018] Fig. 7 is signaling diagram showing an example procedure of a state transition from the RRC_CONNECTED state to the RRC_INACTIVE state.

5 **[00019]** Fig. 8 is a diagrammatic view depicting a wireless terminal moving out of an area defined by *ranAreaInformation* and then performing a RAN-based notification area update (RAU).

[00020] Fig. 9 is signaling diagram showing an example RAN-based notification area update (RAU) procedure

10 **[00021]** Fig. 10 is a diagrammatic view depicting an example scenario of a second example embodiment and mode in which tracking area code (TAC) is used as an identification of a RAN area.

[00022] Fig. 12 is a diagrammatic views depicting an example scenario of a third example embodiment and mode.

15 **[00023]** Fig. 13 is a diagrammatic view showing example electronic machinery which may comprise node electronic machinery or terminal electronic machinery.

DETAILED DESCRIPTION

[00024] In the following description, for purposes of explanation and not limitation, specific details are set forth such as particular architectures, interfaces, techniques, etc. in order
20 to provide a thorough understanding of the technology disclosed herein. However, it will be apparent to those skilled in the art that the technology disclosed herein may be practiced in other embodiments that depart from these specific details. That is, those skilled in the art will be able to devise various arrangements which, although not explicitly described or shown herein, embody the principles of the technology disclosed herein and are included within its
25 spirit and scope. In some instances, detailed descriptions of well-known devices, circuits, and

methods are omitted so as not to obscure the description of the technology disclosed herein with unnecessary detail. All statements herein reciting principles, aspects, and embodiments of the technology disclosed herein, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that
5 such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

[00025] Thus, for example, it will be appreciated by those skilled in the art that block diagrams herein can represent conceptual views of illustrative circuitry or other functional units embodying the principles of the technology. Similarly, it will be appreciated that any
10 flow charts, state transition diagrams, pseudocode, and the like represent various processes which may be substantially represented in computer readable medium and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

[00026] As used herein, the term “core network” can refer to a device, group of devices, or sub-system in a telecommunication network that provides services to users of the
15 telecommunications network. Examples of services provided by a core network include aggregation, authentication, call switching, service invocation, gateways to other networks, etc.

[00027] As used herein, the term “wireless terminal” can refer to any electronic device used to communicate voice and/or data via a telecommunications system, such as (but not limited to) a cellular network. Other terminology used to refer to wireless terminals and non-
20 limiting examples of such devices can include user equipment terminal, UE, mobile station, mobile device, access terminal, subscriber station, mobile terminal, remote station, user terminal, terminal, subscriber unit, cellular phones, smart phones, personal digital assistants (“PDAs”), laptop computers, netbooks, tablets, e-readers, wireless modems, etc.

[00028] As used herein, the term “access node”, “node”, or “base station” can refer to any
25 device or group of devices that facilitates wireless communication or otherwise provides an interface between a wireless terminal and a telecommunications system. A non-limiting example of an access node may include, in the 3GPP specification, a Node B (“NB”), an enhanced Node B (“eNB”), a home eNB (“HeNB”), or in the 5G terminology, a gNB or even a

transmission and reception point (TRP), or some other similar terminology. Another non-limiting example of a base station is an access point. An access point may be an electronic device that provides access for wireless terminal to a data network, such as (but not limited to) a Local Area Network (“LAN”), Wide Area Network (“WAN”), the Internet, etc. Although
5 some examples of the systems and methods disclosed herein may be described in relation to given standards (e.g., 3GPP Releases 8, 9, 10, 11, ...), the scope of the present disclosure should not be limited in this regard. At least some aspects of the systems and methods disclosed herein may be utilized in other types of wireless communication systems.

[00029] As used herein, the term “telecommunication system” or “communications
10 system” can refer to any network of devices used to transmit information. A non-limiting example of a telecommunication system is a cellular network or other wireless communication system.

[00030] As used herein, the term “cellular network” can refer to a network distributed over cells, each cell served by at least one fixed-location transceiver, such as a base station. A
15 “cell” may be any communication channel that is specified by standardization or regulatory bodies to be used for International Mobile Telecommunications-Advanced (“IMTAdvanced”). All or a subset of the cell may be adopted by 3GPP as licensed bands (e.g., frequency band) to be used for communication between a base station, such as a Node B, and a UE terminal. A cellular network using licensed frequency bands may include configured cells. Configured
20 cells can include cells of which a UE terminal is aware and in which it is allowed by a base station to transmit or receive information.

[00031] Fig. 1A – Fig. 1E shows an example communications systems 20A – 20E wherein area update procedures according to example, non-limiting embodiments and modes of the technology disclosed herein are described. In each of Fig. 1A – Fig. 1E, the components and
25 functionalities that have a same base reference numeral have same or similar structure and operation unless otherwise noted or otherwise clear from context. In the example communications systems 20A – 20E respective radio access nodes 22A – 22E communicate over air or radio interface 24 (e.g., Uu interface) with respective wireless terminals 26A – 26E. As used herein, reference to any one of the radio access nodes 22A – 22E may, for sake of

convenience, be generically noted as node 22, and reference to any one of the wireless terminals 26A- 26E may also be generically noted as wireless terminal 26.

[00032] As mentioned above, the radio access node 22 may be any suitable node for communicating with the wireless terminal 26, such as a base station node, or eNodeB (“eNB”) or gNodeB or gNB, for example. The node 22 comprises node processor circuitry (“node processor 30”) and node transceiver circuitry 32. The node transceiver circuitry 32 typically comprises node transmitter circuitry 34 and node receiver circuitry 36, which are also called node transmitter and node receiver, respectively.

[00033] The wireless terminal 26 comprises terminal processor 40 and terminal transceiver circuitry 42. The terminal transceiver circuitry 42 typically comprises terminal transmitter circuitry 44 and terminal receiver circuitry 46, which are also called terminal transmitter 44 and terminal receiver 46, respectively. The wireless terminal 26 also typically comprises user interface 48. The terminal user interface 48 may serve for both user input and output operations, and may comprise (for example) a screen such as a touch screen that can both display information to the user and receive information entered by the user. The user interface 48 may also include other types of devices, such as a speaker, a microphone, or a haptic feedback device, for example.

[00034] For both the radio access node 22 and wireless terminal 26, the respective transceiver circuitries 22 include antenna(s). The respective transmitter circuits 36 and 46 may comprise, e.g., amplifier(s), modulation circuitry and other conventional transmission equipment. The respective receiver circuits 34 and 44 may comprise, e.g., e.g., amplifiers, demodulation circuitry, and other conventional receiver equipment.

[00035] In general operation node, access node 22 and wireless terminal 26 communicate with each other across radio interface 24 using predefined configurations of information. By way of non-limiting example, the radio access node 22 and wireless terminal 26 may communicate over radio interface 24 using “frames” of information that may be configured to include various channels. In Long Term Evolution (LTE), as a non-limiting example, a frame, which may have both downlink portion(s) and uplink portion(s), may comprise plural

subframes, with each LTE subframe in turn being divided into two slots. The frame may be conceptualized as a resource grid (a two dimensional grid) comprised of resource elements (RE). Each column of the two dimensional grid represents a symbol (e.g., an OFDM symbol on downlink (DL) from node to wireless terminal; an SC-FDMA symbol in an uplink (UL) frame from wireless terminal to node). Each row of the grid represents a subcarrier. The frame and subframe structure serves only as an example of a technique of formatting of information that is to be transmitted over a radio or air interface. It should be understood that “frame” and “subframe” may be utilized interchangeably or may include or be realized by other units of information formatting, and as such may bear other terminology (such as blocks, or symbol, slot, mini-slot in 5G for example).

[00036] To cater to the transmission of information between radio access node 22A and wireless terminal 26 over radio interface 24, the node processor 30 and terminal processor 40 of Fig. 1 are shown as comprising respective information handlers. For an example implementation in which the information is communicated via frames, the information handler for radio access node 22 is shown as node frame/signal scheduler/handler 50, while the information handler for wireless terminal 26 is shown as terminal frame/signal handler 52. The terminal processor 40 further comprises synchronization information generator 54.

[00037] The technology disclosed herein particularly concerns area update procedure(s) and the base stations (e.g., radio access nodes) and wireless terminals that participate in the area update procedure(s), and methods of operation of such base stations/nodes and wireless terminals. Various area update procedures described herein are area updates that may occur during radio resource control (RRC) states, and particularly to an area update procedure that may occur in the mobile station in a RRC_INACTIVE state. To this end, radio access node 22A is shown as comprising node radio resource controller 54 and wireless terminal 26A is shown as comprising terminal radio resource controller 56. Both node random access procedure controller 54 and terminal radio resource controller 56 govern Radio Resource Control (RRC) operations, including RRC states and transitions between the RRC states. The node radio resource controller 54 and terminal radio resource controller 56 participate in the example embodiments and modes of the area update procedures described herein.

[00038] It should be understood that apparatus, functionalities, acts and the like that are commonly numbered throughout the various example embodiments and modes have essentially the same structure and/or operation for each of the example embodiments and modes unless otherwise noted.

5 **[00039]** For yet other example embodiments and modes, aspects of the various embodiments and modes may be used in combination with one another.

[00040] The node radio resource controller 54 and the terminal radio resource controller 56 may participate in RRC states such as the New Radio (NR) system radio resource control (RRC) states shown in Fig. 2. Such RRC states may include the RRC_CONNECTED state,
10 the RRC_IDLE state, and the RRC_INACTIVE state. These RRC states may be characterized, at least in part, as follows:

RRC_IDLE:

- A UE specific DRX (discontinuous reception) may be configured by upper layers;
- UE controlled mobility based on network configuration;
- 15 - The UE:
 - Monitors a Paging channel;
 - Performs neighboring cell measurements and cell (re-)selection;
 - Acquires system information.

20 **RRC_INACTIVE:**

- A UE specific DRX may be configured by upper layers or by RRC layer;
- UE controlled mobility based on network configuration;
- The UE stores the Access Stratum (AS) context;
- The UE:
 - 25 - Monitors a Paging channel;
 - Performs neighboring cell measurements and cell (re-)selection;
 - Performs RAN-based notification area updates when moving outside the RAN-based notification area;
 - Acquires system information.

30

RRC_CONNECTED:

- The UE stores the AS context.
- Transfer of unicast data to/from UE.
- At lower layers, the UE may be configured with a UE specific DRX;
- 35 - Network controlled mobility, i.e. handover within NR and to/from E-UTRAN.;

- The UE;
- Monitors a Paging channel;
- Monitors control channels associated with the shared data channel to determine if data is scheduled for it;
- 5 - Provides channel quality and feedback information;
- Performs neighboring cell measurements and measurement reporting;
- Acquires system information.

[00041] 1.0 FIRST EXAMPLE EMBODIMENT

[00042] A first and generic example embodiment and mode of the radio access node 22 and wireless terminal 26 are illustrated in Fig. 1A. Example acts or steps performed by the wireless terminal 26 and the radio access node 22A of the first example embodiment and mode are illustrated in Fig. 3. The wireless terminal acts and the access node access of Fig. 3 are further understood and described with reference to the RRC state transitions and RRC procedures of Fig. 6, Fig. 7, and Fig. 9, for example.

15 **[00043]** The acts or steps performed by wireless terminal 26A in a first and generic example embodiment and mode are shown on the left side of Fig. 3, and are labelled as acts 3T-x. Act 3T-1 of Fig. 3 comprises the wireless terminal 26, and particularly the terminal processor 40, establishing a radio connection with radio access nodes, such as radio access node 22A. Act 3T-2 comprises the wireless terminal 26 receiving from a radio access node an identification of connection context information. Act 3T-3, performed, e.g., by the terminal radio resource controller 56 when the wireless terminal is in an inactivity state, comprises initiating an area update procedure upon moving out of a coverage area defined by a first area information.

[00044] The acts or steps performed by radio access node 22A in a first and generic example embodiment and mode are shown on the right side of Fig. 3, and are labelled as acts 3N-x. Act 3N-1 comprises the radio access node 22A establishing a connection with a wireless terminal. Act 3N-2 comprises determining first area information as a paging coverage area for the wireless terminal in an inactive state. Act 3N-3 comprises the radio access node 22A sending to the wireless terminal an identification of connection context information. 3N-4
30 comprises the radio access node 22A instructing the wireless terminal to enter the inactivity

state. Act 3N-5 comprises the radio access node 22A receiving and processing an area update from the wireless terminal.

[00045] As shown in Fig. 4, features of the first and generic example embodiment and mode include but are not limited to:

- 5 • providing the wireless terminal 26A, when the wireless terminal 26A enters an inactivity state (e.g., the RRC_INACTIVE state), with
 - (1a) an identification of connection context information (see act 3T-2 and act 3N-3) and
 - (1b) “first area information” (see act 3T-3), and
- 10 • (2) the wireless terminal 26A (when in the inactivity state) initiating an area update procedure upon moving out of a coverage area defined by a first area information (see act 3T-3 and act 3N-5).

[00046] As used herein, the “connection context information” may include AS context, e.g., a set of parameters that the wireless terminal 26A and the Radio Access Network (RAN) 15 established during the RRC_CONNECTED state. The connection context information may include parameters such as security keys for encryptions and data integrity. The connection context information, e.g., the AS context, is stored by the wireless terminal 26A when entering the RRC_INACTIVE state (always from the RRC_CONNECTED state), and also preserved and shared within the RAN.

20 **[00047]** The “first area information” mentioned in conjunction with act 3T-3 and 3N-2 is also referred to herein as information describing a RAN-based notification area. In the RRC_INACTIVE state, the mobility of the wireless terminal 26A is managed by such RAN-based notification area. The information describing the RAN-based notification area, e.g., the “first area information”, essentially defines a coverage area which, when left or exited by the 25 wireless terminal 26A in the RRC_INACTIVE state, requires performance of at least some

type of update procedure relative to the radio access network. The definition of such coverage area, i.e., the first area information or information describing the RAN-based notification area, is preferably maintained (e.g., stored) in a RAN node or server, such as an access node or a server of a management entity (such as a Mobility Management Entity [MME], for example).

5 In differing example embodiment and modes, the first area information may be expressed in differing ways. The generic example embodiment and mode of Fig. 1A encompasses and may employ any suitable manner of expression of the first area information.

[00048] Fig. 5 depicts an example expression of the first area information in an exemplary deployment of the RAN-based notification area. In the example expression of Fig. 10 5, the RAN-based notification area comprises multiple cells controlled by gNBs (gNB1, gNB2 and gNB3). The cells of the RAN-based notification area of Fig. 5 are shown as stippled hexagons, with three cells of the RAN-based notification area being controlled by radio access node gNB1, two cells being controlled by access node gNB2, and five cells being controlled by access node gNB3. The example expression of the information describing the RAN-based 15 notification area of Fig. 5 may be a listing of cell identities, e.g., a listing of cell identifies comprising the RAN-based notification area. In one configuration, when incoming downlink data is received by the radio access network for transmission to wireless terminal 26A, the RAN may send a paging message to the RAN-based notification area.

[00049] Fig. 6 shows an example procedure of a state transition from RRC_IDLE state 20 to RRC_CONNECTED state. The state transition from RRC_IDLE state to RRC_CONNECTED state may be triggered by a suitable event, such as uplink user/signaling data transfer, receipt of a paging from the network, etc. As shown in Fig. 6, the wireless terminal 26A initiates the connection establishment procedure. The connection establishment procedure comprises the wireless terminal 26A sending a message 6-1 with a *Random Access* 25 *Preamble* to the radio access node 22; the radio access node 22 sending a *Random Access Response* message 6-2; the wireless terminal 26A sending a *RRCConnectionRequest* message 6-3; the access node 22 sending a *RRCConnectionSetup* message 6-4; and the wireless terminal 26A sending a *RRCConnectionSetupComplete* message 6-5. After the connection establishment procedure, the wireless terminal 26A enters the RRC_CONNECTED state. The 30 wireless terminal 26A and the radio access node 22A may then perform data transaction(s) 6-6.

[00050] Fig. 7 shows an example procedure of a state transition from the RRC_CONNECTED state to the RRC_INACTIVE state. During the RRC_CONNECTED state, the current access node (the gNB that currently maintains connection with the wireless terminal 26A) may decide to place the wireless terminal in the RRC_INACTIVE state by sending a *RRConnectionSuspend* message 7-1 to the wireless terminal 26A. This may happen, for example, when the access node detects data inactivity for a pre-determined duration. The access node may be the same as the gNBs in Fig. 6 if the wireless terminal 26A is stationary, or may be different if the wireless terminal 26A has performed a handover after the connection establishment.

[00051] The *RRConnectionSuspend* message (see message 7-1 of Fig. 7) may include information elements such as *resumeIdentity* and *ranAreaInformation*. The *resumeIdentity* information element identifies the UE-specific AS context saved in the RAN; the *ranAreaInformation* information element comprises information or parameters indicating the RAN-based notification area, e.g., the first area information. For example, the *ranAreaInformation* information element may comprise a list of cell identities. In one example implementation, the *RRConnectionSuspend* message may be formatted as follows:

```
-- ASN1START
RRConnectionSuspend ::= SEQUENCE {
20   criticalExtensions    CHOICE {
      c1 CHOICE {
          rrcConnectionRelease RRCConnectionSuspend-IEs,
          spare3 NULL, spare2 NULL, spare1 NULL
      },
25   criticalExtensionsFuture SEQUENCE {}
  }
}

RRConnectionSuspend-IEs ::= SEQUENCE {
30   resumeIdentity      ResumeIdentity
   ranAreaInformation  RANAreaInformation
   nonCriticalExtension RRCConnectionSuspend-vxyz-IEs
   OPTIONAL
}
35 ResumeIdentity ::= BIT STRING (SIZE(40))

RANAreaInformation ::= CellIdentityList
```

```

CellIdentityList ::= SEQUENCE (SIZE (1..128)) OF
CellIdentity
5 CellIdentity ::= BIT STRING (SIZE (28))
-- ASN1STOP

```

[00052] After entering the RRC_INACTIVE state, the wireless terminal 26A may roam
 10 in the RAN-based notification area and perform cell reselections, as far as the cells that
 wireless terminal 26A camps on are listed in *ranAreaInformation*. As shown in Fig. 8, when
 the wireless terminal 26A moves out of the area defined by *ranAreaInformation*, the wireless
 terminal 26A then may perform a RAN-based notification area update (RAU).

[00053] Fig. 9 shows an example RAN-based notification area update (RAU) procedure.
 15 The RAN-based notification area update (RAU) procedure includes the wireless terminal 26A
 sending a message 9-1 with a *Random Access Preamble* to the radio access node 22; the radio
 access node 22 sending a *Random Access Response* message 9-2; the wireless terminal 26A
 sending a *RRCConnectionResumeRequest* message 9-3; the access node 22 sending a
RRCConnectionResume message 9-4; and the wireless terminal 26A sending a
 20 *RRCConnectionResumeComplete* message 9-5.

[00054] As shown in Fig. 9, after Random Access Preamble/Response, the wireless
 terminal 26A sends the *RRCConnectionResumeRequest* message 9-3 to the camping cell
 controlled by the gNB4 (see Fig. 8), which includes the *resumeIdentity* obtained upon entering
 the RRC_INACTIVE state. The gNB4 may then attempt to retrieve the UE-specific UE
 25 context saved in the RAN. In one configuration, *resumeIdentity* may indicate the location in
 the RAN where the UE context is saved. In another configuration, the UE context is saved in a
 predetermined location. When the retrieval of the UE context is successful, the gNB4 may
 response back to the wireless terminal 26A with *RRCConnectionResume* message 9-4,
 followed by the wireless terminal 26A sending back *RRCConnectionResumeComplete* message
 30 9-5. The wireless terminal 26A may stay in the RRC_CONNECTED state or eventually
 transition to the RRC_INACTIVE state as shown in Fig. 7 if the current gNB chooses to do so.

[00055] 2.0 SECOND EXAMPLE EMBODIMENT

[00056] As mentioned above, in the generic example embodiment and mode of Fig. 1A the expression of the first area information may be of any suitable manner. In a second example embodiment and mode, the RAN-based notification area may be defined as a sub-area or a list of sub-areas of an area that has significance or definition apart from the RRC_INACTIVE state. As such, for the second example embodiment and mode the first area information is said to comprise “sub-area information” or “sub-area identification”, which also may be known as “second area identification” or “second area information”. The “sub-area information” or “sub-area identification” of the second embodiment and mode embodiment and mode which comprises the first area information is periodically broadcast by each cell in a system information message.

[00057] For example, in one example implementation, the sub-area identification that each cell broadcasts may be an independently defined field solely purposed for defining RAN areas. Alternatively, the sub-area identification may be shared with another identifier that specifies a certain geographic area. As an example of the latter alternative, a Tracking Area Code (TAC) that identifies a tracking area (TA), used for the wireless terminal 26A to perform a tracking area update (TAU) for a core network, can be also used for defining a RAN area.

[00058] Fig. 1B shows an example implementation of a radio access node 22B and a wireless terminal 26B for the second example embodiment and mode. The radio access node 22B of Fig. 1B resembles the radio access node 22A of Fig. 1A, but further comprises or has access to sub-area identification generator 60. The wireless terminal 26B of Fig. 1B resembles the wireless terminal 26A of Fig. 1A, but further comprises sub-area identification storage 62, which may take the form of an electronic memory (in accordance with any of the memory types herein described). It should be understood that the radio access node 22B and wireless terminal 26B of Fig. 1B perform the generic acts of Fig. 3 and include the generic features of Fig. 4, but differ in the definition of the first area information as comprising second area information which is expressed in terms of a sub-area or list of sub-areas.

[00059] As mentioned above, in the example embodiment and mode of Fig. 1A an identification of the sub-area is periodically broadcasted by each cell via a system information message. As such, the *RRCCConnectionSuspend* message may include a list of such sub-area identifications as (e.g., in the information element) *ranAreaInformation*. Moreover, upon each
5 cell reselection, the wireless terminal 26B in the RRC_INACTIVE state that has received *RRCCConnectionSuspend* may obtain the broadcasted sub-area identification when camping on a new cell and perform RAU as disclosed in the first embodiment if the received sub-area identification is not included in the *ranAreaInformation*.

[00060] Fig. 10 illustrates one example scenario of the second example embodiment and
10 mode in which tracking area code (TAC) is used as an identification of a RAN area. Initially in the Fig. 10 situation the wireless terminal 26B has been provided with a list of TACs (TAC_1, TAC_2 and TAC_3) when the wireless terminal 26B first attached to the core network. The wireless terminal 26B then transitions to the RRC_INACTIVE state by receiving the *RRCCConnectionSuspend* message (shown as time 10-1 in Fig. 10), and in this example receives
15 an *RRCCConnectionSuspend* message that specifies TAC_1 as the RAN-based notification area. Receipt of the *RRCCConnectionSuspend* message with the new definition of the RAN-based notification area (now defined as being only TAC_1) causes wireless terminal 26B to perform a RAN-based notification area update when the wireless terminal 26B later enters a cell with TAC=TAC_2 (shown at time 10-2 in Fig. 10). At this time 10-2 the wireless terminal 26B
20 may not perform the tracking area update since TAC_2 is included in the current TAC list, which remains available to the wireless terminal 26B. But subsequently, after the RAN-based notification area update, at a time such as time 10-3 in Fig. 10, the wireless terminal 26B may eventually fall back to the RRC_INACTIVE state by a procedure such as that shown in Fig. 7. Then, at time 10-4, the wireless terminal 26B enters a cell that belongs to TAC_4 and at time
25 10-4 may perform a tracking area update (TAU), instead of a RAN-based notification area update (RAU), since TAC_4 is not in the TAC list.

[00061] Fig. 11 shows example acts and messages comprising an example tracking area update (TAU) procedure. In the TAU of Fig. 11, wireless terminal 26B follows the resume process as essentially shown in Fig. 9, but in Fig. 11 the *RRCCConnectionResumeComplete*
30 message now contains “TAU Request”. The *RRCCConnectionResumeComplete* message

comprising the “TAU Request” is conveyed to and processed in the core network, resulting in the core network sending back the TAU Accept message to the wireless terminal 26B.

Similarly, the wireless terminal 26B may stay in `RRC_CONNECTED` or eventually go back to `RRC_INACTIVE` if directed. When going back to `RRC_INACTIVE`, a new RAN-based

5 notification area (`TAC_4`) is provided via *RRConnectionSuspend*.

[00062] The following is one exemplary implementation of the format for *RRConnectionSuspend*, with a list of TACs defining the RAN-based notification area.

```
-- ASN1START
10 RRConnectionSuspend ::= SEQUENCE {
    criticalExtensions CHOICE {
        c1 CHOICE {
            rrcConnectionRelease RRConnectionSuspend-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
15        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

20 RRConnectionSuspend-IEs ::= SEQUENCE {
    resumeIdentity ResumeIdentity
    ranAreaInformation RANAreaInformation
    nonCriticalExtension RRConnectionSuspend-vxyz-IEs
    OPTIONAL
25 }

ResumeIdentity ::= BIT STRING (SIZE(40))

RANAreaInformation ::= TrackingAreaCodeList
30 TrackingAreaCodeList ::= SEQUENCE (SIZE (1..8)) OF
TrackingAreaCode

TrackingAreaCode ::= BIT STRING (SIZE (16))
35 -- ASN1STOP
```

[00063] 3.0 THIRD EXAMPLE EMBODIMENT

[00064] As mentioned above, in the generic example embodiment and mode of Fig. 1A the expression of the first area information may be of any suitable manner. In the second example embodiment and mode of Fig. 1B, the RAN-based notification area may be defined as a sub-area or a list of sub-areas of an area that has significance or definition apart from the RRC_INACTIVE state. In a third example embodiment and mode illustrated in Fig. 1C, the RAN-based notification area may be specified as a combination of cell identities and sub-area identities. In other words, the third example embodiment and mode uses an expression of the RAN-based notification area which is a combination of the second embodiment expression (sub-area information) and other expressions, such as an expression of a list of cell identifies. Thus, in the second example embodiment and mode the *RRCConnectionSuspend* may include these combined identifications. Similar to the second embodiment, one implementation of the sub-area identity may be (for example) TAC to identify TA. In such case, the following is an example format of the message.

```

15  -- ASN1START

RRCConnectionSuspend ::=      SEQUENCE {
    criticalExtensions          CHOICE {
        c1                      CHOICE {
20      rrcConnectionRelease    RRCConnectionSuspend-IEs,
        spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
25  }

RRCConnectionSuspend-IEs ::=  SEQUENCE {
    resumeIdentity              ResumeIdentity
    ranAreaInformation          RANAreaInformation
30  nonCriticalExtension        RRCConnectionSuspend-vxyz-IEs
    OPTIONAL
}

ResumeIdentity ::=             BIT STRING (SIZE(40))
35

RANAreaInformation ::=         SEQUENCE {
    cellIdentityList            CellIdentityList
    trackingAreaCodeList        TrackingAreaCodeList

```

```

    nonCriticalExtension      RANAreaInformation-vxyz
    OPTIONAL
}
5  TrackingAreaCodeList

CellIdentityList ::=          SEQUENCE (SIZE (1..128)) OF
CellIdentity

10 CellIdentity ::=            BIT STRING (SIZE (28))

TrackingAreaCodeList ::=      SEQUENCE (SIZE (1..8)) OF
TrackingAreaCode

15 TrackingAreaCode ::=        BIT STRING (SIZE (16))

-- ASN1STOP

```

[00065] Fig. 1C shows an example implementation of a radio access node 22C and a
 20 wireless terminal 26C for the third example embodiment and mode. The radio access node
 22C of Fig. 1C resembles the radio access node 22A of Fig. 1A, but further comprises or has
 access to combinatorial area identification generator 64. The wireless terminal 26C of Fig. 1C
 resembles the wireless terminal 26A of Fig. 1A, but further comprises combinatorial area
 identification storage 62, which may take the form of an electronic memory (in accordance
 25 with any of the memory types herein described). It should be understood that the radio access
 node 22C and wireless terminal 26C of Fig. 1C preform the generic acts of Fig. 3 and include
 the generic features of Fig. 4, but differ in the definition of the first area information as
 comprising second area information which is expressed in terms of combinatorial expression of
 areas.

[00066] Fig. 12 depicts a scenario of the third example embodiment and mode. In Fig.
 30 12, at time 12-1 it is assumed that wireless terminal 26C has performed a tracking area update
 and obtained from the core network a tracking area code list including TAC_1 and TAC_2.
 Thereafter at time 12-2 the wireless terminal 26C transitions to the RRC_INACTIVE state in
 the tracking area with TAC=TAC_1. At this time 12-2, the UE receives
 35 *RRCCConnectionSuspend* with *ranAreaInformation* including TAC_1. The UE then at time 12-3
 moves out of cells under TAC_1 and enters a cell with TAC_2. The wireless terminal 26C at

time 12-3 initiates RAU (understood with reference to the second embodiment). Eventually, at time 12-4 the wireless terminal 26C receives another *RRCCConnectionSuspend*, which now includes *ranAreaInformation* containing not only TAC_2 but also a list of cell identities, i.e. Cell_a, Cell_b, Cell_c and Cell_d, which may not belong to TAC_2 (which, in fact, belong to TAC_1 in the example shown in Fig. 12). The wireless terminal 26c roams around within the area of TAC_2 then at time 12-5 enters Cell_c under TAC_1. Since the cell Cell_c under TAC_1 is in the cell identity list obtained via the latest *RRCCConnectionSuspend*, the wireless terminal 26C considers itself still in the current RAN-based notification area and therefore may refrain from performing a RAN-based notification area update (RAU). Later, however, such as at time 12-6, when moving out of the combined area of TAC_2 and the four cells under TAC_1, the UE may finally perform a RAN-based notification area update (RAU), which may resulting in receiving *RRCCConnectionSuspend* with different identity lists in *ranAreaInformation* (TAC_1 in the example shown in Fig. 12).

[00067] 4.0 FOURTH EXAMPLE EMBODIMENT

[00068] Both the fourth example embodiment and mode and the fifth example embodiment and mode are based on the second or third example embodiment and modes, with an addition of automatic RAN-based notification area update at a boundary of a pre-defined area. In the fourth example embodiment and mode there is no explicit signal to a wireless terminal to direct the wireless terminal to perform the RAN-based notification area update at a boundary of a pre-defined area, while in the fifth example embodiment and mode there is an explicit signal to direct the wireless terminal to perform the RAN-based notification area update at a boundary of a pre-defined area. Therefore, Fig. 1D shows that the node radio resource controller 54 of radio access node 22D comprises node automatic RAN-based notification area update logic 70, and terminal radio resource controller 56 of wireless terminal 26D comprises terminal automatic RAN-based notification area update logic 72.

[00069] In an implementation in which the first area information concerns tracking areas (TAs), for example, the wireless terminal knows that it is at a boundary of the pre-defined area when a wireless terminal notices a change in a tracking area code broadcast by the cell. The wireless terminal 26D preferably has a list of tracking area codes that may consist of multiple

tracking areas. If the wireless terminal 26D changes from camping on a cell with a first tracking area code of the list to camping on a cell with a second tracking code of the list, the wireless terminal 26D must perform RAN-based notification area update (RNU) at the cell boundary. But if the camped on cell has a tracking area code that is not on the tracking area
5 list, then the wireless terminal 26D must perform a tracking area update (TAU) to the core network (in essentially the same manner as done in LTE).

[00070] In the fourth example embodiment and mode, and in the case where the pre-determined area is a tracking area, without explicit update requirement signaling from the network the wireless terminal 26D always performs a RAN-based notification area update
10 when crossing the boundary of a tracking area either (1) when *ranAreaInformation* includes no *TrackingAreaCodeList* or (2) when *TrackingAreaCodeList* is empty. On the other hand, if *ranAreaInformation* does include a non-empty *TrackingAreaCodeList*, this explicitly signaled *TrackingAreaCodeList* information may supersede the default configuration. The term “default configuration” refers to the automatic RAN-based notification area update (RAU),
15 which means that if *TrackingAreaCodeList* is non-empty, the wireless terminal 26D may perform RAU at the boundary of the area defined in this IE, in accordance with the second example embodiment and mode, and may disable the automatic RAU at the TA boundary.

[00071] If the RAN-based notification area signaled from the network includes a list of cell identifications but no area identifications, the UE may form a RAN-based notification area
20 by combining the cells in the cell list and the current TA. In this case, when crossing a tracking area boundary the UE may perform RAN-based notification area update if the new cell is not in the list of cell identifications, or may not do if the new camped cell is in the list.

[00072] 5.0 FIFTH EXAMPLE EMBODIMENT

[00073] As indicated above, in the fifth example embodiment and mode there is an
25 explicit signal to direct the wireless terminal to perform the RAN-based notification area update at a boundary of a pre-defined area. Therefore, Fig. 1E shows that the node radio resource controller 54 of radio access node 22E comprises node automatic RAN-based

notification area update logic 70 with explicit signaling switch 74, and terminal radio resource controller 56 of wireless terminal 26D comprises terminal automatic RAN-based notification area update logic 72 with explicit signaling switch 76.

[00074] In the fifth example embodiment and mode, the switch (represented, e.g., in the radio access node 22E by switch 74 and in the wireless terminal 26E by switch 76) is provided to specify whether the procedure of the fourth example embodiment and mode is to be performed, or a procedure of the fifth example embodiment and mode. In an example implementation, the switch is an information element known as *autoUpdateAtTA*. In such example implementation, if a value (Boolean value) of the switch is TRUE or ON, then the procedure of the fourth example embodiment and mode is performed. In such situation (when the switch is TRUE), the *TrackingAreaCodeList* is likely not present, but in any event there is an automatic RAN-based notification area update on the TA code boundaries (except if a Tracking Area Update (TAU) is required at the boundary). Otherwise, if the value (Boolean value) of the switch is FALSE, then the procedure of the fifth example embodiment and mode is performed. When the switch is FALSE or OFF, then the wireless terminal 26E performs a RAN-based notification area update based on the area definition included in the first area information. Thus, in the fifth embodiment and mode, when the switch is FALSE or OFF, RAU is performed; (1) in accordance with the first embodiment and mode if the cell identity list is present in the first area information, (2) in accordance with the second embodiment and mode if the sub-area identification list is present in the first area information, or (3) in accordance with the third embodiment and mode if both the cell identity and the sub-area identification lists are present in the first area information.

[00075] In the fifth example embodiment and mode the network may explicitly signal via the switch (e.g., *autoUpdateatTA*) whether the UE performs the automatic RAN-based notification area update at a boundary of a pre-defined area. For example, if a tracking area is used as the pre-defined area, in one configuration the gNB may include the switch/Boolean field *autoUpdateatTA* in *ranAreaInformation* of *RRCCConnectionSuspend* as shown below.

```

-- ASN1START
5  RRCConnectionSuspend ::=          SEQUENCE {
    criticalExtensions                CHOICE {
      c1                             CHOICE {
10         rrcConnectionRelease      RRCConnectionSuspend-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture     SEQUENCE {}
      }
    }
15  RRCConnectionSuspend-IEs ::=      SEQUENCE {
    resumeIdentity                   ResumeIdentity
    ranAreaInformation               RANAreaInformation
    nonCriticalExtension              RRCConnectionSuspend-vxyz-IEs    OPTIONAL
  }
20  ResumeIdentity ::=                BIT STRING (SIZE(40))
  RANAreaInformation ::=              SEQUENCE {
    cellIdentityList                 CellIdentityList                  OPTIONAL
    autoUpdateAtTA                   BOOLEAN
25    trackingAreaCodeList            TrackingAreaCodeList             OPTIONAL
    nonCriticalExtension              RANAreaInformation-vxyz          OPTIONAL
  }
  TrackingAreaCodeList
30  CellIdentityList ::=               SEQUENCE (SIZE (1..128)) OF CellIdentity
  CellIdentity ::=                    BIT STRING (SIZE (29))
35  TrackingAreaCodeList ::=           SEQUENCE (SIZE (1..3)) OF TrackingAreaCode
  TrackingAreaCode ::=                BIT STRING (SIZE (16))
-- ASN1STOP
40

```

[00076] When the wireless terminal 26E receives the message shown above, and if *autoUpdateAtTA* is set to TRUE, the wireless terminal 26E may perform RAN-based notification area update at the tracking area boundary, regardless of whether the *trackingAreaCodeList* is present. (In one configuration, when *autoUpdateAtTA* is set to TRUE, the optional field *trackingAreaCodeList* may be omitted). Similar to the fourth embodiment, the wireless terminal 26E may construct the RAN-based notification area by combining the current TA and the cells in *CellIdentityList* if it is present and non-empty. If *autoUpdateAtTA* is set to FALSE, then the wireless terminal 26E may follow the methods described in the embodiments disclosed earlier.

[00077] In another configuration, each gNB may include *autoUpdateAtTA* in a periodically broadcasted message, such as system information.

[00078] Although the processes and methods of the disclosed embodiments may be discussed as being implemented as a software routine, some of the method steps that are disclosed therein may be performed in hardware as well as by a processor running software. As such, the embodiments may be implemented in software as executed upon a computer system, in hardware as an application specific integrated circuit or other type of hardware implementation, or a combination of software and hardware. The software routines of the disclosed embodiments are capable of being executed on any computer operating system, and is capable of being performed using any CPU architecture. The instructions of such software are stored on non-transient computer readable media.

[00079] The functions of the various elements including functional blocks, including but not limited to those labeled or described as “computer”, “processor” or “controller”, may be provided through the use of hardware such as circuit hardware and/or hardware capable of executing software in the form of coded instructions stored on computer readable medium. Thus, such functions and illustrated functional blocks are to be understood as being either hardware-implemented and/or computer-implemented, and thus machine-implemented.

[00080] In terms of hardware implementation, the functional blocks may include or encompass, without limitation, digital signal processor (DSP) hardware, reduced instruction set processor, hardware (e.g., digital or analog) circuitry including but not limited to application specific integrated circuit(s) [ASIC], and/or field programmable gate array(s) (FPGA(s)), and (where appropriate) state machines capable of performing such functions.

[00081] Certain units and functionalities of node 22 and wireless terminal 26 are, in example embodiments, implemented by electronic machinery, computer, and/or circuitry. For example, the node processors 30 and terminal processors 40 of the example embodiments herein described and/or encompassed may be comprised by the computer circuitry of Fig. 13. Fig. 13 shows an example of such electronic machinery or circuitry, whether node or terminal, as comprising one or more processor(s) circuits 190, program instruction memory 191; other memory 192 (e.g., RAM, cache, etc.); input/output interfaces 193; peripheral interfaces 194; support circuits 195; and busses 196 for communication between the aforementioned units.

[00082] The program instruction memory 191 may comprise coded instructions which, when executed by the processor(s), perform acts including but not limited to those described herein. Thus is understood that each of node processor 30 and terminal processor 40, for example, comprise memory in which non-transient instructions are stored for execution.

5 **[00083]** In terms of computer implementation, a computer is generally understood to comprise one or more processors or one or more controllers, and the terms computer and processor and controller may be employed interchangeably herein. When provided by a computer or processor or controller, the functions may be provided by a single dedicated computer or processor or controller, by a single shared computer or processor or controller, or
10 by a plurality of individual computers or processors or controllers, some of which may be shared or distributed. Moreover, use of the term “processor” or “controller” shall also be construed to refer to other hardware capable of performing such functions and/or executing software, such as the example hardware recited above.

[00084] The functions of the various elements including functional blocks, including but
15 not limited to those labeled or described as “computer”, “processor” or “controller”, may be provided through the use of hardware such as circuit hardware and/or hardware capable of executing software in the form of coded instructions stored on computer readable medium. Thus, such functions and illustrated functional blocks are to be understood as being either hardware-implemented and/or computer-implemented, and thus machine-implemented.

20 **[00085]** Nodes that communicate using the air interface also have suitable radio communications circuitry. Moreover, the technology can additionally be considered to be embodied entirely within any form of computer-readable memory, such as solid-state memory, magnetic disk, or optical disk containing an appropriate set of computer instructions that would cause a processor to carry out the techniques described herein.

25 **[00086]** It will be appreciated that the technology disclosed herein is directed to solving radio communications-centric issues and is necessarily rooted in computer technology and overcomes problems specifically arising in radio communications. Moreover, in at least one of its aspects the technology disclosed herein improves the functioning of the basic function of a

wireless terminal and/or node itself so that, for example, the wireless terminal and/or node can operate more effectively by prudent use of radio resources.

[00087] One or more of the following documents (all of which are incorporated herein by reference) may be relevant to the technology described herein:

- 5 [1] R2-1704120 RAN area updating due to mobility in RRC_INACTIVE Ericsson
- [2] R2-1704121 Periodic RAN area updates in RRC_INACTIVE Ericsson
- [3] R2-1704122 CN area updating in RRC_INACTIVE Ericsson
- [4] R2-1704149 RRC procedures for the RAN notification area for NR Samsung
- [5] R2-1704242 Relocation of anchor gNB CATT
- 10 [6] R2-1704312 Comparison and Discussion on RAN-based Notification Area Update MTI
- [7] R2-1704550 RAN Update Procedure in RRC_INACTIVE PANASONIC R&D Center Germany
- [8] R2-1704883 Scenarios and solution for state mismatch Huawei, HiSilicon
- [9] R2-1704890 Periodic RAN-based notification area update Huawei, HiSilicon
- [10] R2-1704891 Discussion on LAU and RNA update for inactive state Huawei, HiSilicon
- 15 [11] R2-1705260 RAN-based area update procedure Fujitsu
- [12] R2-1705269 Location update at RAN-based notification area boundary NEC

[00088] The technology disclosed herein thus encompasses, but is not limited to, the following example embodiments and modes:

20

[00089] Example embodiment 1: A wireless terminal comprising:

receiver circuitry and transmitter circuitry configured to communicate across a radio interface with a radio access node;

processor circuitry configured to:

25

establish a radio connection with radio access nodes;

receive from a radio access node an identification of connection context information;

in an inactivity state initiate an area update procedure upon moving out of a coverage area defined by a first area information.

[00090] Example embodiment 2: The wireless terminal of example embodiment 1, wherein the connection context information includes security keys used for encryption and/or data integrity during the period of the radio connection.

5 **[00091]** Example embodiment 3: The wireless terminal of example embodiment 1, wherein the area update procedure comprises the wireless terminal sending to the current serving radio access node a message including the identification of the connection context information.

[00092] Example embodiment 4: The wireless terminal of example embodiment 1, wherein the first area information is provided by a radio access node.

10 **[00093]** Example embodiment 5: The wireless terminal of example embodiment 4, wherein the first area information is provided in the message where the connection context information is present.

[00094] Example embodiment 6: The wireless terminal of example embodiment 4, wherein the first area information comprises at least one cell identity.

15 **[00095]** Example embodiment 7: The wireless terminal of example embodiment 4, wherein the first area information comprises at least one second area identification, where each cell under the control of the radio access node broadcasts a designated second area identification.

20 **[00096]** Example embodiment 8: The wireless terminal of example embodiment 7, wherein the second area identification is a tracking area code.

[00097] Example embodiment 9: The wireless terminal of example embodiment 7, wherein the first area information further includes at least one cell identification.

[00098] Example embodiment 10: The wireless terminal of example embodiment 9, wherein the wireless terminal performs the area update procedure upon moving out of the

coverage defined by the combination of the cell identifications and the second area identifications.

[00099] Example embodiment 11: The wireless terminal of example embodiment 1, wherein the first area information is pre-determined.

5 **[000100]** Example embodiment 12: The wireless terminal of example embodiment 11, wherein each tracking area is considered as a defined coverage of a first area information.

[000101] Example embodiment 13: The wireless terminal of example embodiment 12, wherein the wireless terminal receives an indication from a radio access node indicating whether the area update procedure is to be performed when moving out of the coverage
10 defined by the first area information.

[000102] Example embodiment 14: The wireless terminal of any one of example embodiment 4 and example embodiment 11, wherein the wireless terminal combines both the first area information provided by the radio access node and the pre-defined first area information to define the coverage area for the area update procedure.

15 **[000103]** Example embodiment 15: A radio access node comprising:

receiver circuitry and transmitter circuitry configured to communicate across a radio interface with a wireless terminal;

processor circuitry configured to:

establish a connection with a wireless terminal;

20 determine first area information as a paging coverage area for the wireless terminal in an inactive state;

send to the wireless terminal an identification of connection context information;

instruct the wireless terminal to enter the inactivity state;

25 receive and process an area update from the wireless terminal.

[000104] Example embodiment 16: The radio access node of example embodiment 15, wherein the connection context information includes security keys used for encryption and data integrity during the period of the radio connection.

5 **[000105]** Example embodiment 17: The radio access node of example embodiment 15, wherein the area update procedure comprises the radio access node receiving from the wireless terminal a message including the identification of the connection context information.

[000106] Example embodiment 18: The radio access node of example embodiment 15, wherein the radio access node provides the wireless terminal the first area information.

10 **[000107]** Example embodiment 19: The radio access node of example embodiment 18, wherein the first area information is provided in the message where the connection context information is present.

[000108] Example embodiment 20: The radio access node of example embodiment 18, wherein the first area information comprises at least one cell identity.

15 **[000109]** Example embodiment 21: The radio access node of example embodiment 18, wherein the first area information comprises at least one second area identification, where each cell under the control of the radio access node broadcasts a designated second area identification.

[000110] Example embodiment 22: The radio access node of example embodiment 21, wherein the second area identification is a tracking area code.

20 **[000111]** Example embodiment 23: The radio access node of example embodiment 21, wherein the first area information further includes at least one cell identification.

[000112] Example embodiment 24: The radio access node of example embodiment 15, wherein the first area information is pre-determined.

[000113] Example embodiment 25: The radio access node of example embodiment 24, wherein each tracking area is considered as a defined coverage of a first area information.

[000114] Example embodiment 26: The radio access node of example embodiment 25, wherein the radio access node sends to the wireless terminal an indication indicating whether the area update procedure is to be performed when moving out of the coverage defined by the first area information.

[000115] Example embodiment 27: A method in a wireless terminal comprising:

using receiver circuitry and transmitter circuitry configured to communicate across a radio interface with a radio access node;

using processor circuitry to:

establish a radio connection with radio access nodes;

receive from a radio access node an identification of connection context information;

in the inactivity state initiate an area update procedure upon moving out of the coverage area defined by first area information.

[000116] Example embodiment 28: The method of example embodiment 27, wherein the connection context information includes security keys used for encryption and data integrity during the period of the radio connection.

[000117] Example embodiment 29: The method of example embodiment 27, wherein the area update procedure comprises sending a message including the identification of the connection context information.

[000118] Example embodiment 30: The method of example embodiment 27, wherein the first area information is provided by a radio access node.

[000119] Example embodiment 31: The method of example embodiment 30, wherein the first area information is provided in the message where the connection context information is present.

[000120] Example embodiment 32: The method of example embodiment 30, wherein the first area information comprises at least one cell identity.

[000121] Example embodiment 33: The method of example embodiment 30, wherein the first area information comprises at least one second area identification, where each cell under the control of the radio access node broadcasts a designated second area identification.

[000122] Example embodiment 34: The method of example embodiment 33, wherein the second area identification is a tracking area code.

[000123] Example embodiment 35: The method of example embodiment 33, wherein the area information further includes at least one cell identification.

[000124] Example embodiment 36: The method of example embodiment 35, wherein further performing the area update procedure upon moving out of the coverage defined by the combination of the cell identifications and the second area identifications.

[000125] Example embodiment 37: The method of example embodiment 27, wherein the first area information is pre-determined.

[000126] Example embodiment 38: The method of example embodiment 27, wherein each tracking area is considered as a defined coverage of a first area information.

[000127] Example embodiment 39: The method of example embodiment 38, wherein further receiving an indication from a radio access node indicating whether the area update procedure is to be performed when moving out of the coverage defined by the first area information.

[000128] Example embodiment 40: The method of any one of example embodiment 30 and example embodiment 37, wherein further combining both the first area information provided by the radio access node and the pre-defined first area information to define a aggregated coverage area for the area update procedure.

[000129] Example embodiment 41: A method in a radio access node comprising:

using receiver circuitry and transmitter circuitry to communicate across a radio interface with a wireless terminal;

using processor circuitry to:

- 5 establish a connection with a wireless terminal;
- determine first area information as a paging coverage area for the wireless terminal in an inactive state;
- send to the wireless terminal an identification of connection context information;
- 10 instruct the wireless terminal to enter said inactivity state;
- receive and process an area update from the wireless terminal.

[000130] Example embodiment 42: The method of example embodiment 41, wherein the connection context information includes security keys used for encryption and data integrity during the period of the radio connection.

- 15 **[000131]** Example embodiment 43: The method of example embodiment 41, wherein the area update procedure comprises receiving a message including the identification of the connection context information.

[000132] Example embodiment 44: The method of example embodiment 41, wherein providing the first area information.

- 20 **[000133]** Example embodiment 45: The method of example embodiment 44, wherein the first area information is provided in the message where the connection context information is present.

[000134] Example embodiment 46: The method of example embodiment 44, wherein the first area information comprises at least one cell identity.

[000135] Example embodiment 47: The method of example embodiment 44, wherein the first area information comprises at least one second area identification, where each cell under the control of the radio access node broadcasts a designated second area identification.

[000136] Example embodiment 48: The method of example embodiment 47, wherein the
5 second area identification is a tracking area code.

[000137] Example embodiment 49: The method of example embodiment 44, wherein the first area information further includes at least one cell identification.

[000138] Example embodiment 50: The method of example embodiment 41, wherein the first area information is pre-determined.

10 **[000139]** Example embodiment 51: The method of example embodiment 50, wherein each tracking area is considered as a defined coverage of a first area information.

[000140] Example embodiment 52: The method of example embodiment 51, wherein further sending an indication indicating whether the area update procedure is to be performed when moving out of the coverage defined by the first area information.

15 **[000141]** Although the description above contains many specificities, these should not be construed as limiting the scope of the technology disclosed herein but as merely providing illustrations of some of the presently preferred embodiments of the technology disclosed herein. Thus the scope of the technology disclosed herein should be determined by the appended claims and their legal equivalents. Therefore, it will be appreciated that the scope of
20 the technology disclosed herein fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the technology disclosed herein is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural, chemical, and functional equivalents to the elements
25 of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the

present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the technology disclosed herein, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element,

5 component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

WHAT IS CLAIMED IS:

1 1. A wireless terminal comprising:
2 receiver circuitry and transmitter circuitry configured to communicate across a radio
3 interface with a radio access node;
4 processor circuitry configured to:
5 establish a radio connection with radio access nodes;
6 receive from a radio access node an identification of connection context
7 information;
8 in an inactivity state initiate an area update procedure upon moving out of a
9 coverage area defined by a first area information.

1 2. The wireless terminal of claim 1, wherein the connection context information
2 includes security keys used for encryption and/or data integrity during the period of the radio
3 connection.

1 3. The wireless terminal of claim 1, wherein the area update procedure comprises
2 the wireless terminal sending to the current serving radio access node a message including the
3 identification of the connection context information.

1 4. The wireless terminal of claim 1, wherein the first area information is provided
2 by a radio access node.

1 5. The wireless terminal of claim 4, wherein the first area information is provided
2 in the message where the connection context information is present.

1 6. The wireless terminal of claim 4, wherein the first area information comprises at
2 least one cell identity.

1 7. The wireless terminal of claim 4, wherein the first area information comprises at
2 least one second area identification, where each cell under the control of the radio access node
3 broadcasts a designated second area identification.

1 8. The wireless terminal of claim 7, wherein the second area identification is a
2 tracking area code.

1

1 9. The wireless terminal of claim 7, wherein the first area information further
2 includes at least one cell identification.

1

1 10. The wireless terminal of claim 9, wherein the wireless terminal performs the
2 area update procedure upon moving out of the coverage defined by the combination of the cell
3 identifications and the second area identifications.

1

1 11. The wireless terminal of claim 1, wherein the first area information is pre-
2 determined.

1

1 12. The wireless terminal of claim 11, wherein each tracking area is considered as a
2 defined coverage of a first area information.

1

1 13. The wireless terminal of claim 12, wherein the wireless terminal receives an
2 indication from a radio access node indicating whether the area update procedure is to be
3 performed when moving out of the coverage defined by the first area information.

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1 14. The wireless terminal of any one of claim 4 and claim 11, wherein the wireless
2 terminal combines both the first area information provided by the radio access node and the
3 pre-defined first area information to define the coverage area for the area update procedure.

1

1 15. A radio access node comprising:
2 receiver circuitry and transmitter circuitry configured to communicate across a radio
3 interface with a wireless terminal;
4 processor circuitry configured to:
5 establish a connection with a wireless terminal;
6 determine first area information as a paging coverage area for the wireless
7 terminal in an inactive state;

8 send to the wireless terminal an identification of connection context
9 information;
10 instruct the wireless terminal to enter the inactivity state;
11 receive and process an area update from the wireless terminal.

1

1 16. The radio access node of claim 15, wherein the connection context information
2 includes security keys used for encryption and data integrity during the period of the radio
3 connection.

1

1 17. The radio access node of claim 15, wherein the area update procedure
2 comprises the radio access node receiving from the wireless terminal a message including the
3 identification of the connection context information.

1

1 18. The radio access node of claim 15, wherein the radio access node provides the
2 wireless terminal the first area information.

1

1 19. The radio access node of claim 18, wherein the first area information is
2 provided in the message where the connection context information is present.

1

1 20. The radio access node of claim 18, wherein the first area information comprises
2 at least one cell identity.

1

1 21. The radio access node of claim 18, wherein the first area information comprises
2 at least one second area identification, where each cell under the control of the radio access
3 node broadcasts a designated second area identification.

1

1 22. The radio access node of claim 21, wherein the second area identification is a
2 tracking area code.

1

1 23. The radio access node of claim 21, wherein the first area information further
2 includes at least one cell identification.

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1 24. The radio access node of claim 15, wherein the first area information is pre-
2 determined.

1 25. The radio access node of claim 24, wherein each tracking area is considered as a
2 defined coverage of a first area information.

1 26. The radio access node of claim 25, wherein the radio access node sends to the
2 wireless terminal an indication indicating whether the area update procedure is to be performed
3 when moving out of the coverage defined by the first area information.

1 27. A method in a wireless terminal comprising:
2 using receiver circuitry and transmitter circuitry configured to communicate across a
3 radio interface with a radio access node;
4 using processor circuitry to:
5 establish a radio connection with radio access nodes;
6 receive from a radio access node an identification of connection context
7 information;
8 in the inactivity state initiate an area update procedure upon moving out of the
9 coverage area defined by first area information.

1 28. The method of claim 27, wherein the connection context information includes
2 security keys used for encryption and data integrity during the period of the radio connection.

1 29. The method of claim 27, wherein the area update procedure comprises sending
2 a message including the identification of the connection context information.

1 30. The method of claim 27, wherein the first area information is provided by a
2 radio access node.

1 31. The method of claim 30, wherein the first area information is provided in the
2 message where the connection context information is present.

1 32. The method of claim 30, wherein the first area information comprises at least
2 one cell identity.

1

1 33. The method of claim 30, wherein the first area information comprises at least
2 one second area identification, where each cell under the control of the radio access node
3 broadcasts a designated second area identification.

1

1 34. The method of claim 33, wherein the second area identification is a tracking
2 area code.

1

1 35. The method of claim 33, wherein the area information further includes at least
2 one cell identification.

1

1 36. The method of claim 35, wherein further performing the area update procedure
2 upon moving out of the coverage defined by the combination of the cell identifications and the
3 second area identifications.

1

1 37. The method of claim 27, wherein the first area information is pre-determined.

1

1 38. The method of claim 27, wherein each tracking area is considered as a defined
2 coverage of a first area information.

1

1 39. The method of claim 38, wherein further receiving an indication from a radio
2 access node indicating whether the area update procedure is to be performed when moving out
3 of the coverage defined by the first area information.

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1 40. The method of any one of claim 30 and claim 37, wherein further combining
2 both the first area information provided by the radio access node and the pre-defined first area
3 information to define a aggregated coverage area for the area update procedure.

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1 41. A method in a radio access node comprising:
2 using receiver circuitry and transmitter circuitry to communicate across a radio
3 interface with a wireless terminal;
4 using processor circuitry to:
5 establish a connection with a wireless terminal;
6 determine first area information as a paging coverage area for the wireless
7 terminal in an inactive state;
8 send to the wireless terminal an identification of connection context
9 information;
10 instruct the wireless terminal to enter said inactivity state;
11 receive and process an area update from the wireless terminal.

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1 42. The method of claim 41, wherein the connection context information includes
2 security keys used for encryption and data integrity during the period of the radio connection.

1

1 43. The method of claim 41, wherein the area update procedure comprises receiving
2 a message including the identification of the connection context information.

1

1 44. The method of claim 41, wherein providing the first area information.

1

1 45. The method of claim 44, wherein the first area information is provided in the
2 message where the connection context information is present.

1

1 46. The method of claim 44, wherein the first area information comprises at least
2 one cell identity.

1

1 47. The method of claim 44, wherein the first area information comprises at least
2 one second area identification, where each cell under the control of the radio access node
3 broadcasts a designated second area identification.

1

1 48. The method of claim 47, wherein the second area identification is a tracking
2 area code.

1

1 49. The method of claim 44, wherein the first area information further includes at
2 least one cell identification.

1

1 50. The method of claim 41, wherein the first area information is pre-determined.

1

1 51. The method of claim 50, wherein each tracking area is considered as a defined
2 coverage of a first area information.

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1 52. The method of claim 51, wherein further sending an indication indicating
2 whether the area update procedure is to be performed when moving out of the coverage
3 defined by the first area information.

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ABSTRACT OF THE DISCLOSURE

In one of its aspects the technology disclosed herein concerns a communications system comprising an access node (22) and a wireless terminal (26). The wireless terminal comprises receiver circuitry (40) and transmitter circuitry (44) as well as terminal processor circuitry (40).

5 The receiver circuitry (40) and transmitter circuitry (44) are configured to communicate across a radio interface (24) with the radio access node (22). The terminal processor circuitry (40) is configured to establish a radio connection with radio access nodes; receive from a radio access node an identification of connection context information; and, in an inactivity state initiate an area update procedure upon moving out of a coverage area defined by a first area information.

Electronic Acknowledgement Receipt

EFS ID:	29426368
Application Number:	62516586
International Application Number:	
Confirmation Number:	3417
Title of Invention:	AREA UPDATE PROCEDURE(S) FOR RADIO SYSTEM
First Named Inventor/Applicant Name:	Atsushi ISHII
Customer Number:	126613
Filer:	H. Warren Burnam
Filer Authorized By:	
Attorney Docket Number:	SLA 3747P_6112-99
Receipt Date:	07-JUN-2017
Filing Date:	
Time Stamp:	19:42:47
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 260
RAM confirmation Number	060817INTEFSW19432800
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1	Application Data Sheet	SLA3747P_6112-99_hwb_ADS.pdf	1822705	no	8
			0bd0edc7555f0d1e7bc3e110289af90c61ddbca2		
Warnings:					
Information:					
2	Provisional Cover Sheet (SB16)	SLA3747P_6112-99_Provisional_transmittal.pdf	1477099	no	3
			49577d207884dbf64774647b6ee8a9e03205b2c7		
Warnings:					
Information:					
3	Drawings-only black and white line drawings	SLA3747P_6112-99_drawings.pdf	463657	no	14
			b976cc73aa5d71fd354172cdf1b4dad4818d6cba		
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4		SLA3747P_6112-99_app_USproov_June_7_2017.pdf	324955	yes	42
			f4bf51b93a1855b8c2dc6a50709c29b3bf43076		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	34	
	Claims		35	41	
	Abstract		42	42	
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	30123	no	2
			735317786600ca5ecf5a3a327be6f83faabb500a		

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