



(51) International Patent Classification:
H04L 27/00 (2006.01)

(21) International Application Number:
PCT/CN2022/123500

(22) International Filing Date:
30 September 2022 (30.09.2022)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH,

(54) Title: METHODS AND APPARATUSES FOR AI/ML MODEL SELECTION AND NLOS IDENTIFICATION FOR NR POSITIONING ESTIMATION ENHANCEMENT

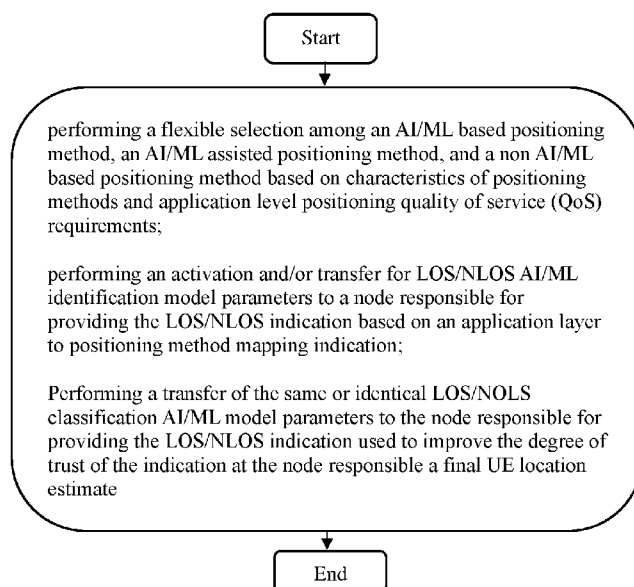


FIG. 2

(57) Abstract: A method for artificial intelligence (AI) /machine learning (ML) model selection and non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement performed by a communication network system includes performing a flexible selection among an AI/ML based positioning method, an AI/ML assisted positioning method, and a non AI/ML based positioning method based on characteristics of positioning methods and application level positioning quality of service (QoS) requirements; performing an activation and/or transfer for LOS/NLOS AI/ML identification model parameters to a node responsible for providing the LOS/NLOS indication based on an application layer to positioning method mapping indication; and/or performing a transfer of the same or identical LOS/NOLS classification AI/ML model parameters to the node responsible for providing the LOS/NLOS indication

TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS,
ZA, ZM, ZW.

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

Published:

— *with international search report (Art. 21(3))*

used to improve the degree of trust of the indication at the node responsible a final UE location estimate.

METHODS AND APPARATUSES FOR AI/ML MODEL SELECTION AND NLOS IDENTIFICATION FOR NR
POSITIONING ESTIMATION ENHANCEMENT

BACKGROUND OF DISCLOSURE

1. Field of the Disclosure

[0001] The present disclosure relates to the field of wireless communication systems, and more particularly, to methods and apparatuses for artificial intelligence (AI)/machine learning (ML) model selection and non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement. For example, the present disclosure relates to enhancing the current NR radio access network (RAN) signaling and procedures to support AI/ML based positioning methods for improving the accuracy of UE location estimation.

2. Description of the Related Art

[0002] In 3gpp RAN #94 meeting, a new study item (SI) on AI/ML for NR air interface has been approved with the main goal of exploring the benefits of enhancing the air interface with features enabling an improved support of AI/ML based algorithms for enhanced performance and/or reduced complexity/overhead. The aims of this study item are to focus on studying a few carefully selected use cases like CSI feedback, beam management and positioning accuracy enhancement, with the goal of identifying the areas where AI/ML could improve the performance of the air interface functions.

[0003] Regarding AI positioning accuracy enhancements, it was agreed in RAN1#109 meeting to study two options of AI-based positioning enhancements namely direct AI-based and AI-assisted positioning method. In direct AI positioning option, an AI-based model is supposed to replace an existing positioning method and to be utilized directly for final UE location estimate. On the other hand, in AI-assisted positioning method an AI model is used to assist the existing positioning method on improving UE positioning estimation accuracy. For this option, it is reported by some companies during RAN1#109 meeting that this option may provide a slightly less positioning accuracy than the AI-based positioning method but it has the advantage of backward compatibility with the existing non-AI based positioning methods, good model generalization capability and less overhead and/or system complexity. In addition, it is more suitable for the indoor scenario with heavy non-line-of-sight (NLOS) condition, as this method relies on leveraging AI/ML models on improving the accuracy of NLOS identification for positioning technologies which rely on the line-of-sight (LOS) measurements for UE positioning estimation. For such kind of positioning technologies, it was agreed in 3gpp release 17 standard to introduce providing LOS/NLOS indication from UE or the positioning transmission and reception points (TRP) to node responsible for UE location estimation to assist in improving the positioning estimation; however, it has not been disclosed by the standard how NLOS/LOS indication can be obtained. Without clarifying this aspect, different node i.e., responsible for providing the NLOS/LOS indication may use different estimation approaches with different degree of estimation error to identify LOS/NOLS for a path, and such untrusted or unreliable NLOS/LOS indication may impact the final location estimation accuracy.

[0004] Apart from the above considerations, according to the application-level positioning accuracy requirement provided in TR 38.857, it is observable that different NR positioning application categories have different level of positioning QoS accuracy requirement. For example, some positioning applications require a very relaxed positioning accuracy level that can be guaranteed by only using of the traditional non-AI positioning methods. While some others applications require a moderate level which can be guaranteed by using AI-assisted method. On the other hand, some others applications require stricter positioning accuracy level which can only be guaranteed when AI-based

positioning methods. Therefore, it is very likely that R18 positioning enhancement will support both AI based and AI assisted on the top of the existing positioning solutions to address the difference in the positioning QoS or accuracy requirements for different positioning applications. Under such consideration, it is not clear how to select between AI/ML based or AI/ML assisted or non-AI positioning methods given the characteristics of each method as discussed above and the difference in positioning application QoS or accuracy requirement. Additionally, it is also not clear and how the issue of determining the NLOS/LOS conditions could be handled in the case that an AI/ML assisted method is selected as preferred method for UE positioning estimation. This report provides a method for flexible selection of the preferred positioning methods based on QoS requirements of the positioning application and the characteristics of the positioning estimation methods and introduces a mechanism to address the NLOS/LOS indication reliably issue.

SUMMARY

[0005] An object of the present disclosure is to propose methods and apparatuses for artificial intelligence (AI)/machine learning (ML) model selection and non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement.

[0006] In a first aspect of the present disclosure, a method for artificial intelligence (AI)/machine learning (ML) model selection for non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement performed by a communication network system includes performing a flexible selection among an AI/ML based positioning method, an AI/ML assisted positioning method, and a non AI/ML based positioning method based on characteristics of positioning methods and application level positioning quality of service (QoS) requirements; performing an activation and/or transfer for LOS/NLOS AI/ML identification model parameters to a node responsible for providing the LOS/NLOS indication based on an application layer to positioning method mapping indication; and/or performing a transfer of the same or identical LOS/NLOS classification AI/ML model parameters to the node responsible for providing the LOS/NLOS indication used to improve the degree of trust of the indication at the node responsible for a final UE location estimate.

[0007] In a second aspect of the present disclosure, a communication network system comprises a memory, a transceiver, and a processor coupled to the memory and the transceiver. The processor is configured to perform the above method.

[0008] In a third aspect of the present disclosure, a non-transitory machine readable storage medium has stored thereon instructions that, when executed by a computer, cause the computer to perform the above method.

[0009] In a fourth aspect of the present disclosure, a chip includes a processor, configured to call and run a computer program stored in a memory, to cause a device in which the chip is installed to execute the above method.

[0010] In a fifth aspect of the present disclosure, a computer readable storage medium, in which a computer program is stored, causes a computer to execute the above method.

[0011] In a sixth aspect of the present disclosure, a computer program product includes a computer program, and the computer program causes a computer to execute the above method.

[0012] In a seventh aspect of the present disclosure, a computer program causes a computer to execute the above method.

BRIEF DESCRIPTION OF DRAWINGS

[0013] In order to illustrate the embodiments of the present disclosure or related art more clearly, the following figures will be described in the embodiments are briefly introduced. It is obvious that the drawings are merely some

embodiments of the present disclosure, a person having ordinary skill in this field can obtain other figures according to these figures without paying the premise.

[0014] FIG. 1 is a block diagram of one or more user equipments (UEs) and first and second RAN nodes of communication in a communication network system according to an embodiment of the present disclosure.

5 **[0015]** FIG. 2 is a flowchart illustrating a method for artificial intelligence (AI)/machine learning (ML) model selection for non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement performed by a communication network system according to an embodiment of the present disclosure.

[0016] FIG. 3 is an example of NR positioning system architectures with different AI positioning model location and collaboration options according to an embodiment of the present disclosure.

10 **[0017]** FIG. 4 is an example of Direct AI/ML based positioning and AI/ML assisted positioning methods according to an embodiment of the present disclosure.

[0018] FIG. 5 is an example of AI/ML assisted positioning methods for LOS/NLOS identification according to an embodiment of the present disclosure.

15 **[0019]** FIG. 6 is an example of Possible Signaling for exchanging the mapping or indication for positioning methods selection according to an embodiment of the present disclosure.

[0020] FIG. 7A is an example of Signaling for exchanging the mapping or indication for AI-assisted measurement configuration and LOS/NLOS identification according to an embodiment of the present disclosure.

20 **[0021]** FIG. 7B is an example of Signaling for exchanging the mapping or indication for AI-assisted/AI-based measurement configuration, LOS/NLOS identification and/or model parameters transfer according to an embodiment of the present disclosure.

[0022] FIG. 8 is an example of signaling for exchanging the mapping or indication for AI-assisted/AI-based measurement configuration, LOS/NLOS identification and/or model parameters transfer according to an embodiment of the present disclosure.

25 **[0023]** FIG. 9 is an example of signaling and procedure related to requesting or transferring of AI/ML model parameters assuming model at location server (AMF/LMF/5GC) according to an embodiment of the present disclosure.

[0024] FIG. 10 is a block diagram of a system for wireless communication according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

30 **[0025]** Embodiments of the present disclosure are described in detail with the technical matters, structural features, achieved objects, and effects with reference to the accompanying drawings as follows. Specifically, the terminologies in the embodiments of the present disclosure are merely for describing the purpose of the certain embodiment, but not to limit the disclosure.

35 **[0026]** FIG. 1 illustrates that, in some embodiments, a target device 10, an RAN node (e.g., gNB) 20, and a network node (e.g., LMF or AMF, location server (LCS)) 30 for communication in a communication network system 40 according to an embodiment of the present disclosure are provided. The communication network system 40 includes the target device 10, the RAN node (e.g., gNB) 20, and the network node (e.g., LMF or AMF, location server (LCS)) 30. The target device 10 may include a memory 12, a transceiver 13, and a processor 11 coupled to the memory 12 and the transceiver 13. The RAN node (e.g., gNB) 20 may include a memory 22, a transceiver 23, and a processor 21 coupled to the memory 22 and the transceiver 23. The network node (e.g., LMF or AMF, location server (LCS)) 30

may include a memory 32, a transceiver 33, and a processor 31 coupled to the memory 32 and the transceiver 33. The processor 11, 21, or 31 may be configured to implement proposed functions, procedures and/or methods described in this description. Layers of radio interface protocol may be implemented in the processor 11, 21, or 31. The memory 12, 22, or 32 is operatively coupled with the processor 11, 21, or 31 and stores a variety of information to operate the processor 11, 21, or 31. The transceiver 13, 23, or 33 is operatively coupled with the processor 11, 21, or 31, and the transceiver 13, 23, or 33 transmits and/or receives a radio signal.

[0027] The processor 11, 21, or 31 may include application specific integrated circuit (ASIC), other chipset, logic circuit and/or data processing device. The memory 12, 22, or 32 may include read only memory (ROM), random access memory (RAM), flash memory, memory card, storage medium and/or other storage device. The transceiver 13, 23, or 33 may include baseband circuitry to process radio frequency signals. When the embodiments are implemented in software, the techniques described herein can be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. The modules can be stored in the memory 12, 22, or 32 and executed by the processor 11, 21, or 31. The memory 12, 22, or 32 can be implemented within the processor 11, 21, or 31 or external to the processor 11, 21, or 31 in which case those can be communicatively coupled to the processor 11, 21, or 31 via various means as is known in the art. In some embodiments, the communication network system 40 is configured to perform a flexible selection among an AI/ML based positioning method, an AI/ML assisted positioning method, and a non AI/ML based positioning method based on characteristics of positioning methods and application level positioning quality of service (QoS) requirements; perform an activation and/or transfer for LOS/NLOS AI/ML identification model parameters to a node responsible for providing the LOS/NLOS indication based on an application layer to positioning method mapping indication; and/or perform a transfer of the same or identical LOS/NLOS classification AI/ML model parameters to the node responsible for providing the LOS/NLOS indication used to improve the degree of trust of the indication at the node responsible a final UE location estimate.

[0028] FIG. 2 is a flowchart illustrating a method for artificial intelligence (AI)/machine learning (ML) model selection for non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement performed by a communication network system according to an embodiment of the present disclosure. FIG. 3 illustrates that in some embodiments, a method for artificial intelligence (AI)/machine learning (ML) model selection for non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement performed by a communication network system includes performing a flexible selection among an AI/ML based positioning method, an AI/ML assisted positioning method, and a non AI/ML based positioning method based on characteristics of positioning methods and application level positioning quality of service (QoS) requirements; performing an activation and/or transfer for LOS/NLOS AI/ML identification model parameters to a node responsible for providing the LOS/NLOS indication based on an application layer to positioning method mapping indication; and/or performing a transfer of the same or identical LOS/NLOS classification AI/ML model parameters to the node responsible for providing the LOS/NLOS indication used to improve the degree of trust of the indication at the node responsible a final UE location estimate.

[0029] In 3gpp RAN #94 meeting, a new study item (SI) on artificial intelligence/machine learning for NR air interface has been approved with the main goal of exploring the benefits of enhancing the air interface with features enabling an improved support of AI/ML-based algorithms for enhanced performance and/or reduced complexity/overhead. The aims of this study item is to focus on studying a few carefully selected use-cases like CSI feedback, beam management and positioning accuracy enhancement, with the goal of identifying the areas where

AI/ML could improve the performance of air-interface functions and studying the common AI/ML framework, including functional requirements of AI/ML architecture, and the specification impact that would be required to enable using of AI/ML techniques for improving the air interface performance. Regarding NR AI positioning accuracy enhancements, it was agreed in RAN1 #109 meeting, to further study different location of AI based positioning model e.g., AI model one side or one entity (UE, gNB or LMF) ;where, both training and inference are conducted at either, or partial AI model at one side; where, the training and inference are conducted at one side of network or UE, but requires additional signaling or procedure enhancements between two sides, potentially with existing signaling framework. Moreover, it has been also agreed in this meeting to take into account different levels of network-UE collaboration e.g., no collaboration, signaling-based collaboration without model transfer and signaling-based collaboration with model transfer for further considerations (as illustrated in FIG. 3), and to further study AI/ML model generalization aspect for NR positioning.

[0030] In addition to the above, it was also agreed in 3gpp RAN1 #109 meeting to further study the following use cases for AI/ML based positioning accuracy enhancement including:

[0031] Direct AI/ML based positioning: where an AI/ML based method is can replace the existing positioning methods and utilized to estimate UE location with reference to new type of measurements and/or measurement reports such as the amplitude, time of arrival (TOA), Angle of Arrival (AoA), channel impulse response (CIR), Beam index, TRP index, power and/or reflection order of signal received from multiple transmission and reception points (TRPs) (as illustrated in FIG. 4).

[0032] Indirect or AI/ML assisted positioning: where AI is used to assist an existing positioning method to enhance the UE location estimation e.g., by extracting an intermediate feature from measurements and/or measurement reports such as downlink-reference signal timing difference (DL-RSTD), DL-angle of departure (DL-AoD), uplink-relative time of arrival (UL-RTOA), uplink sounding reference signal-reference signal received power (SRS-RSRP), DL positioning reference signal RSRP (DL PRS-RSRP) , UE Rx-Tx time difference and gNB Rx-Tx time difference, UL-AOA or AoD or zenith angle of arrival (ZOA) values per path; then, estimating the final UE position according to the extracted intermediate feature (as illustrated in FIG. 4 and FIG. 5).

[0033] Apart from the above considerations, according to the application-level positioning accuracy requirement provided in TR 38.857 (Table 1, which shows the maximum allowable positioning error for each positioning) it is observable that different NR positioning application categories have different level of positioning QoS accuracy requirement. For example, some positioning applications requires a very relaxed positioning accuracy level that can be guaranteed by only using of the traditional non-AI positioning methods. While some others applications require a moderate level which can be guaranteed by using AI-assisted method. On the other hand, some others applications require stricter positioning accuracy level which can only be guaranteed when AI-based positioning methods. Therefore, it is very likely that R18 positioning enhancement will support both AI based and AI assisted on the top of the existing positioning solutions to address the difference in the positioning QoS or accuracy requirements for different positioning applications.

[0034] Under the above consideration, it is not clear how to select between AI/ML based or AI/ML assisted or non-AI positioning methods given the characteristics of each method as discussed above and the difference in positioning application QoS or accuracy requirement. Additionally, it is also not clear and how the issue of determining the NLOS/LOS conditions could be handled in the case that an AI/ML assisted method is selected as prefers method for UE positioning estimation. This report provides a method for flexible selection of the preferred positioning methods

based on QoS requirements of the positioning application and the characteristics of positioning estimation methods and introduces a mechanism to address the NLOS/LOS indication reliably issue.

[0035] Table 1: NR positioning application categories

[0036]

Application categories	Maximum allowable positioning error ((vertical/horizontal))	Preferred positioning method
Safety-Critical Applications	Typical range: $\geq 1.5\text{m}$ to $< 5\text{m}$	AI/ML assisted
Payment Critical Applications	Typical range: $\geq 1.5\text{m}$ to $< 25\text{m}$	Existing method
Smart Mobility	Typical range: $\geq 1.5\text{m}$ to $< 25\text{m}$	Existing method
Safety-Critical Applications	Typical range: $\geq 2.5\text{m}$ to $< 25\text{m}$	Existing method
Liability-Critical Applications	Typical range: $\geq 25\text{m}$ to $< 62.5\text{m}$	Existing method
AGV Applications	Typical range: ≥ 0.5 (0.2)m to $< 3\text{m}$	AI/ML Assisted

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[0037] Some embodiments of this disclosure, in order to address the issue related to the positioning model selection, a QoS based or QoS-assisted method for positioning methods selection is proposed which allows flexible selection between AI-based, AI assisted and non-AI based positioning methods based on the characteristics of these positioning methods (e.g., drawback and advantages) as well as the application level positioning QoS requirements as recommended per TR 38.857. Additionally, in order to help UE determining the NLOS/LOS condition or providing a reliable NLOS/LOS indication to assist improving the positioning accuracy estimation if an AI-assisted based positioning is selected for positioning estimation, the method also proposed to utilizes the application level indication and/or the mapping information as a trigger for providing or requesting or transferring of a proper AI/ML classification model parameters to assist the entity responsible for providing the LOS/NLOS indication for identifying or classifying the NLOS/LOS conditions process at UE or TRPs.

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[0038] This disclosure provides a method for A Method for AI/ML model selection for Non-Light of Sight Identification for NR Positioning Estimation Enhancement. The major advantages of these methods include:

[0039] 1. The new method introduces the concept of flexible selection between AI/ML based, AI/ML assisted, and non-AI/ML based positioning method based on the characteristics of these positioning methods and the application level positioning QoS requirements as recommended per TR 38.857, which could help in providing an agile integration of AI/ML with the existing traditional positioning methods.

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[0040] 2. The new methods introduce the concept of activation and/or transfer for LOS/NOLS AI/ML identification model to node responsible for providing the LOS/NLOS indication (UE or TRP) based on the application layer to positioning method mapping indication which could help addressing an issue in the prior art related to how the node responsible for providing the LOS/NLOS indication determines or estimate the NLOS/LOS condition.

5 **[0041]** 3. The new method proposes the concept of transfer of the same or identical LOS/NOLS classification AI/ML model parameters to the node responsible for providing the LOS/NLOS indication (UE or TRP) which could help unifying the degree of trust of the indication at the node which calculate the final location and help in addressing the reliability issue of NLOS/LOS indication which could improve the final location estimations.

[0042] Embodiment 1: Detailed Description

10 **[0043]** In order to address the issue related to the positioning model selection, a QoS based or QoS-assisted method for positioning methods selection is proposed which allows flexible selection between AI-based, AI assisted and non-AI based positioning methods based on the characteristics of these positioning methods (e.g., drawback and advantages) as well as the application level positioning QoS requirements as recommended per TR 38.857. In this methods, an application QoS level to a positioning methods mapping or indication is proposed to be exchanged
15 between the entity or the node or device requesting a UE location estimate (e.g., a target device such as a UE or a location server) and the entity or the node or responsible for final location estimation (a target device or a location server or location management entity LMF or a signaling reference source) for the purpose of assisting the entity/node on selecting the appropriate positioning methods among one of AI/ML-based positioning methods, AI/ML assisted positioning methods or a non-AI positioning methods based on the exchanged indication or the positioning QoS
20 mapping information provided by upper layer (FIG. 6). In addition, to address the help UE determining the NLOS/LOS condition or providing a reliable NLOS/LOS indication to assist improving the positioning accuracy estimation if an AI-assisted based positioning is selected for positioning estimation, the method also proposed to utilizes the application level indication and/or the mapping information as a trigger for providing or requesting or transferring of an identical AI/ML classification model parameters to the all entity/node responsible of providing the LOS/NLOS
25 indications (e.g., a target device UE or reference source TRPs) to assist the entity on identifying or classifying the NLOS/LOS conditions or in LOS/NLOS identification process(FIG. 7A and FIG. 7B). The detail of the method is given below (FIG. 8).

[0044] The target device (UE) or the location server receives an indication from application layer level containing a mapping between the positioning application QoS requirement and preferred positioning method as given in Table
30 2 or an indication of a preferred positioning method derived from the mapping as given in Table 3.

[0045] The target device (UE) and the location server may exchange a request and/or response carrying information related to the exchanging of the indication between each other's.

[0046] The target device (UE) and the location server may exchange request and/or response carrying information related to the exchanging of the indication between each other directly via LTE location protocols (LLP) signaling
35 procedures.

[0047] The target device (UE) and the location server may exchange request and/or response carrying information related to the exchanging of the indication between each other directly via LTE location protocols (LLP) signaling procedures indirectly through the reference source (gNB) via NR positioning protocol a (NRPPa) signaling and NR Radio interface Signaling.

[0048] The target device (UE) and the location server may exchange request and/or response carrying information related to the exchanging of the indication to the reference source (gNB) via NR positioning protocol a (NRPPa) signaling and NR Radio interface Signaling.

[0049] The reference source (gNB) may exchange, the indication about the mapping between the positioning application QoS requirement and the preferred positioning method or the indication of the preferred positioning method according to the mapping to other neighboring reference source (gNB) involved in location estimation over Xn or X2 interface.

[0050] The target device (UE) and/or the location server and/or the reference source (gNB) may utilized the indication about the mapping between the positioning application QoS requirement and the preferred positioning method or the indication of the preferred positioning method according to the mapping, to select among one of AI-based, AI assisted and non-AI based positioning methods locally and/or to requesting or providing an activation/deactivation of a positioning method and/or requesting or transferring of a trained AI/ML model parameters for an AI-based or AI-assisted position method or transferring measurements configurations related to a AI-based or AI-assisted or an existing positioning method between each other's.

[0051] Upon the response of the exchanged mapping or indication, the target device (UE) and an entity of core network (CN) (e.g., 5G location server) may perform a mothed selection according to Table 4, which indicate.

[0052] The trained AI/ML for AI- based or AI-assisted model parameters could be as follows:

[0053] For AI-based method: could be a neural network (NN) model parameters such as [the NN input and output types, Number of Inputs/output layers, Number of hidden layers, number of neurons within hidden layers, activation function, initial weights and learning rate]. Where the input type could be a Channel Impulse Response (CIR), the Power Delay Profile (PDP) a Layer 1 Reference Signal Received Power (L1-RSRP) on an existing positioning measurement over the time. The output type could be a final UE location or (X, Y and Z) UE coordinate.

[0054] For AI-assisted method: could be a simple AI/ML classifier model parameters such as [the classifier input and output types, initial weights, learning rate parameter, binary variables, (0,1) for binary classification, or an enumerated variables for multi-level classification]. Where the input type can be a Channel Impulse Response (CIR), the Power Delay Profile (PDP) a Layer 1 Reference Signal Received Power (L1-RSRP), and/or channel frequency response in frequency domain (CFR). The output type could be an LOS/NLOS probability of the different channel paths and/or a DL-RSTD, or UE Rx-Tx time difference, PRS RSRPP and/or DL-AoD/ZoD or DL-AoA/ZoA for the path.

[0055] For the signaling and procedures related to requesting or transferring of a trained AI/-based or AI-assisted model parameters based on the mapping or indication are given in some embodiments assuming the trained AI/ML positioning model is located at reference source (gNB) and in some other embodiments assuming the trained AI/ML positioning model is located at Location Server (LMF, AMF or 5GC).

[0056] Table 2: Direct Mapping between positioning level application QoS and the preferred positioning method

Application categories	Allowable Positioning Error	Preferred Method
Safety-Critical Applications	Typical range: $\geq 1.5\text{m}$ to $< 5\text{m}$	AI-Assisted
Payment Critical Applications		

Smart Mobility	Typical range: >1.5m to <62.5m	Non-AI
Safety-Critical Applications		
Liability-Critical Applications		
AGV Applications	Typical range: ≥ 0.5 (0.2)m to <3m (vertical/horizontal)	AI-based

[0057] Table 3: indication of a preferred positioning method based on application level QoS

Application categories	Application layer Indication
0.5 (0.2)m to <3m	1
≥ 1.5 m to <5m	0
>1.5m to <62.5m	Field Not configured within the signaling message

[0058] Table 4: Target device/location server/reference source entity actions upon the reception of the indication/mapping

Application layer Indication/mapping	Target device (UE), (location server), reference source entity actions upon the reception of the indication/mapping
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1 or AI-based	Upon a reception of the application Qos to preferred method indication/mapping, with an indication value set to 1 or a mapping indicating AI-Based, the entity may configure a measurement request or a measurement report related to AI-based positioning methods, it may also request each other's to provide an AI-Based positioning model parameters transfer
0 or AI-Assisted	Upon a reception of the application Qos to preferred method mapping indication/mapping with an indication value set to 0 or mapping indicating an AI-Assisted, the entity may configure a measurement, request or a measurement report related to at least one of the following AI assisted methods Downlink Time Difference of Arrival (DL-TDOA), Downlink angle of departure DL-AoD, Multi-Round Trip Time (Multi-RTT), it may also request each other's to transfer to each other's or to TRPs involved in the location estimation process, an identical version of an AI assisted model parameters for the inference of the NLOS/LOS from the measurement.
No configured or non-AI	Upon a reception of the application Qos to preferred method mapping indication/mapping with an indication value set to 0 or a mapping indicating non-AI, the entity shall configure a measurement request related to at least one of these existing positioning methods: A-GNSS, observed Time Difference of Arrival (OTDO) A, Enhanced Cell-ID (E-CID, DL-TDOA, DL-AoD, Multi-RTT, UL-TDOA, uplink angle of arrival (UL-AoA).

[0059] Embodiment 2: Signaling and procedure related to requesting or transferring of AI/ML model parameters assuming trained AI model is located at reference source or gNB

[0060] For the case that trained AI/ML positioning model is located at the reference source or the gNB side, the signaling and the procedures related to exchange of AI/ML model parameters for supporting an AI-assisted or AI based positioning method is given in FIG. 8 and as below:

[0061] The target device (UE) or the location server receives an indication from application layer level containing a mapping between the positioning application QoS requirement and preferred positioning method as given in or an indication of a preferred positioning method derived from the mapping. The target device (UE) exchanges the indication or mapping to the location server over NAS signaling or LPP signaling exchange procedures.

5 **[0062]** Based on the provided indication or mapping, the lactation server (LMF/AMF) entity forwards a positioning measurement and/or an AI-based/AI-assisted model parameters transfer request toward the reference source or the gNB via NR PPa signaling exchange procedures.

10 **[0063]** The reference source or the gNB, transfers an AI-based/AI-assisted model parameters as indicated by the location server and/or initiates a measurement request or provides a gap configuration to support the specific AI-based/AI-assisted model to the target device (UE) via NR/LTE radio signaling.

[0064] The target device (UE) utilizes the transferred model parameters to perform the AI-based/AI-assisted measurement as requested and transmit the measurement and/or the LOS/NLOS indication to the lactation server (LMF/AMF) entity either directly via NAS or LLP signaling or indirectly via NR/LTE radio signaling and NR-PPa signaling for final UE locations estimation.

15 **[0065] Embodiment 3: Signaling and procedure related to requesting or transferring of AI/ML model parameters assuming that the trained AI model is located at location server (AMF/LMF/5GC)**

[0066] For the case that trained AI/ML positioning model is located at the location server (AMF/LMF/5GC) side, the signaling and the procedures related to exchange of AI/ML model parameters for supporting an AI-assisted or AI based positioning method is given in FIG. 9 and as below:

20 **[0067]** The target device (UE) or the location server receives an indication from application layer level containing a mapping between the positioning application QoS requirement and preferred positioning method as given in or an indication of a preferred positioning method derived from the mapping.

[0068] The target device (UE) exchanges the indication or mapping to the location server over NAS signaling or LPP signaling exchange procedures.

25 **[0069]** Based on the provided indication or mapping, the lactation server (LMF/AMF) initiates an AI-based/AI-assisted model parameters process and forwards a positioning measurement request to support the transferred AI-based/AI-assisted toward the target device (UE) either directly via directly via NAS or LLP signaling or indirectly via NR-PPa signaling and NR/LTE radio signaling.

30 **[0070]** The target device (UE) utilizes the transferred model parameters to perform the AI-based/AI-assisted measurement as requested and transmit the measurement and/or the LOS/NLOS indication to the lactation server (LMF/AMF) entity either directly via NAS or LLP signaling or indirectly via NR/LTE radio signaling and NR-PPa signaling for final UE locations estimation.

35 **[0071]** FIG. 10 is a block diagram of an example system 700 for wireless communication according to an embodiment of the present disclosure. Embodiments described herein may be implemented into the system using any suitably configured hardware and/or software. FIG. 10 illustrates the system 700 including a radio frequency (RF) circuitry 710, a baseband circuitry 720, an application circuitry 730, a memory/storage 740, a display 750, a camera 760, a sensor 770, and an input/output (I/O) interface 780, coupled with each other at least as illustrated. The application circuitry 730 may include a circuitry such as, but not limited to, one or more single core or multi core processors. The processors may include any combination of general purpose processors and dedicated processors, such as graphics processors, application processors. The processors may be coupled with the memory/storage and

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configured to execute instructions stored in the memory/storage to enable various applications and/or operating systems running on the system.

[0072] While the present disclosure has been described in connection with what is considered the most practical and preferred embodiments, it is understood that the present disclosure is not limited to the disclosed embodiments but is intended to cover various arrangements made without departing from the scope of the broadest interpretation of the appended claims.

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What is claimed is:

1. A method for artificial intelligence (AI)/machine learning (ML) model selection for non-light of sight (NLOS) identification for new radio (NR) positioning estimation enhancement performed by a communication network system, comprising:

5 performing a flexible selection among an AI/ML based positioning method, an AI/ML assisted positioning method, and a non AI/ML based positioning method based on characteristics of positioning methods and application level positioning quality of service (QoS) requirements;

performing an activation and/or transfer for LOS/NLOS AI/ML identification model parameters to a node responsible for providing the LOS/NLOS indication based on an application layer to positioning method mapping indication; and/or

10 performing a transfer of the same or identical LOS/NOLS classification AI/ML model parameters to the node responsible for providing the LOS/NLOS indication used to improve the degree of trust of the indication at the node responsible a final UE location estimate.

2. The method according to claim 1, wherein an application QoS level to a positioning method mapping or indication is exchanged between the node requesting a UE location estimate and the node responsible for final location estimation for assisting the node on selecting an appropriate positioning method among the AI/ML based positioning method, the AI/ML assisted positioning method or the non AI/ML positioning method based on an exchanged indication or a positioning QoS mapping information provided by an upper layer.

3. The method according to claim 1 or 2, wherein the application level indication and/or the mapping information is used as a trigger for providing or requesting or transferring of identical AI/ML classification model parameters to all nodes responsible of providing the LOS/NLOS indications to assist the node on identifying or classifying NLOS/LOS conditions or in LOS/NLOS identification process.

4. The method according to any one of claims 1 to 3, wherein a target device or a location server receives an indication from application layer level containing a mapping between the positioning application QoS requirements and a positioning method or an indication of another positioning method derived from the mapping.

5. The method according to any one of claims 1 to 4, wherein the target device and the location server exchange a request and/or response carrying information related to the exchanging of the indication between each other's.

6. The method according to any one of claims 1 to 5, wherein the target device and the location server exchange the request and/or response carrying information related to the exchanging of the indication between each other directly via LTE location protocols (LLP) signaling procedures.

7. The method according to any one of claims 1 to 6, wherein the target device and the location server exchange the request and/or response carrying information related to the exchanging of the indication between each other directly via LTE location protocols (LLP) signaling procedures indirectly through a reference source via NR positioning protocol a (NRPPa) signaling and NR radio interface signaling.

8. The method according to any one of claims 1 to 7, wherein the target device and the location server exchange the request and/or response carrying information related to the exchanging of the indication to the reference source via the NR positioning protocol a (NRPPa) signaling and the NR radio interface signaling.

9. The method according to any one of claims 1 to 7, wherein the reference source exchanges, the indication about the mapping between the positioning application QoS requirement and the positioning method or the indication of the positioning method according to the mapping to other neighboring reference source involved in location estimation over Xn or X2 interface.

10. The method according to any one of claims 1 to 9, wherein the target device and/or the location server and/or the reference source utilizes the indication about the mapping between the positioning application QoS requirement and the positioning method or the indication of the positioning method according to the mapping, to select one from the AI/ML based, AI/ML assisted and non AI/ML based positioning methods locally and/or to request or provide an activation/deactivation of a positioning method and/or to request or transfer of trained AI/ML model parameters for an AI-based or AI-assisted position method or transferring measurements configurations related to a AI-based or AI-assisted or an existing positioning method between each other's.

11. The method according to any one of claims 1 to 10, wherein upon the response of the exchanged mapping or indication, the target device and an entity of core network (CN) perform a method selection according to a table, which indicates that a type of information is for AI/ML based information or for AI/ML assisted information.

12. The method according to claim 11, wherein the type of information is for AI/ML based information and comprises neural network (NN) model parameters including a NN input and output types, a number of input/output layers, a number of hidden layers, a number of neurons within hidden layers, an activation function, initial weights and learning rate.

13. The method according to claim 12, wherein the input type is a channel impulse response (CIR), a power delay profile (PDP), a layer 1 reference signal received power (L1 RSRP) on an existing positioning measurement over time.

14. The method according to claim 12 or 13, the output type is a final UE location or UE coordinate.

15. The method according to claim 11, wherein the type of information is for AI/ML assisted information and comprises AI/ML classifier model parameters including the classifier input and output types, initial weights, a learning rate parameter, binary variables, (0,1) for binary classification, or an enumerated variables for multi-level classification.

16. The method according to claim 15, wherein the input type is a CIR, a PDP, a L1 RSRP, and/or a channel frequency response in frequency domain (CFR).

17. The method according to claim 15 or 16, wherein the output type is an LOS/NLOS probability of different channel paths and/or a DL RSTD, or UE Rx Tx time difference, a PRS a RSRPP and/or DL AoD/ZoD or DL AoA/ZoA for the path.

18. A communication network system, comprising:

a memory;

a transceiver; and

a processor coupled to the memory and the transceiver;

wherein the processor is configured to execute the method of any one of claims 1 to 17.

19. A non-transitory machine readable storage medium having stored thereon instructions that, when executed by a computer, cause the computer to perform the method of any one of claims 1 to 17.

20. A chip, comprising:

a processor, configured to call and run a computer program stored in a memory, to cause a device in which the chip is installed to execute the method of any one of claims 1 to 17.

21. A computer readable storage medium, in which a computer program is stored, wherein the computer program causes a computer to execute the method of any one of claims 1 to 17.

22. A computer program product, comprising a computer program, wherein the computer program causes a computer to execute the method of any one of claims 1 to 17.

23. A computer program, wherein the computer program causes a computer to execute the method of any one of claims 1 to 17.

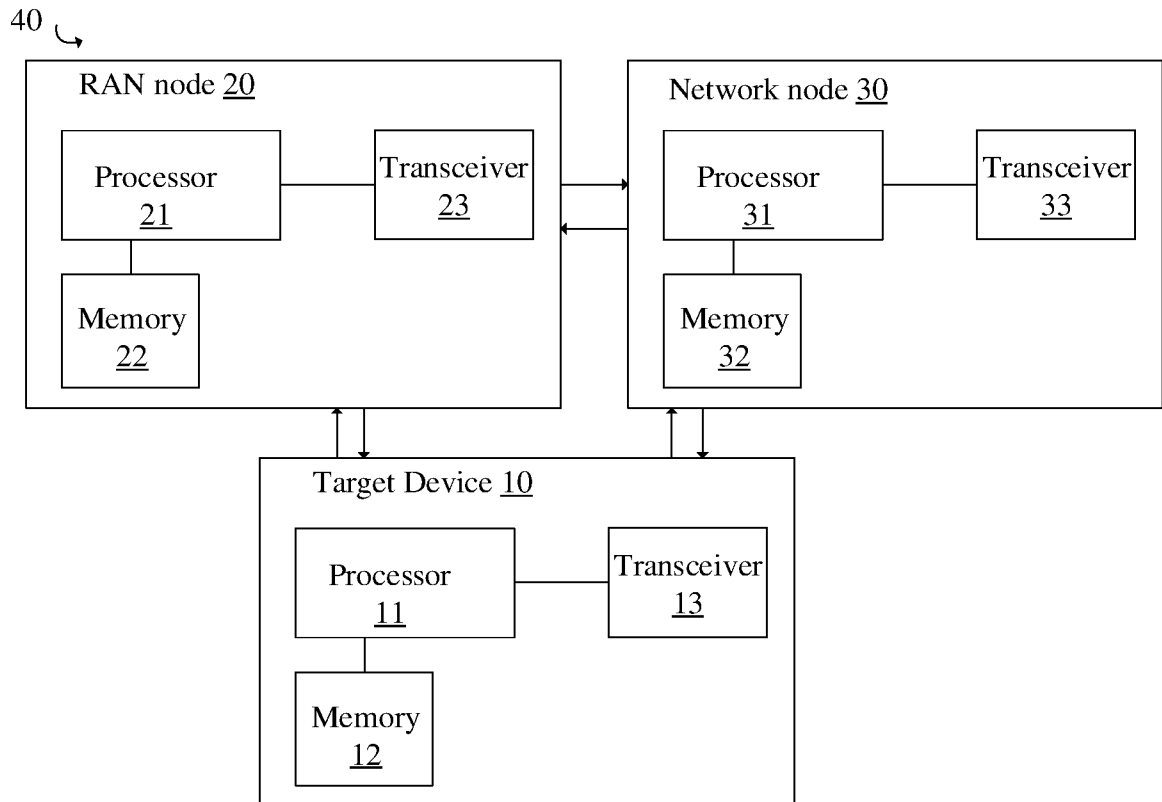


FIG. 1

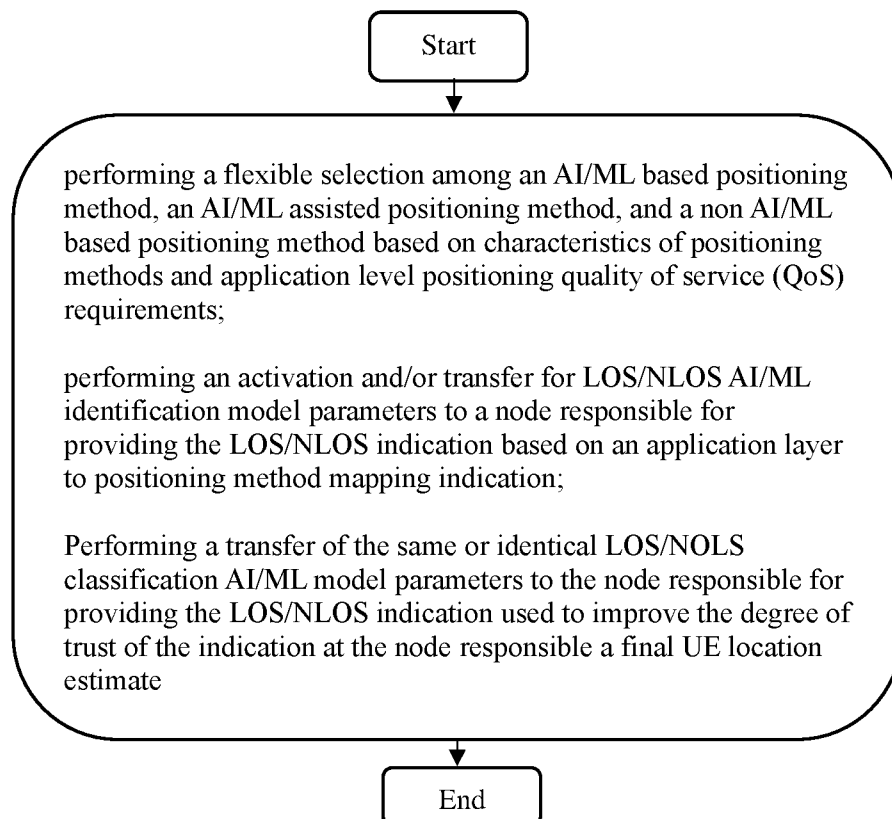


FIG. 2

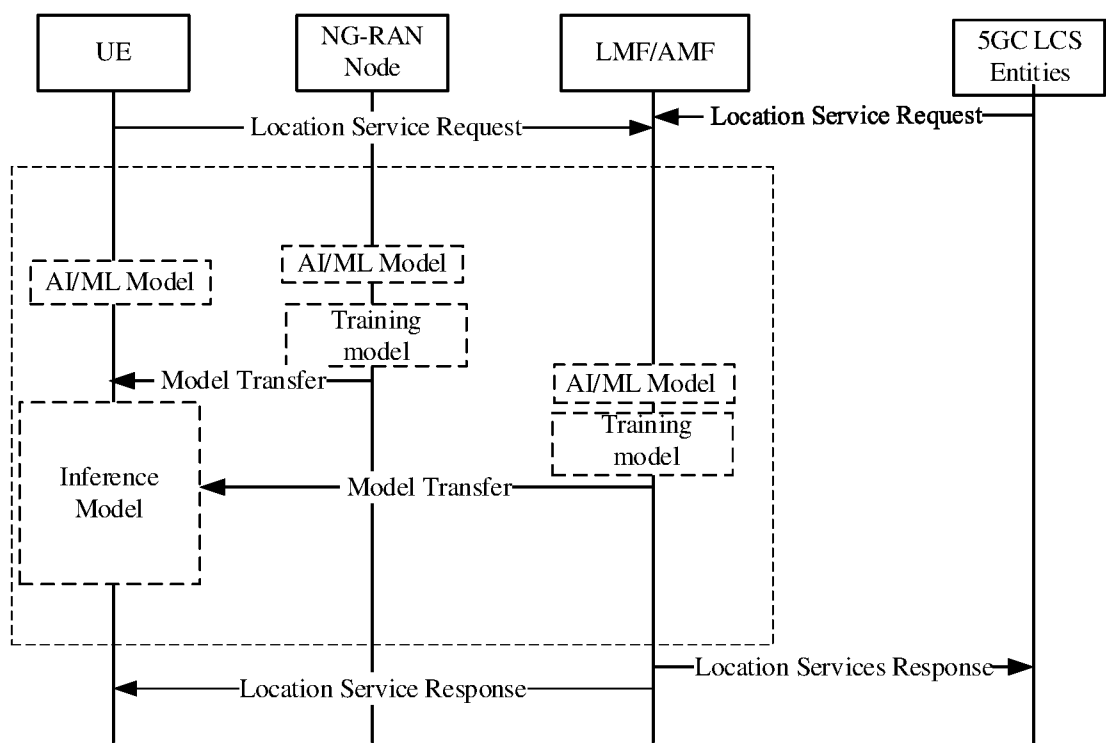


FIG. 3

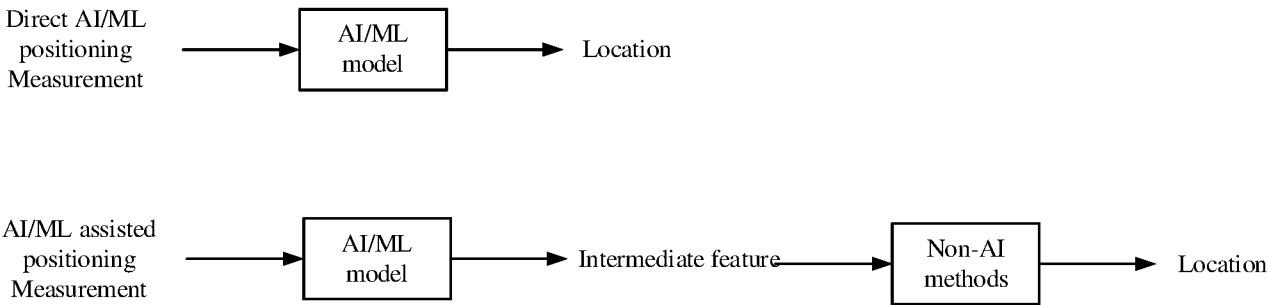


FIG. 4

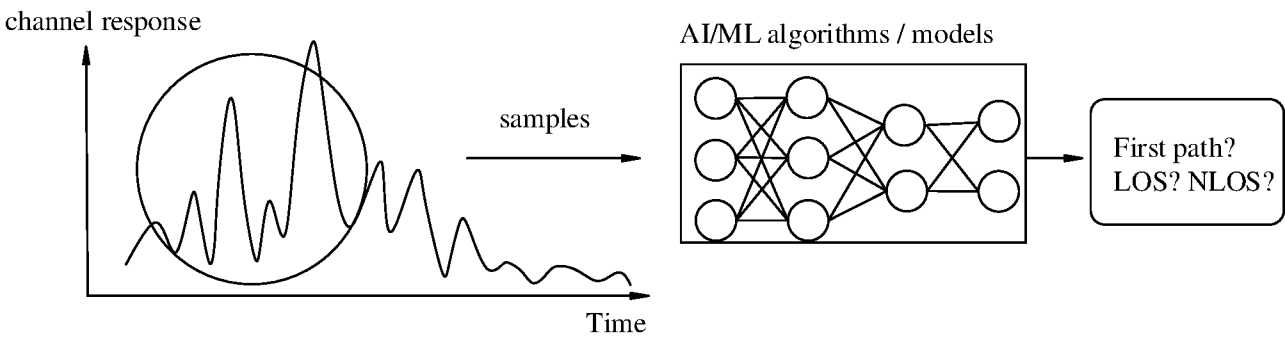


FIG. 5

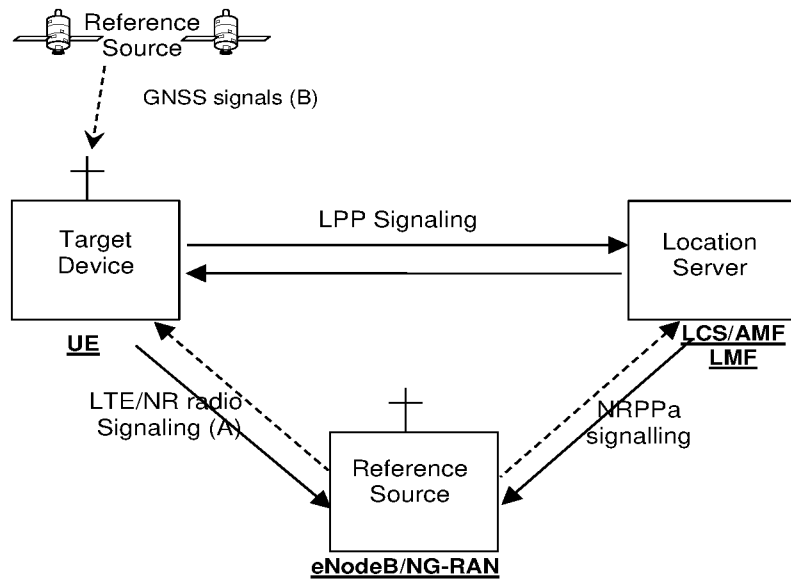


FIG. 6

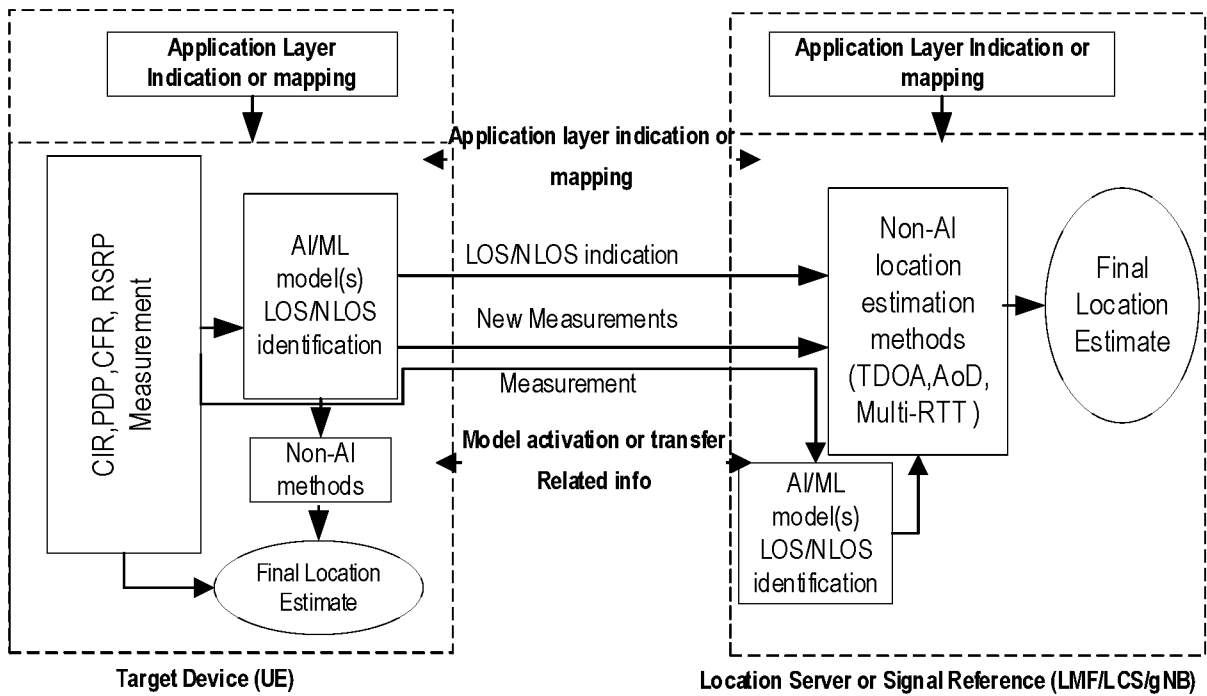


FIG. 7A

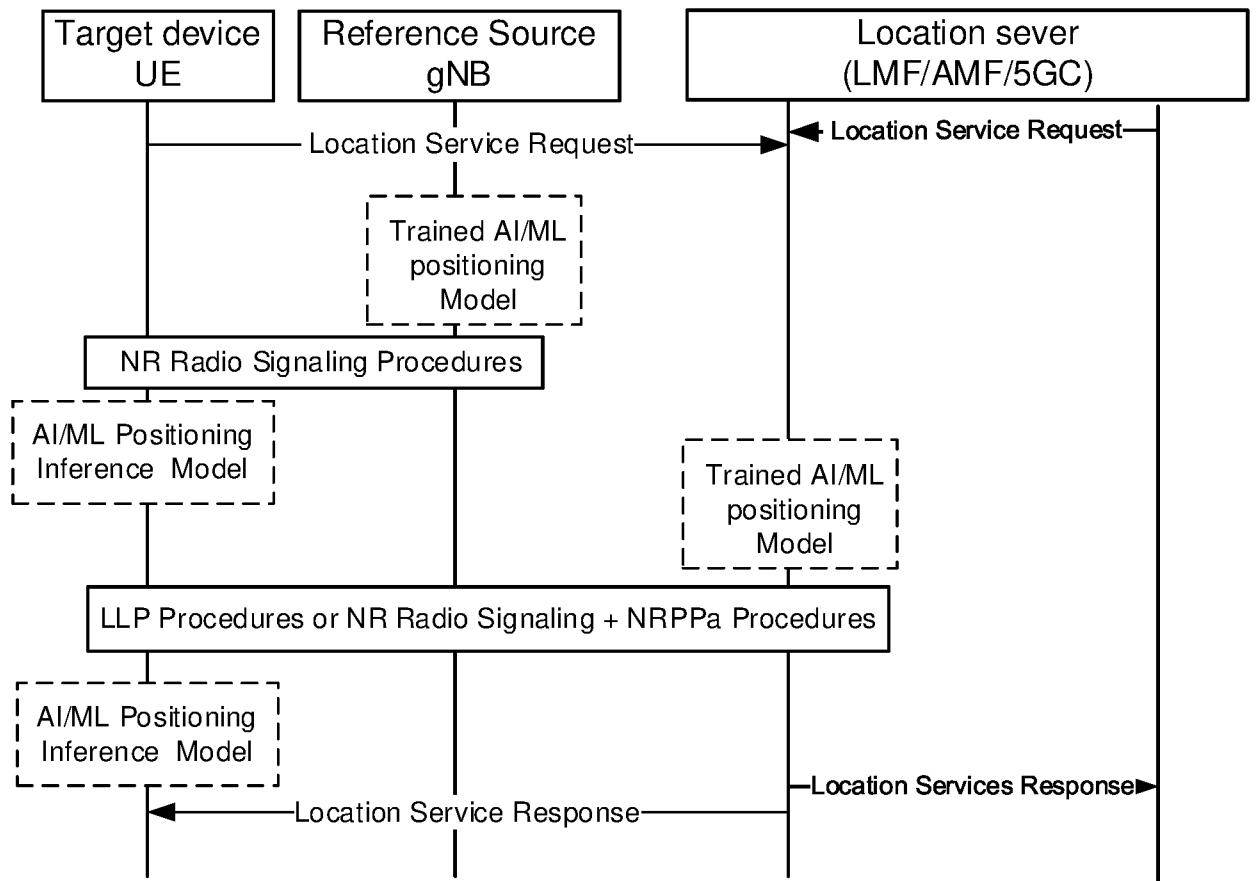


FIG. 7B

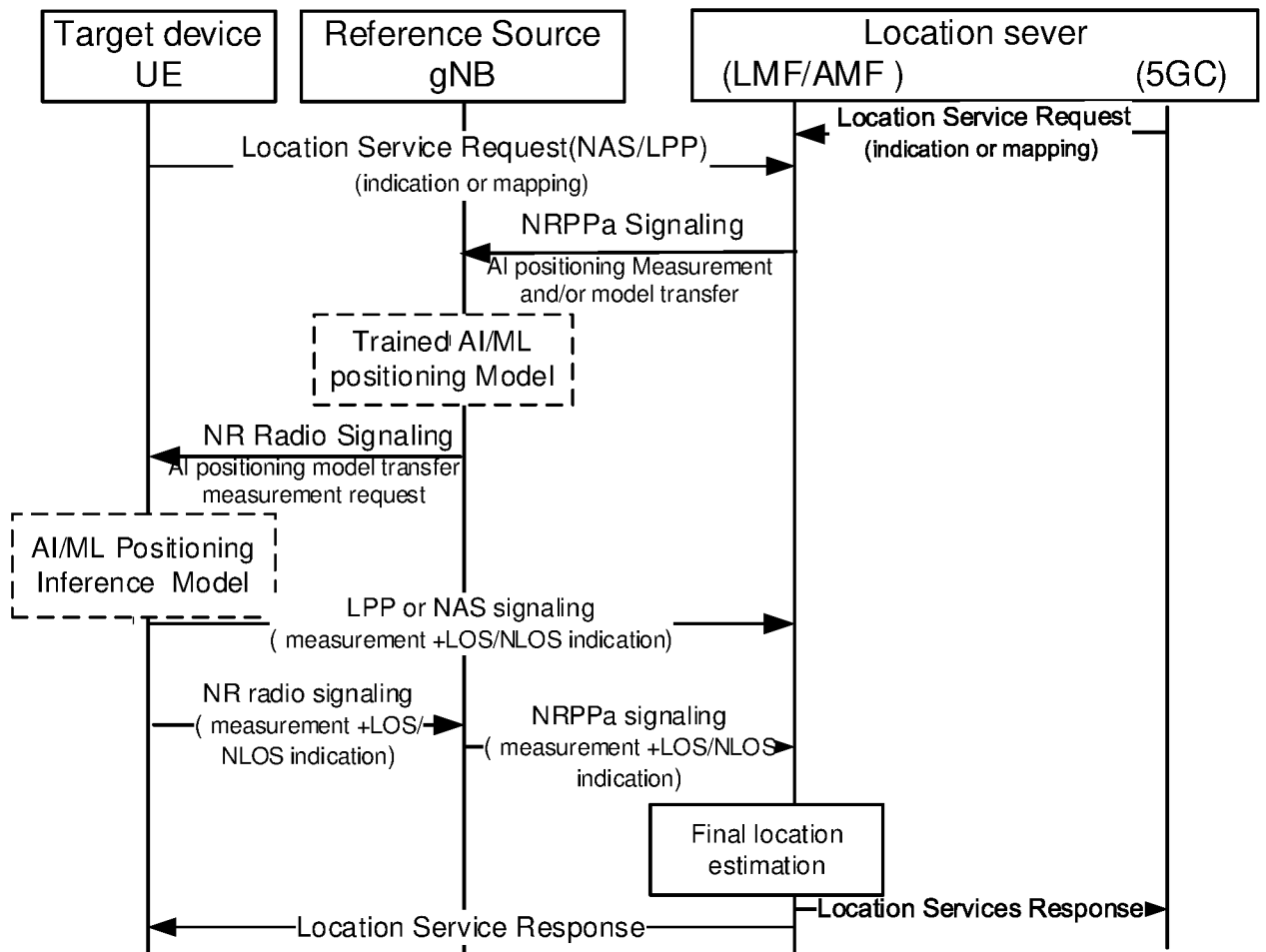


FIG. 8

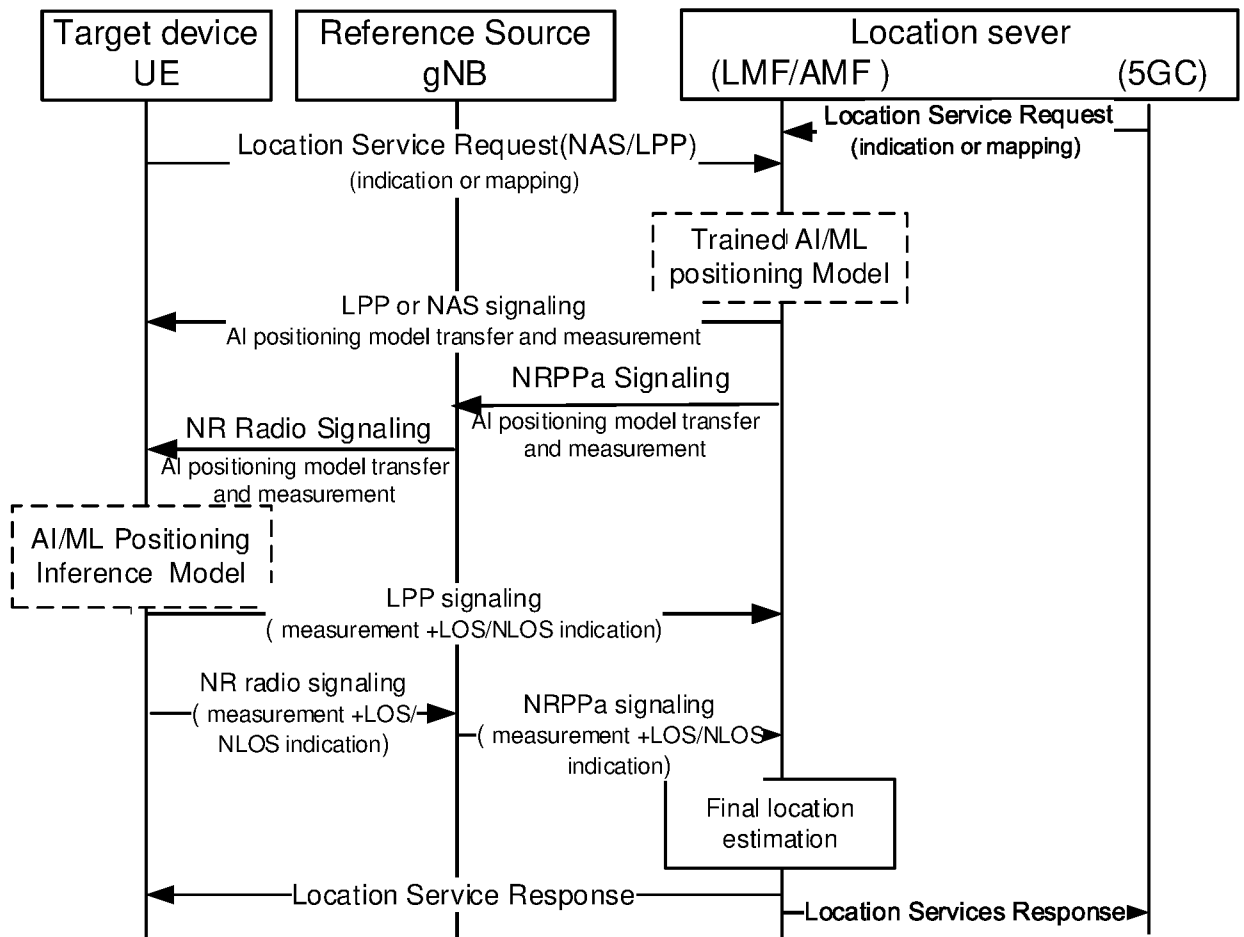


FIG. 9

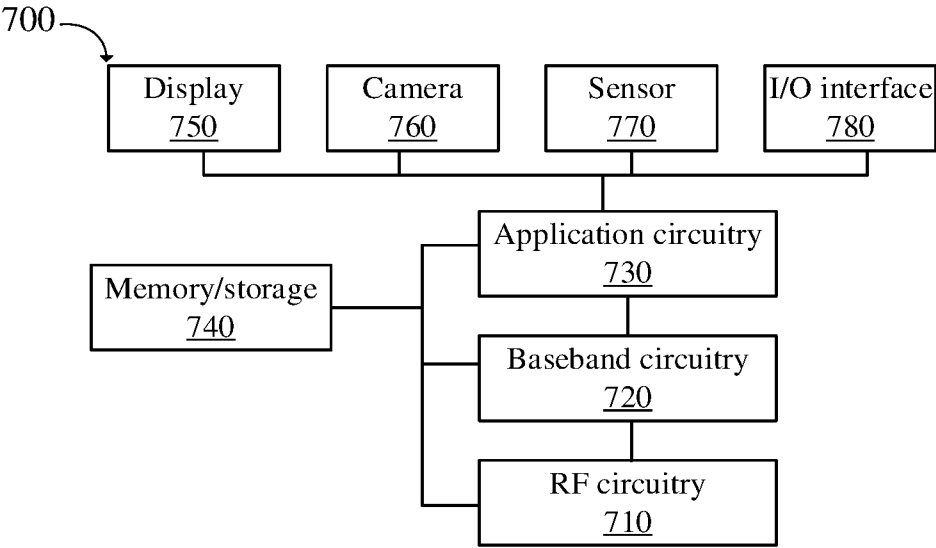


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/123500

A. CLASSIFICATION OF SUBJECT MATTER

H04L27/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, ENTXT, VEN, CNKI, IEEE, 3GPP: AI, artificial intelligence, ML, machine learning, LOS, NLOS, select+, indication, location, position, UE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 102021112407 A1 (INTEL CORP.) 23 December 2021 (2021-12-23) description, paragraphs [0016]-[0020]	1-23
A	US 2022113365 A1 (APPLE INC.) 14 April 2022 (2022-04-14) the whole document	1-23
A	US 2011053613 A1 (SAMSUNG ELECTRONICS CO., LTD.) 03 March 2011 (2011-03-03) the whole document	1-23
A	WO 2014047352 A2 (TRUEPOSITION, INC.) 27 March 2014 (2014-03-27) the whole document	1-23
A	WO 2021262570 A1 (QUALCOMM INC.) 30 December 2021 (2021-12-30) the whole document	1-23
A	https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/17.00.00_60/ts_138300v170000p.pdf . "3GPP TS 38.300 version 17.0.0 Release 17" 3GPP, 31 May 2022 (2022-05-31), the whole document	1-23



Further documents are listed in the continuation of Box C.



See patent family annex.

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“O” document referring to an oral disclosure, use, exhibition or other means

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

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

16 May 2023

Date of mailing of the international search report

22 May 2023

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2022/123500

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				CN	104813187	A	29 July 2015
				IN	201503028	P1	10 June 2016
WO	2021262570	A1	30 December 2021	None			