



(51) International Patent Classification:
H04L 65/80 (2022.01)

(21) International Application Number:
PCT/EP2024/077201

(22) International Filing Date:
27 September 2024 (27.09.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PCT/CN2023/123078
03 October 2023 (03.10.2023) CN

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

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT,

(54) Title: SERVER NODE, CLIENT NODE, VERTICAL APPLICATION LAYER SERVER AND METHODS PERFORMED IN A WIRELESS COMMUNICATION NETWORK

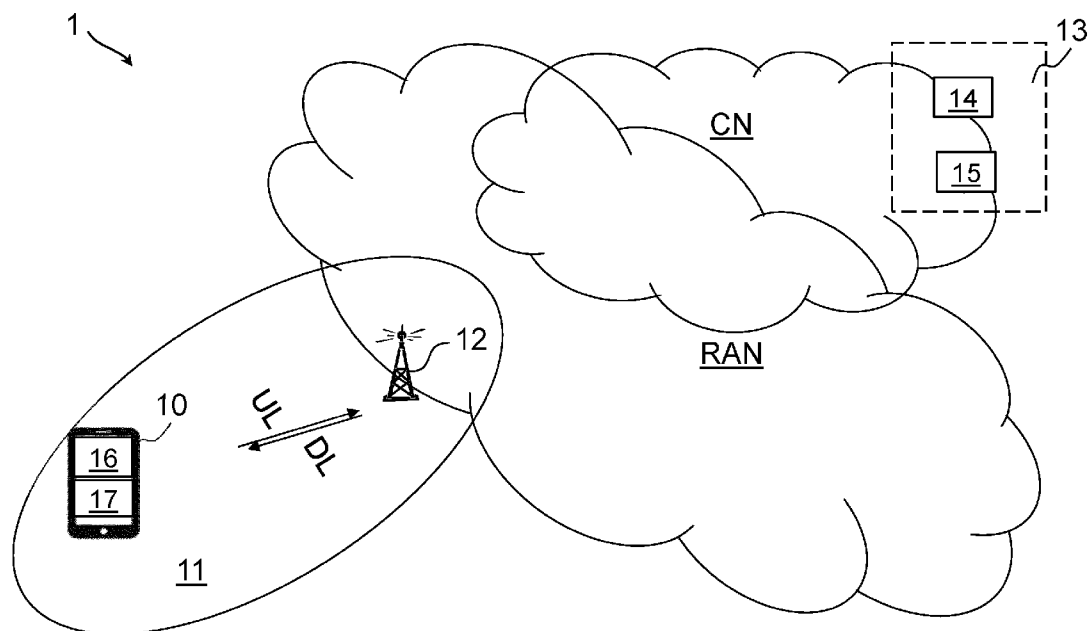


Fig. 5

(57) Abstract: Embodiments herein relates to, for example, a method performed by a server node (15), such as SEALDD server, for handling data delivery in a wireless communication network (1). The server node (15) obtains a burst arrival time (BAT) offset and/or a proposed periodicity of a data transmission, and sends an indication of the obtained BAT offset and/or proposed periodicity to a client node (17).

LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE,
SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN,
GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *in black and white; the international application as filed
contained color or greyscale and is available for download
from PATENTSCOPE*

SERVER NODE, CLIENT NODE, VERTICAL APPLICATION LAYER SERVER AND METHODS PERFORMED IN A WIRELESS COMMUNICATION NETWORK

TECHNICAL FIELD

5 Embodiments herein relate to a server node, a client node, a vertical application layer (VAL) server and methods performed therein regarding wireless communication. Furthermore, a computer program product and a computer-readable storage medium are also provided herein. Especially, embodiments herein relate to handling or enabling communication, such as managing data delivery, in a communication network.

10

BACKGROUND

 In a typical communication network, user equipments (UE), also known as wireless communication devices, mobile stations, stations (STA) and/or wireless devices, communicate via a Radio Access Network (RAN) to one or more core networks (CN).

15 The RAN covers a geographical area which is divided into service areas or cell areas, with each service area or cell area being served by a network node such as an access node e.g. a Wi-Fi access point or a radio base station (RBS), which in some radio access technologies (RAT) may also be called, for example, a NodeB, an evolved NodeB (eNodeB) and a gNodeB (gNB). The service area or cell area is a geographical area

20 where radio coverage is provided by a network node. The network node operates on radio frequencies to communicate over an air interface with the UEs within range of the access node. The network node communicates over a downlink (DL) to the UE, and the UE communicates over an uplink (UL) to the access node.

 A Universal Mobile Telecommunications System (UMTS) is a third generation

25 telecommunication network, which evolved from the second generation (2G) Global System for Mobile Communications (GSM). The UMTS terrestrial radio access network (UTRAN) is essentially a RAN using wideband code division multiple access (WCDMA) and/or High-Speed Packet Access (HSPA) for communication with user equipments. In a forum known as the Third Generation Partnership Project (3GPP), telecommunications

30 suppliers propose and agree upon standards for present and future generation networks and UTRAN specifically, and investigate enhanced data rate and radio capacity. In some RANs, e.g., as in UMTS, several network nodes may be connected, e.g., by landlines or microwave, to a controller node, such as a radio network controller (RNC) or a base

station controller (BSC), which supervises and coordinates various activities of the plural network nodes connected thereto. The RNCs are typically connected to one or more CNs.

Specifications for the Evolved Packet System (EPS) have been completed within the 3rd Generation Partnership Project (3GPP) and this work continues in the coming
5 3GPP releases, such as fifth generation (5G) and sixth generation (6G) networks. The EPS comprises the Evolved Universal Terrestrial Radio Access Network (E-UTRAN), also known as the Long-Term Evolution (LTE) radio access network, and the Evolved Packet Core (EPC), also known as System Architecture Evolution (SAE) core network. E-UTRAN/LTE is a 3GPP radio access technology wherein the network nodes are directly
10 connected to the EPC core network. As such, the RAN of an EPS has an essentially non-hierarchical architecture comprising network nodes connected directly to one or more CNs.

With the emerging 5G technologies also known as new radio (NR) and/or upcoming 6G RAN the use of very many transmit- and receive-antenna elements may
15 utilize beamforming, such as transmit-side and receive-side beamforming. Transmit-side beamforming means that the transmitter can amplify the transmitted signals in a selected direction or directions, while suppressing the transmitted signals in other directions. Similarly, on the receive-side, a receiver can amplify signals from a selected direction or directions, while suppressing unwanted signals from other directions. The benefit is to
20 increase the cell capacity and coverage.

Furthermore, Vehicle to everything (V2X) communication is also supported, which includes any combination of direct communication between vehicles, pedestrians, and infrastructure. V2X communication may take advantage of a Network (NW) infrastructure, when available, but at least basic V2X connectivity should be possible even in case of
25 lack of coverage. Providing an LTE-based V2X interface may be economically advantageous because of the LTE economies of scale and it may enable tighter integration between communications with the NW infrastructure e.g. Vehicle to Infrastructure (V2I) and Vehicle to Pedestrians (V2P) and Vehicle to Vehicle (V2V) communications, as compared to using a dedicated V2X technology.

30 There are many research projects and field tests of connected vehicles in various countries or regions, including projects that are based on the use of existing cellular infrastructure.

V2X communications may carry both non-safety and safety information, where each of the applications and services may be associated with specific requirements, in

terms of e.g. latency, reliability, capacity, etc. From an application point of view, V2X includes the following types of communication/services shown with reference to **Fig. 1**.

5 Vehicle to vehicle (V2V): This covers communication between vehicles using V2V applications and is predominantly broadcast-based. V2V may be realized by either direct communication between the devices in the respective vehicles, or via infrastructure such as a cellular network. An example of V2V is the transmission of a cooperative awareness message (CAM) with vehicle status information, such as position, direction, and speed, transmitted to other vehicles in the proximity repeatedly e.g. every 100ms-1s. Another example is the transmission of a decentralized environmental notification message (DENM), which is an event-triggered message to alert vehicles. These two examples are taken from the ETSI Intelligent Transport Systems (ITS) specification of V2X applications, which also specifies the conditions under which the messages are generated. Main characteristic of V2V applications is the tight requirements on latency that can vary from 20ms, for pre-crash warning messages, to 100ms for other road safety services.

15 Vehicle to infrastructure (V2I): This comprises communication between vehicles and a Roadside Unit (RSU). The RSU may be a stationary transportation infrastructure entity which communicates with vehicles in its proximity. An example of V2I is transmission of speed notifications from the RSU to vehicles, as well as queue information, collision risk alerts, curve speed warnings. Due to the safety related nature of V2I, delay requirements are similar to V2V requirements.

Vehicle to pedestrian (V2P): This covers communication between vehicles and vulnerable road users, such as pedestrians, using V2P applications. V2P typically takes place between distinct vehicles and pedestrians either directly or via infrastructure such as a cellular network.

25 Vehicle to network (V2N): This covers communication between a vehicle and a centralized application server, or an ITS Traffic Management Center, both using V2N applications, via infrastructure, such as a cellular network. One example is a bad road condition warning sent to all vehicles in a wide area, or traffic flow optimization in which V2N application suggests speeds to vehicles and coordinates traffic lights. Therefore, V2N messages are supposed to be controlled by a centralized entity, such as a Traffic Management Center, and may be provisioned to vehicles in a large geographical area, rather than in a small area. Additionally, unlike V2V/V2I, latency requirements are more relaxed in V2N because it is not meant to be used for non-safety purposes, e.g. a latency requirement of 1s is typically considered.

Since 3GPP Release 16, Service Enablement Architecture Layer for Verticals (SEAL) has been introduced to support vertical applications such as V2X applications. 3GPP TS 23.434 v.18.5.0 specifies application plane and signalling plane entities for application-enabling services, e.g., group management, configuration management, location management, identity/key management, network resource management, that can be reused across vertical applications. SEAL also specifies the northbound application programming interfaces (API) for its individual services to enable flexible integration with vertical applications.

Fig. 2 illustrates the generic on-network functional model of SEAL. In the VAL, a VAL client communicates with a VAL server over VAL-UU reference point. VAL-UU supports both unicast and multicast delivery modes.

The SEAL functional entities on the UE and the server are grouped into SEAL client(s) and SEAL server(s), respectively. The SEAL consists of a common set of services, e.g., group management, location management, and reference points. The SEAL offers its services to the vertical application layer (VAL).

The SEAL client(s) communicates with the SEAL server(s) over the SEAL-UU reference points. SEAL-UU supports both unicast and multicast delivery modes. The SEAL client(s) provides the service enabler layer support functions to the VAL client(s) over SEAL-C reference points. The VAL server(s) communicate with the SEAL server(s) over the SEAL-S reference points. The SEAL server(s) may communicate with the underlying 3GPP network systems using the respective 3GPP interfaces specified by the 3GPP network system.

One of the capabilities that SEAL provides is Data Delivery (DD), and **Fig. 3** illustrates the on-network functional model of SEAL for DD. For uplink traffic, a VAL client sends application data traffic to a Service Enablement Architecture Layer for Verticals Data Delivery (SEALDD) client for SEALDD service over interface SEALDD-C. After data plane packet processing by the SEALDD client, the application data traffic is converted to SEALDD data traffic and transferred to a SEALDD server over SEALDD-UU. The SEALDD server restores the application data traffic and sends it to a VAL server over SEALDD-S. For downlink traffic, the VAL server sends application data traffic to the SEALDD server for SEALDD service over SEALDD-S. After data plane packet processing by the SEALDD server, the application data traffic is converted to SEALDD data traffic and transferred to the SEALDD client over interface SEALDD-UU. The SEALDD client restores the application data traffic and sends it to the VAL client over SEALDD-C.

Optionally, VAL deployments may choose to route application signalling traffic and application data traffic for some or all functions it offers using SEALDD service and **Fig. 4** illustrates the architecture for achieving this. In this case the VAL client and VAL server may choose not to maintain application connection by themselves and transfer all the application traffic over SEALDD connections for those functions.

NOTE: SEALDD capabilities are provided as APIs to the VAL Layer, it is up to VAL layer to decide which traffic to be transferred, e.g., application signalling, application data.

The SEAL Data Delivery client interacts with the SEAL data delivery server to establish application layer data transport path.

Through this path, the SEALDD server and client provide data transport service capabilities such as data plane packet processing, e.g., packet duplication, elimination or transport coordination, data forwarding, data caching, background data transfer, etc. to support the VAL server and client.

SEALDD connection can be established by either SEALDD client or SEALDD server, as described in clause 9.2 and clause 9.3 of 3GPP TS 23.433 v.18.1.0.

TS 23.433 also specifies some transmission quality assurance methods, e.g., using redundant transmission, see clause 9.9 of 3GPP TS 23.433 v.18.1.0.

SUMMARY

As part of developing embodiments herein one or more problems was first identified. As part of the Release 19 (Rel-19) scope, the SEALDD layer can utilize new capability exposed by 3GPP network and such information can be used by SEALDD, as application handling the VAL traffic, for adjust data transmission.

An object of embodiments herein is, thus, to provide a mechanism that improves the performance of a wireless communication network.

According to an aspect the object is achieved by providing a method performed by a server node, such as a SEALDD server, for handling data delivery in a wireless communication network. The server node obtains burst arrival time (BAT) offset and/or a proposed periodicity of a data transmission. The server node sends an indication of the obtained BAT offset and/or the proposed periodicity to the client node. The indication may indicate UL periodicity and/or BAT offset for UL data.

According to another aspect the object is achieved by providing a method performed by a client node, such as a SEALDD client, for handling data delivery in a wireless communication network. The client node receives from a server node an indication of an obtained BAT offset and/or proposed periodicity of a data transmission.

The indication may indicate UL periodicity and/or BAT offset for UL data. The client node may use the BAT offset and/or proposed periodicity in adjusting data transmission.

According to yet another aspect the object is achieved by providing a method performed by a VAL server for handling data delivery in a wireless communication
5 network. The VAL server requests a server node to apply data transmission adjustment, or a data transmission adjustment policy and indicates a data transmission adjustment need in SEALDD layer.

It is furthermore provided herein a computer program product comprising instructions, which, when executed on at least one processor, cause the at least one
10 processor to carry out the methods herein, as performed by the server node, client node, and VAL server, respectively.

It is additionally provided herein a computer-readable storage medium, having stored thereon a computer program product comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the
15 methods herein, as performed by the server node, client node, and VAL server, respectively.

According to still another aspect the object is achieved by providing a server node, such as a SEALDD server, for handling data delivery in a wireless communication network. The server node is configured to obtain a BAT offset and/or a proposed
20 periodicity of a data transmission, and to send an indication of the obtained BAT offset and/or proposed periodicity to the client node.

According to yet still another aspect the object is achieved by providing a client node, such as a SEALDD client, for handling data delivery in a wireless communication network. The client node is configured to receive from a server node, an indication of an
25 obtained BAT offset and/or a proposed periodicity of a data transmission.

According to another aspect the object is achieved by providing a VAL server for handling data delivery in a wireless communication network, wherein the VAL server is configured to request a server node to apply data transmission adjustment, or a data transmission adjustment policy and indicates a data transmission adjustment need in
30 SEALDD layer.

It is herein proposed a solution that describes a new transmission quality guarantee approach to optimize the data transmission via SEALDD considering the network capability and application adaptation. The transmission quality guarantee approach comprises that the client node receives the indication of BAT offset and/or
35 proposed periodicity of a data transmission. The client node may then use, if needed, this

indication in a data transmission adjustment for the VAL client and/or VAL server. Thus, this will result in an improved performance of the wireless communication network.

BRIEF DESCRIPTION OF THE DRAWINGS

- 5 Embodiments will now be described in more detail in relation to the enclosed drawings, in which:
- Fig. 1 shows an overview of V2X services according to prior art;
- Fig. 2 shows a schematic overview of a generic on-network functional model of SEAL according to prior art;
- 10 Fig. 3 shows a schematic overview of an Architecture for SEAL Data Delivery Service according to prior art;
- Fig. 4 shows a schematic overview of an architecture for application traffic transfer;
- Fig. 5 shows a schematic overview of a wireless communication network according to embodiments herein;
- 15 Fig. 6 shows a combined flowchart and signalling scheme according to embodiments herein;
- Fig. 7 shows a flowchart depicting a method performed by a server node according to embodiments herein;
- Fig. 8 shows a flowchart depicting a method performed by a client node according to
20 embodiments herein;
- Fig. 9 shows a flowchart depicting a method performed by a VAL server according to embodiments herein;
- Fig. 10 shows a combined flowchart and signalling scheme according to embodiments herein;
- 25 Fig. 11 is a block diagram depicting a server node according to embodiments herein;
- Fig. 12 is a block diagram depicting a client node according to embodiments herein; and
- Fig. 13 is a block diagram depicting a VAL server according to embodiments herein.

DETAILED DESCRIPTION

- 30 Embodiments herein are described within the context of 3GPP NR radio technology. It is understood that the problems and solutions described herein are equally applicable to wireless access networks and UEs implementing other access technologies and standards. NR is used as an example technology where embodiments are suitable, and using NR in the description therefore is particularly useful for understanding the

problem and solutions solving the problem. In particular, embodiments are applicable also to 6G, 3GPP LTE, or 3GPP LTE and NR integration, also denoted as non-standalone NR.

Embodiments herein relate to wireless communication networks in general. **Fig. 5** is a schematic overview depicting **a wireless communication network 1**. The wireless communication network 1 comprises one or more RANs and one or more CNs. The wireless communication network 1 may use one or a number of different technologies. Embodiments herein relate to recent technology trends that are of particular interest in a NR context, however, embodiments are also applicable in further developments of existing wireless communications systems such as e.g. 6G, LTE or WCDMA.

In the wireless communication network 1, **a user equipment (UE) 10**, such as a mobile station, a wireless device, a non-access point (non-AP) STA, a STA, and/or a wireless terminal, is communicating via, e.g., one or more Access Networks (AN), e.g., RAN, to one or more CNs. It should be understood by the skilled in the art that "UE" is a non-limiting term which means any terminal, wireless communications terminal or device, user equipment, narrowband (NB)- internet of things (IoT) device, Machine Type Communication (MTC) device, Device to Device (D2D) terminal, or node, e.g., smart phone, laptop, mobile phone, sensor, relay, mobile tablets or even a small base station capable of communicating using radio communication with a network node within an area served by the network node.

The wireless communication network 10 comprises **a radio network node 12**, e.g., an access node, an access controller, a base station, e.g. a radio base station such as a gNodeB (gNB), an evolved Node B (eNB, eNode B), a NodeB, a base transceiver station, a radio remote unit, an Access Point Base Station, a base station router, a Wireless Local Area Network (WLAN) access point or an Access Point Station (AP STA), a stand-alone access point, or any other network unit or node capable of communicating with a UE within **a service area 11**, such as a cell, served by the radio network node 12 depending e.g., on a radio access technology and terminology used. The service area 11 may also be referred to as a cell, a beam or a beam group of a first radio access technology (RAT), such as 6G, 5G, LTE, Wi-Fi, or similar. The radio network node 12 may be associated with a first Public Land Mobile Network (PLMN) and/or a first Non-Public Network (NPN).

The wireless communication network 10 further comprises **a network node 13** handling service data. The network node 13 may comprise **a VAL server 14** and a **server node 15**, such as a SEALDD server. It should be understood that the VAL server 14 and the server node 15 may be separated nodes or co-located nodes.

The UE 10 may comprise a **VAL client 16** and a SEALDD client, also referred to as a **client node 17**. It should be understood that the VAL client 16 and the client node 17 may be separated clients or co-located clients.

According to embodiments herein the SEALDD layer can utilize new capability exposed by 3GPP network and such capability information can be used by SEALDD, as an application handling the VAL traffic, for adjusting data transmission.

The client node 17 receives an indication of BAT offset and/or proposed periodicity of a data transmission such as UL data and/or DL data. The client node 17 may then use this indication in a data transmission adjustment for the VAL client and/or VAL server.

Embodiments herein add a new transmission quality guarantee approach to optimize the data transmission via SEALDD considering the network capability and application adaptation.

Fig. 6 is a combined flowchart and signalling scheme according to some embodiments herein. Fig. 6 illustrates a procedure of using 3GPP CN capability for BAT and periodicity report and application layer adjustment in SEALDD layer for data transmission.

Action 601. The VAL client 16 may request the client node 17 to apply data transmission adjustment.

Action 602. Additionally, or alternatively, the VAL server 14 may request the server node 15 to apply data transmission adjustment. Alternatively, the VAL server 14 may indicate a data transmission adjustment policy. The request may comprise a data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer. The data transmission adjustment policy may indicate quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

Action 603. The client node 17 may transmit a capability indication to the server node 15. The capability indication indicates the client node's capability for BAT and/or periodicity adaptation, and/or transmission assistance information. BAT stands for Burst Arrival Time. Capability indications may be exchanged between the client node 17 and the server node 15. The respective capability indication may indicate capability for BAT and periodicity adaptation and/or transmission assistance information. The capability for BAT and periodicity adaptation indicates BAT and periodicity adaptation capability for SEALDD client in a client-side initiated request. The transmission assistance information indicates transmission assistance information for

uplink SEALDD traffic in a client-side initiated request. This may include BAT, BAT window, periodicity, and periodicity range.

Action 604. The server node 15 may subscribe to a session with quality of service (QoS) with capability for BAT adaptation.

5 **Action 605.** The server node 15 obtains BAT offset and/or proposed periodicity, for example, from the wireless communication network 1. Note: a session management function (SMF) is responsible for mapping the BAT, BAT Window, Periodicity and Periodicity Range from an external clock, when available, to the 5G clock based on the time offset and cumulative rateRatio, when available, between the external clock time
10 and 5GS time as measured and reported by the UPF.

Action 606. The server node 15 then sends the indication of the obtained BAT offset and/or proposed periodicity to the client node 17. The indication may indicate UL periodicity and/or BAT offset for UL data.

15 **Action 607.** The client node 17 may then use the BAT offset and/or proposed periodicity in a data delivery adjustment, for example, in UL delivery.

Action 608. The server node 15 may then use the BAT offset and/or proposed periodicity in a data delivery adjustment, for example, in DL delivery.

20 **Fig. 7** illustrates an example of a method performed by the server node 15, such as SEALDD server, for handling data delivery in the wireless communication network 1 in accordance with embodiments herein. Optional actions are shown using a dashed line. The acts in Fig. 7 may be performed in any suitable order.

25 **Action 701.** The server node 15 may receive a request from the VAL server 14 to apply data transmission adjustment. Alternatively, the server node 15 may receive a request for a data transmission adjustment policy. The request may comprise a data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer. The data transmission adjustment policy may indicate quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

30 **Action 702.** The server node 15 may receive the capability indication from the client node 17. The capability indication may indicate the capability for BAT and periodicity adaptation and/or transmission assistance information. The capability for BAT and periodicity adaptation indicates BAT and periodicity adaptation capability for SEALDD client. This may include BAT, BAT window, periodicity, and periodicity range.

Action 703. The server node 15 may subscribe to a session with QoS with capability for BAT adaptation and/or transmission assistance information. This may be based on the capability indication as well as its own capability.

5 **Action 704.** The server node 15 obtains BAT offset and/or proposed periodicity, for example, from the wireless communication network 1.

Action 705. The server node 15 sends to the client node 17 the indication of the obtained BAT offset and/or proposed periodicity of a data transmission. The indication may indicate UL periodicity and/or BAT offset for UL data.

10 **Action 706.** The server node 15 may then use or apply the obtained BAT offset and/or proposed periodicity, such as BAT, BAT window, periodicity, and periodicity range, in a data delivery adjustment, for example, in DL delivery. The BAT offset and/or periodicity may be used by a SEALDD server to adjust a packet sending time and its internal packet buffering/scheduling.

15 **Fig. 8** illustrates an example of a method performed by the client node 17, such as SEALDD client, for handling data delivery in the wireless communication network 1 in accordance with embodiments herein. Optional actions are shown using a dashed line. The acts in Fig. 8 may be performed in any suitable order.

20 **Action 801.** The client node 17 may receive a request from the VAL client 16 to apply data transmission adjustment. The request may comprise the data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer, and/or quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

25 **Action 802.** The client node 17 may transmit the capability indication to the server node 15. The capability indication indicates the client node's capability for BAT and/or periodicity adaptation, and/or transmission assistance information. Capability indications may be exchanged between the client node 17 and the server node 15, upon request or retrieval. The capability indication may indicate capability for BAT and periodicity adaptation and/or transmission assistance information. The capability for
30 BAT and periodicity adaptation indicates BAT and periodicity adaptation capability for SEALDD client in a client-side initiated request. The transmission assistance information indicates transmission assistance information for uplink SEALDD traffic in a client-side initiated request. This may include BAT, BAT window, periodicity, and periodicity range.

Action 803. The client node 17 receives from the server node 15, the indication of the obtained BAT offset and/or proposed periodicity of a data transmission. The indication may indicate UL periodicity and/or BAT offset for UL data.

Action 804. The client node 17 may then apply or use the BAT offset and/or proposed periodicity in a data delivery adjustment, for example, in UL delivery. The BAT offset and/or periodicity may be used by a SEALDD client to adjust a packet sending time and its internal packet buffering and/or scheduling.

Fig. 9 illustrates an example of a method performed by the VAL server 14 for handling data delivery in the wireless communication network 1 in accordance with embodiments herein. Optional actions are shown using a dashed line. The acts in Fig. 9 may be performed in any suitable order.

Action 901. The VAL server 14 requests the server node 15 to apply data transmission adjustment. Alternatively, the VAL server 14 may indicate the data transmission adjustment policy. The request may comprise the data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer. The data transmission adjustment policy may indicate quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

Proposed changes in TS 23.433 underlined:

* * * First Change * * * *

9.9.2.x SEALDD enabled data transmission quality guarantee with BAT and periodicity adaptation

Figure 9.9.2.x-1 illustrates the procedure of using 3GPP CN (5GS) capability for BAT and periodicity report and application layer adjustment in SEALDD layer for data transmission.
Pre-conditions:

Either VAL client or VAL server needs to have data transmission optimization when using SEALDD service.

Figure 10: SEALDD data transmission quality guarantee with BAT and periodicity adaptation

11. A VAL client and server establish a SEALDD regular or redundant connection to transport the application data as described in clause 9.2 or clause 9.3. During the connection establishment, VAL may request SEALDD layer to apply data transmission adjustment:

- The VAL client may request the SEALDD client to apply data transmission adjustment, then the SEALDD client includes an indication for data transmission adjustment request as part of the connection establishment over SEALDD-UU reference point.

- The VAL server may request the SEALDD server to apply data transmission adjustment in SEALDD regular or URLLC transmission request. Alternatively, the VAL server may indicate the data transmission adjustment policy to be performed in SEALDD policy configuration request.

5 In SEALDD-UU connection establishment, the SEALDD client also includes its capability for BAT and periodicity adaptation, or transmission assistance info to the SEALDD server in the connection establishment request (SEALDD client triggered establishment) or response (SEALDD server triggered establishment).

10 12. The SEALDD server, based on received data transmission adjustment request from VAL server or SEALDD client, its own capability and/or received capability from SEALDD client for BAT and periodicity adaptation, and its own DL transmission assistance info and/or received transmission assistance info from SEALDD client, subscribes to 5GS AF session with QoS service with capability for BAT adaptation or transmission assistance info.

13. The SEALDD server receives BAT offset and proposed periodicity (which was adjusted in 5GS) in AF session with QoS notification from 5GS.

15 14. If the SEALDD client indicated its BAT and periodicity adaptation capability in step 11 during SEALDD connection establishment, the SEALDD server sends UL periodicity and BAT window to the SEALDD client in Transmission quality management request with transmission parameter adjustment action.

15. The SEALDD client applies UL periodicity and BAT offset for uplink SEALDD data.

20 16. The SEALDD server locally applies DL periodicity and BAT offset for downlink SEALDD data.

NOTE: Step 16 can happen before step 15.

* * * Next Change * * * *

9.2.3.1 SEALDD enabled regular transmission request

25 Table 9.2.3.1-1 describes the information flow from the VAL server to the SEALDD server for requesting the regular application transmission service.

Table 9.2.3.1-1: SEALDD enabled Regular transmission request

Information element	Status	Description
VAL server ID	M	Identity of the VAL server
VAL service ID	O	Identity of the VAL service
UE identity	O	Identifier of specific UE, e.g. UE ID, UE address
SEALDD-S Data transmission connection information	M	Address/port and/or URL of the VAL server to receive the application packets from the SEALDD server
QoS information	O	QoS information provided by VAL server
VAL server's total bandwidth limit	O (See NOTE)	The total bandwidth limit of VAL server, including UL/DL
VAL users' bandwidth limit	O (See NOTE)	The bandwidth limits (i.e. minimum bandwidth requirement and maximum bandwidth limit) for VAL users, including UL/DL
Data transmission adjustment Indication	O	Indicates the data transmission adjustment need in SEALDD layer.
NOTE: These IEs are used for the SEALDD enabled bandwidth control for different VAL users.		

* * * Next Change * * * *

9.2.3.3 SEALDD regular transmission connection establishment request

Table 9.2.3.3-1 describes the information flow from the SEALDD client to the SEALDD server or from the SEALDD server to the SEALDD client for requesting the regular SEALDD connection establishment.

5 **Table 9.2.3.3-1: SEALDD regular transmission connection establishment request**

Information element	Status	Description
Requestor ID	M	Identity of the requestor (SEALDD client or SEALDD server).
SEALDD flow ID	M (See NOTE 1)	Identity of the SEALDD flow.
VAL server ID	O	Identity of the VAL server, applicable for SEALDD client side initiated request.
VAL service ID	O	Identity of the VAL service
Selected VAL server endpoint	M	Endpoint of the selected VAL server
SEALDD traffic descriptor	O	SEALDD traffic descriptor (e.g. address, port, URL, transport layer protocol) of the SEALDD client side (for client side initiated request) or the SEALDD server side (for server side initiated request) used to establish SEALDD connection.
VAL UE/user identity	O	The VAL user ID of the VAL user or VAL UE ID.
SEALDD communication lifetime	O	Identifies the DD communication lifetime, applicable for SEALDD server side initiated request.
Capability for BAT and periodicity adaptation	O (See NOTE 2)	Indicates BAT and periodicity adaptation capability for SEALDD client in client side initiated request.
Transmission assistance info	O (See NOTE 2)	Indicates transmission assistance information for uplink SEALDD traffic in client side initiated request. It includes BAT, BAT window, periodicity, and periodicity range.
NOTE 1: The SEALDD flow ID is used by the SEALDD client and SEALDD server to identify different application traffic, and it is mapped to the identifiers of the application traffic and data transmission session.		
NOTE 2: One of these IEs may be present in the message.		

9.2.3.4 SEALDD regular transmission connection establishment response

Table 9.2.3.4-1 describes the information flow from the SEALDD server to the SEALDD client or from the SEALDD client to the SEALDD server for responding to the regular SEALDD connection establishment.

Table 9.2.3.4-1: SEALDD regular transmission connection establishment response

Information element	Status	Description
Result	M	Indicates the success or failure of establishing the SEALDD connection.
SEALDD traffic descriptor	O	SEALDD traffic descriptor (e.g. address, port, URL, transport layer protocol) of the SEALDD server side (for client side initiated request) or the SEALDD client side (for server side initiated request) used to establish SEALDD connection.
Pending timer	O (See NOTE 1)	The pending timer to trigger the re-connection from SEALDD client when bandwidth limit check is failed.
Suggested traffic transmission bandwidth	O (See NOTE 1)	The suggested traffic transmission bandwidth used by SEALDD client or SEALDD server to perform bandwidth control for VAL users, including UL/DL.
<u>Capability for BAT and periodicity adaptation</u>	<u>O</u> (See NOTE 2)	<u>Indicates BAT and periodicity adaptation capability for SEALDD client in server side initiated request.</u>
<u>Transmission assistance info</u>	<u>O</u> (See NOTE 2)	<u>Indicates transmission assistance information for uplink SEALDD traffic in server side initiated request.</u> <u>It includes BAT, BAT window, periodicity, and periodicity range.</u>
NOTE 1: These IEs are used for the SEALDD enabled bandwidth control for different VAL users, applicable for client side initiated request.		
NOTE 2: One of these IEs may be present in the message.		

*** Next Change ***

9.3.3.3 SEALDD URLLC transmission connection establishment request

5 Table 9.3.3.3-1 describes the information flow from the SEALDD client to the SEALDD server for requesting the URLLC transmission connection establishment.

Table 9.3.3.3-1: SEALDD URLLC transmission connection establishment request

Information element	Status	Description
SEALDD client ID	M	Identity of the SEALDD client.
VAL UE/user identity	O	The VAL user ID of the VAL user or VAL UE ID
SEALDD flow ID	M (See NOTE 1)	Identity of the SEALDD flow.
VAL server ID	O (See NOTE 1)	Identity of the VAL server.
VAL service ID	O (See NOTE 1)	Identity of the VAL service.
SEALDD traffic descriptors	O	A pair of SEALDD traffic descriptors (e.g. address, port, transport layer protocol) of the SEALDD client side used to establish redundant SEALDD connection.
Capability for BAT and periodicity adaptation	O (See NOTE 2)	Indicates BAT and periodicity adaptation capability for SEALDD client in client side initiated request.
Transmission assistance info	O (See NOTE 2)	Indicates transmission assistance information for uplink SEALDD traffic in client side initiated request. It includes BAT, BAT window, periodicity, and periodicity range. For URLLC transmission, it includes assistance information per SEALDD traffic descriptor.
NOTE 1: The SEALDD flow ID is used by the SEALDD client and SEALDD server to identify different application traffic, and it is mapped from the VAL service ID.		
NOTE 2: One of these IEs may be present in the message.		

9.3.3.4 SEALDD URLLC transmission connection establishment response

Table 9.3.3.4-1 describes the information flow from the SEALDD server to the SEALDD client for responding to the URLLC transmission connection establishment.

5

Table 9.3.3.4-1: SEALDD URLLC transmission connection establishment response

Information element	Status	Description
Result	M	Indicates the success or failure of establishing the SEALDD connection.
SEALDD traffic descriptors	O	A pair of SEALDD traffic descriptors (e.g. address, port, transport layer protocol) of the SEALDD server side used to establish redundant SEALDD connection.
Capability for BAT and periodicity adaptation	O (See NOTE)	Indicates BAT and periodicity adaptation capability for SEALDD client in server side initiated request.
Transmission assistance info	O (See NOTE)	Indicates transmission assistance information for uplink SEALDD traffic in server side initiated request. It includes BAT, BAT window, periodicity, and periodicity range. For URLLC transmission, it includes assistance information per SEALDD traffic descriptor.
NOTE: One of these IEs may be present in the message.		

*** Next Change ***

9.9.3.1 Transmission quality guarantee request

Table 9.9.3.1-1 describes the information flow from the SEALDD server to the SEALDD client for requesting data transmission quality guarantee.

10

Table 9.9.3.1-1: Transmission quality guarantee request

Information element	Status	Description
SEALDD flow ID	M	Identifier of the SEALDD flow.
Transmission quality guarantee action	M	Indicates the data transmission quality guarantee action (e.g. redundant transmission path, re-establish transmission path, switch to backup transmission path) or <u>optimization action (return back to single transmission path, transmission parameter adjustment)</u> that triggering by event (e.g. measurement threshold).
UL periodicity	O	<u>Uplink periodicity.</u>
BAT offset for UL	O	<u>BAT offset for Uplink data.</u>

NOTE: The triggering event (e.g. measurement threshold) is changeable with the transmission quality guarantee event.

- 5 Editor's Note: The Transmission quality guarantee action is to be changed to the quality guarantee policy in Table 9.7.3.6. The SEALDD policy configuration request in table 9.10.3.1-1 is to be aligned by adding the Transmission quality guarantee policy in this table.

* * * Next Change * * * *

9.10.3.1 SEALDD policy configuration request

- 10 Table 9.10.3.1-1 describes the information flow from the VAL server to the SEALDD server for requesting the SEALDD policy configuration.

Table 9.10.3.1-1: SEALDD policy configuration request

Information element	Status	Description
Application traffic identifiers	M	Identify of the application traffic (e.g. VAL server ID, VAL service ID)
VAL UE identity	O	Identifier of the VAL UE for which SEALDD policy applies
SEALDD policy	M	The SEALDD policy associated with application traffic identifiers, VAL UE identify
> Quality guarantee policy	O (See NOTE 1)	Indicates the action to be performed when the measurement event (e.g. measurement threshold) occurs, in order to meet the quality guarantee.
> <u>Quality optimization policy</u>	O	<u>Indicates the data transmission adjustment policy (e.g., adjustment need) to be performed in SEALDD layer.</u>
> Bandwidth control policy	O (See NOTE 2)	The bandwidth control policy from VAL server, e.g. re-allocating the bandwidth limit between different VAL users, including UL/DL
NOTE 1: This IE is used for the SEALDD enabled transmission quality guarantee, as specified in clause 9.9.		
NOTE 2: This IE is used for the SEALDD enabled bandwidth control, as specified in clause 9.8.		

- 15 **Fig. 11** depicts embodiment of the server node 15, such as the SEAL server, for handling data delivery in the wireless communication network according to embodiments herein.

The server node 15 may comprise **processing circuitry 1101**, e.g. one or more processors, configured to perform the methods herein.

The server node 15 and/or the processing circuitry 1101 may be configured to receive the request from the VAL server 14 to apply data transmission adjustment. Alternatively, the server node 15 and/or the processing circuitry 1101 may be configured to receive the request for the data transmission adjustment policy. The request may
5 comprise the data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer. The data transmission adjustment policy may indicate quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

10 The server node 15 and/or the processing circuitry 1101 may be configured to receive the capability indication from the client node 17. The capability indication may indicate capability for BAT and periodicity adaptation and/or transmission assistance information. The capability for BAT and periodicity adaptation indicates BAT and periodicity adaptation capability for SEALDD client. This may include BAT, BAT window, periodicity, and periodicity range.

15 The server node 15 and/or the processing circuitry 1101 may be configured to subscribe to a session with QoS with capability for BAT adaptation and/or transmission assistance information. This may be based on the capability indication as well as its own capability.

20 The server node 15 and/or the processing circuitry 1101 is configured to obtain the BAT offset and/or the proposed periodicity, for example, from the wireless communication network 1.

The server node 15 and/or the processing circuitry 1101 is configured to send the indication of the obtained BAT offset and/or the proposed periodicity to the client node 17. The indication may indicate UL periodicity and/or BAT offset for UL data.

25 The server node 15 and/or the processing circuitry 1101 may be configured to use or apply the obtained BAT offset and/or proposed periodicity, such as BAT, BAT window, periodicity, and periodicity range, in a data delivery adjustment, for example, in DL delivery.

30 The server node 15 further comprises a **memory 1105**. The memory 1105 comprises one or more units to be used to store data on, such as indications, mapping, capability indication, capability, measurements, packets, BAT information, transmission assistance information, data related to nodes, and applications to perform the methods disclosed herein when being executed, and similar. Furthermore, the server node 15 may comprise a **communication interface 1106** such as comprising a transmitter, a receiver,
35 a transceiver and/or one or more antennas, such as antenna arrays.

The methods according to the embodiments described herein for the server node 15 are respectively implemented using e.g., a **computer program product 1107** or a computer program, comprising instructions, i.e., software code portions, which, when executed on at least one processor, cause the at least one processor to carry out the actions described herein, as performed by the server node 15. The computer program product 1107 may be stored on a **computer-readable storage medium 1108**, e.g., a disc, a universal serial bus (USB) stick or similar. The computer-readable storage medium 1108, having stored thereon the computer program product, may comprise the instructions which, when executed on at least one processor, cause the at least one processor to carry out the actions described herein, as performed by the server node 15. In some embodiments, the computer-readable storage medium may be a transitory or a non-transitory computer-readable storage medium. Thus, embodiments herein may disclose a server node 15 for handling data delivery in a wireless communication network, wherein the server node 15 comprises processing circuitry and a memory, the memory comprising instructions executable by the processing circuitry whereby the server node 15 is operative to perform any of the methods herein.

Fig. 12 depicts embodiment of the client node 17 for handling data delivery in the wireless communication network according to embodiments herein.

The client node 17 may comprise **processing circuitry 1201**, e.g., one or more processors, configured to perform the methods herein.

The client node 17 and/or the processing circuitry 1201 may be configured to receive the request from the VAL client 16 to apply data transmission adjustment. The request may comprise the data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer, and/or the quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

The client node 17 and/or the processing circuitry 1201 may be configured to transmit the capability indication to the server node 15. The capability indication indicates the client node's capability for BAT and/or periodicity adaptation, and/or transmission assistance information. Capability indications may be exchanged between the client node 17 and the server node 15, upon request or retrieval. The capability indication may indicate capability for BAT and periodicity adaptation and/or transmission assistance information. The capability for BAT and periodicity adaptation indicates BAT and periodicity adaptation capability for SEALDD client in a client-side initiated request. The transmission assistance information indicates transmission

assistance information for uplink SEALDD traffic in client-side initiated request. This may include BAT, BAT window, periodicity, and periodicity range.

The client node 17 and/or the processing circuitry 1201 is configured to receive from the server node 15, the indication of the obtained BAT offset and/or the proposed
5 periodicity. The indication may indicate UL periodicity and/or BAT offset for UL data.

The client node 17 and/or the processing circuitry 1201 may be configured to use the BAT offset and/or proposed periodicity in a data delivery adjustment, for example, in UL delivery.

The client node 17 further comprises a **memory 1205**. The memory 1205
10 comprises one or more units to be used to store data on, such as indications, mapping, capability indication, capability, measurements, packets, BAT information, transmission assistance information, data related to nodes, and applications to perform the methods disclosed herein when being executed, and similar. Furthermore, the client node 17 may comprise a **communication interface 1206** such as comprising a transmitter, a receiver,
15 a transceiver and/or one or more antennas, such as antenna arrays.

The methods according to the embodiments described herein for the client node 17 are respectively implemented using e.g., a **computer program product 1207** or a computer program, comprising instructions, i.e., software code portions, which, when executed on at least one processor, cause the at least one processor to carry out the
20 actions described herein, as performed by the client node 17. The computer program product 1207 may be stored on a **computer-readable storage medium 1208**, e.g., a disc, a universal serial bus (USB) stick or similar. The computer-readable storage medium 1208, having stored thereon the computer program product, may comprise the instructions which, when executed on at least one processor, cause the at least one
25 processor to carry out the actions described herein, as performed by the client node 17. In some embodiments, the computer-readable storage medium may be a transitory or a non-transitory computer-readable storage medium. Thus, embodiments herein may disclose a client node 17 for handling data delivery in a wireless communication network, wherein the client node 17 comprises processing circuitry and a memory, the memory comprising
30 instructions executable by the processing circuitry whereby the client node 17 is operative to perform any of the methods herein.

Fig. 13 depicts embodiment of the VAL server 14 for handling data delivery in the wireless communication network according to embodiments herein.

The VAL server 14 may comprise **processing circuitry 1301**, e.g. one or more processors, configured to perform the methods herein.

The VAL server 14 and/or the processing circuitry 1301 is configured to request the server node 15 to apply data transmission adjustment. Alternatively, the VAL server
5 14 and/or the processing circuitry 1301 is configured to indicate the data transmission adjustment policy. The request may comprise a data transmission adjustment indication that indicates the data transmission adjustment need in SEALDD layer. The data transmission adjustment policy may indicate quality optimization policy indicating the data transmission adjustment policy to be performed in SEALDD layer.

10 The VAL server 14 further comprises **a memory 1305**. The memory 1305 comprises one or more units to be used to store data on, such as indications, mapping, capability indication, capability, measurements, packets, BAT information, transmission assistance information, data related to nodes, and applications to perform the methods disclosed herein when being executed, and similar. Furthermore, the VAL server 14 may
15 comprise **a communication interface 1306** such as comprising a transmitter, a receiver, a transceiver and/or one or more antennas, such as antenna arrays.

The methods according to the embodiments described herein for the VAL server 14 are respectively implemented using e.g., **a computer program product 1307** or a computer program, comprising instructions, i.e., software code portions, which, when
20 executed on at least one processor, cause the at least one processor to carry out the actions described herein, as performed by the VAL server 14. The computer program product 1307 may be stored on **a computer-readable storage medium 1308**, e.g., a disc, a universal serial bus (USB) stick or similar. The computer-readable storage medium 1308, having stored thereon the computer program product, may comprise the
25 instructions which, when executed on at least one processor, cause the at least one processor to carry out the actions described herein, as performed by the VAL server 14. In some embodiments, the computer-readable storage medium may be a transitory or a non-transitory computer-readable storage medium. Thus, embodiments herein may disclose a VAL server 14 for handling data delivery in a wireless communication network,
30 wherein the VAL server 14 comprises processing circuitry and a memory, the memory comprising instructions executable by the processing circuitry whereby the VAL server 14 is operative to perform any of the methods herein.

In some embodiments, a more general term “network node” is used and it can correspond to any type of radio network node or any network node, which communicates
35 with a UE and/or with another network node. Examples of network nodes are NodeB,

Master eNB, Secondary eNB, a network node belonging to Master cell group (MCG) or Secondary cell group (SCG), base station (BS), multi-standard radio (MSR) radio node such as MSR BS, eNodeB, network controller, radio-network controller (RNC), base station controller (BSC), relay, donor node controlling relay, base transceiver station (BTS), access point (AP), transmission points, transmission nodes, Remote radio Unit (RRU), Remote Radio Head (RRH), nodes in distributed antenna system (DAS), etc.

In some embodiments, the non-limiting term wireless device or UE is used and it refers to any type of wireless device communicating with a network node and/or with another wireless device in a cellular or mobile communication system. Examples of UE are IoT capable device, target device, device to device (D2D) UE, proximity capable UE (aka ProSe UE), machine type UE or UE capable of machine to machine (M2M) communication, Tablet, mobile terminals, smart phone, laptop embedded equipped (LEE), laptop mounted equipment (LME), USB dongles, etc.

Embodiments are applicable to any RAT or multi-RAT systems, where the wireless device receives and/or transmit signals (e.g. data) e.g. New Radio (NR), Wi-Fi, Long Term Evolution (LTE), LTE-Advanced, Wideband Code Division Multiple Access (WCDMA), Global System for Mobile communications/enhanced Data rate for GSM Evolution (GSM/EDGE), Worldwide Interoperability for Microwave Access (WiMax), or Ultra Mobile Broadband (UMB), just to mention a few possible implementations.

As will be readily understood by those familiar with communications design, that functions means or circuits may be implemented using digital logic and/or one or more microcontrollers, microprocessors, or other digital hardware. In some embodiments, several or all of the various functions may be implemented together, such as in a single application-specific integrated circuit (ASIC), or in two or more separate devices with appropriate hardware and/or software interfaces between them. Several of the functions may be implemented on a processor shared with other functional components of a wireless device or network node, for example.

Alternatively, several of the functional elements of the processing means discussed may be provided through the use of dedicated hardware, while others are provided with hardware for executing software, in association with the appropriate software or firmware. Thus, the term “processor” or “controller” as used herein does not exclusively refer to hardware capable of executing software and may implicitly include, without limitation, digital signal processor (DSP) hardware and/or program or application data. Other hardware, conventional and/or custom, may also be included.

Designers of communications devices will appreciate the cost, performance, and maintenance trade-offs inherent in these design choices.

Although the computing devices described herein (e.g., UEs, network nodes, hosts) may include the illustrated combination of hardware components, other
5 embodiments may comprise computing devices with different combinations of components. It is to be understood that these computing devices may comprise any suitable combination of hardware and/or software needed to perform the tasks, features, functions and methods disclosed herein. Determining, calculating, obtaining or similar operations described herein may be performed by processing circuitry, which
10 may process information by, for example, converting the obtained information into other information, comparing the obtained information or converted information to information stored in the network node, and/or performing one or more operations based on the obtained information or converted information, and as a result of said processing making a determination. Moreover, while components are depicted as single boxes
15 located within a larger box, or nested within multiple boxes, in practice, computing devices may comprise multiple different physical components that make up a single illustrated component, and functionality may be partitioned between separate components. For example, a communication interface may be configured to include any of the components described herein, and/or the functionality of the components
20 may be partitioned between the processing circuitry and the communication interface. In another example, non-computationally intensive functions of any of such components may be implemented in software or firmware and computationally intensive functions may be implemented in hardware.

In certain embodiments, some or all of the functionality described herein may
25 be provided by processing circuitry executing instructions stored on in memory, which in certain embodiments may be a computer program product in the form of a non-transitory computer-readable storage medium. In alternative embodiments, some or all of the functionality may be provided by the processing circuitry without executing instructions stored on a separate or discrete device-readable storage medium, such as
30 in a hard-wired manner. In any of those particular embodiments, whether executing instructions stored on a non-transitory computer-readable storage medium or not, the processing circuitry can be configured to perform the described functionality. The benefits provided by such functionality are not limited to the processing circuitry alone or to other components of the computing device, but are enjoyed by the computing
35 device as a whole, and/or by end users and a wireless network generally.

It will be appreciated that the foregoing description and the accompanying drawings represent non-limiting examples of the methods and apparatus taught herein. As such, the apparatus and techniques taught herein are not limited by the foregoing description and accompanying drawings. Instead, the embodiments herein are limited
5 only by the following claims and their legal equivalents.

CLAIMS

1. A method performed by a server node (15) for handling data delivery in a wireless communication network (1), the method comprising
 - 5 - *obtaining* (704) a burst arrival time, BAT, offset and/or a proposed periodicity of a data transmission, and
 - *sending* (705) an indication of the obtained BAT offset and/or proposed periodicity to a client node (17).
- 10 2. The method according to claim 1, further comprising
 - *receiving* (701) from a vertical application layer, VAL, server (14) a request for a data transmission adjustment, or an indication indicating a data transmission adjustment policy.
- 15 3. The method according to any of the claims 1-2, further comprising
 - *receiving* (702) a capability indication from the client node (17), wherein the capability indication indicates capability for BAT and periodicity adaptation and/or transmission assistance information.
- 20 4. The method according to any of the claims 1-3, further comprising
 - *subscribing* (703) to a session with quality of service, QoS, with capability for BAT adaptation and/or transmission assistance information.
- 25 5. The method according to any of the claims 1-4, further comprising
 - *applying* (706) the obtained BAT offset and/or proposed periodicity in a data delivery adjustment.
- 30 6. A method performed by a client node (17) for handling data delivery in a wireless communication network (1), the method comprising
 - *receiving* (803), from a server node (15), an indication of an obtained burst arrival time, BAT, offset and/or a proposed periodicity of a data transmission.
7. The method according to claim 6, further comprising

- *receiving* (801) a request from a vertical application layer, VAL, client (16) to apply data transmission adjustment.
- 8. The method according to any of the claims 6-7, further comprising
 - 5 - *transmitting* (802) a capability indication to the server node (15), wherein the capability indication indicates the client node's capability for BAT and/or periodicity adaptation, and/or transmission assistance information.
- 9. The method according to any of the claims 6-8, further comprising
 - 10 - *applying* (804) the obtained BAT offset and/or proposed periodicity in a data delivery adjustment.
- 10. A method performed by a vertical application layer, VAL, server (14) for handling data delivery in a wireless communication network (1), the method comprising
 - 15 - *requesting* (901) a server node (15) to apply data transmission adjustment, or a data transmission adjustment policy and indicates a data transmission adjustment need in Service Enablement Architecture Layer for Verticals Data Delivery, SEALDD, layer.
- 20 11. A server node (15) for handling data delivery in a wireless communication network (1), wherein the server node is configured to
 - obtain a burst arrival time, BAT, offset and/or a proposed periodicity of a data transmission, and
 - send an indication of the obtained BAT offset and/or proposed periodicity to
 - 25 a client node (17).
- 12. The server node (15) according to claim 11, wherein the server node (15) is configured to perform the method according to any of the claims 2-5.
- 30 13. A client node (17) for handling data delivery in a wireless communication network (1), wherein the client node (17) is configured to
 - receive from a server node (15), an indication of an obtained burst arrival time, BAT, offset and/or a proposed periodicity of a data transmission.

14. The client node (17) according to claim 13, wherein the client node (17) is configured to perform the method according to any of the claims 7-9.

5 15. A vertical application layer, VAL, server (14) for handling data delivery in a wireless communication network (1), wherein the VAL server (14) is configured to request a server node (15) to apply data transmission adjustment, or a data transmission adjustment policy and indicates a data transmission adjustment need in Service Enablement Architecture Layer for Verticals Data Delivery, SEALDD, layer.

10

16. A computer program product comprising instructions, which, when executed on at least one processor, cause the at least one processor to carry out the method according to any of the claims 1-10, as performed by the server node (15), client node (17), and VAL server (14), respectively.

15

17. A computer-readable storage medium, having stored thereon a computer program product comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any of the claims 1-10, as performed by the server node (15), client node (17), and VAL server (14), respectively.

20

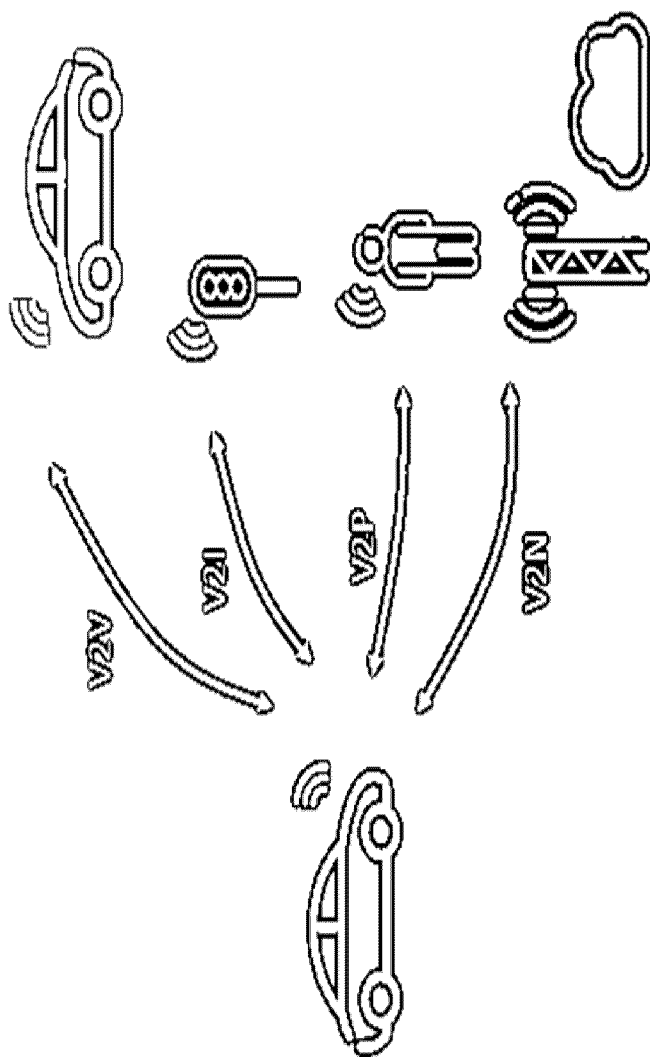


Fig. 1

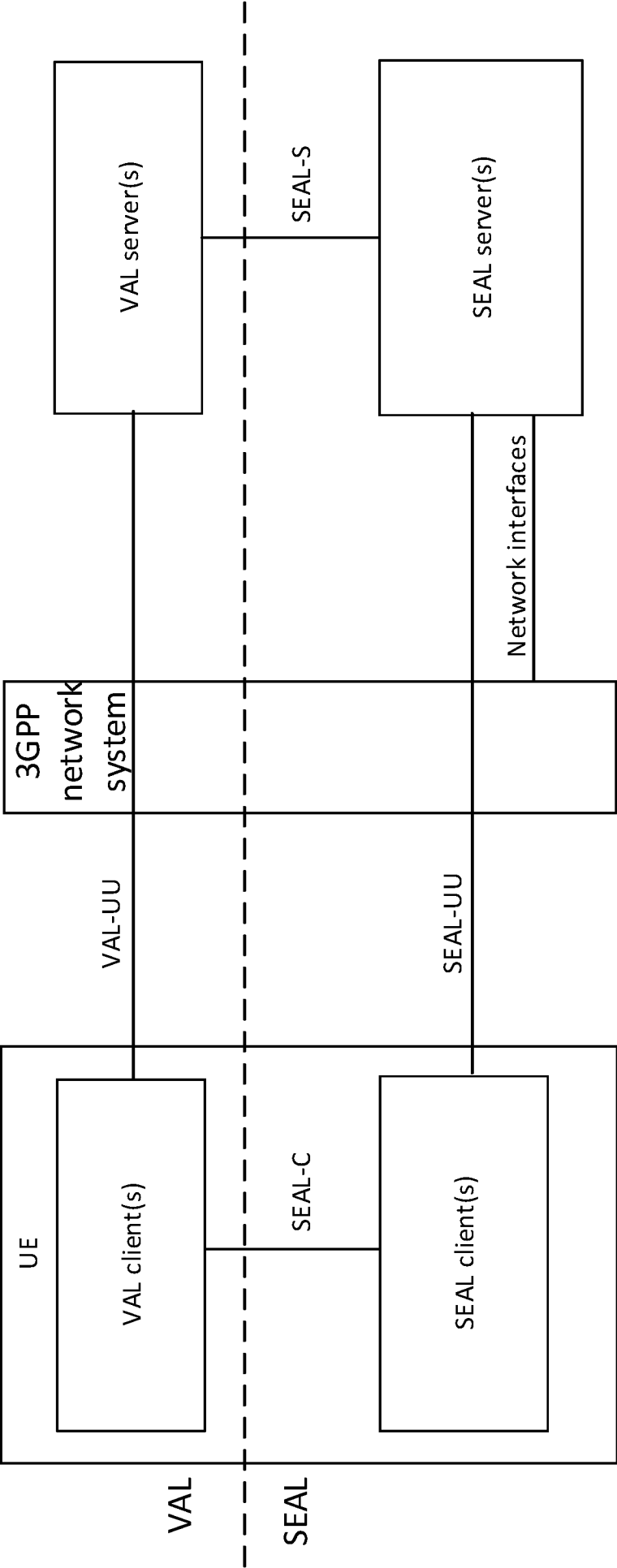


Fig. 2

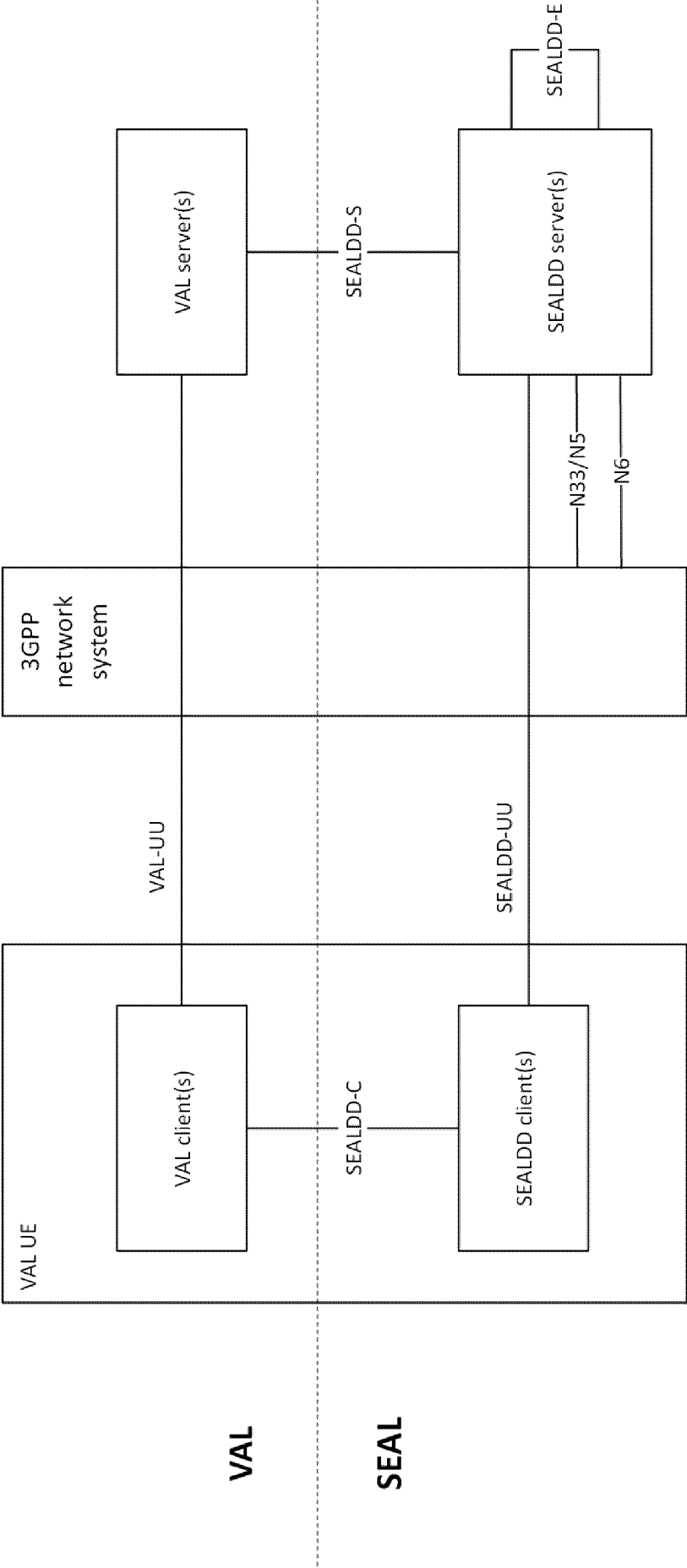


Fig. 3

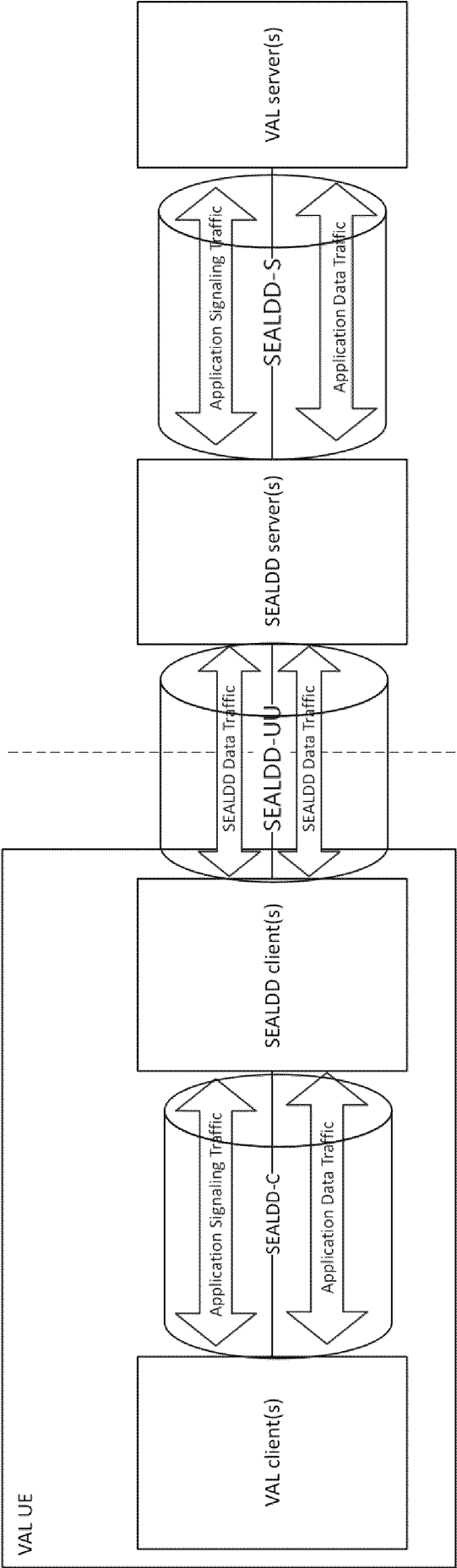


Fig. 4

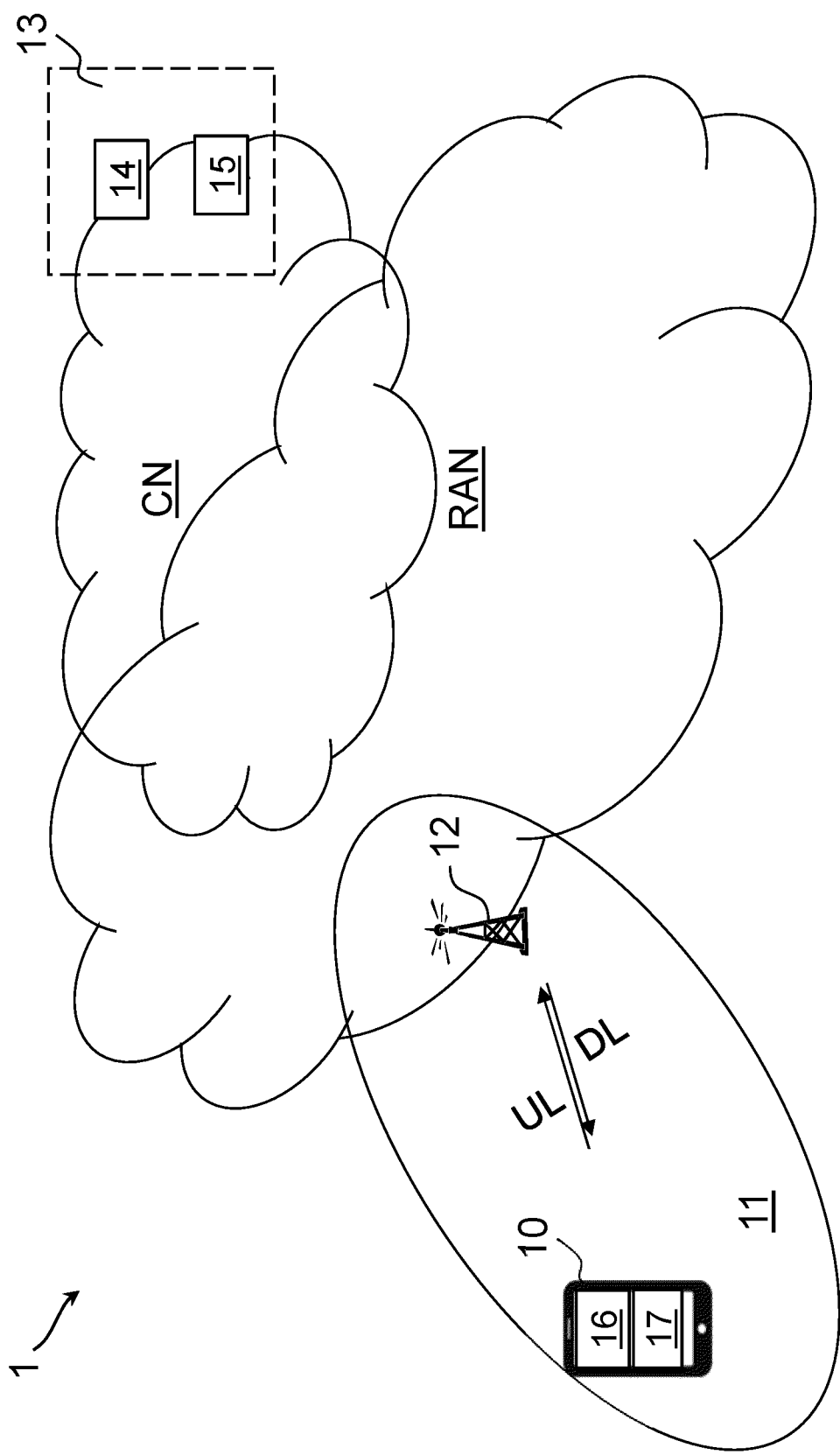


Fig. 5

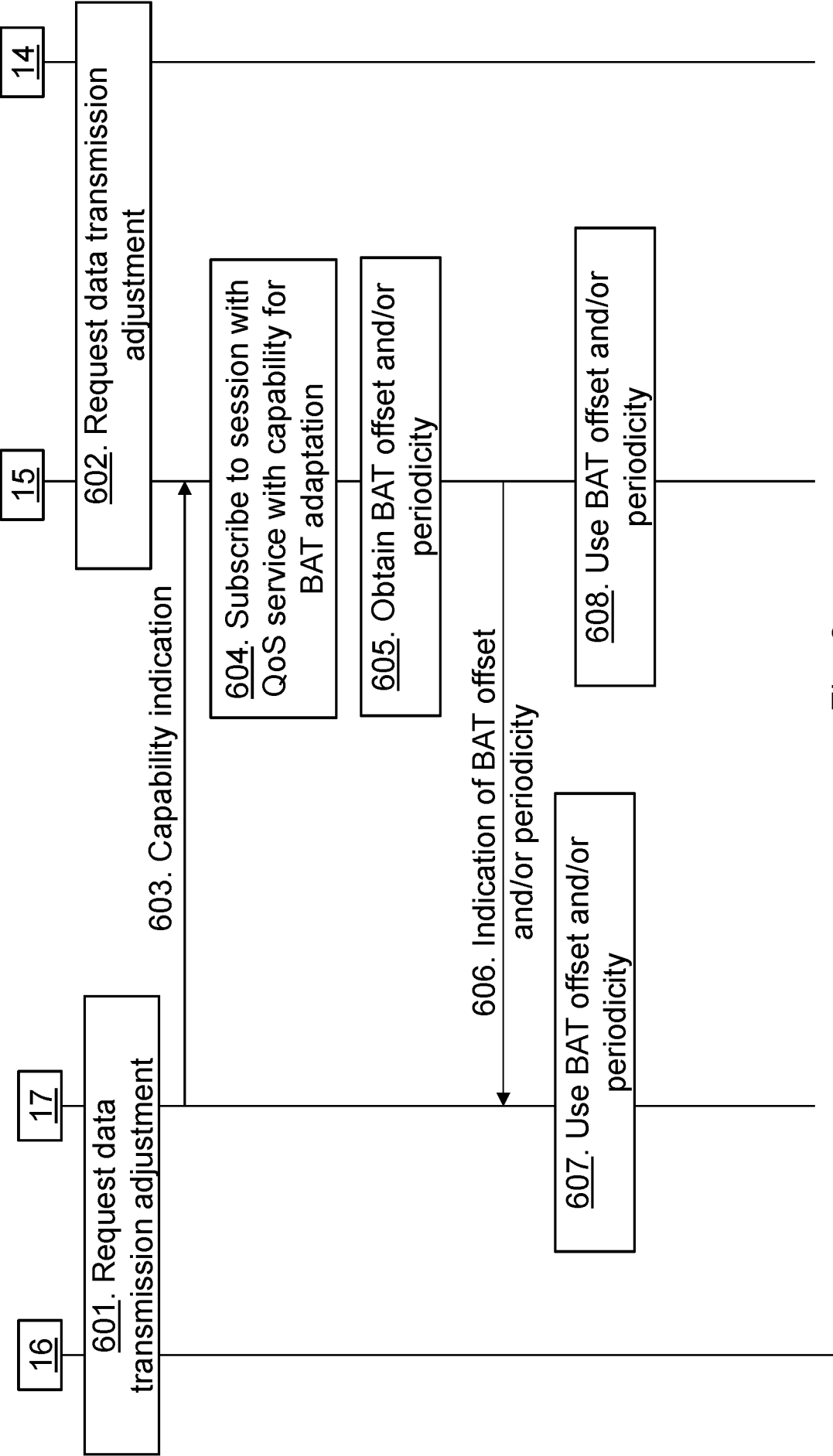


Fig. 6

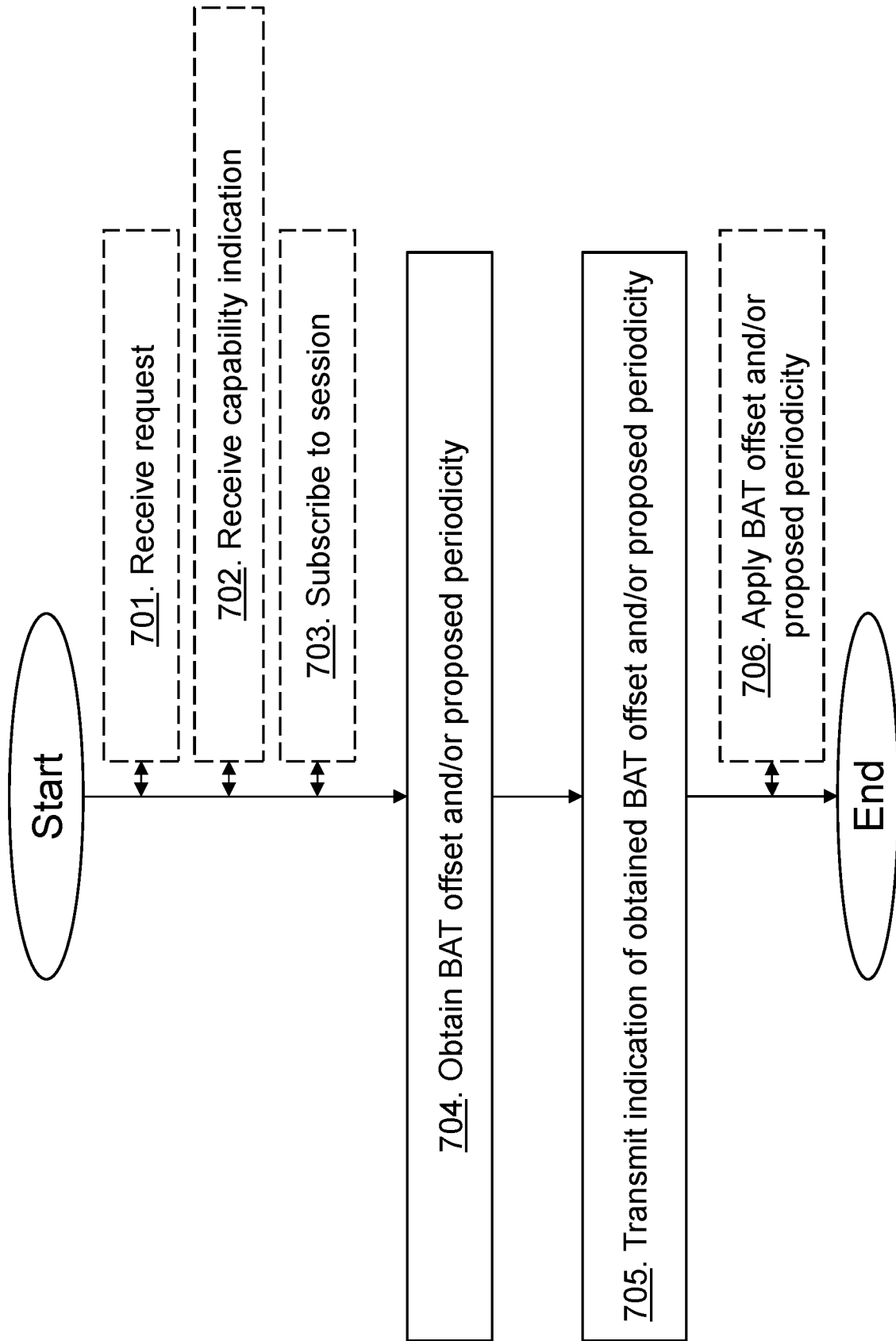


Fig. 7

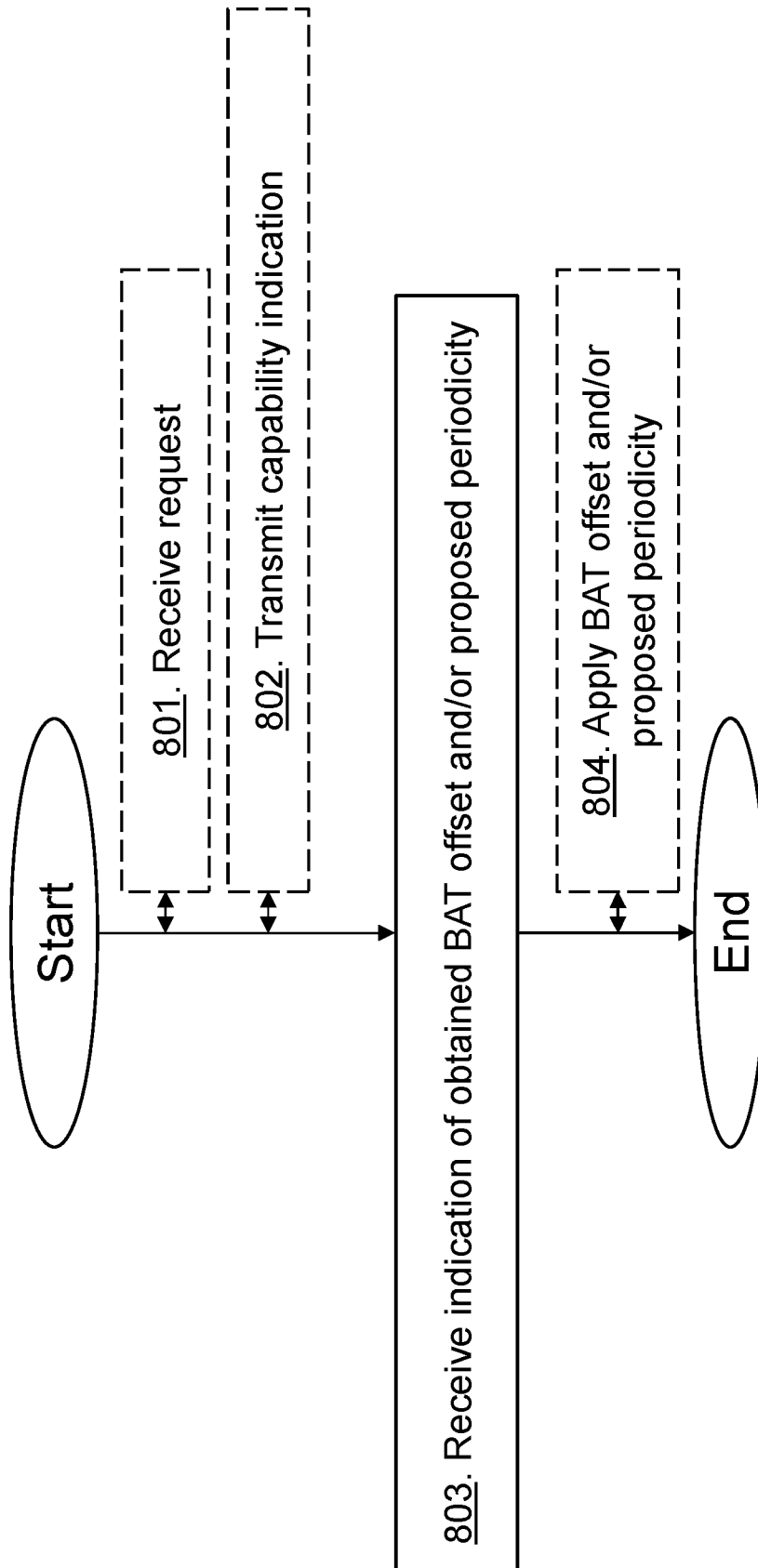


Fig. 8

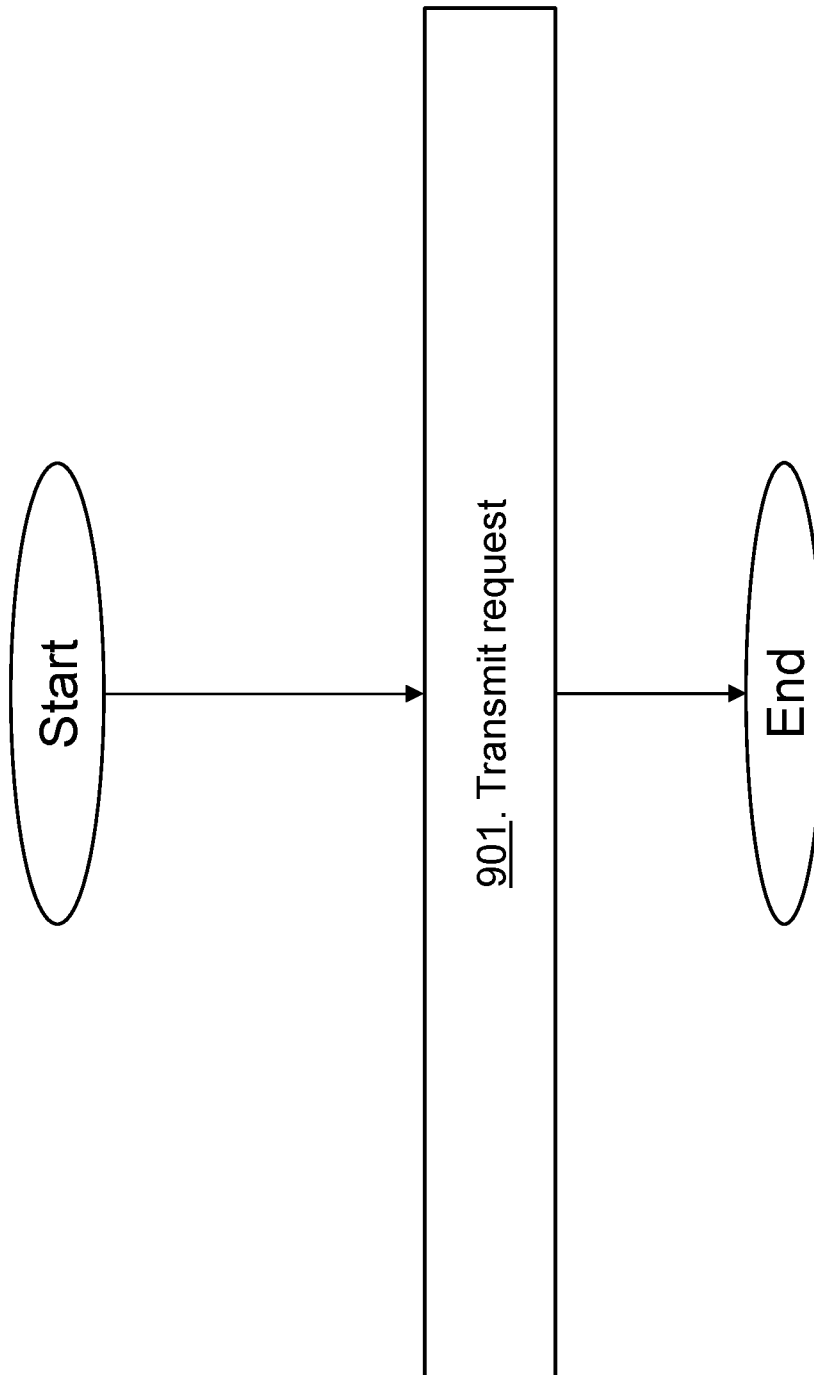


Fig. 9

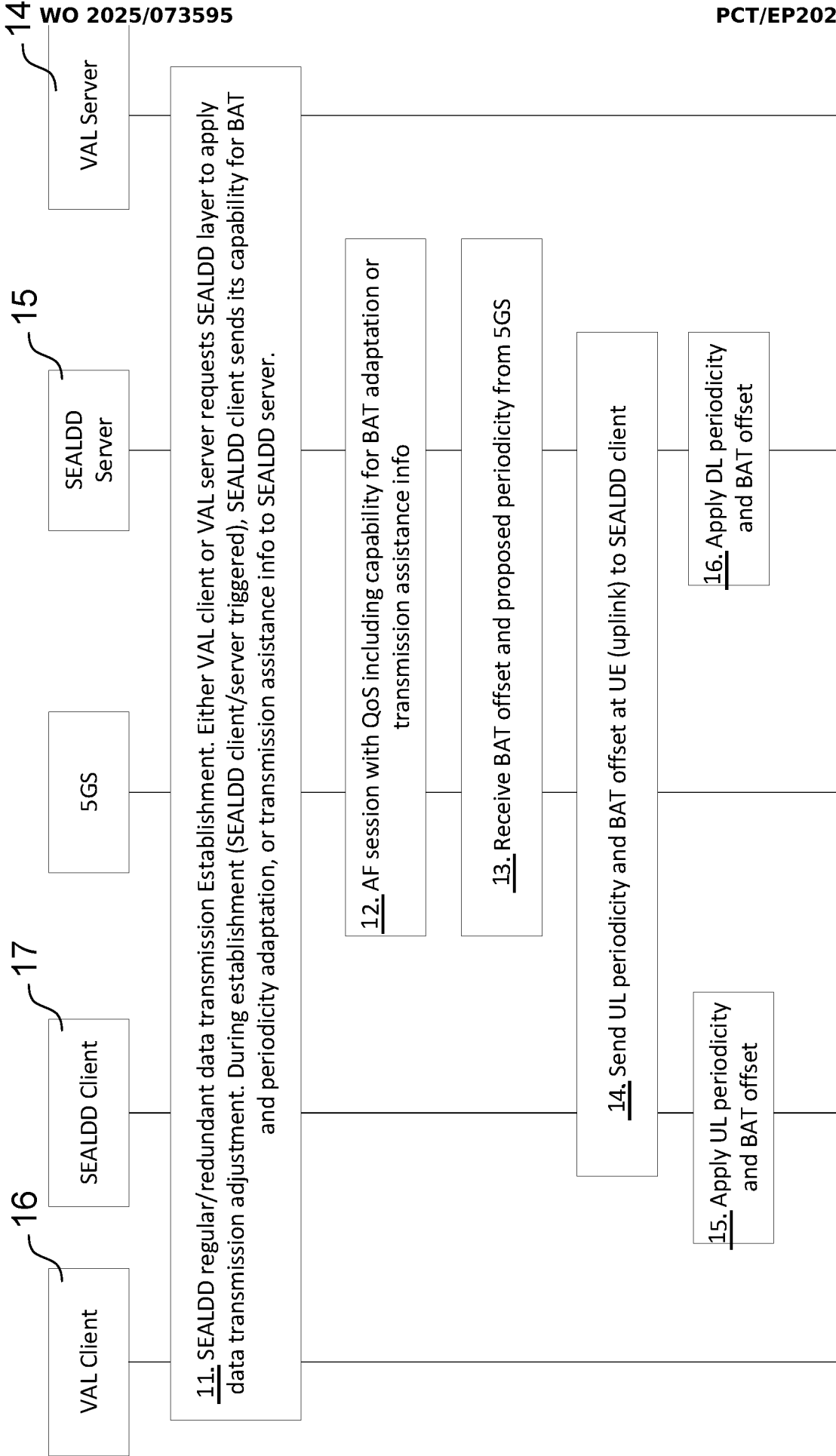


Fig. 10

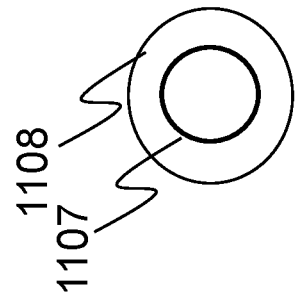
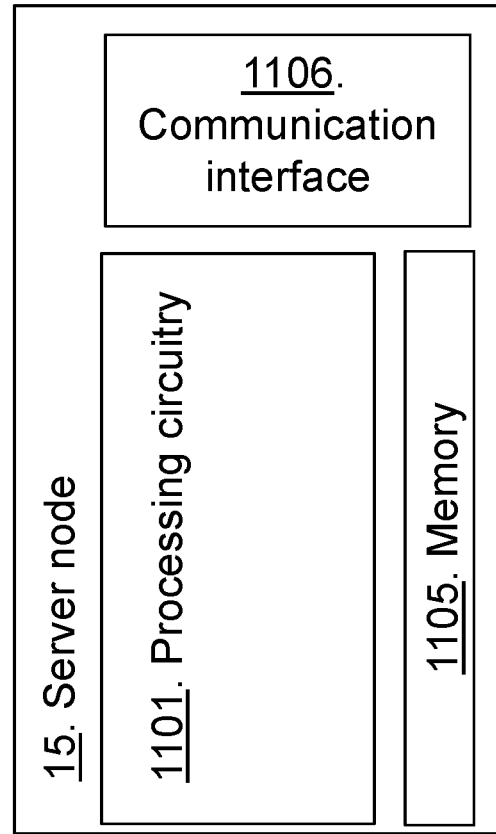


Fig. 11

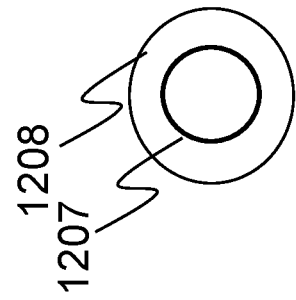
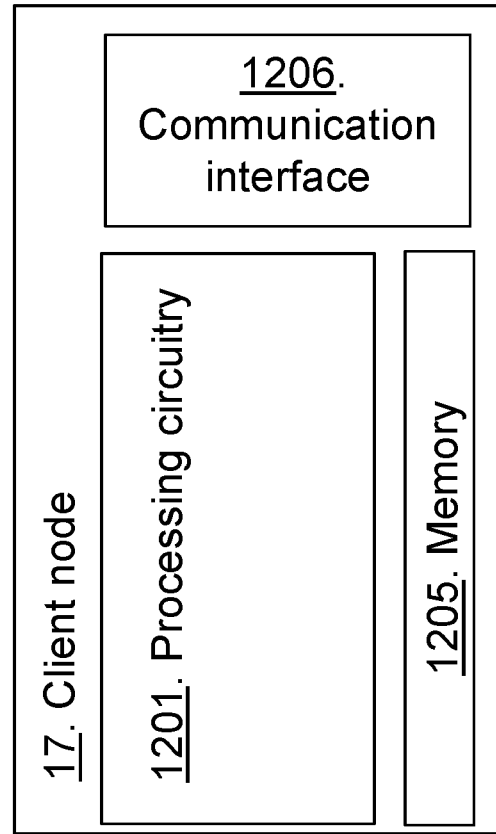


Fig. 12

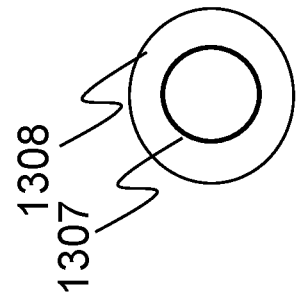
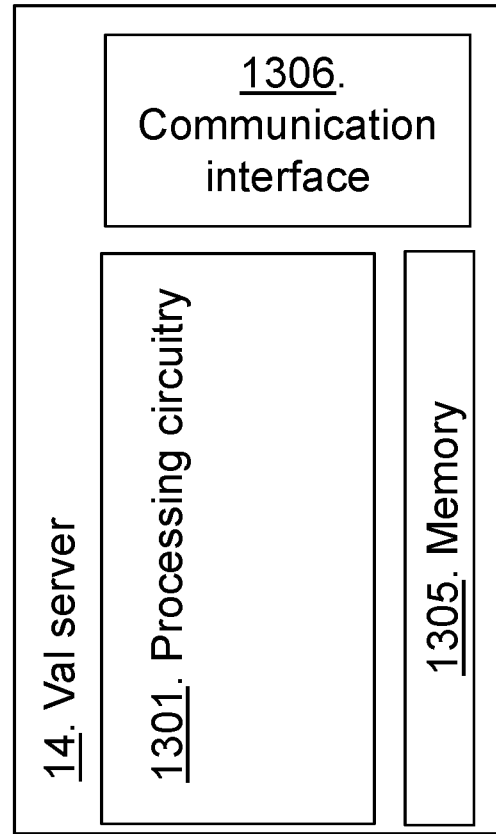


Fig. 13

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2024/077201

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04L65/80

ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04L H04W

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

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

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2022/417972 A1 (ROSSBACH RALF [DE] ET AL) 29 December 2022 (2022-12-29)	1,6,10, 11,13, 15-17
Y	paragraphs [0215] - [0232] -----	2-5,7-9, 12,14
X	US 2022/046567 A1 (KAHN COLIN [US] ET AL) 10 February 2022 (2022-02-10)	1,6,10, 11,13, 15-17
Y	paragraphs [0028] - [0041]; figures 1,2 -----	2-5,7-9, 12,14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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

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"&" document member of the same patent family

Date of the actual completion of the international search

21 November 2024

Date of mailing of the international search report

16/12/2024

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/077201

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2022417972 A1	29-12-2022	CN 115769656 A	07-03-2023
		EP 4144166 A1	08-03-2023
		US 2022417972 A1	29-12-2022
		WO 2022266994 A1	29-12-2022

US 2022046567 A1	10-02-2022	EP 3952253 A1	09-02-2022
		US 2022046567 A1	10-02-2022
