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(54) **REPORTING CHANNEL STATE INFORMATION FEEDBACK FOR NETWORK-SIDE MODEL TRAINING**

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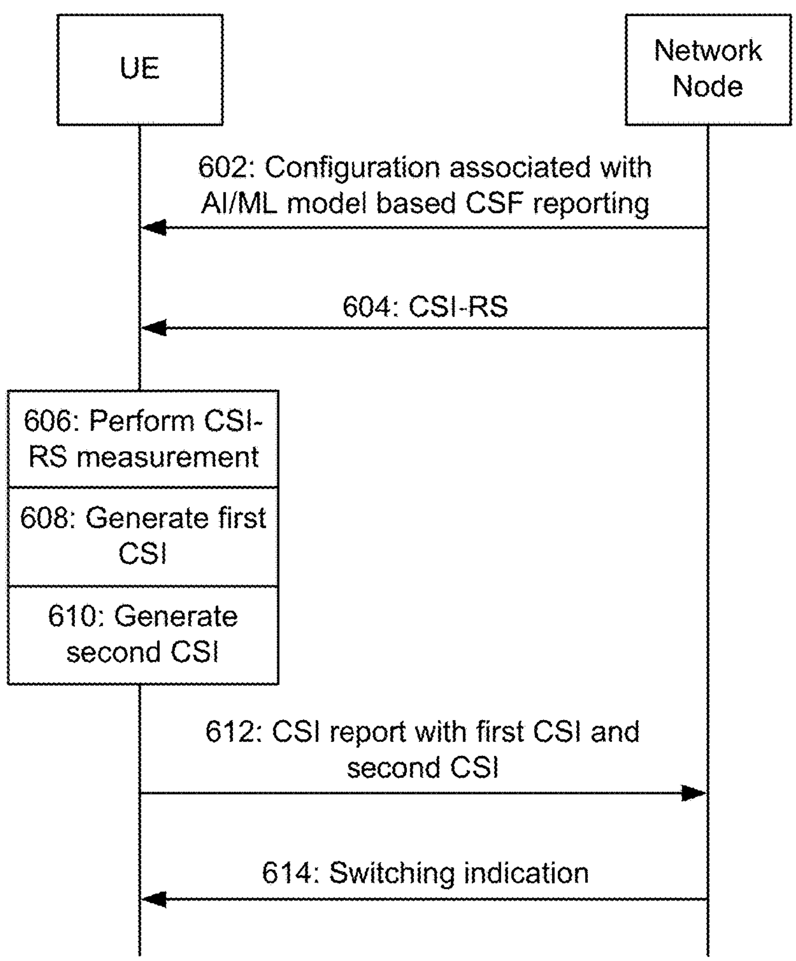
(52) **U.S. Cl.**
CPC *H04W 24/10* (2013.01); *G06N 3/0455* (2023.01)

(57) **ABSTRACT**

Various aspects of the present disclosure generally relate to wireless communication. In some aspects, a user equipment (UE) may receive a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting. The UE may transmit, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. Numerous other aspects are described.

600



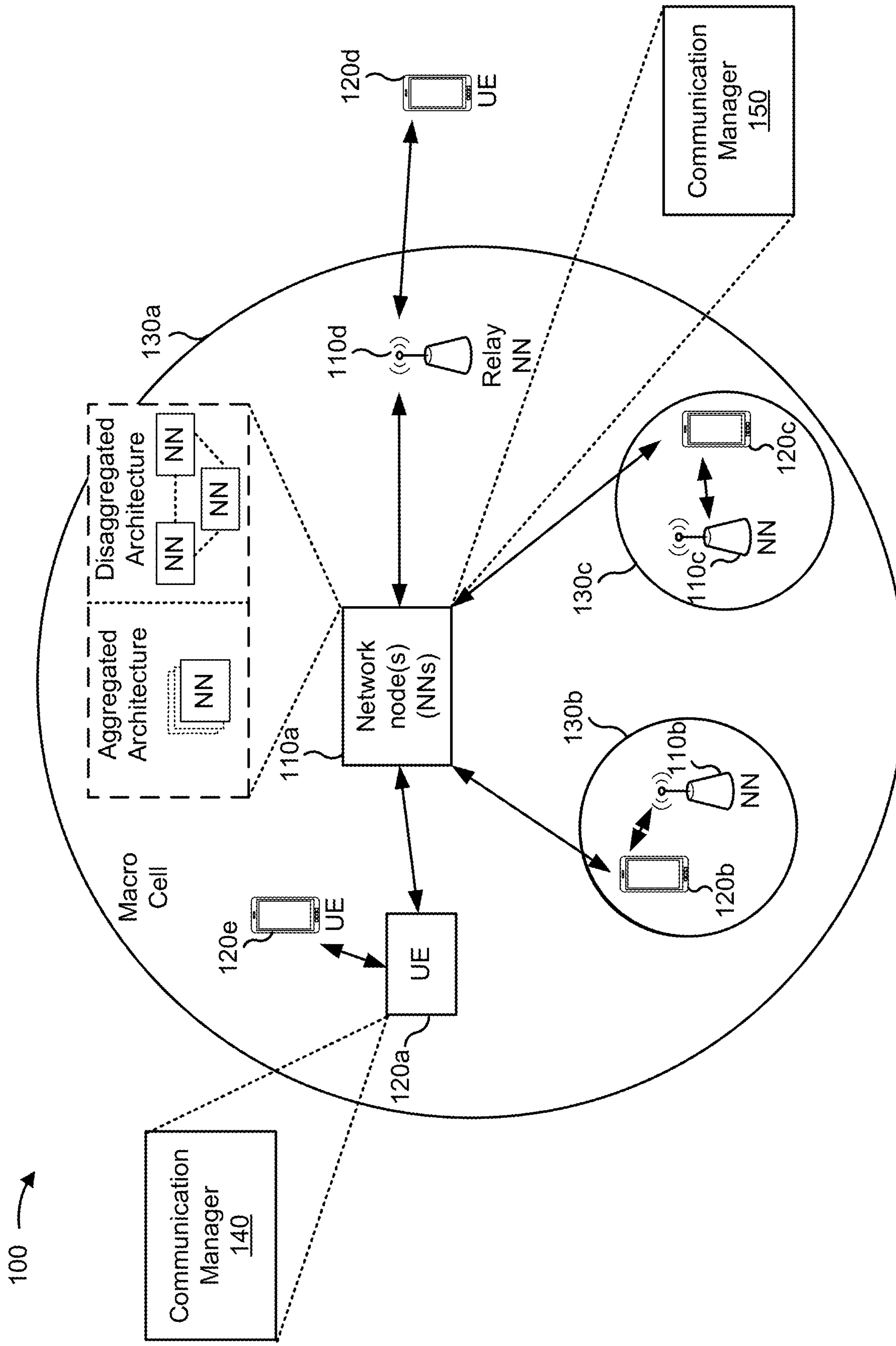

100
Communication Manager 140
Macro Cell
120e
UE
UE
120a
Aggregated Architecture
NN
Disaggregated Architecture
NN
NN
NN
Network node(s) (NNs)
110a
130a
110d
Relay NN
120d
UE
Communication Manager 150
130b
110b
NN
120b
130c
110c
NN
120c

FIG. 1

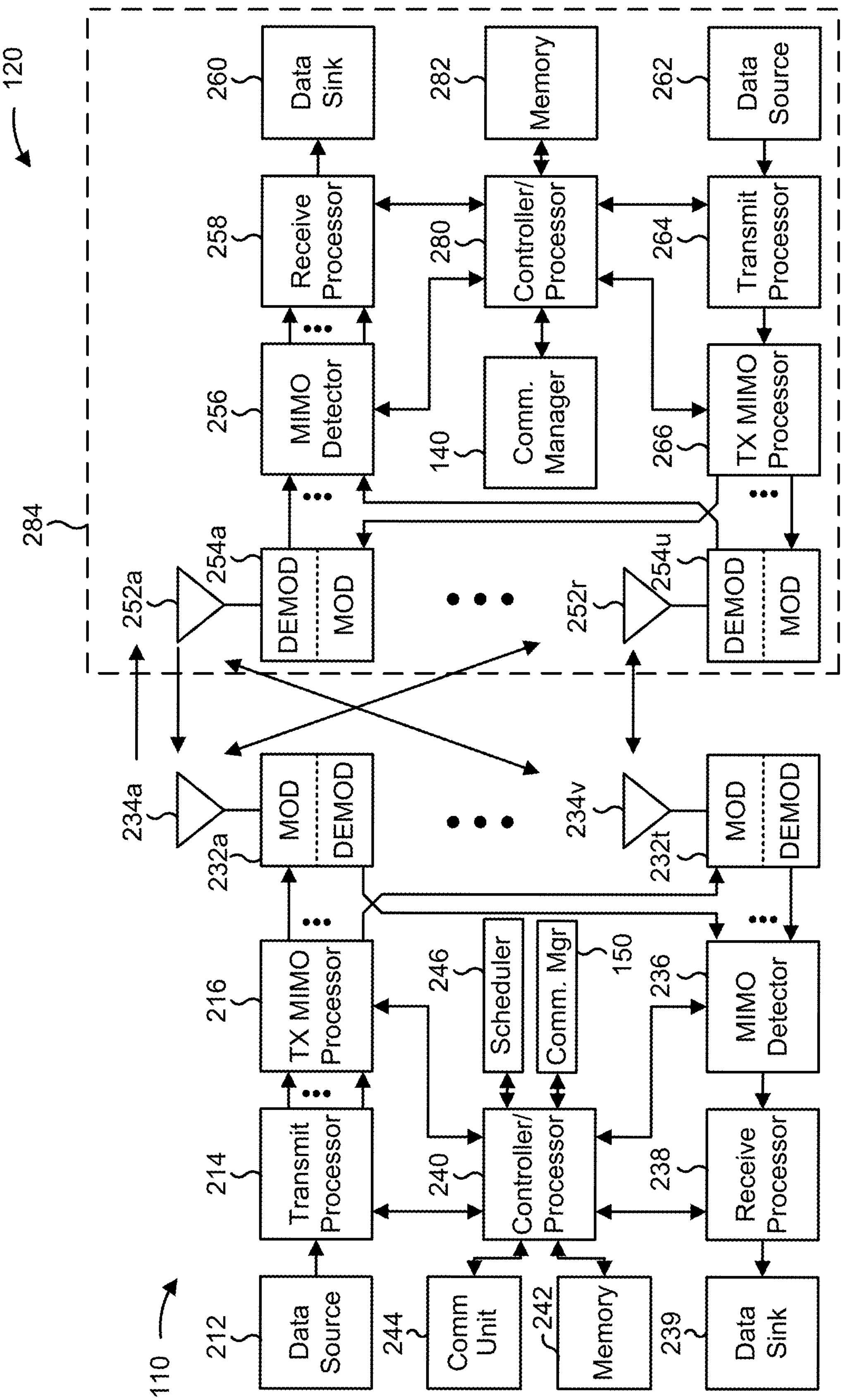

120
284
260
Data Sink
282
Memory
262
Data Source
258
Receive Processor
280
Controller/ Processor
264
Transmit Processor
256
MIMO Detector
140
Comm. Manager
266
TX MIMO Processor
252a
254a
DEMOD
MOD
252r
254u
DEMOD
MOD
234a
232a
MOD
DEMOD
234v
232t
MOD
DEMOD
216
TX MIMO Processor
246
Scheduler
Comm. Mgr
150
236
MIMO Detector
214
Transmit Processor
240
Controller/ Processor
238
Receive Processor
110
212
Data Source
244
Comm Unit
242
Memory
239
Data Sink

FIG. 2

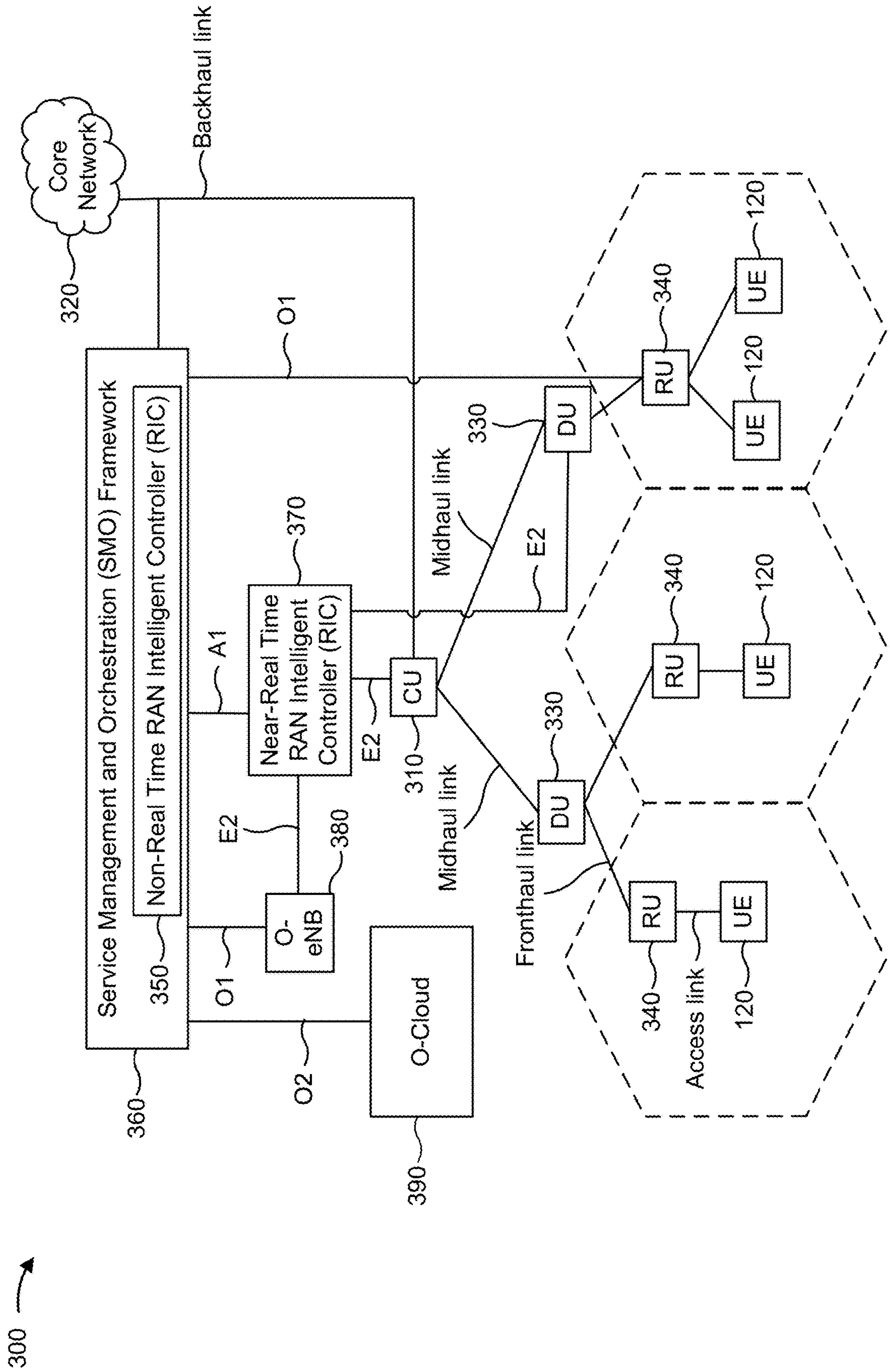

300
Core Network
320
Backhaul link
Service Management and Orchestration (SMO) Framework
Non-Real Time RAN Intelligent Controller (RIC)
350
360
O1
A1
Near-Real Time RAN Intelligent Controller (RIC)
370
E2
O-eNB
380
O1
O2
O-Cloud
390
CU
310
E2
Midhaul link
DU
330
Midhaul link
E2
DU
330
Fronthaul link
RU
340
UE
120
Access link
RU
340
UE
120
RU
340
UE
120
UE
120

FIG. 3

400

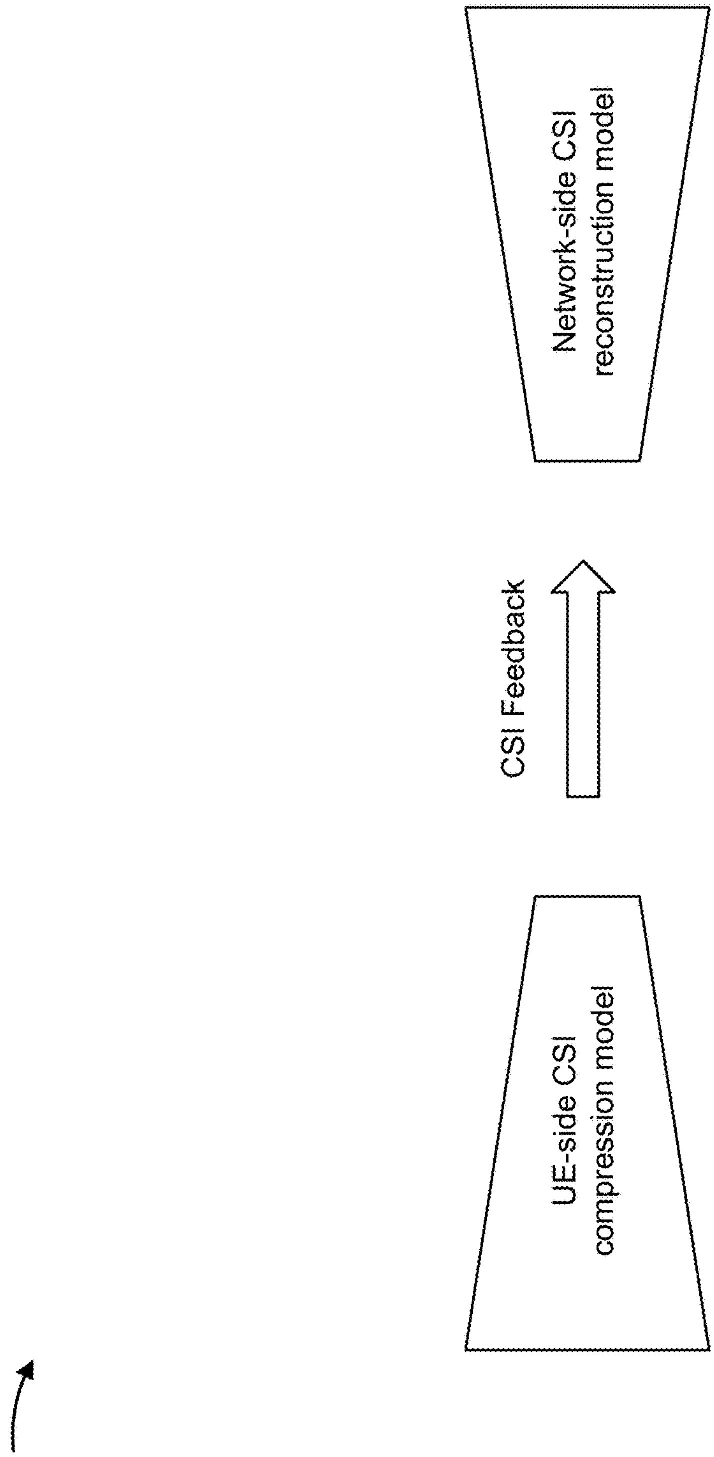

Network-side CSI reconstruction model
CSI Feedback
UE-side CSI compression model

FIG. 4

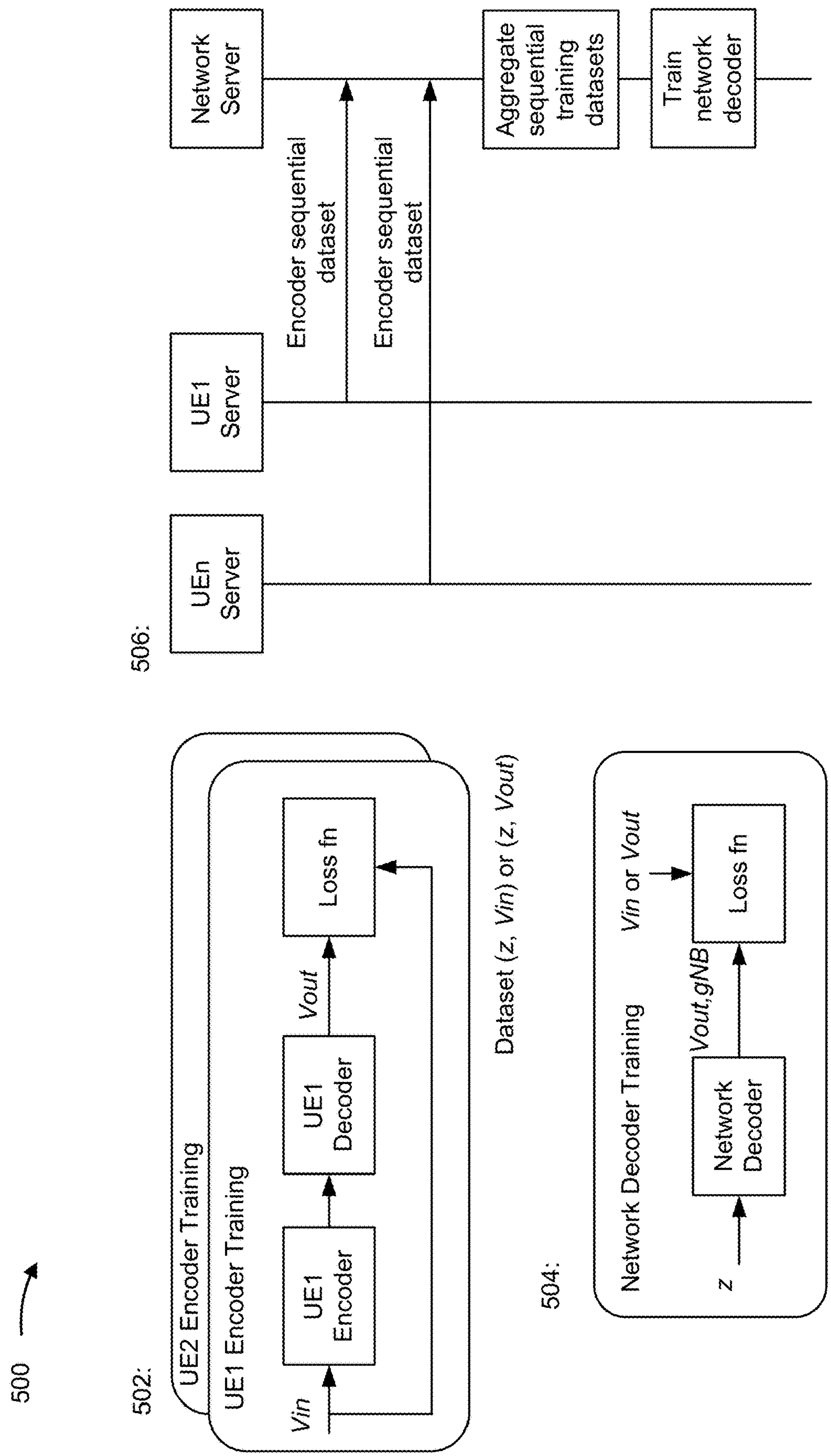

500
502:
UE2 Encoder Training
UE1 Encoder Training
Vin
UE1 Encoder
UE1 Decoder
Vout
Loss fn
Dataset (z, Vin) or (z, Vout)
504:
Network Decoder Training
z
Network Decoder
Vout,gNB
Vin or Vout
Loss fn
506:
UEn Server
UE1 Server
Network Server
Encoder sequential dataset
Encoder sequential dataset
Aggregate sequential training datasets
Train network decoder

FIG. 5

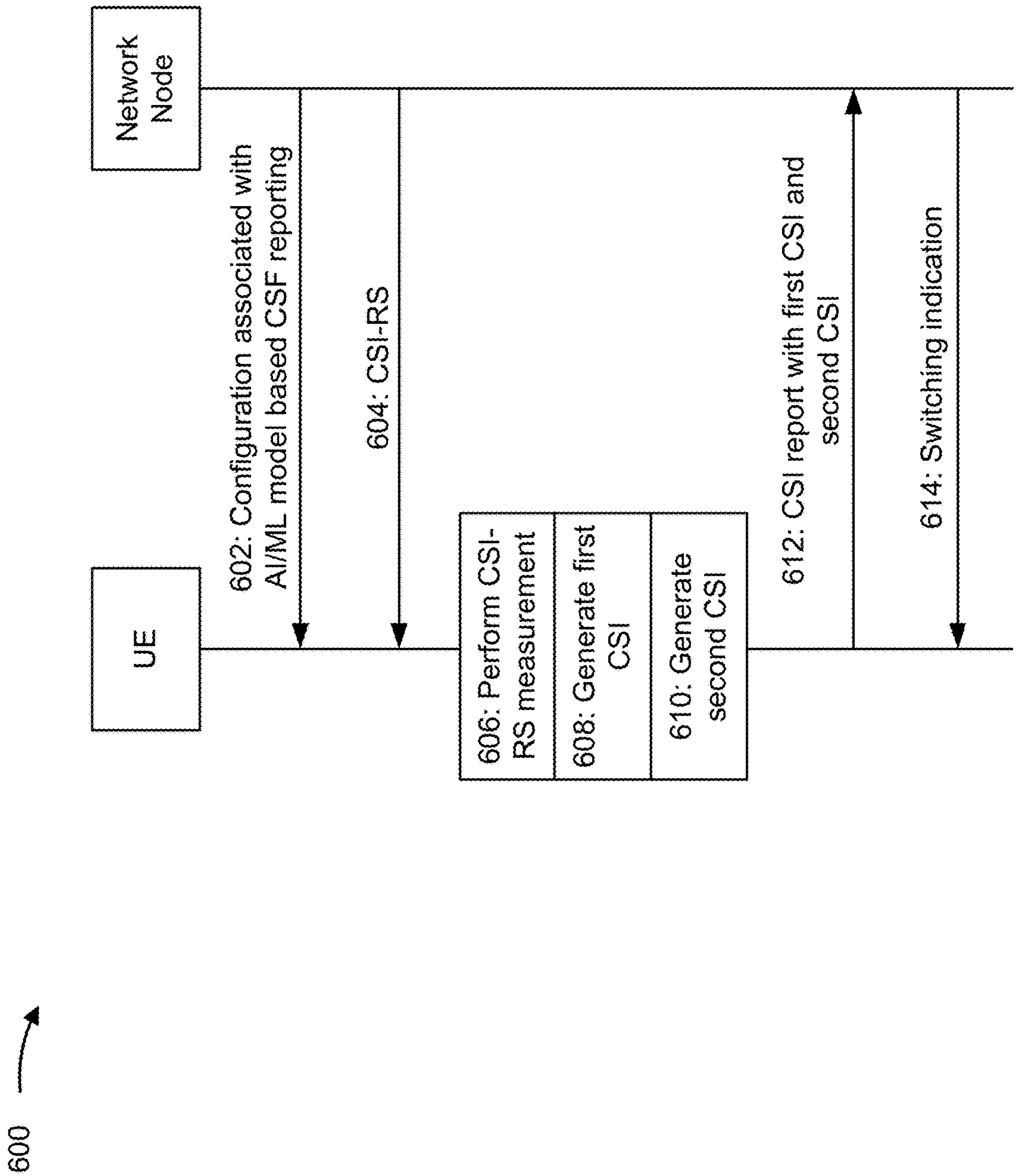

600
UE
Network Node
602: Configuration associated with AI/ML model based CSF reporting
604: CSI-RS
606: Perform CSI-RS measurement
608: Generate first CSI
610: Generate second CSI
612: CSI report with first CSI and second CSI
614: Switching indication

FIG. 6

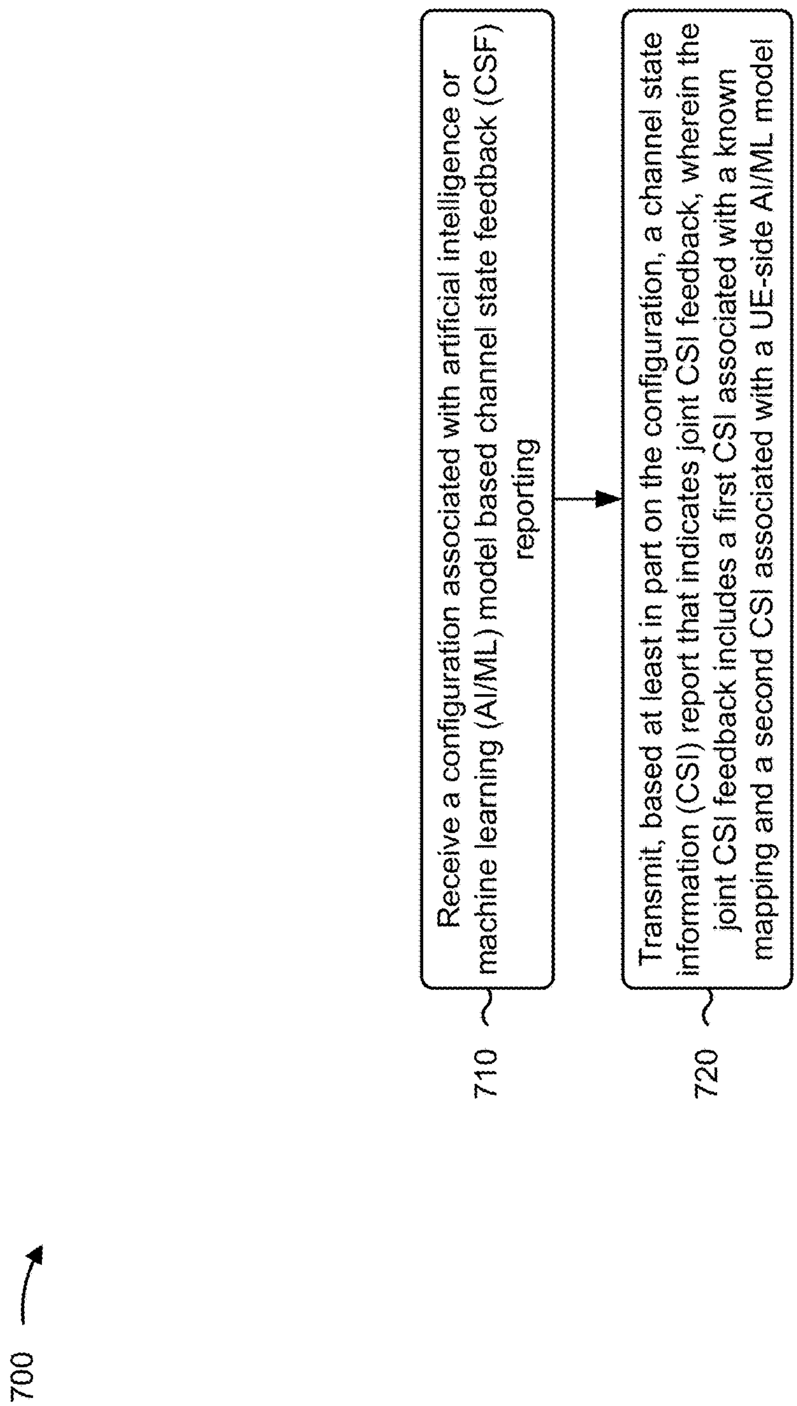

700
710
Receive a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting
720
Transmit, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model

FIG. 7

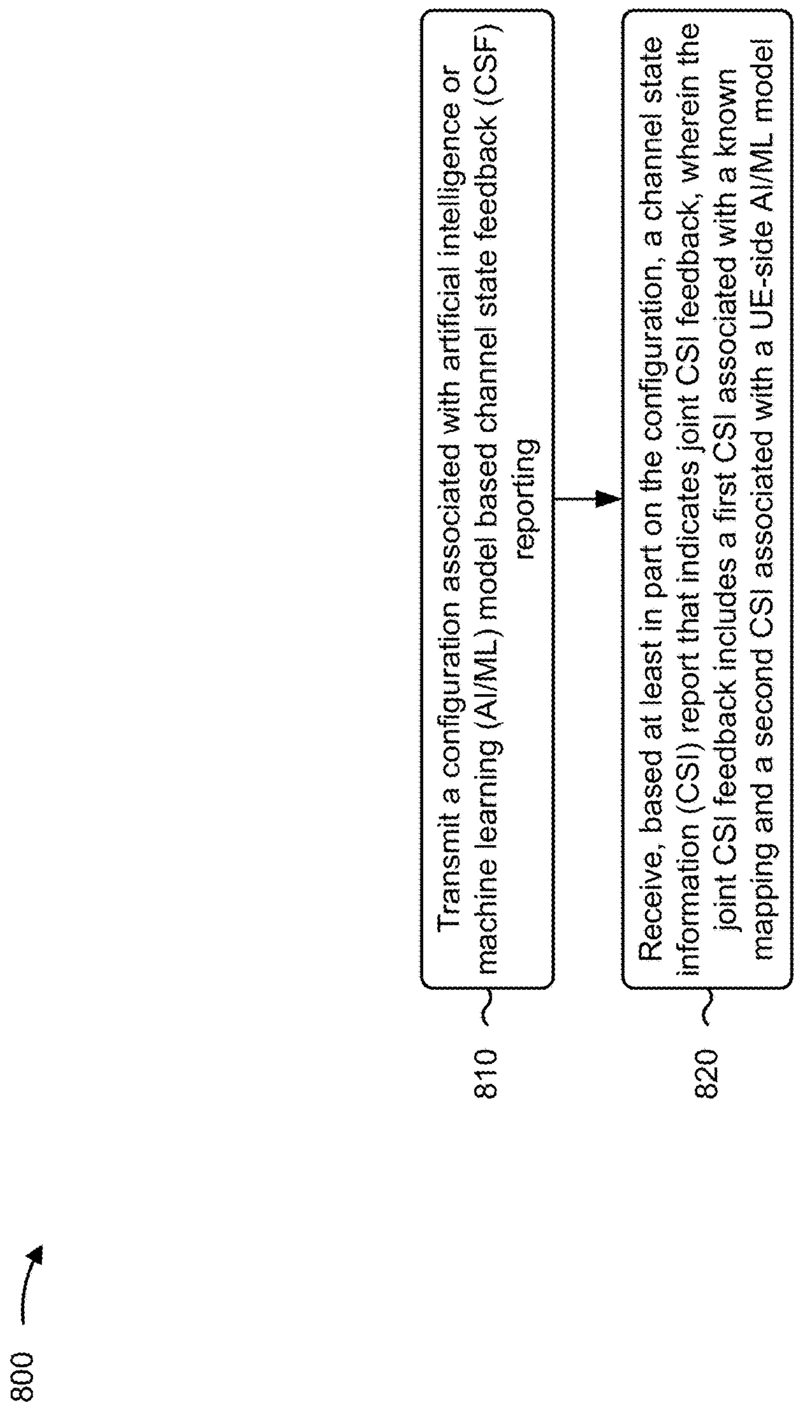

800
810
Transmit a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting
820
Receive, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model

FIG. 8

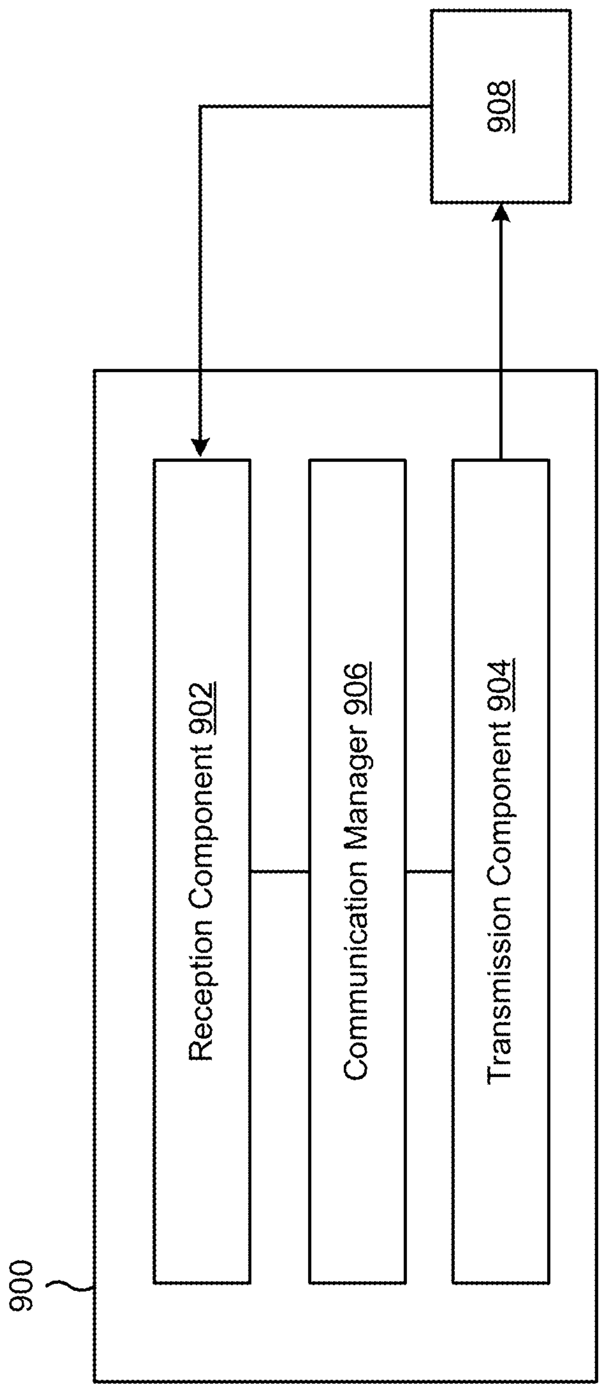
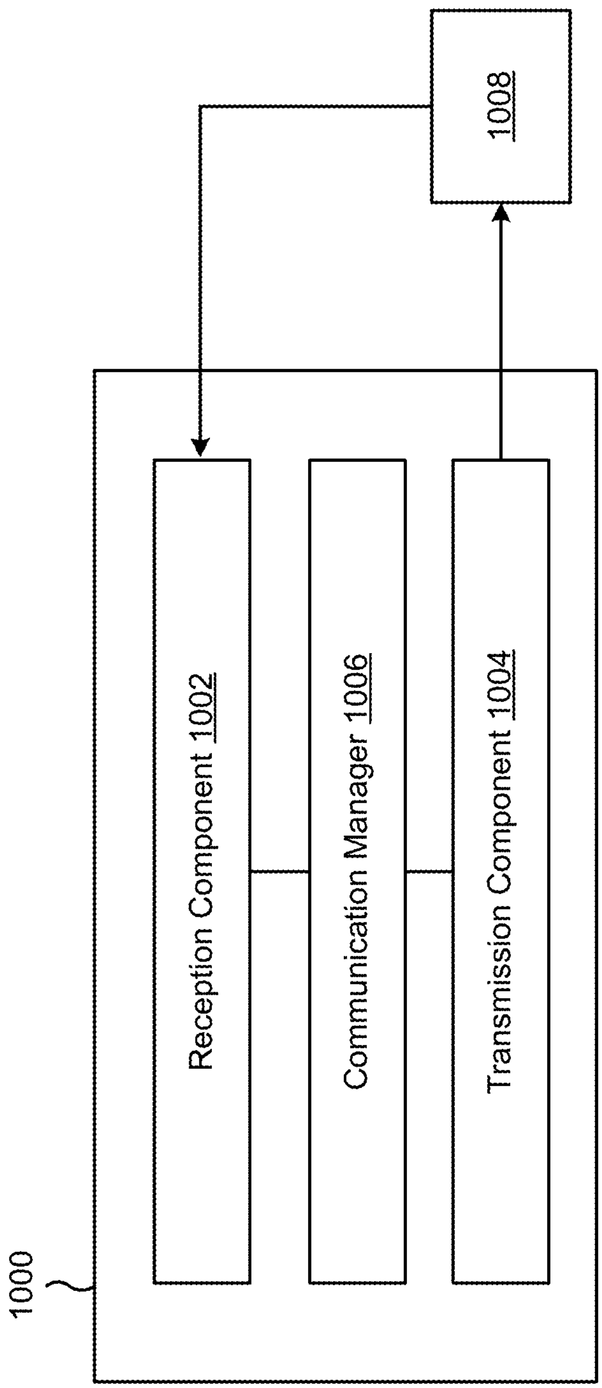

900
Reception Component 902
Communication Manager 906
Transmission Component 904
908

FIG. 9



1008
Reception Component 1002
Communication Manager 1006
Transmission Component 1004
1000

FIG. 10

REPORTING CHANNEL STATE INFORMATION FEEDBACK FOR NETWORK-SIDE MODEL TRAINING

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This Patent Application claims priority to U.S. Provisional Patent Application No. 63/553,359, filed on Feb. 14, 2024, entitled "REPORTING CHANNEL STATE INFORMATION FEEDBACK FOR NETWORK-SIDE MODEL TRAINING," and assigned to the assignee hereof. The disclosure of the prior Application is considered part of and is incorporated by reference into this Patent Application.

FIELD OF THE DISCLOSURE

[0002] Aspects of the present disclosure generally relate to wireless communication and specifically relate to techniques, apparatuses, and methods for reporting channel state information (CSI) feedback for network-side model training.

BACKGROUND

[0003] Wireless communication systems are widely deployed to provide various services that may include carrying voice, text, messaging, video, data, and/or other traffic. The services may include unicast, multicast, and/or broadcast services, among other examples. Typical wireless communication systems may employ multiple-access radio access technologies (RATs) capable of supporting communication with multiple users by sharing available system resources (for example, time domain resources, frequency domain resources, spatial domain resources, and/or device transmit power, among other examples). Examples of such multiple-access RATs include code division multiple access (CDMA) systems, time division multiple access (TDMA) systems, frequency division multiple access (FDMA) systems, orthogonal frequency division multiple access (OFDMA) systems, single-carrier frequency division multiple access (SC-FDMA) systems, and time division synchronous code division multiple access (TD-SCDMA) systems.

[0004] The above multiple-access RATs have been adopted in various telecommunication standards to provide common protocols that enable different wireless communication devices to communicate on a municipal, national, regional, or global level. An example telecommunication standard is New Radio (NR). NR, which may also be referred to as 5G, is part of a continuous mobile broadband evolution promulgated by the Third Generation Partnership Project (3GPP). NR (and other mobile broadband evolutions beyond NR) may be designed to better support Internet of things (IoT) and reduced capability device deployments, industrial connectivity, millimeter wave (mmWave) expansion, licensed and unlicensed spectrum access, non-terrestrial network (NTN) deployment, sidelink and other device-to-device direct communication technologies (for example, cellular vehicle-to-everything (CV2X) communication), massive multiple-input multiple-output (MIMO), disaggregated network architectures and network topology expansions, multiple-subscriber implementations, high-precision positioning, and/or radio frequency (RF) sensing, among other examples. As the demand for mobile broadband access continues to increase, further improvements in NR may be implemented, and other radio access technologies such as 6G may be introduced, to further advance mobile broadband evolution.

SUMMARY

[0005] In some implementations, an apparatus for wireless communication at a user equipment (UE) includes one or more memories; and one or more processors, coupled to the one or more memories, which, individually or in any combination, are operable to cause the apparatus to: receive a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting; and transmit, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0006] In some implementations, an apparatus for wireless communication at a network node includes one or more memories; and one or more processors, coupled to the one or more memories, which, individually or in any combination, are operable to cause the apparatus to: transmit a configuration associated with AI/ML model based CSF reporting; and receive, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0007] In some implementations, a method of wireless communication performed by a UE includes receiving a configuration associated with AI/ML model based CSF reporting; and transmitting, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0008] In some implementations, a method of wireless communication performed by a network node includes transmitting a configuration associated with AI/ML model based CSF reporting; and receiving, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0009] In some implementations, a non-transitory computer-readable medium storing a set of instructions for wireless communication includes one or more instructions that, when executed by one or more processors of a UE, cause the UE to: receive a configuration associated with AI/ML model based CSF reporting; and transmit, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0010] In some implementations, a non-transitory computer-readable medium storing a set of instructions for wireless communication includes one or more instructions that, when executed by one or more processors of a network node, cause the network node to: transmit a configuration associated with AI/ML model based CSF reporting; and receive, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint

CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0011] In some implementations, an apparatus for wireless communication includes means for receiving a configuration associated with AI/ML model based CSF reporting; and means for transmitting, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0012] In some implementations, an apparatus for wireless communication includes means for transmitting a configuration associated with AI/ML model based CSF reporting; and means for receiving, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0013] Aspects of the present disclosure may generally be implemented by or as a method, apparatus, system, computer program product, non-transitory computer-readable medium, user equipment, base station, network node, network entity, wireless communication device, and/or processing system as substantially described with reference to, and as illustrated by, the specification and accompanying drawings.

[0014] The foregoing paragraphs of this section have broadly summarized some aspects of the present disclosure. These and additional aspects and associated advantages will be described hereinafter. The disclosed aspects may be used as a basis for modifying or designing other aspects for carrying out the same or similar purposes of the present disclosure. Such equivalent aspects do not depart from the scope of the appended claims. Characteristics of the aspects disclosed herein, both their organization and method of operation, together with associated advantages, will be better understood from the following description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The appended drawings illustrate some aspects of the present disclosure, but are not limiting of the scope of the present disclosure because the description may enable other aspects. Each of the drawings is provided for purposes of illustration and description, and not as a definition of the limits of the claims. The same or similar reference numbers in different drawings may identify the same or similar elements.

[0016] FIG. **1** is a diagram illustrating an example of a wireless network, in accordance with the present disclosure.

[0017] FIG. **2** is a diagram illustrating an example of a network node in communication with a user equipment (UE) in a wireless network, in accordance with the present disclosure.

[0018] FIG. **3** is a diagram illustrating an example disaggregated base station architecture, in accordance with the present disclosure.

[0019] FIG. **4** is a diagram illustrating an example of using trained artificial intelligence and/or machine learning (AI/ML) models for implementing a function, in accordance with the present disclosure.

[0020] FIG. **5** is a diagram illustrating an example of UE-first training, in accordance with the present disclosure.

[0021] FIG. **6** is a diagram illustrating an example associated with reporting channel state information (CSI) feedback for network-side model training, in accordance with the present disclosure.

[0022] FIGS. **7-8** are diagrams illustrating example processes associated with reporting CSI feedback for network-side model training, in accordance with the present disclosure.

[0023] FIGS. **9-10** are diagrams of example apparatuses for wireless communication, in accordance with the present disclosure.

DETAILED DESCRIPTION

[0024] Various aspects of the present disclosure are described hereinafter with reference to the accompanying drawings. However, aspects of the present disclosure may be embodied in many different forms and is not to be construed as limited to any specific aspect illustrated by or described with reference to an accompanying drawing or otherwise presented in this disclosure. Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. One skilled in the art may appreciate that the scope of the disclosure is intended to cover any aspect of the disclosure disclosed herein, whether implemented independently of or in combination with any other aspect of the disclosure. For example, an apparatus may be implemented or a method may be practiced using various combinations or quantities of the aspects set forth herein. In addition, the scope of the disclosure is intended to cover an apparatus having, or a method that is practiced using, other structures and/or functionalities in addition to or other than the structures and/or functionalities with which various aspects of the disclosure set forth herein may be practiced. Any aspect of the disclosure disclosed herein may be embodied by one or more elements of a claim.

[0025] Several aspects of telecommunication systems will now be presented with reference to various methods, operations, apparatuses, and techniques. These methods, operations, apparatuses, and techniques will be described in the following detailed description and illustrated in the accompanying drawings by various blocks, modules, components, circuits, steps, processes, or algorithms (collectively referred to as "elements"). These elements may be implemented using hardware, software, or a combination of hardware and software. Whether such elements are implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system.

[0026] A user equipment (UE) and a network node may use an artificial intelligence or machine learning (AI/ML)-based air interface and AI/ML models to implement a function. For example, when the UE intends to convey channel state information (CSI) to the network node, the UE may use a neural network to derive a compressed representation to feedback to the network node. The UE may derive the compressed representation using a UE-side CSI compression model. The network node may use another neural network to reconstruct a target CSI from the compressed representation. The network node may reconstruct the target CSI using a network-side CSI reconstruction model. The CSI may include a precoding matrix that the UE prefers that the network node use based at least in part on an observed channel. For the CSI reconstruction to be accurate, UE-side AI/ML models and network-side AI/ML models should be trained in a collaborative manner so that the compressed representation created by the UE-side AI/ML model is interpreted and decoded correctly by the network-side AI/ML model. When this requirement is satisfied, then such a pair of AI/ML models may be compatible with each other.

[0027] An issue with the training of two-sided AI/ML models may occur when the UE-side AI/ML model and the network-side AI/ML model are under the control of two different vendors. In this case, vendors may need to collaborate during training to ensure compatibility. Specifically, both the UE-side and the network-side (e.g., both a UE vendor and a network vendor) should have a common understanding of a mapping (or codebook) between a CSI feedback payload and a preferred precoding matrix represented by the CSI feedback payload. One approach is to require each pair of vendors to collaborate offline to align various aspects of the model training to ensure that resulting models are compatible. However, this approach may not be scalable since every network vendor may not be able to collaborate with every UE vendor or vice versa. A more scalable approach may be needed to develop compatible models that does not require every vendor to necessarily coordinate with every other vendor outside of standardized interfaces.

[0028] Various aspects relate generally to reporting CSI feedback for network-side model training. Some aspects more specifically relate to reporting joint CSI feedback based at least in part on a configuration associated with AI/ML model based channel state feedback (CSF) reporting. In some examples, a UE may receive, from a network node, the configuration associated with AI/ML model based CSF reporting. The UE may transmit, to the network node and based at least in part on the configuration, a CSI report that indicates the joint CSI feedback. The joint CSI feedback may include a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. The UE-side AI/ML model may be an encoder model. The known mapping may be based at least in part on a legacy CSI feedback, or the known mapping may be based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model. The preexisting network-side AI/ML model may be in contrast to a network-side AI/ML model to be trained. The known mapping may be a mapping known to the network node, where the mapping may be between CSI feedback and a precoder (or precoding matrix). The network node may be able to interpret the first CSI, such that the network node may derive an estimated precoder based at least in part on the first CSI. The network node may not be able to interpret the second CSI based at least in part on no compatible network-side AI/ML model. The network node may include the estimated precoder and the second CSI as one CSI sample in a dataset for training a network-side AI/ML model, where the network-side AI/ML model may be a decoder model. After obtaining a plurality of CSI samples (e.g., corresponding estimated precoder and second CSI pairs) over a period of time, the network node may be able to activate the network-side AI/ML model. The network node may transmit, to the UE, an indication to activate the UE-side AI/ML model. At this point, the UE-side AI/ML model and the network-side AI/ML model may be compatible with each other. The UE-side AI/ML model may be associated with a UE vendor, and the network-side AI/ML model may be associated with a network vendor.

[0029] Particular aspects of the subject matter described in this disclosure can be implemented to realize one or more of the following potential advantages. In some examples, by configuring the UE to transmit the CSI report that includes the joint CSI feedback, the described techniques can be used, by the network node, to use the first CSI and the second CSI associated with the joint CSI feedback for training the network-side AI/ML model. The UE and the network node may be able to use an air interface for data collection needed for training the network-side AI/ML model. As a result, the UE vendor and the network vendor may be able to develop compatible AI/ML models that do not require each of the vendors to necessarily coordinate with each other outside of standardized interfaces, which may improve scalability when developing compatible AI/ML models. Since every network vendor may not be able to collaborate with every UE vendor, or vice versa, an ability for the UE to provide over-the-air feedback to aid in network-side AI/ML model training may improve an overall system performance.

[0030] Multiple-access radio access technologies (RATs) have been adopted in various telecommunication standards to provide common protocols that enable wireless communication devices to communicate on a municipal, enterprise, national, regional, or global level. For example, 5G New Radio (NR) is part of a continuous mobile broadband evolution promulgated by the Third Generation Partnership Project (3GPP). 5G NR supports various technologies and use cases including enhanced mobile broadband (eMBB), ultra-reliable low-latency communication (URLLC), massive machine-type communication (mMTC), millimeter wave (mmWave) technology, beamforming, network slicing, edge computing, Internet of Things (IoT) connectivity and management, and network function virtualization (NFV).

[0031] As the demand for broadband access increases and as technologies supported by wireless communication networks evolve, further technological improvements may be adopted in or implemented for 5G NR or future RATs, such as 6G, to further advance the evolution of wireless communication for a wide variety of existing and new use cases and applications. Such technological improvements may be associated with new frequency band expansion, licensed and unlicensed spectrum access, overlapping spectrum use, small cell deployments, non-terrestrial network (NTN) deployments, disaggregated network architectures and network topology expansion, device aggregation, advanced duplex communication, sidelink and other device-to-device direct communication, IoT (including passive or ambient IoT) networks, reduced capability (RedCap) UE functionality, industrial connectivity, multiple-subscriber implementations, high-precision positioning, radio frequency (RF) sensing, and/or AI/ML, among other examples. These technological improvements may support use cases such as wireless backhauls, wireless data centers, extended reality (XR) and metaverse applications, meta services for supporting vehicle connectivity, holographic and mixed reality communication, autonomous and collaborative robots, vehicle platooning and cooperative maneuvering, sensing networks, gesture monitoring, human-brain interfacing, digital twin applications, asset management, and universal coverage applications using non-terrestrial and/or aerial platforms, among other examples. The methods, operations, apparatuses, and techniques described herein may enable one or more of the foregoing technologies and/or support one or more of the foregoing use cases.

[0032] FIG. **1** is a diagram illustrating an example of a wireless communication network **100** in accordance with the present disclosure. The wireless communication network **100** may be or may include elements of a 5G (or NR) network or a 6G network, among other examples. The wireless communication network **100** may include multiple network nodes **110**, shown as a network node (NN) **110***a*, a network node **110***b*, a network node **110***c*, and a network node **110***d*. The network nodes **110** may support communications with multiple UEs **120**, shown as a UE **120***a*, a UE **120***b*, a UE **120***c*, a UE **120***d*, and a UE **120***e*.

[0033] The network nodes **110** and the UEs **120** of the wireless communication network **100** may communicate using the electromagnetic spectrum, which may be subdivided by frequency or wavelength into various classes, bands, carriers, and/or channels. For example, devices of the wireless communication network **100** may communicate using one or more operating bands. In some aspects, multiple wireless networks **100** may be deployed in a given geographic area. Each wireless communication network **100** may support a particular RAT (which may also be referred to as an air interface) and may operate on one or more carrier frequencies in one or more frequency ranges. Examples of RATs include a 4G RAT, a 5G/NR RAT, and/or a 6G RAT, among other examples. In some examples, when multiple RATs are deployed in a given geographic area, each RAT in the geographic area may operate on different frequencies to avoid interference with one another.

[0034] Various operating bands have been defined as frequency range designations FR1 (410 MHz through 7.125 GHz), FR2 (24.25 GHz through 52.6 GHz), FR3 (7.125 GHz through 24.25 GHz), FR4a or FR4-1 (52.6 GHz through 71 GHz), FR4 (52.6 GHz through 114.25 GHz), and FR5 (114.25 GHz through 300 GHz). Although a portion of FR1 is greater than 6 GHz, FR1 is often referred to (interchangeably) as a “Sub-6 GHz” band in some documents and articles. Similarly, FR2 is often referred to (interchangeably) as a “millimeter wave” band in some documents and articles, despite being different than the extremely high frequency (EHF) band (30 GHz through 300 GHz), which is identified by the International Telecommunications Union (ITU) as a “millimeter wave” band. The frequencies between FR1 and FR2 are often referred to as mid-band frequencies, which include FR3. Frequency bands falling within FR3 may inherit FR1 characteristics or FR2 characteristics, and thus may effectively extend features of FR1 or FR2 into mid-band frequencies. Thus, “sub-6 GHz,” if used herein, may broadly refer to frequencies that are less than 6 GHz, that are within FR1, and/or that are included in mid-band frequencies. Similarly, the term “millimeter wave,” if used herein, may broadly refer to frequencies that are included in mid-band frequencies, that are within FR2, FR4, FR4-a or FR4-1, or FR5, and/or that are within the EHF band. Higher frequency bands may extend 5G NR operation, 6G operation, and/or other RATs beyond 52.6 GHz. For example, each of FR4a, FR4-1, FR4, and FR5 falls within the EHF band. In some examples, the wireless communication network **100** may implement dynamic spectrum sharing (DSS), in which multiple RATs (for example, 4G/LTE and 5G/NR) are implemented with dynamic bandwidth allocation (for example, based on user demand) in a single frequency band. It is contemplated that the frequencies included in these operating bands (for example, FR1, FR2, FR3, FR4, FR4-a, FR4-1, and/or FR5) may be modified, and techniques described herein may be applicable to those modified frequency ranges.

[0035] A network node **110** may include one or more devices, components, or systems that enable communication between a UE **120** and one or more devices, components, or systems of the wireless communication network **100**. A network node **110** may be, may include, or may also be referred to as an NR network node, a 5G network node, a 6G network node, a Node B, an eNB, a gNB, an access point (AP), a transmission reception point (TRP), a mobility element, a core, a network entity, a network element, a network equipment, and/or another type of device, component, or system included in a radio access network (RAN).

[0036] A network node **110** may be implemented as a single physical node (for example, a single physical structure) or may be implemented as two or more physical nodes (for example, two or more distinct physical structures). For example, a network node **110** may be a device or system that implements part of a radio protocol stack, a device or system that implements a full radio protocol stack (such as a full gNB protocol stack), or a collection of devices or systems that collectively implement the full radio protocol stack. For example, and as shown, a network node **110** may be an aggregated network node (having an aggregated architecture), meaning that the network node **110** may implement a full radio protocol stack that is physically and logically integrated within a single node (for example, a single physical structure) in the wireless communication network **100**. For example, an aggregated network node **110** may consist of a single standalone base station or a single TRP that uses a full radio protocol stack to enable or facilitate communication between a UE **120** and a core network of the wireless communication network **100**.

[0037] Alternatively, and as also shown, a network node **110** may be a disaggregated network node (sometimes referred to as a disaggregated base station), meaning that the network node **110** may implement a radio protocol stack that is physically distributed and/or logically distributed among two or more nodes in the same geographic location or in different geographic locations. For example, a disaggregated network node may have a disaggregated architecture. In some deployments, disaggregated network nodes **110** may be used in an integrated access and backhaul (IAB) network, in an open radio access network (O-RAN) (such as a network configuration in compliance with the O-RAN Alliance), or in a virtualized radio access network (vRAN), also known as a cloud radio access network (C-RAN), to facilitate scaling by separating base station functionality into multiple units that can be individually deployed.

[0038] The network nodes **110** of the wireless communication network **100** may include one or more central units (CUs), one or more distributed units (DUs), and/or one or more radio units (RUs). A CU may host one or more higher layer control functions, such as radio resource control (RRC) functions, packet data convergence protocol (PDCP) functions, and/or service data adaptation protocol (SDAP) functions, among other examples. A DU may host one or more of a radio link control (RLC) layer, a medium access control (MAC) layer, and/or one or more higher physical

(PHY) layers depending, at least in part, on a functional split, such as a functional split defined by the 3GPP. In some examples, a DU also may host one or more lower PHY layer functions, such as a fast Fourier transform (FFT), an inverse FFT (iFFT), beamforming, physical random access channel (PRACH) extraction and filtering, and/or scheduling of resources for one or more UEs **120**, among other examples. An RU may host RF processing functions or lower PHY layer functions, such as an FFT, an iFFT, beamforming, or PRACH extraction and filtering, among other examples, according to a functional split, such as a lower layer functional split. In such an architecture, each RU can be operated to handle over the air (OTA) communication with one or more UEs **120**.

[0039] In some aspects, a single network node **110** may include a combination of one or more CUs, one or more DUs, and/or one or more RUs. Additionally or alternatively, a network node **110** may include one or more Near-Real Time (Near-RT) RAN Intelligent Controllers (RICs) and/or one or more Non-Real Time (Non-RT) RICs. In some examples, a CU, a DU, and/or an RU may be implemented as a virtual unit, such as a virtual central unit (VCU), a virtual distributed unit (VDU), or a virtual radio unit (VRU), among other examples. A virtual unit may be implemented as a virtual network function, such as associated with a cloud deployment.

[0040] Some network nodes **110** (for example, a base station, an RU, or a TRP) may provide communication coverage for a particular geographic area. In the 3GPP, the term "cell" can refer to a coverage area of a network node **110** or to a network node **110** itself, depending on the context in which the term is used. A network node **110** may support one or multiple (for example, three) cells. In some examples, a network node **110** may provide communication coverage for a macro cell, a pico cell, a femto cell, or another type of cell. A macro cell may cover a relatively large geographic area (for example, several kilometers in radius) and may allow unrestricted access by UEs **120** with service subscriptions. A pico cell may cover a relatively small geographic area and may allow unrestricted access by UEs **120** with service subscriptions. A femto cell may cover a relatively small geographic area (for example, a home) and may allow restricted access by UEs **120** having association with the femto cell (for example, UEs **120** in a closed subscriber group (CSG)). A network node **110** for a macro cell may be referred to as a macro network node. A network node **110** for a pico cell may be referred to as a pico network node. A network node **110** for a femto cell may be referred to as a femto network node or an in-home network node. In some examples, a cell may not necessarily be stationary. For example, the geographic area of the cell may move according to the location of an associated mobile network node **110** (for example, a train, a satellite base station, an unmanned aerial vehicle, or an NTN network node).

[0041] The wireless communication network **100** may be a heterogeneous network that includes network nodes **110** of different types, such as macro network nodes, pico network nodes, femto network nodes, relay network nodes, aggregated network nodes, and/or disaggregated network nodes, among other examples. In the example shown in FIG. **1**, the network node **110***a* may be a macro network node for a macro cell **130***a*, the network node **110***b* may be a pico network node for a pico cell **130***b*, and the network node **110***c* may be a femto network node for a femto cell **130***c*. Various different types of network nodes **110** may generally transmit at different power levels, serve different coverage areas, and/or have different impacts on interference in the wireless communication network **100** than other types of network nodes **110**. For example, macro network nodes may have a high transmit power level (for example, 5 to 40 watts), whereas pico network nodes, femto network nodes, and relay network nodes may have lower transmit power levels (for example, 0.1 to 2 watts).

[0042] In some examples, a network node **110** may be, may include, or may operate as an RU, a TRP, or a base station that communicates with one or more UEs **120** via a radio access link (which may be referred to as a "Uu" link). The radio access link may include a downlink and an uplink. "Downlink" (or "DL") refers to a communication direction from a network node **110** to a UE **120**, and "uplink" (or "UL") refers to a communication direction from a UE **120** to a network node **110**. Downlink channels may include one or more control channels and one or more data channels. A downlink control channel may be used to transmit downlink control information (DCI) (for example, scheduling information, reference signals, and/or configuration information) from a network node **110** to a UE **120**. A downlink data channel may be used to transmit downlink data (for example, user data associated with a UE **120**) from a network node **110** to a UE **120**. Downlink control channels may include one or more physical downlink control channels (PDCCHs), and downlink data channels may include one or more physical downlink shared channels (PDSCHs). Uplink channels may similarly include one or more control channels and one or more data channels. An uplink control channel may be used to transmit uplink control information (UCI) (for example, reference signals and/or feedback corresponding to one or more downlink transmissions) from a UE **120** to a network node **110**. An uplink data channel may be used to transmit uplink data (for example, user data associated with a UE **120**) from a UE **120** to a network node **110**. Uplink control channels may include one or more physical uplink control channels (PUCCHs), and uplink data channels may include one or more physical uplink shared channels (PUSCHs). The downlink and the uplink may each include a set of resources on which the network node **110** and the UE **120** may communicate.

[0043] Downlink and uplink resources may include time domain resources (frames, subframes, slots, and/or symbols), frequency domain resources (frequency bands, component carriers, subcarriers, resource blocks, and/or resource elements), and/or spatial domain resources (particular transmit directions and/or beam parameters). Frequency domain resources of some bands may be subdivided into bandwidth parts (BWPs). A BWP may be a continuous block of frequency domain resources (for example, a continuous block of resource blocks) that are allocated for one or more UEs **120**. A UE **120** may be configured with both an uplink BWP and a downlink BWP (where the uplink BWP and the downlink BWP may be the same BWP or different BWPs). A BWP may be dynamically configured (for example, by a network node **110** transmitting a DCI configuration to the one or more UEs **120**) and/or reconfigured, which means that a BWP can be adjusted in real-time (or near-real-time) based on changing network conditions in the wireless communication network **100** and/or based on the specific requirements of the one or more UEs **120**. This enables more efficient use of the available frequency domain resources in the wireless communication network **100** because fewer frequency domain resources may be allocated to a BWP for a UE **120** (which may reduce the quantity of frequency domain resources that a UE **120** is required to monitor), leaving more frequency domain resources to be spread across multiple UEs **120**. Thus, BWPs may also assist in the implementation of lower-capability UEs **120** by facilitating the configuration of smaller bandwidths for communication by such UEs **120**.

[0044] As described above, in some aspects, the wireless communication network **100** may be, may include, or may be included in, an IAB network. In an IAB network, at least one network node **110** is an anchor network node that communicates with a core network. An anchor network node **110** may also be referred to as an IAB donor (or "IAB-donor"). The anchor network node **110** may connect to the core network via a wired backhaul link. For example, an Ng interface of the anchor network node **110** may terminate at the core network. Additionally or alternatively, an anchor network node **110** may connect to one or more devices of the core network that provide a core access and mobility management function (AMF). An IAB network also generally includes multiple non-anchor network nodes **110**, which may also be referred to as relay network nodes or simply as IAB nodes (or "IAB-nodes"). Each non-anchor network node **110** may communicate directly with the anchor network node **110** via a wireless backhaul link to access the core network, or may communicate indirectly with the anchor network node **110** via one or more other non-anchor network nodes **110** and associated wireless backhaul links that form a backhaul path to the core network. Some anchor network node **110** or other non-anchor network node **110** may also communicate directly with one or more UEs **120** via wireless access links that carry access traffic. In some examples, network resources for wireless communication (such as time resources, frequency resources, and/or spatial resources) may be shared between access links and backhaul links.

[0045] In some examples, any network node **110** that relays communications may be referred to as a relay network node, a relay station, or simply as a relay. A relay may receive a transmission of a communication from an upstream station (for example, another network node **110** or a UE **120**) and transmit the communication to a downstream station (for example, a UE **120** or another network node **110**). In this case, the wireless communication network **100** may include or be referred to as a "multi-hop network." In the example shown in FIG. **1**, the network node **110***d* (for example, a relay network node) may communicate with the network node **110***a* (for example, a macro network node) and the UE **120***d* in order to facilitate communication between the network node **110***a* and the UE **120***d*. Additionally or alternatively, a UE **120** may be or may operate as a relay station that can relay transmissions to or from other UEs **120**. A UE **120** that relays communications may be referred to as a UE relay or a relay UE, among other examples.

[0046] The UEs **120** may be physically dispersed throughout the wireless communication network **100**, and each UE **120** may be stationary or mobile. A UE **120** may be, may include, or may be included in an access terminal, another terminal, a mobile station, or a subscriber unit. A UE **120** may be, include, or be coupled with a cellular phone (for example, a smart phone), a personal digital assistant (PDA), a wireless modem, a wireless communication device, a handheld device, a laptop computer, a cordless phone, a wireless local loop (WLL) station, a tablet, a camera, a gaming device, a netbook, a smartbook, an ultrabook, a medical device, a biometric device, a wearable device (for example, a smart watch, smart clothing, smart glasses, a smart wristband, and/or smart jewelry, such as a smart ring or a smart bracelet), an entertainment device (for example, a music device, a video device, and/or a satellite radio), an XR device, a vehicular component or sensor, a smart meter or sensor, industrial manufacturing equipment, a Global Navigation Satellite System (GNSS) device (such as a Global Positioning System device or another type of positioning device), a UE function of a network node, and/or any other suitable device or function that may communicate via a wireless medium.

[0047] A UE **120** and/or a network node **110** may include one or more chips, system-on-chips (SoCs), chipsets, packages, or devices that individually or collectively constitute or comprise a processing system. The processing system includes processor (or "processing") circuitry in the form of one or multiple processors, microprocessors, processing units (such as central processing units (CPUs), graphics processing units (GPUs), neural processing units (NPUs) and/or digital signal processors (DSPs)), processing blocks, application-specific integrated circuits (ASIC), programmable logic devices (PLDs) (such as field programmable gate arrays (FPGAs)), or other discrete gate or transistor logic or circuitry (all of which may be generally referred to herein individually as "processors" or collectively as "the processor" or "the processor circuitry"). One or more of the processors may be individually or collectively configurable or configured to perform various functions or operations described herein. A group of processors collectively configurable or configured to perform a set of functions may include a first processor configurable or configured to perform a first function of the set and a second processor configurable or configured to perform a second function of the set, or may include the group of processors all being configured or configurable to perform the set of functions.

[0048] The processing system may further include memory circuitry in the form of one or more memory devices, memory blocks, memory elements or other discrete gate or transistor logic or circuitry, each of which may include tangible storage media such as random-access memory (RAM) or read-only memory (ROM), or combinations thereof (all of which may be generally referred to herein individually as "memories" or collectively as "the memory" or "the memory circuitry"). One or more of the memories may be coupled (for example, operatively coupled, communicatively coupled, electronically coupled, or electrically coupled) with one or more of the processors and may individually or collectively store processor-executable code (such as software) that, when executed by one or more of the processors, may configure one or more of the processors to perform various functions or operations described herein. Additionally or alternatively, in some examples, one or more of the processors may be preconfigured to perform various functions or operations described herein without requiring configuration by software. The processing system may further include or be coupled with one or more modems (such as a Wi-Fi (for example, IEEE compliant) modem or a cellular (for example, 3GPP 4G LTE, 5G, or 6G compliant) modem). In some implementations, one or more processors of the processing system include or implement one or more of the modems. The processing system may further include or be coupled with multiple radios (collectively "the radio"), multiple RF chains, or multiple transceivers, each of which may in turn be coupled with one or more of multiple antennas. In some implementations, one or more processors of the processing system include or implement one or more of the radios, RF chains or transceivers. The UE **120** may include or may be included in a housing that houses components associated with the UE **120** including the processing system.

[0049] Some UEs **120** may be considered machine-type communication (MTC) UEs, evolved or enhanced machine-type communication (eMTC), UEs, further enhanced eMTC (feMTC) UEs, or enhanced feMTC (efeMTC) UEs, or further evolutions thereof, all of which may be simply referred to as "MTC UEs". An MTC UE may be, may include, or may be included in or coupled with a robot, an uncrewed aerial vehicle, a remote device, a sensor, a meter, a monitor, and/or a location tag. Some UEs **120** may be considered IoT devices and/or may be implemented as NB-IoT (narrowband IoT) devices. An IoT UE or NB-IoT device may be, may include, or may be included in or coupled with an industrial machine, an appliance, a refrigerator, a doorbell camera device, a home automation device, and/or a light fixture, among other examples. Some UEs **120** may be considered Customer Premises Equipment, which may include telecommunications devices that are installed at a customer location (such as a home or office) to enable access to a service provider's network (such as included in or in communication with the wireless communication network **100**).

[0050] Some UEs **120** may be classified according to different categories in association with different complexities and/or different capabilities. UEs **120** in a first category may facilitate massive IoT in the wireless communication network **100**, and may offer low complexity and/or cost relative to UEs **120** in a second category. UEs **120** in a second category may include mission-critical IoT devices, legacy UEs, baseline UEs, high-tier UEs, advanced UEs, full-capability UEs, and/or premium UEs that are capable of URLLC, enhanced mobile broadband (eMBB), and/or precise positioning in the wireless communication network **100**, among other examples. A third category of UEs **120** may have mid-tier complexity and/or capability (for example, a capability between UEs **120** of the first category and UEs **120** of the second capability). A UE **120** of the third category may be referred to as a reduced capacity UE ("RedCap UE"), a mid-tier UE, an NR-Light UE, and/or an NR-Lite UE, among other examples. RedCap UEs may bridge a gap between the capability and complexity of NB-IoT devices and/or eMTC UEs, and mission-critical IoT devices and/or premium UEs. RedCap UEs may include, for example, wearable devices, IoT devices, industrial sensors, and/or cameras that are associated with a limited bandwidth, power capacity, and/or transmission range, among other examples. RedCap UEs may support healthcare environments, building automation, electrical distribution, process automation, transport and logistics, and/or smart city deployments, among other examples.

[0051] In some examples, two or more UEs **120** (for example, shown as UE **120***a* and UE **120***e*) may communicate directly with one another using sidelink communications (for example, without communicating by way of a network node **110** as an intermediary). As an example, the UE **120***a* may directly transmit data, control information, or other signaling as a sidelink communication to the UE **120***e*. This is in contrast to, for example, the UE **120***a* first transmitting data in an UL communication to a network node **110**, which then transmits the data to the UE **120***e* in a DL communication. In various examples, the UEs **120** may transmit and receive sidelink communications using peer-to-peer (P2P) communication protocols, device-to-device (D2D) communication protocols, vehicle-to-everything (V2X) communication protocols (which may include vehicle-to-vehicle (V2V) protocols, vehicle-to-infrastructure (V2I) protocols, and/or vehicle-to-pedestrian (V2P) protocols), and/or mesh network communication protocols. In some deployments and configurations, a network node **110** may schedule and/or allocate resources for sidelink communications between UEs **120** in the wireless communication network **100**. In some other deployments and configurations, a UE **120** (instead of a network node **110**) may perform, or collaborate or negotiate with one or more other UEs to perform, scheduling operations, resource selection operations, and/or other operations for sidelink communications.

[0052] In various examples, some of the network nodes **110** and the UEs **120** of the wireless communication network **100** may be configured for full-duplex operation in addition to half-duplex operation. A network node **110** or a UE **120** operating in a half-duplex mode may perform only one of transmission or reception during particular time resources, such as during particular slots, symbols, or other time periods. Half-duplex operation may involve time-division duplexing (TDD), in which DL transmissions of the network node **110** and UL transmissions of the UE **120** do not occur in the same time resources (that is, the transmissions do not overlap in time). In contrast, a network node **110** or a UE **120** operating in a full-duplex mode can transmit and receive communications concurrently (for example, in the same time resources). By operating in a full-duplex mode, network nodes **110** and/or UEs **120** may generally increase the capacity of the network and the radio access link. In some examples, full-duplex operation may involve frequency-division duplexing (FDD), in which DL transmissions of the network node **110** are performed in a first frequency band or on a first component carrier and transmissions of the UE **120** are performed in a second frequency band or on a second component carrier different than the first frequency band or the first component carrier, respectively. In some examples, full-duplex operation may be enabled for a UE **120** but not for a network node **110**. For example, a UE **120** may simultaneously transmit an UL transmission to a first network node **110** and receive a DL transmission from a second network node **110** in the same time resources. In some other examples, full-duplex operation may be enabled for a network node **110** but not for a UE **120**. For example, a network node **110** may simultaneously transmit a DL transmission to a first UE **120** and receive an UL transmission from a second UE **120** in the same time resources. In some other examples, full-duplex operation may be enabled for both a network node **110** and a UE **120**.

[0053] In some examples, the UEs **120** and the network nodes **110** may perform MIMO communication. "MIMO" generally refers to transmitting or receiving multiple signals (such as multiple layers or multiple data streams) simultaneously over the same time and frequency resources. MIMO techniques generally exploit multipath propagation. MIMO may be implemented using various spatial processing or spatial multiplexing operations. In some examples, MIMO may support simultaneous transmission to multiple receivers, referred to as multi-user MIMO (MU-MIMO). Some RATs may employ advanced MIMO techniques, such as mTRP operation (including redundant transmission or reception on multiple TRPs), reciprocity in the time domain or the frequency domain, single-frequency-network (SFN) transmission, or non-coherent joint transmission (NC-JT).

[0054] In some aspects, a UE (e.g., the UE **120**) may include a communication manager **140**. As described in more detail elsewhere herein, the communication manager **140** may receive a configuration associated with AI/ML model based CSF reporting; and transmit, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. Additionally, or alternatively, the communication manager **140** may perform one or more other operations described herein.

[0055] In some aspects, a network node (e.g., the network node **110**) may include a communication manager **150**. As described in more detail elsewhere herein, the communication manager **150** may transmit a configuration associated with AI/ML model based CSF reporting; and receive, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. Additionally, or alternatively, the communication manager **150** may perform one or more other operations described herein.

[0056] As indicated above, FIG. **1** is provided as an example. Other examples may differ from what is described with regard to FIG. **1**.

[0057] FIG. **2** is a diagram illustrating an example network node **110** in communication with an example UE **120** in a wireless network in accordance with the present disclosure.

[0058] As shown in FIG. **2**, the network node **110** may include a data source **212**, a transmit processor **214**, a transmit (TX) MIMO processor **216**, a set of modems **232** (shown as **232***a* through **232***t*, where t≥1), a set of antennas **234** (shown as **234***a* through **234***v*, where v≥1), a MIMO detector **236**, a receive processor **238**, a data sink **239**, a controller/processor **240**, a memory **242**, a communication unit **244**, a scheduler **246**, and/or a communication manager **150**, among other examples. In some configurations, one or a combination of the antenna(s) **234**, the modem(s) **232**, the MIMO detector **236**, the receive processor **238**, the transmit processor **214**, and/or the TX MIMO processor **216** may be included in a transceiver of the network node **110**. The transceiver may be under control of and used by one or more processors, such as the controller/processor **240**, and in some aspects in conjunction with processor-readable code stored in the memory **242**, to perform aspects of the methods, processes, and/or operations described herein. In some aspects, the network node **110** may include one or more interfaces, communication components, and/or other components that facilitate communication with the UE **120** or another network node.

[0059] The terms "processor," "controller," or "controller/processor" may refer to one or more controllers and/or one or more processors. For example, reference to "a/the processor," "a/the controller/processor," or the like (in the singular) should be understood to refer to any one or more of the processors described in connection with FIG. **2**, such as a single processor or a combination of multiple different processors. Reference to "one or more processors" should be understood to refer to any one or more of the processors described in connection with FIG. **2**. For example, one or more processors of the network node **110** may include transmit processor **214**, TX MIMO processor **216**, MIMO detector **236**, receive processor **238**, and/or controller/processor **240**. Similarly, one or more processors of the UE **120** may include MIMO detector **256**, receive processor **258**, transmit processor **264**, TX MIMO processor **266**, and/or controller/processor **280**.

[0060] In some aspects, a single processor may perform all of the operations described as being performed by the one or more processors. In some aspects, a first set of (one or more) processors of the one or more processors may perform a first operation described as being performed by the one or more processors, and a second set of (one or more) processors of the one or more processors may perform a second operation described as being performed by the one or more processors. The first set of processors and the second set of processors may be the same set of processors or may be different sets of processors. Reference to "one or more memories" should be understood to refer to any one or more memories of a corresponding device, such as the memory described in connection with FIG. **2**. For example, operation described as being performed by one or more memories can be performed by the same subset of the one or more memories or different subsets of the one or more memories.

[0061] For downlink communication from the network node **110** to the UE **120**, the transmit processor **214** may receive data ("downlink data") intended for the UE **120** (or a set of UEs that includes the UE **120**) from the data source **212** (such as a data pipeline or a data queue). In some examples, the transmit processor **214** may select one or more MCSs for the UE **120** in accordance with one or more channel quality indicators (CQIs) received from the UE **120**. The network node **110** may process the data (for example, including encoding the data) for transmission to the UE **120** on a downlink in accordance with the MCS(s) selected for the UE **120** to generate data symbols. The transmit processor **214** may process system information (for example, semi-static resource partitioning information (SRPI)) and/or control information (for example, CQI requests, grants, and/or upper layer signaling) and provide overhead symbols and/or control symbols. The transmit processor **214** may generate reference symbols for reference signals (for example, a cell-specific reference signal (CRS), a demodulation reference signal (DMRS), or a CSI reference signal (CSI-RS)) and/or synchronization signals (for example, a primary synchronization signal (PSS) or a secondary synchronization signals (SSS)).

[0062] The TX MIMO processor **216** may perform spatial processing (for example, precoding) on the data symbols, the control symbols, the overhead symbols, and/or the reference symbols, if applicable, and may provide a set of output symbol streams (for example, T output symbol streams) to the set of modems **232**. For example, each output symbol stream may be provided to a respective modulator component (shown as MOD) of a modem **232**. Each modem **232** may use the respective modulator component to process (for example, to modulate) a respective output symbol stream (for example, for orthogonal frequency division multiplexing (OFDM)) to obtain an output sample stream. Each modem **232** may further use the respective modulator component to process (for example, convert to analog, amplify, filter, and/or upconvert) the output sample stream to obtain a time domain downlink signal. The modems **232***a* through **232***t* may together transmit a set of downlink signals (for example, T downlink signals) via the corresponding set of antennas **234**.

[0063] A downlink signal may include a DCI communication, a MAC control element (MAC-CE) communication, an RRC communication, a downlink reference signal, or another type of downlink communication. Downlink signals may be transmitted on a PDCCH, a PDSCH, and/or on another downlink channel. A downlink signal may carry one or more transport blocks (TBs) of data. A TB may be a unit of data that is transmitted over an air interface in the wireless communication network **100**. A data stream (for example, from the data source **212**) may be encoded into multiple TBs for transmission over the air interface. The quantity of TBs used to carry the data associated with a particular data stream may be associated with a TB size common to the multiple TBs. The TB size may be based on or otherwise associated with radio channel conditions of the air interface, the MCS used for encoding the data, the downlink resources allocated for transmitting the data, and/or another parameter. In general, the larger the TB size, the greater the amount of data that can be transmitted in a single transmission, which reduces signaling overhead. However, larger TB sizes may be more prone to transmission and/or reception errors than smaller TB sizes, but such errors may be mitigated by more robust error correction techniques.

[0064] For uplink communication from the UE **120** to the network node **110**, uplink signals from the UE **120** may be received by an antenna **234**, may be processed by a modem **232** (for example, a demodulator component, shown as DEMOD, of a modem **232**), may be detected by the MIMO detector **236** (for example, a receive (Rx) MIMO processor) if applicable, and/or may be further processed by the receive processor **238** to obtain decoded data and/or control information. The receive processor **238** may provide the decoded data to a data sink **239** (which may be a data pipeline, a data queue, and/or another type of data sink) and provide the decoded control information to a processor, such as the controller/processor **240**.

[0065] The network node **110** may use the scheduler **246** to schedule one or more UEs **120** for downlink or uplink communications. In some aspects, the scheduler **246** may use DCI to dynamically schedule DL transmissions to the UE **120** and/or UL transmissions from the UE **120**. In some examples, the scheduler **246** may allocate recurring time domain resources and/or frequency domain resources that the UE **120** may use to transmit and/or receive communications using an RRC configuration (for example, a semi-static configuration), for example, to perform semi-persistent scheduling (SPS) or to configure a configured grant (CG) for the UE **120**.

[0066] One or more of the transmit processor **214**, the TX MIMO processor **216**, the modem **232**, the antenna **234**, the MIMO detector **236**, the receive processor **238**, and/or the controller/processor **240** may be included in an RF chain of the network node **110**. An RF chain may include one or more filters, mixers, oscillators, amplifiers, analog-to-digital converters (ADCs), and/or other devices that convert between an analog signal (such as for transmission or reception via an air interface) and a digital signal (such as for processing by one or more processors of the network node **110**). In some aspects, the RF chain may be or may be included in a transceiver of the network node **110**.

[0067] In some examples, the network node **110** may use the communication unit **244** to communicate with a core network and/or with other network nodes. The communication unit **244** may support wired and/or wireless communication protocols and/or connections, such as Ethernet, optical fiber, common public radio interface (CPRI), and/or a wired or wireless backhaul, among other examples. The network node **110** may use the communication unit **244** to transmit and/or receive data associated with the UE **120** or to perform network control signaling, among other examples. The communication unit **244** may include a transceiver and/or an interface, such as a network interface.

[0068] The UE **120** may include a set of antennas **252** (shown as antennas **252***a* through **252***r*, where r≥1), a set of modems **254** (shown as modems **254***a* through **254***u*, where u≥1), a MIMO detector **256**, a receive processor **258**, a data sink **260**, a data source **262**, a transmit processor **264**, a TX MIMO processor **266**, a controller/processor **280**, a memory **282**, and/or a communication manager **140**, among other examples. One or more of the components of the UE **120** may be included in a housing **284**. In some aspects, one or a combination of the antenna(s) **252**, the modem(s) **254**, the MIMO detector **256**, the receive processor **258**, the transmit processor **264**, or the TX MIMO processor **266** may be included in a transceiver that is included in the UE **120**. The transceiver may be under control of and used by one or more processors, such as the controller/processor **280**, and in some aspects in conjunction with processor-readable code stored in the memory **282**, to perform aspects of the methods, processes, or operations described herein. In some aspects, the UE **120** may include another interface, another communication component, and/or another component that facilitates communication with the network node **110** and/or another UE **120**.

[0069] For downlink communication from the network node **110** to the UE **120**, the set of antennas **252** may receive the downlink communications or signals from the network node **110** and may provide a set of received downlink signals (for example, R received signals) to the set of modems **254**. For example, each received signal may be provided to a respective demodulator component (shown as DEMOD) of a modem **254**. Each modem **254** may use the respective demodulator component to condition (for example, filter, amplify, downconvert, and/or digitize) a received signal to obtain input samples. Each modem **254** may use the respective demodulator component to further demodulate or process the input samples (for example, for OFDM) to obtain received symbols. The MIMO detector **256** may obtain received symbols from the set of modems **254**, may perform MIMO detection on the received symbols if applicable, and may provide detected symbols. The receive processor **258** may process (for example, decode) the detected symbols, may provide decoded data for the UE **120** to the data sink **260** (which may include a data pipeline, a data queue, and/or an application executed on the UE **120**), and may provide decoded control information and system information to the controller/processor **280**.

[0070] For uplink communication from the UE **120** to the network node **110**, the transmit processor **264** may receive and process data ("uplink data") from a data source **262**

(such as a data pipeline, a data queue, and/or an application executed on the UE **120**) and control information from the controller/processor **280**. The control information may include one or more parameters, feedback, one or more signal measurements, and/or other types of control information. In some aspects, the receive processor **258** and/or the controller/processor **280** may determine, for a received signal (such as received from the network node **110** or another UE), one or more parameters relating to transmission of the uplink communication. The one or more parameters may include a reference signal received power (RSRP) parameter, a received signal strength indicator (RSSI) parameter, a reference signal received quality (RSRQ) parameter, a CQI parameter, or a transmit power control (TPC) parameter, among other examples. The control information may include an indication of the RSRP parameter, the RSSI parameter, the RSRQ parameter, the CQI parameter, the TPC parameter, and/or another parameter. The control information may facilitate parameter selection and/or scheduling for the UE **120** by the network node **110**.

[0071] The transmit processor **264** may generate reference symbols for one or more reference signals, such as an uplink DMRS, an uplink sounding reference signal (SRS), and/or another type of reference signal. The symbols from the transmit processor **264** may be precoded by the TX MIMO processor **266**, if applicable, and further processed by the set of modems **254** (for example, for DFT-s-OFDM or CP-OFDM). The TX MIMO processor **266** may perform spatial processing (for example, precoding) on the data symbols, the control symbols, the overhead symbols, and/or the reference symbols, if applicable, and may provide a set of output symbol streams (for example, U output symbol streams) to the set of modems **254**. For example, each output symbol stream may be provided to a respective modulator component (shown as MOD) of a modem **254**. Each modem **254** may use the respective modulator component to process (for example, to modulate) a respective output symbol stream (for example, for OFDM) to obtain an output sample stream. Each modem **254** may further use the respective modulator component to process (for example, convert to analog, amplify, filter, and/or upconvert) the output sample stream to obtain an uplink signal.

[0072] The modems **254*a*** through **254*u*** may transmit a set of uplink signals (for example, R uplink signals or U uplink symbols) via the corresponding set of antennas **252**. An uplink signal may include a UCI communication, a MAC-CE communication, an RRC communication, or another type of uplink communication. Uplink signals may be transmitted on a PUSCH, a PUCCH, and/or another type of uplink channel. An uplink signal may carry one or more TBs of data. Sidelink data and control transmissions (that is, transmissions directly between two or more UEs **120**) may generally use similar techniques as were described for uplink data and control transmission, and may use sidelink-specific channels such as a physical sidelink shared channel (PSSCH), a physical sidelink control channel (PSCCH), and/or a physical sidelink feedback channel (PSFCH).

[0073] One or more antennas of the set of antennas **252** or the set of antennas **234** may include, or may be included within, one or more antenna panels, one or more antenna groups, one or more sets of antenna elements, or one or more antenna arrays, among other examples. An antenna panel, an antenna group, a set of antenna elements, or an antenna array may include one or more antenna elements (within a single housing or multiple housings), a set of coplanar antenna elements, a set of non-coplanar antenna elements, or one or more antenna elements coupled with one or more transmission or reception components, such as one or more components of FIG. **2**. As used herein, "antenna" can refer to one or more antennas, one or more antenna panels, one or more antenna groups, one or more sets of antenna elements, or one or more antenna arrays. "Antenna panel" can refer to a group of antennas (such as antenna elements) arranged in an array or panel, which may facilitate beamforming by manipulating parameters of the group of antennas. "Antenna module" may refer to circuitry including one or more antennas, which may also include one or more other components (such as filters, amplifiers, or processors) associated with integrating the antenna module into a wireless communication device.

[0074] In some examples, each of the antenna elements of an antenna **234** or an antenna **252** may include one or more sub-elements for radiating or receiving radio frequency signals. For example, a single antenna element may include a first sub-element cross-polarized with a second sub-element that can be used to independently transmit cross-polarized signals. The antenna elements may include patch antennas, dipole antennas, and/or other types of antennas arranged in a linear pattern, a two-dimensional pattern, or another pattern. A spacing between antenna elements may be such that signals with a desired wavelength transmitted separately by the antenna elements may interact or interfere constructively and destructively along various directions (such as to form a desired beam). For example, given an expected range of wavelengths or frequencies, the spacing may provide a quarter wavelength, a half wavelength, or another fraction of a wavelength of spacing between neighboring antenna elements to allow for the desired constructive and destructive interference patterns of signals transmitted by the separate antenna elements within that expected range.

[0075] The amplitudes and/or phases of signals transmitted via antenna elements and/or sub-elements may be modulated and shifted relative to each other (such as by manipulating phase shift, phase offset, and/or amplitude) to generate one or more beams, which is referred to as beamforming. The term "beam" may refer to a directional transmission of a wireless signal toward a receiving device or otherwise in a desired direction. "Beam" may also generally refer to a direction associated with such a directional signal transmission, a set of directional resources associated with the signal transmission (for example, an angle of arrival, a horizontal direction, and/or a vertical direction), and/or a set of parameters that indicate one or more aspects of a directional signal, a direction associated with the signal, and/or a set of directional resources associated with the signal. In some implementations, antenna elements may be individually selected or deselected for directional transmission of a signal (or signals) by controlling amplitudes of one or more corresponding amplifiers and/or phases of the signal(s) to form one or more beams. The shape of a beam (such as the amplitude, width, and/or presence of side lobes) and/or the direction of a beam (such as an angle of the beam relative to a surface of an antenna array) can be dynamically controlled by modifying the phase shifts, phase offsets, and/or amplitudes of the multiple signals relative to each other.

[0076] Different UEs **120** or network nodes **110** may include different numbers of antenna elements. For example, a UE **120** may include a single antenna element, two antenna elements, four antenna elements, eight antenna elements, or a different number of antenna elements. As another example, a network node **110** may include eight antenna elements, 24 antenna elements, 64 antenna elements, 128 antenna elements, or a different number of antenna elements. Generally, a larger number of antenna elements may provide increased control over parameters for beam generation relative to a smaller number of antenna elements, whereas a smaller number of antenna elements may be less complex to implement and may use less power than a larger number of antenna elements. Multiple antenna elements may support multiple-layer transmission, in which a first layer of a communication (which may include a first data stream) and a second layer of a communication (which may include a second data stream) are transmitted using the same time and frequency resources with spatial multiplexing.

[0077] While blocks in FIG. **2** are illustrated as distinct components, the functions described above with respect to the blocks may be implemented in a single hardware, software, or combination component or in various combinations of components. For example, the functions described with respect to the transmit processor **264**, the receive processor **258**, and/or the TX MIMO processor **266** may be performed by or under the control of the controller/processor **280**.

[0078] As indicated above, FIG. **2** is provided as an example. Other examples may differ from what is described with regard to FIG. **2**.

[0079] FIG. **3** is a diagram illustrating an example disaggregated base station architecture **300** in accordance with the present disclosure. One or more components of the example disaggregated base station architecture **300** may be, may include, or may be included in one or more network nodes (such one or more network nodes **110**). The disaggregated base station architecture **300** may include a CU **310** that can communicate directly with a core network **320** via a backhaul link, or that can communicate indirectly with the core network **320** via one or more disaggregated control units, such as a Non-RT RIC **350** associated with a Service Management and Orchestration (SMO) Framework **360** and/or a Near-RT RIC **370** (for example, via an E2 link). The CU **310** may communicate with one or more DUs **330** via respective midhaul links, such as via F1 interfaces. Each of the DUs **330** may communicate with one or more RUs **340** via respective fronthaul links. Each of the RUs **340** may communicate with one or more UEs **120** via respective RF access links. In some deployments, a UE **120** may be simultaneously served by multiple RUs **340**.

[0080] Each of the components of the disaggregated base station architecture **300**, including the CUs **310**, the DUs **330**, the RUs **340**, the Near-RT RICs **370**, the Non-RT RICs **350**, and the SMO Framework **360**, may include one or more interfaces or may be coupled with one or more interfaces for receiving or transmitting signals, such as data or information, via a wired or wireless transmission medium.

[0081] In some aspects, the CU **310** may be logically split into one or more CU user plane (CU-UP) units and one or more CU control plane (CU-CP) units. A CU-UP unit may communicate bidirectionally with a CU-CP unit via an interface, such as the E1 interface when implemented in an O-RAN configuration. The CU **310** may be deployed to communicate with one or more DUs **330**, as necessary, for network control and signaling. Each DU **330** may correspond to a logical unit that includes one or more base station functions to control the operation of one or more RUs **340**. For example, a DU **330** may host various layers, such as an RLC layer, a MAC layer, or one or more PHY layers, such as one or more high PHY layers or one or more low PHY layers. Each layer (which also may be referred to as a module) may be implemented with an interface for communicating signals with other layers (and modules) hosted by the DU **330**, or for communicating signals with the control functions hosted by the CU **310**. Each RU **340** may implement lower layer functionality. In some aspects, real-time and non-real-time aspects of control and user plane communication with the RU(s) **340** may be controlled by the corresponding DU **330**.

[0082] The SMO Framework **360** may support RAN deployment and provisioning of non-virtualized and virtualized network elements. For non-virtualized network elements, the SMO Framework **360** may support the deployment of dedicated physical resources for RAN coverage requirements, which may be managed via an operations and maintenance interface, such as an O1 interface. For virtualized network elements, the SMO Framework **360** may interact with a cloud computing platform (such as an open cloud (O-Cloud) platform **390**) to perform network element life cycle management (such as to instantiate virtualized network elements) via a cloud computing platform interface, such as an O2 interface. A virtualized network element may include, but is not limited to, a CU **310**, a DU **330**, an RU **340**, a non-RT RIC **350**, and/or a Near-RT RIC **370**. In some aspects, the SMO Framework **360** may communicate with a hardware aspect of a 4G RAN, a 5G NR RAN, and/or a 6G RAN, such as an open eNB (O-eNB) **380**, via an O1 interface. Additionally or alternatively, the SMO Framework **360** may communicate directly with each of one or more RUs **340** via a respective O1 interface. In some deployments, this configuration can enable each DU **330** and the CU **310** to be implemented in a cloud-based RAN architecture, such as a vRAN architecture.

[0083] The Non-RT RIC **350** may include or may implement a logical function that enables non-real-time control and optimization of RAN elements and resources, AI/ML workflows including model training and updates, and/or policy-based guidance of applications and/or features in the Near-RT RIC **370**. The Non-RT RIC **350** may be coupled to or may communicate with (such as via an A1 interface) the Near-RT RIC **370**. The Near-RT RIC **370** may include or may implement a logical function that enables near-real-time control and optimization of RAN elements and resources via data collection and actions via an interface (such as via an E2 interface) connecting one or more CUs **310**, one or more DUs **330**, and/or an O-eNB with the Near-RT RIC **370**.

[0084] In some aspects, to generate AI/ML models to be deployed in the Near-RT RIC **370**, the Non-RT RIC **350** may receive parameters or external enrichment information from external servers. Such information may be utilized by the Near-RT RIC **370** and may be received at the SMO Framework **360** or the Non-RT RIC **350** from non-network data sources or from network functions. In some examples, the Non-RT RIC **350** or the Near-RT RIC **370** may tune RAN behavior or performance. For example, the Non-RT RIC **350** may monitor long-term trends and patterns for performance and may employ AI/ML models to perform corrective actions via the SMO Framework **360** (such as reconfiguration via an O1 interface) or via creation of RAN management policies (such as A1 interface policies).

[0085] The network node **110**, the controller/processor **240** of the network node **110**, the UE **120**, the controller/processor **280** of the UE **120**, the CU **310**, the DU **330**, the RU **340**, or any other component(s) of FIG. **1**, **2**, or **3** may implement one or more techniques or perform one or more operations associated with reporting CSI feedback for network-side model training, as described in more detail elsewhere herein. For example, the controller/processor **240** of the network node **110**, the controller/processor **280** of the UE **120**, any other component(s) of FIG. **2**, the CU **310**, the DU **330**, or the RU **340** may perform or direct operations of, for example, process **700** of FIG. **7**, process **800** of FIG. **8**, or other processes as described herein (alone or in conjunction with one or more other processors). The memory **242** may store data and program codes for the network node **110**, the network node **110**, the CU **310**, the DU **330**, or the RU **340**. The memory **282** may store data and program codes for the UE **120**. In some examples, the memory **242** or the memory **282** may include a non-transitory computer-readable medium storing a set of instructions (for example, code or program code) for wireless communication. The memory **242** may include one or more memories, such as a single memory or multiple different memories (of the same type or of different types). The memory **282** may include one or more memories, such as a single memory or multiple different memories (of the same type or of different types). For example, the set of instructions, when executed (for example, directly, or after compiling, converting, or interpreting) by one or more processors of the network node **110**, the UE **120**, the CU **310**, the DU **330**, or the RU **340**, may cause the one or more processors to perform process **700** of FIG. **7**, process **800** of FIG. **8**, or other processes as described herein. In some examples, executing instructions may include running the instructions, converting the instructions, compiling the instructions, and/or interpreting the instructions, among other examples.

[0086] In some aspects, a UE (e.g., the UE **120**) includes means for receiving a configuration associated with AI/ML model based CSF reporting; and/or means for transmitting, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. The means for the UE to perform operations described herein may include, for example, one or more of communication manager **140**, antenna **252**, modem **254**, MIMO detector **256**, receive processor **258**, transmit processor **264**, TX MIMO processor **266**, controller/processor **280**, or memory **282**.

[0087] In some aspects, a network node (e.g., the network node **110**) includes means for transmitting a configuration associated with AI/ML model based CSF reporting; and/or means for receiving, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. The means for the network node to perform operations described herein may include, for example, one or more of communication manager **150**, transmit processor **214**, TX MIMO processor **216**, modem **232**, antenna **234**, MIMO detector **236**, receive processor **238**, controller/processor **240**, memory **242**, or scheduler **246**.

[0088] As indicated above, FIG. **3** is provided as an example. Other examples may differ from what is described with regard to FIG. **3**.

[0089] FIG. **4** is a diagram illustrating an example **400** of using trained AI/ML models for implementing a function, in accordance with the present disclosure.

[0090] As shown in FIG. **4**, with an AI/ML-based air interface, a UE and a network node may use AI/ML models to implement a function. For example, when the UE intends to convey CSI to the network node, the UE may use a neural network to derive a compressed representation to feedback to the network node. The UE may derive the compressed representation using a UE-side CSI compression model. The network node may use another neural network to reconstruct a target CSI from the compressed representation. The network node may reconstruct the target CSI using a network-side CSI reconstruction model. The CSI may include a precoding matrix that the UE prefers the network node to use based at least in part on an observed channel. For the CSI reconstruction to be accurate, UE-side AI/ML models and network-side AI/ML models should be trained in a collaborative manner so that the compressed representation created by the UE-side AI/ML model is interpreted and decoded correctly by the network-side AI/ML model. When this requirement is satisfied, then such a pair of AI/ML models may be compatible with each other.

[0091] As indicated above, FIG. **4** is provided as an example. Other examples may differ from what is described with regard to FIG. **4**.

[0092] In a CSI feedback enhancement, CSI compression using a two-sided model may be enhanced to improve a trade-off between performance and complexity/overhead. For example, spatial/frequency compression may be extended to spatial/temporal/frequency compression, cell/site specific models, and/or CSI compression plus prediction (as opposed to a non-AI/ML based approach). CSI compression using the two-sided model may be enhanced to alleviate/resolve issues related to inter-vendor training collaboration.

[0093] FIG. **5** is a diagram illustrating an example **500** of UE-first training, in accordance with the present disclosure.

[0094] As shown by reference number **502**, a UE encoder training may involve training an encoder-decoder pair and then generating a dataset. The dataset may include an input (V_{in}), which is an input precoder, and Z, which is a compressed representation of the CSI. Alternatively, the dataset may include an output (V_{out}), which is an output precoder, and Z. As shown by reference number **504**, the dataset may be provided for a network decoder training. A network may train the decoder based at least in part on the dataset. When more than one UE vendor is present, the network may collect multiple datasets and aggregate the datasets as part of the decoder training. As shown by reference number **506**, in a UE-driven sequential training, one or more UE servers may transmit an encoder sequential dataset to a network server. The network server may aggregate the sequential datasets and then train a network decoder. In these examples, UE-first training may involve dataset sharing, which may require offline collaboration between vendors.

[0095] As indicated above, FIG. **5** is provided as an example. Other examples may differ from what is described with regard to FIG. **5**.

[0096] An issue with the training of two-sided AI/ML models may occur when the UE-side AI/ML model and the network-side AI/ML model are under the control of two different vendors. In this case, vendors may need to collaborate during training to ensure compatibility. Specifically, both the UE-side and the network-side (e.g., both a UE vendor and a network vendor) should have a common understanding of a mapping (or codebook) between a CSI feedback payload and a preferred precoding matrix represented by the CSI feedback payload. One approach is to require each pair of vendors to collaborate offline to align various aspects of the model training to ensure that resulting models are compatible. However, this approach may not be scalable since every network vendor may not be able to collaborate with every UE vendor or vice versa. A more scalable approach may be needed to develop compatible models that does not require every vendor to necessarily coordinate with every other vendor outside of standardized interfaces.

[0097] In various aspects of techniques and apparatuses described herein, a UE may receive, from a network node, a configuration associated with AI/ML model based CSF reporting. The UE may transmit, to the network node and based at least in part on the configuration, a CSI report that indicates joint CSI feedback. The joint CSI feedback may include a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. The UE-side AI/ML model may be a encoder model. The known mapping may be based at least in part on a legacy CSI feedback, or the known mapping may be based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model. The known mapping may be a mapping known to the network node, where the mapping may be between CSI feedback and a precoder (or precoding matrix). The network node may be able to interpret the first CSI, such that the network node may derive an estimated precoder based at least in part on the first CSI. The network node may not be able to interpret the second CSI based at least in part on no compatible network-side AI/ML model. The network node may include the estimated precoder and the second CSI as one CSI sample in a dataset for training a network-side AI/ML model, where the network-side AI/ML model may be a decoder model. After obtaining a plurality of CSI samples (e.g., corresponding estimated precoder and second CSI pairs) over a period of time, the network node may be able to activate the network-side AI/ML model. The network node may transmit, to the UE, an indication to activate the UE-side AI/ML model. At this point, the UE-side AI/ML model and the network-side AI/ML model may be compatible with each other. The UE-side AI/ML model may be associated with a UE vendor and the network-side AI/ML model may be associated with a network vendor.

[0098] In some aspects, by configuring the UE to transmit the CSI report that includes the joint CSI feedback, the network node may be able to use the first CSI and the second CSI associated with the joint CSI feedback for training the network-side AI/ML model. The UE and the network node may be able to use an air interface for data collection needed for training the network-side AI/ML model. As a result, the UE vendor and the network vendor may be able to develop compatible AI/ML models that do not require each of the vendors to necessarily coordinate with each other outside of standardized interfaces, which may improve scalability when developing compatible AI/ML models. Since every network vendor may not be able to collaborate with every UE vendor, or vice versa, an ability for the UE to provide over-the-air feedback to aid in network-side AI/ML model training may improve an overall system performance.

[0099] FIG. **6** is a diagram illustrating an example **600** associated with reporting CSI feedback for network-side model training, in accordance with the present disclosure. As shown in FIG. **6**, example **600** includes communication between a UE (e.g., UE **120**) and a network node (e.g., network node **110**). In some aspects, the UE and the network node may be included in a wireless network, such as wireless network **100**.

[0100] As shown by reference number **602**, the UE may receive, from the network node, a configuration associated with AI/ML model based CSF reporting. For example, the UE may receive an RRC configuration of CSI-RS and AI/ML CSF reporting, which may allow the network node to configure the UE to report two types of CSI in the same CSI report. The two types of CSI in the same CSI report may refer to joint CSI feedback, which may include a first CSI and a second CSI.

[0101] In some aspects, the configuration may indicate a first CSI report and a second CSI report, which may be based at least in part on a UE capability. In other words, the UE may be configured to transmit the first CSI report and the second CSI report based at least in part on the UE capability. The first CSI report may only include the first CSI. The second CSI report may include the joint CSI feedback of the first CSI and the second CSI. In some aspects, the first CSI report may be separate from the second CSI report. The second CSI report may be an on-demand aperiodic report triggered via layer 1 (L1) signaling. The second CSI report may be a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report. The second CSI report may be based at least in part on layer 2 (L2) signaling. In some aspects, the first CSI report and the second CSI report may be associated with only one CSI report. A first set of reporting occasions may be associated with only the first CSI. A second set of reporting occasions may be associated with the first CSI and the second CSI.

[0102] As shown by reference number **604**, the UE may receive, from the network node, a CSI-RS (or any other suitable type of reference signal). The UE may receive the CSI-RS on a periodic basis. As shown by reference number **606**, the UE may perform a CSI-RS measurement based at least in part on the CSI-RS. The CSI-RS measurement may be an RSRP measurement and/or any other suitable type of measurement.

[0103] As shown by reference number **608**, the UE may generate the first CSI based at least in part on the CSI-RS measurement and a known mapping. The first CSI may correspond to Z_ref. The known mapping may be based at least in part on a legacy CSI feedback. Alternatively, the known mapping may be based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model. As shown by reference number **610**, the UE may generate the second CSI based at least in part on the CSI-RS measurement and the UE-side AI/ML model, where the UE-side AI/ML model may be an encoder model. The second CSI may correspond to Z.

[0104] As shown by reference number **612**, the UE may transmit, to the network node and based at least in part on the configuration, a CSI report (e.g., the second CSI report) that indicates the joint CSI feedback (Z_ref, Z). The joint CSI feedback may include the first CSI associated with the known mapping and the second CSI associated with the UE-side AI/ML model. The network node may be able to interpret the first CSI based at least in part on the known mapping, such that the network node may derive an estimated precoder (V_est) based at least in part on the first CSI. The network node may not be able to interpret the second CSI based at least in part on no compatible network-side AI/ML model. In other words, the network node may be unable to derive a corresponding estimated precoder from Z. The network node may include the estimated precoder associated with the first CSI and the second CSI as one CSI sample (V_est, Z) in a dataset for training a network-side AI/ML model, where the network-side AI/ML model may be a decoder model.

[0105] As shown by reference number **614**, the network node may transmit, to the UE, a switching indication to activate the UE-side AI/ML model. The switching indication may be based at least in part on the training of the network-side AI/ML model that is compatible with the UE-side AI/ML model. In other words, after obtaining a plurality of CSI samples (e.g., corresponding estimated precoder and second CSI pairs) over a period of time, the network node may be able to activate the network-side AI/ML model.

[0106] In some aspects, over-the-air feedback of an AI/ML CSF mapping may enable UE-first training. The UE-first training with over-the-air mapping feedback may follow a sequential training approach involve an air interface. A UE-side vendor may train a UE-side AI/ML encoder model first and define a mapping between a CSI feedback payload (Z) and a precoding matrix (V). Subsequently, a network vendor may develop a compatible network-side AI/ML decoder model based at least in part on the mapping between the CSI feedback payload and the precoding matrix.

[0107] In some aspects, the network node, which may be associated with the network vendor, may collect a CSI report from a UE containing necessary information needed to learn this mapping. The CSI report may indicate CSI based at least in part on a mapping that is known to the network node (V→Z_ref). The CSI report may also indicate CSI based at least in part on a mapping that is unknown to the network node (V→Z), which may represent information that the network node needs to learn. More specifically, for V→Z_ref, the precoder matrix (V) may be mapped to CSI feedback (Z_ref) based at least in part on the mapping known to the network node. A mapping that is "known" or "unknown" may be with respect to the network node (e.g., whether the network node is aware of the mapping), as the mapping may always be known to the UE. The UE may indicate the CSI feedback (Z_ref) to the network node. The network node may be able to interpret the CSI feedback (Z_ref) and obtain a reconstructed precoder matrix (V_est). For V→Z, the same precoder matrix (V) may be fed into the UE-side AI/ML encoder model, which may produce UE encoder based CSI feedback payload (Z). The UE may indicate the UE encoder based CSI feedback payload (Z) to the network node. The network node may initially not be able to interpret the UE encoder based CSI feedback payload (Z) because the network node may not have a compatible network decoder.

[0108] In some aspects, joint CSI feedback may be based at least in part on a known CSI mapping and an unknown CSI mapping. After a UE-side vendor trains the UE-side AI/ML encoder model, the UE may provide a dataset to the network node by appending the UE encoder based CSI feedback payload (Z, which may be a new AI/ML payload) with the CSI report containing the CSI feedback (Z_ref), which may be generated based at least in part on the known mapping. The known mapping may be used by the network node to determine the unknown mapping. For example, the network node may generate the reconstructed precoder matrix (estimated precoder) (V_est) from Z_ref and the network node may associate V_est with the UE encoder based CSI feedback payload (Z). In other words, from the CSI report, which may contain (Z, Z_ref), the network node may generate one sample (Z, V_est) for training its network decoder AI/ML model. In some aspects, the known CSI mapping may be based at least in part on legacy CSI feedback (e.g., eTypeII codebook feedback). Alternatively, the known CSI mapping may be based at least in part on an already working UE encoder AI/ML model which is compatible with the network decoder AI/ML model. After the network node collects a sufficient number of samples and trains the network decoder AI/ML model at the network node, the network node may determine to activate the network decoder AI/ML model. The network node may instruct the UE to switch to the UE-side AI/ML encoder model.

[0109] In some aspects, the network node may configure two CSI reports. The first CSI report may carry the CSI feedback (Z_ref) based at least in part on the known mapping. The second CSI report may carry the joint CSI feedback. The joint CSI feedback may include the CSI feedback (Z_ref) and the UE encoder based CSI feedback payload (Z). In other words, the second CSI report may carry the joint CSI feedback (Z, Z_ref). For example, the first CSI report may be every 10 slots and the second CSI report may be every 50 slots. The first CSI report may be associated with scheduling, whereas the second CSI report may be associated with dataset collection for network-side AI/ML decoder training.

[0110] In some aspects, since the joint CSI feedback may be associated with increased feedback overhead, the network node may configure the second CSI report to be separate from the first CSI report. The second CSI report may be an on-demand aperiodic report, which may be triggered via L1 signaling. The second CSI report may be a semi-persistent or periodic report with a relatively large periodicity as compared to the first CSI report. The second CSI report may be based at least in part on L2 signaling, such as an uplink MAC-CE. In some aspects, the network node may configure the second CSI report and the first CSI report as one semi-persistent or periodic report with some reporting occasions containing (Z, Z_ref) and other reporting occasions containing only (Z_ref). Two periodicities may be configured for reporting (Z, Z_ref) versus (Z_ref) only.

[0111] In some aspects, a UE vendor may train the UE-side AI/ML encoder model. A network vendor may develop the network-side AI/ML decoder model to be compatible with the UE-side AI/ML encoder model based at least in part on the joint CSI feedback. The joint CSI feedback may provide the network node with the appropriate datasets for training the network-side AI/ML decoder model. The network vendor may develop the network-side AI/ML decoder model without needing an offline collaboration outside of a 3GPP air interface, which may provide increased scalability when developing compatible AI/ML encoder/decoder models at the UE and network node, respectively.

[0112] As indicated above, FIG. **6** is provided as an example. Other examples may differ from what is described with regard to FIG. **6**.

[0113] FIG. **7** is a diagram illustrating an example process **700** performed, for example, at a UE or an apparatus of a UE, in accordance with the present disclosure. Example process **700** is an example where the apparatus or the UE (e.g., UE **120**) performs operations associated with reporting CSI feedback for network-side model training.

[0114] As shown in FIG. **7**, in some aspects, process **700** may include receiving a configuration associated with AI/ML model based CSF reporting (block **710**). For example, the UE (e.g., using reception component **902** and/or communication manager **906**, depicted in FIG. **9**) may receive a configuration associated with AI/ML model based channel CSF reporting, as described above.

[0115] As further shown in FIG. **7**, in some aspects, process **700** may include transmitting, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model (block **720**). For example, the UE (e.g., using transmission component **904** and/or communication manager **906**, depicted in FIG. **9**) may transmit, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model, as described above.

[0116] Process **700** may include additional aspects, such as any single aspect or any combination of aspects described below and/or in connection with one or more other processes described elsewhere herein.

[0117] In a first aspect, the first CSI is interpretable by a network node and an estimated precoder is derivable by the network node based at least in part on the first CSI, the second CSI is not interpretable by the network node based at least in part on no compatible network-side AI/ML model, and the estimated precoder and the second CSI are included as one CSI sample in a dataset for training a network-side AI/ML model, and the network-side AI/ML model is a decoder model.

[0118] In a second aspect, alone or in combination with the first aspect, the known mapping is based at least in part on a legacy CSI feedback.

[0119] In a third aspect, alone or in combination with one or more of the first and second aspects, the known mapping is based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model.

[0120] In a fourth aspect, alone or in combination with one or more of the first through third aspects, process **700** includes receiving a CSI-RS, performing a CSI-RS measurement based at least in part on the CSI-RS, generating the first CSI based at least in part on the known mapping, and generating the second CSI based at least in part on the UE-side AI/ML model, wherein the UE-side AI/ML model is an encoder model.

[0121] In a fifth aspect, alone or in combination with one or more of the first through fourth aspects, process **700** includes receiving a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

[0122] In a sixth aspect, alone or in combination with one or more of the first through fifth aspects, the configuration is associated with a first CSI report and a second CSI report based at least in part on a UE capability, wherein the first CSI report only includes the first CSI, and the second CSI report includes the joint CSI feedback of the first CSI and the second CSI.

[0123] In a seventh aspect, alone or in combination with one or more of the first through sixth aspects, the first CSI report is separate from the second CSI report.

[0124] In an eighth aspect, alone or in combination with one or more of the first through seventh aspects, the second CSI report is an on-demand aperiodic report triggered via L1 signaling, the second CSI report is a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report, or the second CSI report is based at least in part on L2 signaling.

[0125] In a ninth aspect, alone or in combination with one or more of the first through eighth aspects, the first CSI report and the second CSI report are associated with only one CSI report, a first set of reporting occasions is associated with only the first CSI, and a second set of reporting occasions is associated with the first CSI and the second CSI.

[0126] Although FIG. **7** shows example blocks of process **700**, in some aspects, process **700** may include additional blocks, fewer blocks, different blocks, or differently arranged blocks than those depicted in FIG. **7**. Additionally, or alternatively, two or more of the blocks of process **700** may be performed in parallel.

[0127] FIG. **8** is a diagram illustrating an example process **800** performed, for example, at a network node or an apparatus of a network node, in accordance with the present disclosure. Example process **800** is an example where the apparatus or the network node (e.g., network node **110**) performs operations associated with reporting CSI feedback for network-side model training.

[0128] As shown in FIG. **8**, in some aspects, process **800** may include transmitting a configuration associated with AI/ML model based CSF reporting (block **810**). For example, the network node (e.g., using transmission component **1004** and/or communication manager **1006**, depicted in FIG. **10**) may transmit a configuration associated with AI/ML model based CSF reporting, as described above.

[0129] As further shown in FIG. **8**, in some aspects, process **800** may include receiving, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model (block **820**). For example, the network node (e.g., using reception component **1002** and/or communication manager **1006**, depicted in FIG. **10**) may receive, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model, as described above.

[0130] Process **800** may include additional aspects, such as any single aspect or any combination of aspects described below and/or in connection with one or more other processes described elsewhere herein.

[0131] In a first aspect, the first CSI is interpretable by a network node and an estimated precoder is derivable by the network node based at least in part on the first CSI, the second CSI is not interpretable by the network node based at least in part on no compatible network-side AI/ML model, and the estimated precoder and the second CSI are included as one CSI sample in a dataset for training a network-side AI/ML model, and the network-side AI/ML model is a decoder model.

[0132] In a second aspect, alone or in combination with the first aspect, the known mapping is based at least in part on a legacy CSI feedback.

[0133] In a third aspect, alone or in combination with one or more of the first and second aspects, the known mapping is based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model.

[0134] In a fourth aspect, alone or in combination with one or more of the first through third aspects, process **800** includes transmitting a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

[0135] In a fifth aspect, alone or in combination with one or more of the first through fourth aspects, the configuration is associated with a first CSI report and a second CSI report based at least in part on a UE capability, wherein the first CSI report only includes the first CSI, and the second CSI report includes the joint CSI feedback of the first CSI and the second CSI.

[0136] In a sixth aspect, alone or in combination with one or more of the first through fifth aspects, the first CSI report is separate from the second CSI report.

[0137] In a seventh aspect, alone or in combination with one or more of the first through sixth aspects, the second CSI report is an on-demand aperiodic report triggered via L1 signaling, the second CSI report is a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report, or the second CSI report is based at least in part on L2 signaling.

[0138] In an eighth aspect, alone or in combination with one or more of the first through seventh aspects, the first CSI report and the second CSI report are associated with only one CSI report, a first set of reporting occasions is associated with only the first CSI, and a second set of reporting occasions is associated with the first CSI and the second CSI.

[0139] Although FIG. **8** shows example blocks of process **800**, in some aspects, process **800** may include additional blocks, fewer blocks, different blocks, or differently arranged blocks than those depicted in FIG. **8**. Additionally, or alternatively, two or more of the blocks of process **800** may be performed in parallel.

[0140] FIG. **9** is a diagram of an example apparatus **900** for wireless communication, in accordance with the present disclosure. The apparatus **900** may be a UE, or a UE may include the apparatus **900**. In some aspects, the apparatus **900** includes a reception component **902**, a transmission component **904**, and/or a communication manager **906**, which may be in communication with one another (for example, via one or more buses and/or one or more other components). In some aspects, the communication manager **906** is the communication manager **140** described in connection with FIG. **1**. As shown, the apparatus **900** may communicate with another apparatus **908**, such as a UE or a network node (such as a CU, a DU, an RU, or a base station), using the reception component **902** and the transmission component **904**.

[0141] In some aspects, the apparatus **900** may be configured to perform one or more operations described herein in connection with FIG. **6**. Additionally, or alternatively, the apparatus **900** may be configured to perform one or more processes described herein, such as process **700** of FIG. **7**, or a combination thereof. In some aspects, the apparatus **900** and/or one or more components shown in FIG. **9** may include one or more components of the UE described in connection with FIG. **2**. Additionally, or alternatively, one or more components shown in FIG. **9** may be implemented within one or more components described in connection with FIG. **2**. Additionally, or alternatively, one or more components of the set of components may be implemented at least in part as software stored in one or more memories. For example, a component (or a portion of a component) may be implemented as instructions or code stored in a non-transitory computer-readable medium and executable by one or more controllers or one or more processors to perform the functions or operations of the component.

[0142] The reception component **902** may receive communications, such as reference signals, control information, data communications, or a combination thereof, from the apparatus **908**. The reception component **902** may provide received communications to one or more other components of the apparatus **900**. In some aspects, the reception component **902** may perform signal processing on the received communications (such as filtering, amplification, demodulation, analog-to-digital conversion, demultiplexing, deinterleaving, de-mapping, equalization, interference cancellation, or decoding, among other examples), and may provide the processed signals to the one or more other components of the apparatus **900**. In some aspects, the reception component **902** may include one or more antennas, one or more modems, one or more demodulators, one or more MIMO detectors, one or more receive processors, one or more controllers/processors, one or more memories, or a combination thereof, of the UE described in connection with FIG. **2**.

[0143] The transmission component **904** may transmit communications, such as reference signals, control information, data communications, or a combination thereof, to the apparatus **908**. In some aspects, one or more other components of the apparatus **900** may generate communications and may provide the generated communications to the transmission component **904** for transmission to the apparatus **908**. In some aspects, the transmission component **904** may perform signal processing on the generated communications (such as filtering, amplification, modulation, digital-to-analog conversion, multiplexing, interleaving, mapping, or encoding, among other examples), and may transmit the processed signals to the apparatus **908**. In some aspects, the transmission component **904** may include one or more antennas, one or more modems, one or more modulators, one or more transmit MIMO processors, one or more transmit processors, one or more controllers/processors, one or more memories, or a combination thereof, of the UE described in connection with FIG. **2**. In some aspects, the transmission component **904** may be co-located with the reception component **902** in one or more transceivers.

[0144] The communication manager **906** may support operations of the reception component **902** and/or the transmission component **904**. For example, the communication manager **906** may receive information associated with configuring reception of communications by the reception component **902** and/or transmission of communications by the transmission component **904**. Additionally, or alternatively, the communication manager **906** may generate and/or provide control information to the reception component **902** and/or the transmission component **904** to control reception and/or transmission of communications.

[0145] The reception component **902** may receive a configuration associated with AI/ML model based CSF reporting. The transmission component **904** may transmit, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0146] The reception component **902** may receive a CSI-RS. The communication manager **906** may perform a CSI-RS measurement based at least in part on the CSI-RS. The communication manager **906** may generate the first CSI based at least in part on the known mapping. The communication manager **906** may generate the second CSI based at least in part on the UE-side AI/ML model, wherein the UE-side AI/ML model is an encoder model. The reception component **902** may receive a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

[0147] The number and arrangement of components shown in FIG. **9** are provided as an example. In practice, there may be additional components, fewer components, different components, or differently arranged components than those shown in FIG. **9**. Furthermore, two or more components shown in FIG. **9** may be implemented within a single component, or a single component shown in FIG. **9** may be implemented as multiple, distributed components. Additionally, or alternatively, a set of (one or more) components shown in FIG. **9** may perform one or more functions described as being performed by another set of components shown in FIG. **9**.

[0148] FIG. **10** is a diagram of an example apparatus **1000** for wireless communication, in accordance with the present disclosure. The apparatus **1000** may be a network node, or a network node may include the apparatus **1000**. In some aspects, the apparatus **1000** includes a reception component **1002**, a transmission component **1004**, and/or a communication manager **1006**, which may be in communication with one another (for example, via one or more buses and/or one or more other components). In some aspects, the communication manager **1006** is the communication manager **150** described in connection with FIG. **1**. As shown, the apparatus **1000** may communicate with another apparatus **1008**, such as a UE or a network node (such as a CU, a DU, an RU, or a base station), using the reception component **1002** and the transmission component **1004**.

[0149] In some aspects, the apparatus **1000** may be configured to perform one or more operations described herein in connection with FIG. **6**. Additionally, or alternatively, the apparatus **1000** may be configured to perform one or more processes described herein, such as process **800** of FIG. **8**, or a combination thereof. In some aspects, the apparatus **1000** and/or one or more components shown in FIG. **10** may include one or more components of the network node described in connection with FIG. **2**. Additionally, or alternatively, one or more components shown in FIG. **10** may be implemented within one or more components described in connection with FIG. **2**. Additionally, or alternatively, one or more components of the set of components may be implemented at least in part as software stored in one or more memories. For example, a component (or a portion of a component) may be implemented as instructions or code stored in a non-transitory computer-readable medium and executable by one or more controllers or one or more processors to perform the functions or operations of the component.

[0150] The reception component **1002** may receive communications, such as reference signals, control information, data communications, or a combination thereof, from the apparatus **1008**. The reception component **1002** may provide received communications to one or more other components of the apparatus **1000**. In some aspects, the reception component **1002** may perform signal processing on the received communications (such as filtering, amplification, demodulation, analog-to-digital conversion, demultiplexing, deinterleaving, de-mapping, equalization, interference cancellation, or decoding, among other examples), and may provide the processed signals to the one or more other components of the apparatus **1000**. In some aspects, the reception component **1002** may include one or more antennas, one or more modems, one or more demodulators, one or more MIMO detectors, one or more receive processors, one or more controllers/processors, one or more memories, or a combination thereof, of the network node described in connection with FIG. **2**. In some aspects, the reception component **1002** and/or the transmission component **1004** may include or may be included in a network interface. The network interface may be configured to obtain and/or output signals for the apparatus **1000** via one or more communications links, such as a backhaul link, a midhaul link, and/or a fronthaul link.

[0151] The transmission component **1004** may transmit communications, such as reference signals, control information, data communications, or a combination thereof, to the apparatus **1008**. In some aspects, one or more other components of the apparatus **1000** may generate communications and may provide the generated communications to the transmission component **1004** for transmission to the apparatus **1008**. In some aspects, the transmission component **1004** may perform signal processing on the generated communications (such as filtering, amplification, modulation, digital-to-analog conversion, multiplexing, interleaving, mapping, or encoding, among other examples), and may transmit the processed signals to the apparatus **1008**. In some aspects, the transmission component **1004** may include one or more antennas, one or more modems, one or more modulators, one or more transmit MIMO processors, one or more transmit processors, one or more controllers/processors, one or more memories, or a combination thereof, of the network node described in connection with FIG. **2**. In some aspects, the transmission component **1004** may be co-located with the reception component **1002** in one or more transceivers.

[0152] The communication manager **1006** may support operations of the reception component **1002** and/or the transmission component **1004**. For example, the communication manager **1006** may receive information associated with configuring reception of communications by the reception component **1002** and/or transmission of communications by the transmission component **1004**. Additionally, or alternatively, the communication manager **1006** may generate and/or provide control information to the reception component **1002** and/or the transmission component **1004** to control reception and/or transmission of communications.

[0153] The transmission component **1004** may transmit a configuration associated with AI/ML model based CSF reporting. The reception component **1002** may receive, based at least in part on the configuration, a CSI report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model. The transmission component **1004** may transmit a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

[0154] The number and arrangement of components shown in FIG. **10** are provided as an example. In practice, there may be additional components, fewer components, different components, or differently arranged components than those shown in FIG. **10**. Furthermore, two or more components shown in FIG. **10** may be implemented within a single component, or a single component shown in FIG. **10** may be implemented as multiple, distributed components. Additionally, or alternatively, a set of (one or more) components shown in FIG. **10** may perform one or more functions described as being performed by another set of components shown in FIG. **10**.

[0155] The following provides an overview of some Aspects of the present disclosure:

[0156] Aspect 1: A method of wireless communication performed by a user equipment (UE), comprising: receiving a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting; and transmitting, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0157] Aspect 2: The method of Aspect 1, wherein: the first CSI is interpretable by a network node and an estimated precoder is derivable by the network node based at least in part on the first CSI, the second CSI is not interpretable by the network node based at least in part on no compatible network-side AI/ML model, and the estimated precoder and the second CSI are included as one CSI sample in a dataset for training a network-side AI/ML model, and the network-side AI/ML model is a decoder model.

[0158] Aspect 3: The method of any of Aspects 1-2, wherein the known mapping is based at least in part on a legacy CSI feedback.

[0159] Aspect 4: The method of any of Aspects 1-3, wherein the known mapping is based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model.

[0160] Aspect 5: The method of any of Aspects 1-4, further comprising: receiving a channel state information reference signal (CSI-RS); performing a CSI-RS measurement based at least in part on the CSI-RS; generating the first CSI based at least in part on the known mapping; and generating the second CSI based at least in part on the UE-side AI/ML model, wherein the UE-side AI/ML model is an encoder model.

[0161] Aspect 6: The method of any of Aspects 1-5, further comprising: receiving a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

[0162] Aspect 7: The method of any of Aspects 1-6, wherein the configuration is associated with a first CSI report and a second CSI report based at least in part on a UE capability, wherein the first CSI report only includes the first CSI, and the second CSI report includes the joint CSI feedback of the first CSI and the second CSI.

[0163] Aspect 8: The method of Aspect 7, wherein the first CSI report is separate from the second CSI report.

[0164] Aspect 9: The method of Aspect 8, wherein: the second CSI report is an on-demand aperiodic report triggered via layer 1 (L1) signaling, the second CSI report is a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report, or the second CSI report is based at least in part on layer 2 (L2) signaling.

[0165] Aspect 10: The method of Aspect 7, wherein the first CSI report and the second CSI report are associated with only one CSI report, a first set of reporting occasions is associated with only the first CSI, and a second set of reporting occasions is associated with the first CSI and the second CSI.

[0166] Aspect 11: A method of wireless communication performed by a network node, comprising: transmitting a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting; and receiving, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

[0167] Aspect 12: The method of Aspect 11, wherein: the first CSI is interpretable by a network node and an estimated precoder is derivable by the network node based at least in part on the first CSI, the second CSI is not interpretable by the network node based at least in part on no compatible network-side AI/ML model, and the estimated precoder and the second CSI are included as one CSI sample in a dataset for training a network-side AI/ML model, and the network-side AI/ML model is a decoder model.

[0168] Aspect 13: The method of any of Aspects 11-12, wherein the known mapping is based at least in part on a legacy CSI feedback.

[0169] Aspect 14: The method of any of Aspects 11-13, wherein the known mapping is based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model.

[0170] Aspect 15: The method of any of Aspects 11-14, further comprising: transmitting a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

[0171] Aspect 16: The method of any of Aspects 11-15, wherein the configuration is associated with a first CSI report and a second CSI report based at least in part on a UE capability, wherein the first CSI report only includes the first CSI, and the second CSI report includes the joint CSI feedback of the first CSI and the second CSI.

[0172] Aspect 17: The method of Aspect 16, wherein the first CSI report is separate from the second CSI report.

[0173] Aspect 18: The method of Aspect 17, wherein: the second CSI report is an on-demand aperiodic report triggered via layer 1 (L1) signaling, the second CSI report is a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report, or the second CSI report is based at least in part on layer 2 (L2) signaling.

[0174] Aspect 19: The method of Aspect 16, wherein the first CSI report and the second CSI report are associated with only one CSI report, a first set of reporting occasions is associated with only the first CSI, and a second set of reporting occasions is associated with the first CSI and the second CSI.

[0175] Aspect 20: An apparatus for wireless communication at a device, the apparatus comprising one or more processors; one or more memories coupled with the one or more processors; and instructions stored in the one or more memories and executable by the one or more processors to cause the apparatus to perform the method of one or more of Aspects 1-10.

[0176] Aspect 21: An apparatus for wireless communication at a device, the apparatus comprising one or more memories and one or more processors coupled to the one or more memories, the one or more processors configured to cause the device to perform the method of one or more of Aspects 1-10.

[0177] Aspect 22: An apparatus for wireless communication, the apparatus comprising at least one means for performing the method of one or more of Aspects 1-10.

[0178] Aspect 23: A non-transitory computer-readable medium storing code for wireless communication, the code comprising instructions executable by one or more processors to perform the method of one or more of Aspects 1-10.

[0179] Aspect 24: A non-transitory computer-readable medium storing a set of instructions for wireless communication, the set of instructions comprising one or more instructions that, when executed by one or more processors of a device, cause the device to perform the method of one or more of Aspects 1-10.

[0180] Aspect 25: A device for wireless communication, the device comprising a processing system that includes one or more processors and one or more memories coupled with the one or more processors, the processing system configured to cause the device to perform the method of one or more of Aspects 1-10.

[0181] Aspect 26: An apparatus for wireless communication at a device, the apparatus comprising one or more memories and one or more processors coupled to the one or more memories, the one or more processors individually or collectively configured to cause the device to perform the method of one or more of Aspects 1-10.

[0182] Aspect 27: An apparatus for wireless communication at a device, the apparatus comprising one or more processors; one or more memories coupled with the one or more processors; and instructions stored in the one or more memories and executable by the one or more processors to cause the apparatus to perform the method of one or more of Aspects 11-19.

[0183] Aspect 28: An apparatus for wireless communication at a device, the apparatus comprising one or more memories and one or more processors coupled to the one or more memories, the one or more processors configured to cause the device to perform the method of one or more of Aspects 11-19.

[0184] Aspect 29: An apparatus for wireless communication, the apparatus comprising at least one means for performing the method of one or more of Aspects 11-19.

[0185] Aspect 30: A non-transitory computer-readable medium storing code for wireless communication, the code comprising instructions executable by one or more processors to perform the method of one or more of Aspects 11-19.

[0186] Aspect 31: A non-transitory computer-readable medium storing a set of instructions for wireless communication, the set of instructions comprising one or more instructions that, when executed by one or more processors of a device, cause the device to perform the method of one or more of Aspects 11-19.

[0187] Aspect 32: A device for wireless communication, the device comprising a processing system that includes one or more processors and one or more memories coupled with the one or more processors, the processing system configured to cause the device to perform the method of one or more of Aspects 11-19.

[0188] Aspect 33: An apparatus for wireless communication at a device, the apparatus comprising one or more memories and one or more processors coupled to the one or more memories, the one or more processors individually or collectively configured to cause the device to perform the method of one or more of Aspects 11-19.

[0189] The foregoing disclosure provides illustration and description but is not intended to be exhaustive or to limit the aspects to the precise forms disclosed. Modifications and variations may be made in light of the above disclosure or may be acquired from practice of the aspects.

[0190] As used herein, the term "component" is intended to be broadly construed as hardware or a combination of hardware and at least one of software or firmware. "Software" shall be construed broadly to mean instructions, instruction sets, code, code segments, program code, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, threads of execution, procedures, or functions, among other examples, whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise. As used herein, a "processor" is implemented in hardware or a combination of hardware and software. It will be apparent that systems or methods described herein may be implemented in different forms of hardware or a combination of hardware and software. The actual specialized control hardware or software code used to implement these systems or methods is not limiting of the aspects. Thus, the operation and behavior of the systems or methods are described herein without reference to specific software code, because those skilled in the art will understand that software and hardware can be designed to implement the systems or methods based, at least in part, on the description herein. A component being configured to perform a function means that the component has a capability to perform the function, and does not require the function to be actually performed by the component, unless noted otherwise.

[0191] As used herein, "satisfying a threshold" may, depending on the context, refer to a value being greater than the threshold, greater than or equal to the threshold, less than the threshold, less than or equal to the threshold, equal to the threshold, or not equal to the threshold, among other examples.

[0192] As used herein, a phrase referring to "at least one of" a list of items refers to any combination of those items, including single members. As an example, "at least one of: a, b, or c" is intended to cover a, b, c, a+b, a+c, b+c, and a+b+c, as well as any combination with multiples of the same element (for example, a+a, a+a+a, a+a+b, a+a+c, a+b+b, a+c+c, b+b, b+b+b, b+b+c, c+c, and c+c+c, or any other ordering of a, b, and c).

[0193] No element, act, or instruction used herein should be construed as critical or essential unless explicitly described as such. Also, as used herein, the articles "a" and "an" are intended to include one or more items and may be used interchangeably with "one or more." Further, as used herein, the article "the" is intended to include one or more items referenced in connection with the article "the" and may be used interchangeably with "the one or more." Furthermore, as used herein, the terms "set" and "group" are intended to include one or more items and may be used interchangeably with "one or more." Where only one item is intended, the phrase "only one" or similar language is used. Also, as used herein, the terms "has," "have," "having," and similar terms are intended to be open-ended terms that do not limit an element that they modify (for example, an element "having" A may also have B). Further, the phrase "based on" is intended to mean "based on or otherwise in association with" unless explicitly stated otherwise. Also, as used herein, the term "or" is intended to be inclusive when used in a series and may be used interchangeably with "and/or," unless explicitly stated otherwise (for example, if used in combination with "either" or "only one of"). It should be understood that "one or more" is equivalent to "at least one."

[0194] Even though particular combinations of features are recited in the claims or disclosed in the specification, these combinations are not intended to limit the disclosure of various aspects. Many of these features may be combined in ways not specifically recited in the claims or disclosed in the specification. The disclosure of various aspects includes each dependent claim in combination with every other claim in the claim set.

What is claimed is:

1. An apparatus for wireless communication at a user equipment (UE), comprising:

one or more memories; and

one or more processors, coupled to the one or more memories, which, individually or in any combination, are operable to cause the apparatus to:

receive a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting; and

transmit, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

2. The apparatus of claim **1**, wherein:

the first CSI is interpretable by a network node and an estimated precoder is derivable by the network node based at least in part on the first CSI,

the second CSI is not interpretable by the network node based at least in part on no compatible network-side AI/ML model, and

the estimated precoder and the second CSI are included as one CSI sample in a dataset for training a network-side AI/ML model, and the network-side AI/ML model is a decoder model.

3. The apparatus of claim **1**, wherein the known mapping is based at least in part on a legacy CSI feedback.

4. The apparatus of claim **1**, wherein the known mapping is based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model.

5. The apparatus of claim **1**, wherein the one or more processors, individually or in any combination, are operable to cause the apparatus to:

receive a channel state information reference signal (CSI-RS);

perform a CSI-RS measurement based at least in part on the CSI-RS;

generate the first CSI based at least in part on the CSI-RS measurement and the known mapping; and

generate the second CSI based at least in part on the CSI-RS measurement and the UE-side AI/ML model, wherein the UE-side AI/ML model is an encoder model.

6. The apparatus of claim **1**, wherein the one or more processors, individually or in any combination, are operable to cause the apparatus to:

receive a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

7. The apparatus of claim **1**, wherein the configuration is associated with a first CSI report and a second CSI report based at least in part on a UE capability, wherein the first CSI report only includes the first CSI, and the second CSI report includes the joint CSI feedback of the first CSI and the second CSI.

8. The apparatus of claim **7**, wherein the first CSI report is separate from the second CSI report.

9. The apparatus of claim **8**, wherein:

the second CSI report is an on-demand aperiodic report triggered via layer 1 (L1) signaling,

the second CSI report is a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report, or

the second CSI report is based at least in part on layer 2 (L2) signaling.

10. The apparatus of claim **7**, wherein the first CSI report and the second CSI report are associated with only one CSI report, a first set of reporting occasions is associated with only the first CSI, and a second set of reporting occasions is associated with the first CSI and the second CSI.

11. An apparatus for wireless communication at a network node, comprising:
one or more memories; and
one or more processors, coupled to the one or more memories, which, individually or in any combination, are operable to cause the apparatus to:
transmit a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting; and
receive, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

12. The apparatus of claim **11**, wherein:
the first CSI is interpretable by a network node and an estimated precoder is derivable by the network node based at least in part on the first CSI,
the second CSI is not interpretable by the network node based at least in part on no compatible network-side AI/ML model, and
the estimated precoder and the second CSI are included as one CSI sample in a dataset for training a network-side AI/ML model, and the network-side AI/ML model is a decoder model.

13. The apparatus of claim **11**, wherein the known mapping is based at least in part on a legacy CSI feedback.

14. The apparatus of claim **11**, wherein the known mapping is based at least in part on a preexisting UE-side AI/ML model, in relation to the UE-side AI/ML model, that is compatible with a preexisting network-side AI/ML model.

15. The apparatus of claim **11**, wherein the one or more processors, individually or in any combination, are operable to cause the apparatus to:
transmit a switching indication to activate the UE-side AI/ML model, wherein the switching indication is based at least in part on a training of a network-side AI/ML model that is compatible with the UE-side AI/ML model.

16. The apparatus of claim **11**, wherein the configuration is associated with a first CSI report and a second CSI report based at least in part on a UE capability, wherein the first CSI report only includes the first CSI, and the second CSI report includes the joint CSI feedback of the first CSI and the second CSI.

17. The apparatus of claim **16**, wherein the first CSI report is separate from the second CSI report.

18. The apparatus of claim **17**, wherein:
the second CSI report is an on-demand aperiodic report triggered via layer 1 (L1) signaling,
the second CSI report is a semi-persistent or periodic report with a larger periodicity as compared with the first CSI report, or
the second CSI report is based at least in part on layer 2 (L2) signaling.

19. The apparatus of claim **16**, wherein the first CSI report and the second CSI report are associated with only one CSI report, a first set of reporting occasions is associated with only the first CSI, and a second set of reporting occasions is associated with the first CSI and the second CSI.

20. A method of wireless communication performed by a user equipment (UE), comprising:
receiving a configuration associated with artificial intelligence or machine learning (AI/ML) model based channel state feedback (CSF) reporting; and
transmitting, based at least in part on the configuration, a channel state information (CSI) report that indicates joint CSI feedback, wherein the joint CSI feedback includes a first CSI associated with a known mapping and a second CSI associated with a UE-side AI/ML model.

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