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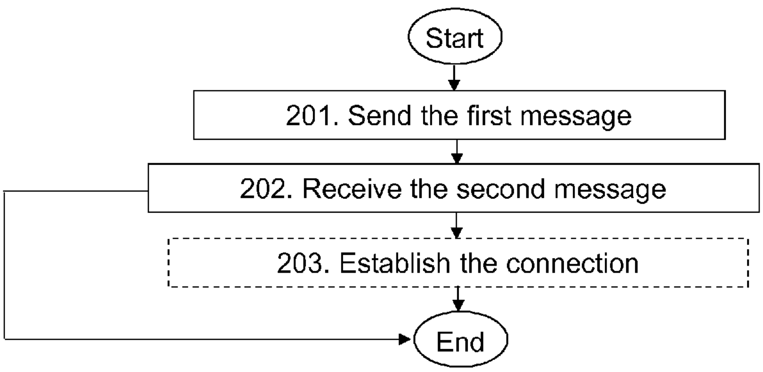


**Figure 2**

(57) **Abstract:** A method performed by a user equipment (130) for handling provisioning of a message broker is disclosed herein. The user equipment (130) operates in a wireless communications network (100). The user equipment (130) sends (201) a first message to a radio network node (110) operating in the wireless communications network (100). The first message requests provisioning of a message broker. The user equipment (130) has set-up a radio connection with the radio network node (110). The user equipment (130) receives (202) a second message from the radio network node (110) in response to the sent first message. The second message comprises a first indication of a provisioned message broker. The provisioned message broker is one of: a) comprised in the radio network node (110), and b) accessible within a local network defined within the wireless communications network (100).

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# USER EQUIPMENT, RADIO NETWORK NODE, AND METHODS PERFORMED THEREBY FOR HANDLING PROVISIONING OF A MESSAGE BROKER

## TECHNICAL FIELD

The present disclosure relates generally to a user equipment and methods performed thereby for handling provisioning of a message broker. The present disclosure also relates generally to a radio network node, and methods performed thereby handling provisioning of a message broker. The present disclosure further relates generally to a computer program product, comprising instructions to carry out the actions described herein, as performed by the user equipment, or the radio network node. The computer program product may be stored on a computer-readable storage medium.

## BACKGROUND

Wireless devices within a wireless communications network may be e.g., User Equipments (UE), stations (STAs), mobile terminals, wireless terminals, terminals, and/or Mobile Stations (MS). Wireless devices are enabled to communicate wirelessly in a cellular communications network or wireless communication network, sometimes also referred to as a cellular radio system, cellular system, or cellular network. The communication may be performed e.g., between two wireless devices, between a wireless device and a regular telephone and/or between a wireless device and a server via a Radio Access Network (RAN) and possibly one or more core networks, comprised within the wireless communications network. Wireless devices may further be referred to as mobile telephones, cellular telephones, laptops, or tablets with wireless capability, just to mention some further examples. The wireless devices in the present context may be, for example, portable, pocket-storable, hand-held, computer-comprised, or vehicle-mounted mobile devices, enabled to communicate voice and/or data, via the RAN, with another entity, such as another terminal or a server.

The wireless communications network covers a geographical area which may be divided into cell areas, each cell area being served by a network node, which may be an access node such as a radio network node, radio node or a base station, e.g., a Radio Base Station (RBS), which sometimes may be referred to as e.g., evolved Node B ("eNB"), "eNodeB", "NodeB", "B node", gNB, Transmission Point (TP), or BTS (Base Transceiver Station), depending on the technology and terminology used. The base stations may be of different classes such as e.g., Wide Area Base Stations, Medium Range Base Stations, Local Area Base Stations, Home Base Stations, pico base stations, etc…, based on transmission power and thereby also cell size. A cell is the geographical area where radio coverage is provided by the base station or radio node at a base station site, or radio node site, respectively. One base station, situated on the base station site, may serve one or several cells. Further, each base station may support one or several communication technologies. The base stations communicate over the air interface operating on radio frequencies with the terminals within range of the base stations. The wireless communications network may also be a non-cellular system, comprising network nodes which may serve receiving nodes, such as wireless devices, with serving beams. In 3rd Generation Partnership Project (3GPP) Long Term Evolution (LTE), base stations, which may be referred to as eNodeBs or even eNBs, may be directly connected to one or more core networks.

The standardization organization 3GPP is currently in the process of specifying a New Radio Interface called NR or 5G-UTRA, as well as a Fifth Generation (5G) Packet Core Network, which may be referred to as Next Generation Core Network, abbreviated as NG-CN, NGC or 5G CN.

**Internet of Things (IoT)**

The Internet of Things (IoT) may be understood as an internetworking of communication devices, e.g., physical devices, vehicles, which may also referred to as "connected devices" and "smart devices", buildings and other items—embedded with electronics, software, sensors, actuators, and network connectivity that may enable these objects to collect and exchange data. The IoT may allow objects to be sensed and/or controlled remotely across an existing network infrastructure.

"Things," in the IoT sense, may refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring, or field operation devices that may assist firefighters in search and rescue operations, home automation devices such as the control and automation of lighting, heating, e.g. a “smart” thermostat, ventilation, air conditioning, and appliances such as washer, dryers, ovens, refrigerators or freezers that may use Wi-Fi for remote monitoring. These devices may collect data with the help of various existing technologies and then autonomously flow the data between other devices.

It is expected that in a near future, the population of IoT devices will be very large. Various predictions exist, among which one assumes that there will be >60000 devices per square kilometer, and another assumes that there will be 1000000 devices per square kilometer. A large fraction of these devices are expected to be stationary, e.g., gas and electricity meters, vending machines, etc.

**Machine Type Communication (MTC)**

Machine Type Communication (MTC) has in recent years, especially in the context of the Internet of Things (IoT), shown to be a growing segment for cellular technologies. An MTC device may be a communication device, typically a wireless communication device or simply wireless device, that is a self and/or automatically controlled unattended machine and that is typically not associated with an active human user in order to generate data traffic. An MTC device may be typically more simple, and typically associated with a more specific application or purpose, than, and in contrast to, a conventional mobile phone or smart phone. MTC involves communication in a wireless communication network to and/or from MTC devices, which communication typically may be of quite different nature and with other requirements than communication associated with e.g. conventional mobile phones and smart phones. In the context of and growth of the IoT it is evident that MTC traffic will be increasing and thus needs to be increasingly supported in wireless communication systems.

IoT is the main example of a use case for MTC in 5G. In the predominant scenarios, sensors may collect data about the environment and this data may be processed for decision making, which may be automated or manual.

Message bus type of protocols may be understood as protocols where messages may never be sent directly between sender and receiver. Instead a publish and/or subscribe pattern may be used towards a message broker. A message broker may be understood as a service from which two or more endpoints in a communication chain may establish their relationship. There are a number of message bus type of protocols, such as e.g., Message Queuing Telemetry Transport (MQTT) and Rabbit Message Queuing (RabbitMQ), that may be used for IoT type of services. For example, MQTT may be used as a message bus protocol when utilizing Amazon Cloud Services. The message bus protocols may supply a message broker through which clients and servers may communicate through a publish-subscribe messaging pattern. A message broker may not understand the contents of the messaging but may be able to transfer a message from a sender to the correct one or more recipients.

In current deployments found in e.g., Amazon Cloud Services, the client(s) may be configured with a hardcoded address to the Amazon Web Services (AWS) MQTT Message Broker, and all messaging may go through that central broker. In existing methods, a message broker may be set-up anywhere, and redundancy and load sharing mechanisms may be applied taking central resource demand into consideration. That is, current networking services may be understood to not try to match clients to specific services, but instead focus on network resource aspects such as e.g., scaling, robustness, redundancy etc to determine which service a specific client may be allowed to utilize. For example, in some existing methods, a client has to decide from which availability zone it may need to request compute and storage resources from. The compute and storage may then be executed and/or provided from hardware located in that availability zone.

While message brokering systems continue to develop to fulfil the demands of evolving telecommunication technologies, existing message brokerage systems are vulnerable to power failures, as well as network hacking, jeopardizing the continuity of service supply to customers. This becomes particularly problematic in some use cases of the IoT networks, such as in the case of smart power grids.

## SUMMARY

It is an object of embodiments herein to improve the handling of provisioning of a message broker in a wireless communications network. It is a particular object of embodiments herein to improve the management of a network slice instance in a communications network.

According to a first aspect of embodiments herein, the object is achieved by a method, performed by a user equipment. The user equipment is for handling provisioning of a message broker. The user equipment operates in a wireless communications network. The user equipment sends a first message to a radio network node operating in the wireless communications network. The first message requests provisioning of a message broker. The user equipment has set-up a radio connection with the radio network node. The user equipment also receives a second message from the radio network node in response to the sent first message. The second message comprises a first indication of a provisioned message broker. The provisioned message broker is one of: a) comprised in the radio network node, and b) accessible within a local network defined within the wireless communications network.

According to a second aspect of embodiments herein, the object is achieved by a method, performed by the radio network node. The radio network node is for handling provisioning of the message broker. The radio network node operates in the wireless communications network. The radio network node receives the first message from the user equipment operating in the wireless communications network. The first message requests provisioning of the message broker. The radio network node has set-up the radio connection with the user equipment. The radio network node sends the second message to the user equipment in response to the received first message. The second message comprises the first indication of the provisioned message broker. The provisioned message broker is one of: a) comprised in the radio network node, and b) accessible within the local network defined within the wireless communications network.

According to a third aspect of embodiments herein, the object is achieved by the user equipment. The user equipment is for handling provisioning of the message broker. The user equipment is configured to operate in the wireless communications network. The user equipment is further configured to send the first message to the radio network node configured to operate in the wireless communications network. The first message is configured to request provisioning of the message broker. The user equipment is further configured to have set-up the radio connection with the radio network node. The user equipment is also configured to receive the second message from the radio network node in response to the first message configured to be sent. The second message is configured to comprise the first indication of the message broker configured to be provisioned. The message broker configured to be provisioned is further configured to be one of: a) comprised in the radio network node, and b) accessible within the local network defined within the wireless communications network.

According to a fourth aspect of embodiments herein, the object is achieved by the radio network node. The radio network node is for handling provisioning of the message broker. The radio network node is configured to operate in the wireless communications network. The radio network node is configured to receive the first message from the user equipment configured to operate in the wireless communications network. The first message is configured to request provisioning of the message broker. The radio network node is further configured to have set-up the radio connection with the user equipment. The radio network node is further configured to send the second message to the user equipment in response to the first message configured to be received. The second message is configured to comprise the first indication of the message broker configured to be provisioned. The message broker configured to be provisioned is configured to be one of: a) comprised in the radio network node, and b) accessible within the local network defined within the wireless communications network.

According to a fifth aspect of embodiments herein, the object is achieved by a computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method performed by the user equipment.

According to a sixth aspect of embodiments herein, the object is achieved by a computer-readable storage medium, having stored thereon the computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method performed by the user equipment.

According to a seventh aspect of embodiments herein, the object is achieved by a computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method performed by the radio network node.

According to an eighth aspect of embodiments herein, the object is achieved by a computer-readable storage medium, having stored thereon the computer program, comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method performed by the radio network node.

By the user equipment sending the first message to the radio network node requesting provisioning of the message broker, and receiving the second message comprising the first indication of the provisioned message broker, which is comprised in the radio network node or accessible within a local network, the user equipment is enabled to find a distributed message broker with independence from central resources. This enables to secure service continuity within the wireless communications network, with local fault resilience. Moreover, subsystem level redundancy for large IoT systems is enabled. Furthermore, the discovery of the most reliable and resilient distributed message brokering service is enabled to be dynamic and automatic.

## BRIEF DESCRIPTION OF THE DRAWINGS

Examples of embodiments herein are described in more detail with reference to the accompanying drawings, according to the following description.

Figure 1 is a schematic diagram illustrating a non-limiting example of a wireless communications network, according to embodiments herein.

Figure 2 is a flowchart depicting embodiments of a method in a user equipment, according to embodiments herein.

Figure 3 is a flowchart depicting embodiments of a method in a radio network node, according to embodiments herein.

Figure 4 is a schematic diagram illustrating an example of components of a wireless communications network, according to embodiments herein.

Figure 5 is a schematic diagram illustrating signalling between a user equipment and a radio network node, according to embodiments herein.

Figure 6 is a schematic diagram illustrating another non-limiting example of a wireless communications network, according to embodiments herein.

Figure 7 is a schematic block diagram illustrating two non-limiting examples, a) and b), of a user equipment, according to embodiments herein.

Figure 8 is a schematic block diagram illustrating two non-limiting examples, a) and b), of a radio network node, according to embodiments herein.

## DETAILED DESCRIPTION

As part of the development of embodiments herein, a problem with existing methods will first be identified and discussed.

Management of existing message brokerage systems is typically implemented in a centralized cloud, which makes it vulnerable to widespread failure due to outage of the network communications through the cloud.

To illustrate the repercussions of this vulnerability, the current effort to develop “smart” power grids run on an IoT network may be used. A message bus and/or queue type of protocol may be understood to be a building block in such an IoT system, providing support to the “smartness” of the power grid. That is, the automatized management system of the power grid. However, circumstances such as, e.g., physical damage of power grid wires, outages of power plants, high energy needs, e.g., a cold winter day, war, earthquake, hacker attack etc. may cut off a geographical area, e.g., an IoT area, from the central power distribution plant(s), and may result in the failure of the “smartness” of such grids due to the ensuing failure of the existing message brokerage systems. In other words, the power grid infrastructure may experience a temporary severance from its management system. In a future where e.g., the power distribution system may be smarter, local resilience in such systems may be a requirement. However, a particular existing problem in current message bus implementations, is that a client is not able to easily be assigned to a specific message broker based on geographical position. That is, a client cannot easily be assigned to a message broker that is executing on hardware that is in the geographical vicinity of the client itself, in other words, a local message broker. The steering of the system in existing methods may therefore fail at the same time as the system, in order to ensure the continuity of its operation, e.g., that a power grid is able to continue to deliver locally produced electricity, such as solar panels, local power plants, small and large scale wind turbines etc, within large parts of an area.

Several embodiments are comprised herein, which address this problem. Embodiments herein may be understood to be related to a distributed messaging for smart IoT networks, aimed at securing the continuity of services providing information to consumers. According to embodiments herein, the compute and storage services of network systems may be located in close proximity to the place where the actual IoT clients operate, to make the network system more fault resilient and robust.

In particular, embodiments herein may provide mechanisms that make it possible to utilize a radio base station for compute and storage purposes. More specifically, embodiments herein disclose a distributed message brokering service where it is possible for a client, e.g., an IoT application, to find a message broker based on client and message broker geographical location. According to embodiments herein, a radio base station may be used as a distributed compute and storage resource that may embrace a new set of services on top of the current mobile network messaging found, for example, in the control and user plane functionality.

Further particularly, embodiments herein may relate to a specific service discovery function for discovery of message brokers that may be implemented by a current message bus protocol such as e.g., MQTT or RabbitMQ, or by a new message bus protocol which may include the service discovery function itself. The later may be embedded in the mobile network functionality in the control and/or user plane.

The embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which examples are shown. In this section, embodiments herein are illustrated by exemplary embodiments. It should be noted that these embodiments are not mutually exclusive. Components from one embodiment or example may be tacitly assumed to be present in another embodiment or example and it will be obvious to a person skilled in the art how those components may be used in the other exemplary embodiments.

Although terminology from Long Term Evolution (LTE)/5G/IoT has been used in this disclosure to exemplify the embodiments herein, this should not be seen as limiting the scope of the embodiments herein to only the aforementioned system. Other wireless systems, support similar or equivalent functionality may also benefit from exploiting the ideas covered within this disclosure. In future radio access, the terms used herein may need to be reinterpreted in view of possible terminology changes in future radio access technologies.

**Figure 1** depicts a non-limiting example of a **wireless communications network 100**, sometimes also referred to as a cellular radio system, cellular network or wireless communications system, in which embodiments herein may be implemented. The wireless communications network 100 may for example be a network such as 5G system, or Next Gen network supporting IoT, e.g., NarrowBand IoT (NB-IoT), a IEEE 802.15.4-based low-power short-range network such as 6LowPAN, 4G Category-M, etc... In some examples, the wireless communications network 100 may comprise network nodes which may serve receiving nodes, such as wireless devices, with serving beams. This may be a typical case in a 5G network using New Radio (NR). The wireless communications network 100 may also support other technologies, such as a Long-Term Evolution (LTE) network, e.g. LTE Frequency Division Duplex (FDD), LTE Time Division Duplex (TDD), LTE Half-Duplex Frequency Division Duplex (HD-FDD), LTE operating in an unlicensed band, Wideband Code Division Multiple Access (WCDMA), Universal Terrestrial Radio Access (UTRA) TDD, Global System for Mobile communications (GSM) network, GSM/Enhanced Data Rate for GSM Evolution (EDGE) Radio Access Network (GERAN) network, Ultra-Mobile Broadband (UMB), EDGE network, network comprising of any combination of Radio Access Technologies (RATs) such as e.g. Multi-Standard Radio (MSR) base stations, multi-RAT base stations etc., any 3rd Generation Partnership Project (3GPP) cellular network, Wireless Local Area Network/s (WLAN) or WiFi network/s, Worldwide Interoperability for Microwave Access (WiMax), Bluetooth, or any cellular network or system.

The wireless communications network 100 comprises a plurality of network nodes, whereof a **radio network node 110** is depicted in the non-limiting example of Figure 1. That is, a transmission point such as a radio base station, for example a New Radio (NR) NodeBs (gNBs), an eNB, or any other network node with similar features capable of serving a wireless device, such as a user equipment or a machine type communication device, in the wireless communications network 100.

The wireless communications network 100 covers a geographical area which may be divided into cell areas, wherein each cell area may be served by a radio network node, although, one radio network node may serve one or several cells. The wireless communications network 100 comprises at least a **cell 120**. In the non-limiting example depicted in Figure 1, the radio network node 110 serves the cell 120. The radio network node 110 may be of different classes, such as, e.g., macro eNodeB, home eNodeB or pico base station, based on transmission power and thereby also cell size. The radio network node 110 may support one or several communication technologies, and its name may depend on the technology and terminology used. In NR , the radio network node 110 may be referred to as an gNB, whereas in LTE, the radio network node 110 may be referred to as an eNB. The radio network node 110 may be directly connected to one or more core networks, which are not depicted in Figure 1 to simplify the Figure. In some examples, the radio network node 110 may be a distributed node, such as a virtual node in the cloud, and it may perform its functions entirely on the cloud, or partially, in collaboration with a radio network node.

A plurality of wireless devices are located in the wireless communication network 100, whereof a **wireless device 130**, which may also be referred to as a device, is depicted in the non-limiting example of Figure 1. The wireless device 130 comprised in the wireless communications network 100 may be a wireless communication device such as a UE, or a 5G UE, which may also be known as e.g., a mobile terminal, wireless terminal and/or mobile station, a mobile telephone, cellular telephone, or laptop with wireless capability, just to mention some further examples. Any of the wireless devices comprised in the wireless communications network 100 may be, for example, portable, pocket-storable, hand-held, computer-comprised, or a vehicle-mounted mobile device, enabled to communicate voice and/or data, via the RAN, with another entity, such as a server, a laptop, a Personal Digital Assistant (PDA), or a tablet, Machine-to-Machine (M2M) device, device equipped with a wireless interface, such as a printer or a file storage device, modem, or any other radio network unit capable of communicating over a radio link in a communications system. The wireless device 130 comprised in the wireless communications network 100 is enabled to communicate wirelessly in the wireless communications network 100. The communication may be performed e.g., via a RAN, and possibly the one or more core networks, which may comprised within the wireless communications network 100.

The transmitting device 101 may be configured to communicate within the wireless communications network 100 with the receiving device 102 over a **link 140**, e.g., a radio link.

In general, the usage of “first” and/or “second” herein may be understood to be an arbitrary way to denote different elements or entities, and may be understood to not confer a cumulative or chronological character to the nouns they modify.

Embodiments of a method performed by the user equipment 130, will now be described with reference to the flowchart depicted in **Figure 2**. The method may be understood to be for handling provisioning of a message broker. The message broker, according to embodiments herein may be a “distributed message broker”, as will be explained below. The user equipment 130 operates in the wireless communications network 100. The wireless communications network 100 may be an internet of things (IoT) network. In particular non-limiting examples, the user equipment may be e.g., a device managing at least one function in a power grid.

The method may comprise the actions described below. Several embodiments are comprised herein. In some embodiments some of the actions may be performed. In some embodiments all the actions may be performed. One or more embodiments may be combined, where applicable. All possible combinations are not described to simplify the description. It should be noted that the examples herein are not mutually exclusive. Components from one example may be tacitly assumed to be present in another example and it will be obvious to a person skilled in the art how those components may be used in the other examples. In Figure 2, optional actions are indicated with dashed boxes.

**Action 201**

During the course of operations of the wireless communications network 100, the user equipment 130, e.g., a client application run by the user equipment 130, may need to find a message broker in order to be able to send and receive information, or not. As stated earlier, according to embodiments herein, a radio base station may be used for compute and storage purposes in order to place the message broker in close proximity to the place where the user equipment 130 operates and thereby increase the robustness and resilience to faults of the wireless communications network 100 or any associated network, so that the continued functionality of the system is ensured independently of the integrity of the connectivity to a centralized cloud.

The user equipment 130, via a client application or an application client, e.g., an application Message Queue (MQ) client run by the user equipment 130, may first need to try to identify which radio base station may be most suitable for message brokering services. There may be procedures within the radio access technology used by radio network nodes within range of the user equipment 130, to establish which radio network node may be most suitable over time from a message brokering perspective. For example, there may be a handshake procedure that may either use a number of search attempts to establish the most suitable radio base station, or there may be address information added to the signaling described herein that may be used to determine if a client belongs to the accessed radio base station for provisioning of the message broker or not. The address that may be sent from the application client may for example be a

Global Positioning System (GPS) position, a street address, an area identity or an Internet Protocol (IP)-address.

In some embodiments, the most suitable radio base station may be the nearest radio base station. In such embodiments, a radio access modem that may be comprised in the user equipment 130 may begin by setting-up a radio connection to the closest radio base station, which in embodiments herein may be understood to be the radio network node 110. This may be done through cell selection procedures or through establishing a link to the “best” radio base station over which negotiation procedures may take place.

Once the most suitable radio base station has been identified, which in embodiments herein, for illustrative purposes, is the radio network node 110, and the user equipment 130 has set-up a radio connection with the radio network node 110, the user equipment 130, in this Action 201, sends a first message to the radio network node 110 operating in the wireless communications network 100. The first message requests provisioning of a message broker. For example, the user equipment 130, via the first message, may ask for the Internet Protocol (IP) address of the message broker.

The first message may be a Radio Resource Control (RRC) message. In other embodiments, the first message may be sent via user plane signaling and packet inspection technologies in the radio network node 110.

Sending in this Action 201 may be implemented, e.g., via the link 140.

In some embodiments, the sending in this Action 201 may be performed by the modem that may be comprised in the user equipment 130, based on a first indication received from the client application that may be run by the user equipment 130. The client application may be the application MQ client. The application MQ client may want to gain access to an appropriate, distributed message broker and may ask the Radio Access Technology (RAT) modem for a message broker to be provisioned by sending the first indication, e.g., a request for the message broker to be provisioned. This may then trigger the modem to send the first message to the radio network node 110. For example, the user equipment 130, via the application MQ client, may use the RAT modem to lookup the message broker that may be running its service in the closest radio base station, which in embodiments herein may be understood to be the radio network node 110. The client application may need to implement an Application Programming Interface (API) towards the RAT modem through which the appropriate message broker address may be provisioned. A “distributed” message broker may be understood as a message broker that may be provided at the edge node(s) of the wireless communications network

100 and for which a client may not need to have any configuration information, such as e.g., IP-address.

According to the foregoing, the message brokering method used in embodiments herein may therefore be a 3GPP based service discovery, in the sense that the radio network node 110 may be used to fetch the address to the message broker.

By sending the first message in this Action 201, the user equipment 130 is enabled to find a message broker based on client and message broker geographical location, without needing to access a centralized cloud, and thereby become vulnerable to disruptions of remote communications. In other words, the the user equipment 130 is enabled to find a distributed message broker.

**Action 202**

In this Action 202, the user equipment 130 receives a second message from the radio network node 110 in response to the sent first message. The second message comprises a first indication of a provisioned message broker. The provisioned message broker is one of: a) comprised in the radio network node 110, and b) accessible within a local network defined within the wireless communications network 100.

Receiving in this Action 202 may be implemented, e.g., via the link 140. The receiving may be performed, e.g., by the modem that may be comprised in the user equipment 130, which may then relay the received second message to the client application that may be comprised in the user equipment 130.

The second message may be an RRC message. In particular examples, the first message and the second message may be RRC messages.

The first indication may be, for example, a service address, e.g., an Internet Protocol (IP) address, of the local message broker.

The local network may be understood to be a network that may be accessible without requiring accessing a cloud environment, e.g., a centralized cloud environment.

In some embodiments, the first message may further comprise a second indication indicating an application level defined area identity, wherein the provisioned message broker may be assigned to the application level defined area identity. An application level defined area identity may be understood as the identity of a group of clients as defined by the network application that may be utilizing the distributed message bus. For example, using the power meter as an example. The power company may be the authority that may divide all power meters into groups or areas. The client may e.g., use a central service to fetch its application level defined area identity. The network application, managed by the power company, may then have to have access to the distributed message brokering services so it may create distributed message brokers for each application defined group or area. The second indication may be, e.g., a GPS position, a street address and area identity or an internet protocol IP Address.

By receiving the second message in this Action 202, the user equipment 130 is enabled to identify a message broker based on client and message broker geographical location, without needing to access a centralized cloud, and thereby become vulnerable to disruptions of remote communications. For example, the application MQ client that may be comprised in the user equipment 130 may then be enabled to use the service address to connect to the message brokering service.

**Action 203**

After having been received with the first indication of the provisioned message broker in Action 202, in some embodiments, the user equipment 130 may, in this Action 203, establish a connection with the broker provisioned by the radio network node 110 in the received second message. Particularly, the application MQ client that may be comprised in the user equipment 130 may use the first indication, e.g., the message broker IP address, to connect to the message brokering service.

By establishing the connection with the broker provisioned by the radio network node 110 in this Action 203, the user equipment 130 may be enabled to receive information, e.g., subscribe to messages on consumption, production, failures etc of a particular area, e.g., an IoT area, such as a local segment of a power grid, comprised the wireless communications network 100.

Embodiments of a method performed by the radio network node 110, will now be described with reference to the flowchart depicted in **Figure 3**. The method is for handling provisioning of a message broker. The radio network node 110 operates in the wireless communications network 100.

The method may comprise the actions described below. Several embodiments are comprised herein. In some embodiments some of the actions may be performed. In some embodiments all the actions may be performed. One or more embodiments may be combined, where applicable. All possible combinations are not described to simplify the description. It should be noted that the examples herein are not mutually exclusive. Components from one example may be tacitly assumed to be present in another example and it will be obvious to a person skilled in the art how those components may be used in the other examples. In Figure 3, optional actions are indicated with dashed boxes.

The detailed description of some of the following corresponds to the same references provided above, in relation to the actions described for the user equipment 130, and will thus not be repeated here to simplify the description. For example, the wireless communications network 100 may be an internet of things (IoT) network.

**Action 301**

In this Action 301, the radio network node 110 receives the first message from the user equipment 130 operating in the wireless communications network 100. The first message requests provisioning of a message broker. The radio network node 110 has set-up a radio connection with the user equipment 130.

Receiving in this Action 301 may be implemented, e.g., via the link 140.

The receiving in this Action 301 may be performed from a modem comprised in the user equipment 130.

**Action 302**

In this Action 302, the radio network node 110 sends the second message to the user equipment 130 in response to the received first message. The second message comprises the first indication of the provisioned message broker. The provisioned message broker is one of: a) comprised in the radio network node 110, and b) accessible within the local network defined within the wireless communications network 100.

In other embodiments, the local network may be accessible without requiring accessing the cloud environment.

The first message may further comprise the second indication indicating the application level defined area identity, wherein the provisioned local message broker may be assigned to the application level defined area identity.

Any of the first message and the second message are Radio Resource Control (RRC) messages. In particular examples, the first message and the second message may be RRC messages.

**Action 303**

In some embodiments, the radio network node 110 may, in this Action 303, establish a connection between the broker provisioned by the radio network node 110 in the sent second message and the user equipment 130.

**Figure 4** is a schematic diagram depicting a non-limiting example of the wireless communications network 100 that may be used to implement embodiments herein. The wireless communications network 100 comprises the user equipment 130 and the radio network node 110. The user equipment 130 comprises, in this example, the RAT modem

401, which the client application 402, here an MQ client, may use, via a first link 403 to lookup the message broker 404 that may be running its service in the closest radio network node, which in this example is the radio network node 110. The RAT modem 401 may communicate with a layer 3 service 405, e.g., RRC messages, in the radio network node 110 using a second link 406. The first link 403 and the second link 406 may be considered as comprised in the link 140 described so far.

**Figure 5** is a schematic diagram depicting a non-limiting example of the signalling that may be exchanged between the user equipment 130 and the radio network node 110 in the wireless communications network 100, according to embodiments herein. In this example, the flow starts when the client application 402, here an MQ Client, wants to gain access to an appropriate message broker 404, here, a distributed message broker. The client application 402, then uses the radio access “modem” 401 and at 501 asks for a message broker to be provisioned. At 502, the radio access modem 401 may just set-up a radio connection to the closest radio base station, here the radio network node 110. This may be done with some handshake pattern 503 to find the most appropriate radio base station from a message brokering perspective. Alternatively, the radio access modem 401 may start with trying to establish which radio base station is most appropriate from the application compute and storage perspective. This may be done through cell selection procedures at 503 or through establishing a link to the “best” radio base station over which negotiation procedures may take place. When the connection to the radio network node 110 has been set-up, the user equipment 130 initiates message broker provisioning procedures at 504 to, e.g., fetch the service address of the local message broker, also referred to herein as the distributed message broker. According to Action 201, the RAT modem 401 sends the first message to the radio network node 110, here, to the layer 3 service 405 of the radio network node 110. This may be an RRC message broker provisioning request asking for the IP address of the message broker. The layer 3 service 405 of the radio network node 110 receives the first message at 301. The address is sent by the layer 3 service 405 of the radio network node 110 in the second message at 202 at 302, and received by the RAT modem 401 at 202, and in turn forwarded to the message queue of the client application 402 at 505, which may then use it to connect to the message brokering service in a message bus connect procedure 506, In accordance with Action 203, the client application 402 sends a connect request at 507 to the message broker 404, which receives it at 508, in accordance with Action 303. Also in accordance with Action 303, the message broker 404 sends a response at 509 that is received by the client application 402 at 510.

**Figure 6** is a schematic diagram depicting a non-limiting example of the wireless communications network 100 that may be used to implement embodiments herein. The wireless communications network 100 comprises here a smart energy grid solution where the production and consumption of electricity is optimized with highly distributed production of e.g., solar, or wind power. The steering of the system is performed by a local network 601, which comprises the radio network node 110. The radio network node 110 is the nearest radio network node to the user equipment 130, which in this example is an electricity control system in a house comprised in a population area 602. The user equipment 130 comprises, in this example, the client application 402, here an MQ client, which communicates with the message broker 404 via the link 140. The functionality of the system is ensured independently of the integrity of the connectivity to a centralized cloud 603.

As a simplified overview of the foregoing, embodiments herein may be understood to relate to a method of finding a message broker in a distributed system utilizing centralized and local mechanisms to secure service continuity. The method may be understood to be a 3GPP based solution whereby a radio access technology may be used to request a message broker service through the radio access system itself. Embodiments herein may utilize the radio base station infrastructure as a distributed compute and storage system with a message broker in each base station.

Embodiments herein may be understood to relate to a distributed solution where the compute and storage resources may be located as close to the antenna of the radio access technology as possible. Embodiments herein may be integrated with cloud technologies, however, this may be done in the opposite of what todays cloud solutions offer, by bringing locality to the cloud. In existing methods, the client needs to be configured with a central endpoint of the message bus service. The provided compute and storage resources may run on hardware anywhere the network decides. The client cannot decide. Embodiments herein, on the other hand, enable a client to decide that compute and storage may be provided by the cloud as close as possible to the client itself.

One advantage of embodiments herein is that, by providing a distributed message brokering system where radio access and network processing/storage may be performed by the same physical equipment higher, independence from central resources may be achieved, with local fault resilience. A further advantage of embodiments herein is that subsystem level redundancy for large IoT systems may be obtained. With distributed compute and storage, there may be less single points of failure. Yet another advantage of embodiments herein is that, they provide mechanisms that will make the discovery of the most reliable and resilient distributed message brokering service dynamic and automatic.

**Figure 7** depicts two different examples in panels a) and b), respectively, of the arrangement that the user equipment 130 may comprise to perform the method actions described above in relation to Figure 2. In some embodiments, the user equipment 130 may comprise the following arrangement depicted in **Figure 7a**. The user equipment 130 is for handling provisioning of a message broker, or may be understood to be configured to handle provisioning of a message broker. The user equipment 130 is configured to operate in the wireless communications network 100.

Several embodiments are comprised herein. Components from one embodiment may be tacitly assumed to be present in another embodiment and it will be obvious to a person skilled in the art how those components may be used in the other exemplary embodiments. The detailed description of some of the following corresponds to the same references provided above, in relation to the actions described for the user equipment 130, and will thus not be repeated here. For example, the wireless communications network 100 may be configured to be an internet of things network.

In Figure 7, optional modules are indicated with dashed boxes.

The user equipment 130 is configured to, e.g. by means of a **sending circuit 701** within the user equipment 130 configured to, send the first message to the radio network node 110 configured to operate in the wireless communications network 100. The first message is configured to request provisioning of a message broker. The user equipment 130 is further configured to have set-up a radio connection with the radio network node 110.

The user equipment 130 is also configured to, e.g. by means of a **receiving circuit 702** within the user equipment 130 configured to, receive the second message from the radio network node 110 in response to the first message configured to be sent. The second message is configured to comprise the first indication of the message broker configured to be provisioned. The message broker configured to be provisioned is further configured to be one of: a) comprised in the radio network node 110, and b) accessible within the local network defined within the wireless communications network 100.

The local network may be configured to be accessible without requiring accessing the cloud environment.

In some embodiments, to send is configured to be performed by the modem configured to be comprised in the user equipment 130, based on the first indication configured to be received from the client application configured to be run by the user equipment 130.

In some embodiments, the user equipment 130 may be configured to, e.g. by means of an **establishing circuit 703** within the user equipment 130 configured to, establish the connection with the broker configured to be provisioned by the radio network node 110 in the second message configured to be received.

In some embodiments, the first message may be further configured to comprise the second indication configured to indicate the application level defined area identity. The message broker configured to be provisioned may be configured to be assigned to the application level defined area identity.

In some embodiments, the first message and the second message may be configured to be RRC messages .

The embodiments herein may be implemented through one or more processors, such as a **processor 704** in the user equipment 130 depicted in Figure 7, together with computer program code for performing the functions and actions of the embodiments herein. The program code mentioned above may also be provided as a computer program product, for instance in the form of a data carrier carrying computer program code for performing the embodiments herein when being loaded into the in the user equipment 130. One such carrier may be in the form of a CD ROM disc. It is however feasible with other data carriers such as a memory stick. The computer program code may furthermore be provided as pure program code on a server and downloaded to the user equipment 130.

The user equipment 130 may further comprise a **memory 705** comprising one or more memory units. The memory 705 is arranged to be used to store obtained information, store data, configurations, schedulings, and applications etc. to perform the methods herein when being executed in the user equipment 130.

In some embodiments, the user equipment 130 may receive information from, e.g., the radio network node 110, through a **receiving port 706**. In some examples, the receiving port 706 may be, for example, connected to one or more antennas in user equipment 130. In other embodiments, the user equipment 130 may receive information from another structure in the wireless communications network 100 through the receiving port 706. Since the receiving port 706 may be in communication with the processor 704, the receiving port 706 may then send the received information to the processor 704. The receiving port 706 may also be configured to receive other information.

The processor 704 in the user equipment 130 may be further configured to transmit or send information to e.g., the radio network node 110, through a **sending port 707**, which may be in communication with the processor 704, and the memory 705.

Those skilled in the art will also appreciate that the sending circuit 701, the receiving circuit 702 and the establishing circuit 703 described above may refer to a combination of analog and digital circuits, and/or one or more processors configured with software and/or firmware, e.g., stored in memory, that, when executed by the one or more processors such as the processor 704, perform as described above. One or more of these processors, as well as the other digital hardware, may be included in a single Application-Specific Integrated Circuit (ASIC), or several processors and various digital hardware may be distributed among several separate components, whether individually packaged or assembled into a System-on-a-Chip (SoC).

Those skilled in the art will also appreciate that the sending circuit 701, the receiving circuit 702 and the establishing circuit 703 described above may refer to a processor 704 of the user equipment 130, or an application running on such processor.

Thus, the methods according to the embodiments described herein for the user equipment 130 may be respectively implemented by means of a **computer program 708** product, comprising instructions, i.e., software code portions, which, when executed on at least one processor 704, cause the at least one processor 704 to carry out the actions described herein, as performed by the user equipment 130. The computer program 708 product may be stored on a **computer-readable storage medium 709**. The computer-readable storage medium 709, having stored thereon the computer program 708, may comprise instructions which, when executed on at least one processor 704, cause the at least one processor 704 to carry out the actions described herein, as performed by the user equipment 130. In some embodiments, the computer-readable storage medium 709 may be a non-transitory computer-readable storage medium, such as a CD ROM disc, a memory stick, or stored in the cloud space. In other embodiments, the computer program 708 product may be stored on a carrier containing the computer program, wherein the carrier is one of an electronic signal, optical signal, radio signal, or the computer-readable storage medium 709, as described above.

The user equipment 130 may comprise an interface unit to facilitate communications between the user equipment 130 and other nodes or devices, e.g., the radio network node 110. In some particular examples, the interface may, for example, include a transceiver configured to transmit and receive radio signals over an air interface in accordance with a suitable standard.

In other embodiments, the user equipment 130 may comprise the following arrangement depicted in Figure 7b. The user equipment 130 may comprise a processing circuitry 704, e.g., one or more processors such as the processor 704, in the user equipment 130 and the memory 705. The user equipment 130 may also comprise a **radio circuitry 710**, which may comprise e.g., the receiving port 706 and the sending port 707. The processing circuitry 704 may be configured to, or operable to, perform the method actions according to Figure 2, in a similar manner as that described in relation to Figure 7a. The radio circuitry 710 may be configured to set up and maintain at least a wireless connection with the radio network node 110. Circuitry may be understood herein as a hardware component. The radio circuitry 710 may be configured to comprise the modem 401.

Hence, embodiments herein also relate to the user equipment 130 operative to handle provisioning of a message broker. The user equipment 130 is configured to operate in the wireless communications network 100. The user equipment 130 may comprise the processing circuitry 704 and the memory 705, said memory 705 containing instructions executable by said processing circuitry 704, whereby the user equipment 130 is further operative to perform the actions described herein in relation to the user equipment 130, e.g., in Figure 2.

**Figure 8** depicts two different examples in panels a) and b), respectively, of the arrangement that the radio network node 110 may comprise to perform the method actions described above in relation to Figure 3. In some embodiments, the radio network node 110 may comprise the following arrangement depicted in **Figure 8a**. The radio network node 110 is for handling provisioning of a message broker, or may be understood to be configured to handle provisioning of a message broker. The radio network node 110 is configured to operate in the wireless communications network 100.

Several embodiments are comprised herein. Components from one embodiment may be tacitly assumed to be present in another embodiment and it will be obvious to a person skilled in the art how those components may be used in the other exemplary embodiments. The detailed description of some of the following corresponds to the same references provided above, in relation to the actions described for the radio network node

110, and will thus not be repeated here. For example, the wireless communications network 100 may be configured to be an internet of things network.

In Figure 8, optional modules are indicated with dashed boxes.

The radio network node 110 is configured to, e.g. by means of a **receiving circuit 801** within the user equipment 130 configured to, receive 301 the first message from the user equipment 130 configured to operate in the wireless communications network 100. The first message is configured to request provisioning of the message broker. The radio network node 110 is further configured to have set-up the radio connection with the user equipment 130.

The user equipment 130 is also configured to, e.g. by means of a **sending circuit 802** within the user equipment 130 configured to, send the second message to the user equipment 130 in response to the first message configured to be received. The second message is configured to comprise the first indication of the message broker configured to be provisioned. The message broker configured to be provisioned is configured to be one of: a) comprised in the radio network node 110, and b) accessible within the local network defined within the wireless communications network 100.

The local network may be configured to be accessible without requiring accessing the cloud environment.

In some embodiments, to receive is performed from the modem 401 configured to be comprised in the user equipment 130.

In some embodiments, the radio network node 110 may be configured to, e.g. by means of an **establishing circuit 803** within the radio network node 110 configured to, establish the connection between the broker configured to be provisioned by the radio network node 110 in the second message configured to be sent and the user equipment 130.

In some embodiments, the first message may be further configured to comprise the second indication configured to indicate the application level defined area identity. The message broker configured to be provisioned may be configured to be assigned to the application level defined area identity.

In some embodiments, the first message and the second message may be configured to be RRC messages.

The embodiments herein may be implemented through one or more processors, such as a **processor 804** in the radio network node 110 depicted in Figure 8, together with computer program code for performing the functions and actions of the embodiments herein. The program code mentioned above may also be provided as a computer program product, for instance in the form of a data carrier carrying computer program code for performing the embodiments herein when being loaded into the in the radio network node 110. One such carrier may be in the form of a CD ROM disc. It is however feasible with other data carriers such as a memory stick. The computer program code may furthermore be provided as pure program code on a server and downloaded to the radio network node 110.

The radio network node 110 may further comprise a **memory 805** comprising one or more memory units. The memory 805 is arranged to be used to store obtained information, store data, configurations, schedulings, and applications etc. to perform the methods herein when being executed in the radio network node 110.

In some embodiments, the radio network node 110 may receive information from, e.g., the user equipment 130, through a **receiving port 806**. In some examples, the receiving port 806 may be, for example, connected to one or more antennas in radio network node 110. In other embodiments, the radio network node 110 may receive information from another structure in the wireless communications network 100 through the receiving port 806. Since the receiving port 806 may be in communication with the processor 804, the receiving port 806 may then send the received information to the processor 804. The receiving port 806 may also be configured to receive other information.

The processor 804 in the radio network node 110 may be further configured to transmit or send information to e.g., the user equipment 130, through a **sending port 807**, which may be in communication with the processor 804, and the memory 805.

Those skilled in the art will also appreciate that the receiving circuit 801, the sending circuit 802 and the establishing circuit 803 described above may refer to a combination of analog and digital circuits, and/or one or more processors configured with software and/or firmware, e.g., stored in memory, that, when executed by the one or more processors such as the processor 804, perform as described above. One or more of these processors, as well as the other digital hardware, may be included in a single Application-Specific Integrated Circuit (ASIC), or several processors and various digital hardware may be distributed among several separate components, whether individually packaged or assembled into a System-on-a-Chip (SoC).

Those skilled in the art will also appreciate that the receiving circuit 801, the sending circuit 802 and the establishing circuit 803 described above may refer to a processor 804 of the radio network node 110, or an application running on such processor.

Thus, the methods according to the embodiments described herein for the radio network node 110 may be respectively implemented by means of a **computer program 808** product, comprising instructions, i.e., software code portions, which, when executed on at least one processor 804, cause the at least one processor 804 to carry out the actions described herein, as performed by the radio network node 110. The computer program 808 product may be stored on a **computer-readable storage medium 809**. The computer-readable storage medium 809, having stored thereon the computer program 808, may comprise instructions which, when executed on at least one processor 804, cause the at least one processor 804 to carry out the actions described herein, as performed by the radio network node 110. In some embodiments, the computer-readable storage medium 809 may be a non-transitory computer-readable storage medium, such as a CD ROM disc, a memory stick, or stored in the cloud space. In other embodiments, the computer program 808 product may be stored on a carrier containing the computer program, wherein the carrier is one of an electronic signal, optical signal, radio signal, or the computer-readable storage medium 809, as described above.

The radio network node 110 may comprise an interface unit to facilitate communications between the radio network node 110 and other nodes or devices, e.g., the user equipment 130. In some particular examples, the interface may, for example, include a transceiver configured to transmit and receive radio signals over an air interface in accordance with a suitable standard.

In other embodiments, the radio network node 110 may comprise the following arrangement depicted in Figure 8b. The radio network node 110 may comprise a processing circuitry 804, e.g., one or more processors such as the processor 804, in the radio network node 110 and the memory 805. The radio network node 110 may also comprise a **radio circuitry 810**, which may comprise e.g., the receiving port 806 and the sending port 807. The processing circuitry 804 may be configured to, or operable to, perform the method actions according to Figure 3, in a similar manner as that described in relation to Figure 8a. The radio circuitry 810 may be configured to set up and maintain at least a wireless connection with the user equipment 130. Circuitry may be understood herein as a hardware component.

Hence, embodiments herein also relate to the radio network node 110 operative to handle provisioning of a message broker. The radio network node 110 is configured to operate in the wireless communications network 100. The radio network node 110 may comprise the processing circuitry 804 and the memory 805, said memory 805 containing instructions executable by said processing circuitry 804, whereby the radio network node

110 is further operative to perform the actions described herein in relation to the radio network node 110, e.g., in Figure 3.

Generally, all terms used herein are to be interpreted according to their ordinary meaning in the relevant technical field, unless a different meaning is clearly given and/or is implied from the context in which it is used. All references to a/an/the element, apparatus, component, means, step, etc. are to be interpreted openly as referring to at least one instance of the element, apparatus, component, means, step, etc., unless explicitly stated otherwise. The steps of any methods disclosed herein do not have to be performed in the exact order disclosed, unless a step is explicitly described as following or preceding another step and/or where it is implicit that a step must follow or precede another step. Any feature of any of the embodiments disclosed herein may be applied to any other embodiment, wherever appropriate. Likewise, any advantage of any of the embodiments may apply to any other embodiments, and vice versa. Other objectives, features and advantages of the enclosed embodiments will be apparent from the following description.

As used herein, the expression “at least one of:” followed by a list of alternatives separated by commas, and wherein the last alternative is preceded by the “and” term, may be understood to mean that only one of the list of alternatives may apply, more than one of the list of alternatives may apply or all of the list of alternatives may apply. This expression may be understood to be equivalent to the expression “at least one of:” followed by a list of alternatives separated by commas, and wherein the last alternative is preceded by the “or” term.

When using the word "comprise" or “comprising”, it shall be interpreted as non-limiting, i.e. meaning "consist at least of".

The embodiments herein are not limited to the above described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention.

As used herein, the expression “in some embodiments” has been used to indicate that the features of the embodiment described may be combined with any other embodiment or example disclosed herein.

As used herein, the expression “in some examples” has been used to indicate that the features of the example described may be combined with any other embodiment or example disclosed herein.

A processor, as used herein, may be understood to be a hardware component.

CLAIMS

1. A method performed by a user equipment (130) for handling provisioning of a message broker, the user equipment (130) operating in a wireless communications network (100), the method comprising:
   - *sending* (201) a first message to a radio network node (110) operating in the wireless communications network (100), the first message requesting provisioning of a message broker, the user equipment (130) having set-up a radio connection with the radio network node (110), and
   - *receiving* (202) a second message from the radio network node (110) in response to the first message sent, the second message comprising a first indication of a provisioned message broker, wherein the provisioned message broker is one of: a) comprised in the radio network node (110), and b) accessible within a local network defined within the wireless communications network (100).

2. The method according to claim 1, wherein the local network is accessible without requiring accessing a cloud environment.

3. The method according to any of claims 1-2, wherein the sending (201) is performed by a modem comprised in the user equipment (130), based on a first indication received from a client application run by the user equipment (130).

4. The method according to any of claims 1-3, further comprising:
   - *establishing* (203) a connection with the broker provisioned by the radio network node (110) in the received second message.

5. The method according to any of claims 1-4, wherein the first message further comprises a second indication indicating an application level defined area identity, wherein the provisioned message broker is assigned to the application level defined area identity.

6. The method according to any of claims 1-5, wherein the first message and the second message are Radio Resource Control messages

7. The method according to any of claims 1-6, wherein the wireless communications network (100) is an internet of things network.

8. A computer program (708), comprising instructions which, when executed on at least one processor (704), cause the at least one processor (704) to carry out the method according to any one of claims 1 to 7.

9. A computer-readable storage medium (709), having stored thereon a computer program (708), comprising instructions which, when executed on at least one processor (704), cause the at least one processor (704) to carry out the method according to any one of claims 1 to 7.

10. A method performed by a radio network node (110) for handling provisioning of a message broker, the radio network node (110) operating in a wireless communications network (100), the method comprising:
   - *receiving* (301) a first message from a user equipment (130) operating in the wireless communications network (100), the first message requesting provisioning of a message broker, the radio network node (110) having set-up a radio connection with the user equipment (130), and
   - *sending* (201) a second message to the user equipment (130) in response to the received first message, the second message comprising a first indication of a provisioned message broker, wherein the provisioned message broker is one of: a) comprised in the radio network node (110), and b) accessible within a local network defined within the wireless communications network (100).

11. The method according to claim 10, wherein the local network is accessible without requiring accessing a cloud environment.

12. The method according to any of claims 10-11, wherein the receiving (301) is performed from a modem comprised in the user equipment (130).

13. The method according to any of claims 10-12, further comprising:
   - *establishing* (203) a connection between the broker provisioned by the radio network node (110) in the sent second message and the user equipment (130).

14. The method according to any of claims 10-13, wherein the first message and the second message are Radio Resource Control messages.

15. The method according to any of claims 10-14, wherein the wireless communications network (100) is an internet of things network.

16. The method according to any of claims 10-15, wherein the first message further comprises a second indication indicating an application level defined area identity, wherein the provisioned local message broker is assigned to the application level defined area identity.

17. A computer program (808), comprising instructions which, when executed on at least one processor (804), cause the at least one processor (804) to carry out the method according to any one of claims 10 to 16.

18. A computer-readable storage medium (809), having stored thereon a computer program (808), comprising instructions which, when executed on at least one processor (804), cause the at least one processor (804) to carry out the method according to any one of claims 10 to 16.

19. A user equipment (130) for handling provisioning of a message broker, the user equipment (130) being configured to operate in a wireless communications network (100), the user equipment (130) being further configured to:
   - send a first message to a radio network node (110) configured to operate in the wireless communications network (100), the first message being configured to request provisioning of a message broker, the user equipment (130) being further configured to have set-up a radio connection with the radio network node (110), and
   - receive a second message from the radio network node (110) in response to the first message configured to be sent, the second message being configured to comprise a first indication of a message broker configured to be provisioned, wherein the message broker configured to be provisioned being further configured to be one of: a) comprised in the radio network node (110), and b) accessible within a local network defined within the wireless communications network (100).

20. The user equipment (130) according to claim 19, wherein the local network is configured to be accessible without requiring accessing a cloud environment.

21. The user equipment (130) according to any of claims 19-20, wherein to send (201) is configured to be performed by a modem configured to be comprised in the user equipment (130), based on a first indication configured to be received from a client application configured to be run by the user equipment (130).

22. The user equipment (130) according to any of claims 19-21, being further configured to:
    - establish a connection with the broker configured to be provisioned by the radio network node (110) in the second message configured to be received.

23. The user equipment (130) according to any of claims 19-22, wherein the first message is further configured to comprise a second indication configured to indicate an application level defined area identity, wherein the message broker configured to be provisioned is configured to be assigned to the application level defined area identity.

24. The user equipment (130) according to any of claims 19-23, wherein the first message and the second message are configured to be Radio Resource Control messages.

25. The user equipment (130) according to any of claims 19-24, wherein the wireless communications network (100) is configured to be an internet of things network.

26. A radio network node (110) for handling provisioning of a message broker, the radio network node (110) being configured to operate in a wireless communications network (100), the radio network node (110) being further configured to:
    - receive a first message from a user equipment (130) configured to operate in the wireless communications network (100), the first message being configured to request provisioning of a message broker, the radio network node (110) being further configured to have set-up a radio connection with the user equipment (130), and
    - send a second message to the user equipment (130) in response to the first message configured to be received, the second message being configured to comprise a first indication of a message broker configured to be provisioned, wherein the message broker configured to be provisioned is configured to be one of: a) comprised in the radio network node (110), and b) accessible within a local network defined within the wireless communications network (100).

27. The radio network node (110) according to claim 26, wherein the local network is configured to be accessible without requiring accessing a cloud environment.

28. The radio network node (110) according to any of claims 26-27, wherein to receive (301) is performed from a modem configured to be comprised in the user equipment (130).

29. The radio network node (110) according to any of claims 26-28, being further configured to:
    - establish a connection between the broker configured to be provisioned by the radio network node (110) in the second message configured to be sent and the user equipment (130).

30. The radio network node (110) according to any of claims 26-29, wherein the first message and the second message are configured to be Radio Resource Control messages.

31. The radio network node (110) according to any of claims 26-30, wherein the wireless communications network (100) is configured to be an internet of things network.

32. The radio network node (110) according to any of claims 26-31, wherein the first message further comprises a second indication configured to indicate an application level defined area identity, wherein the local message broker configured to be provisioned is configured to be assigned to the application level defined area identity.

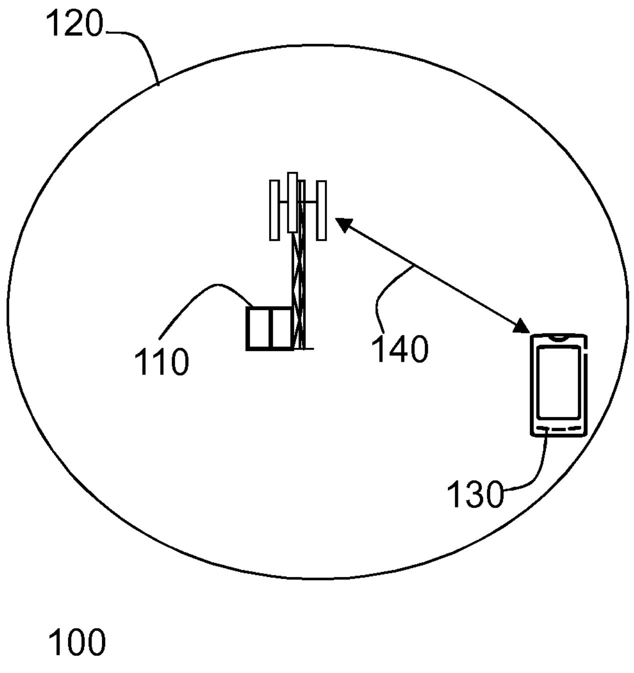



**Figure 1**

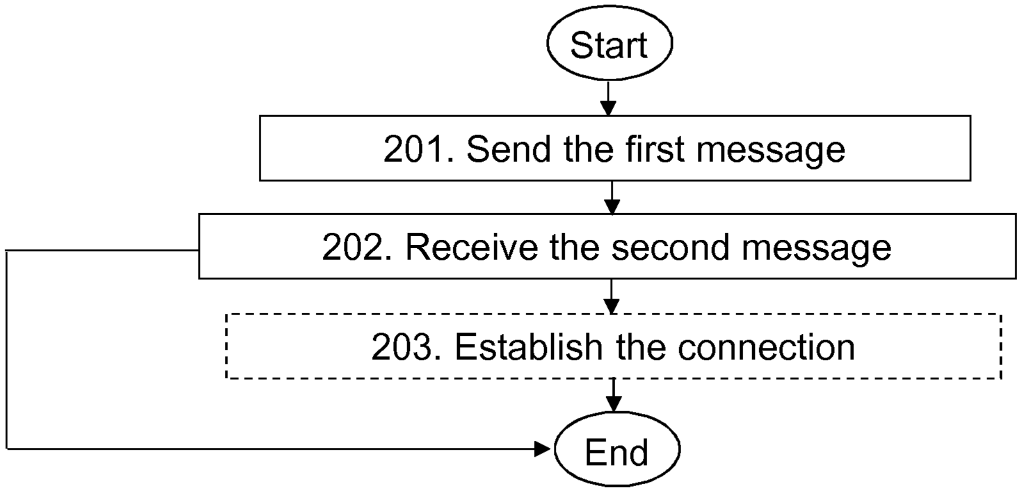



Figure 2

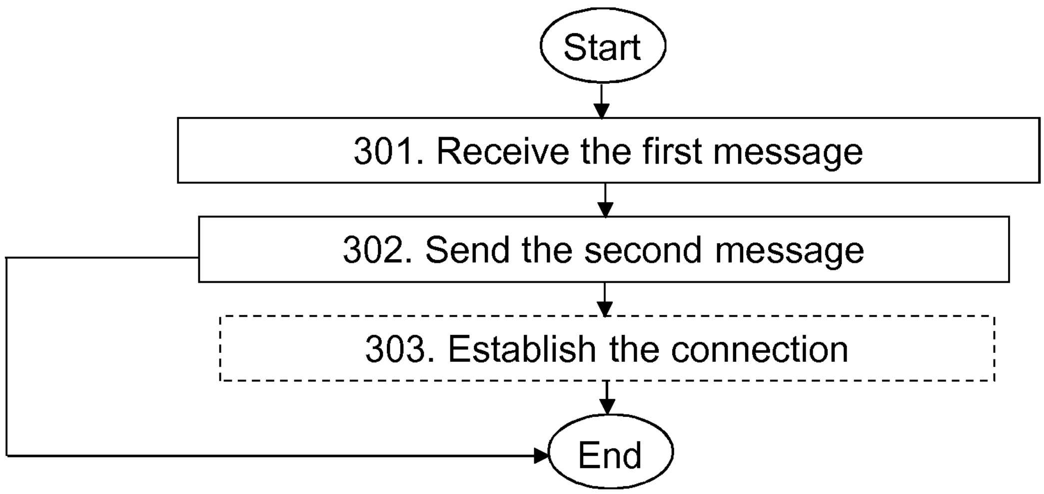



Figure 3

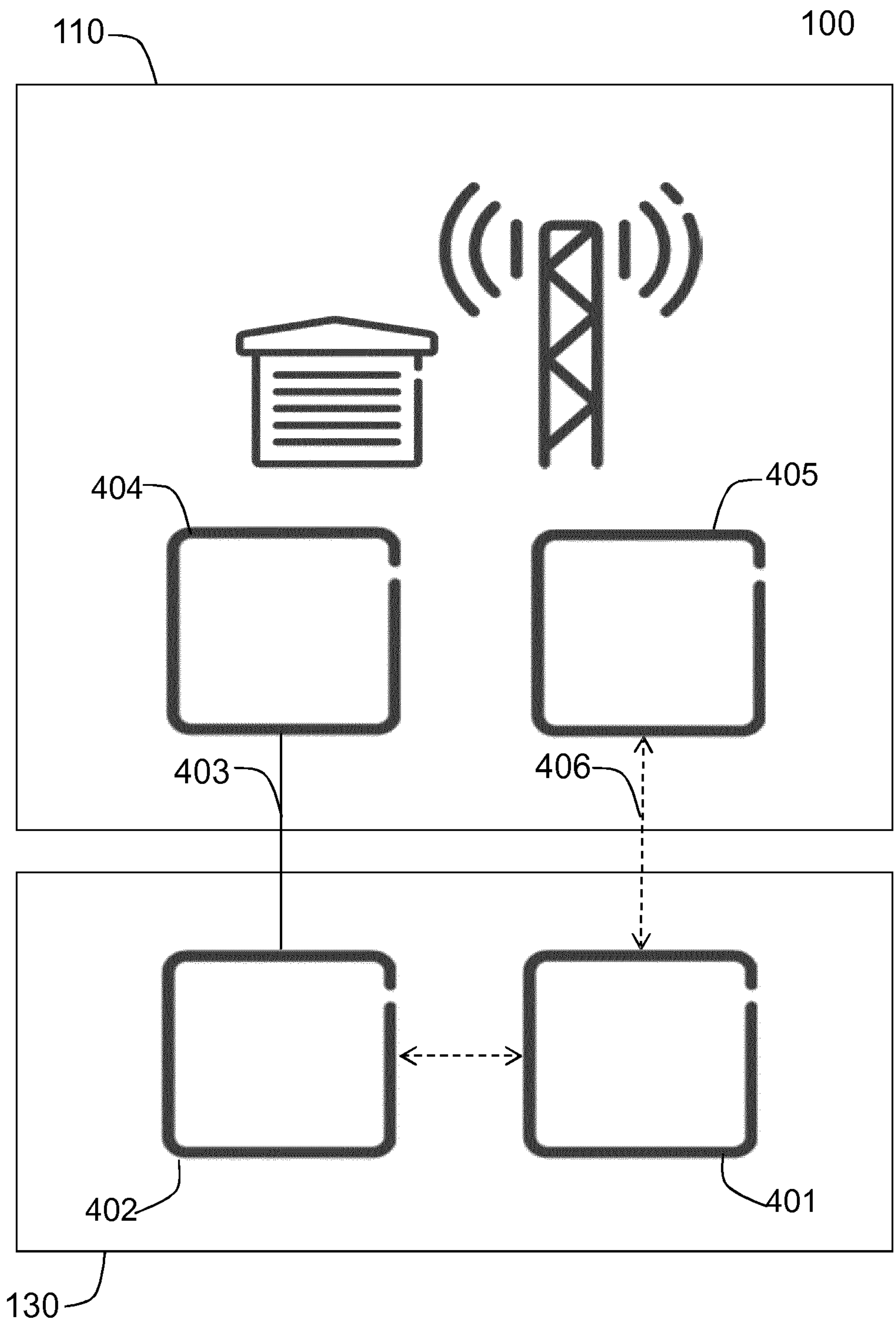



**Figure 4**

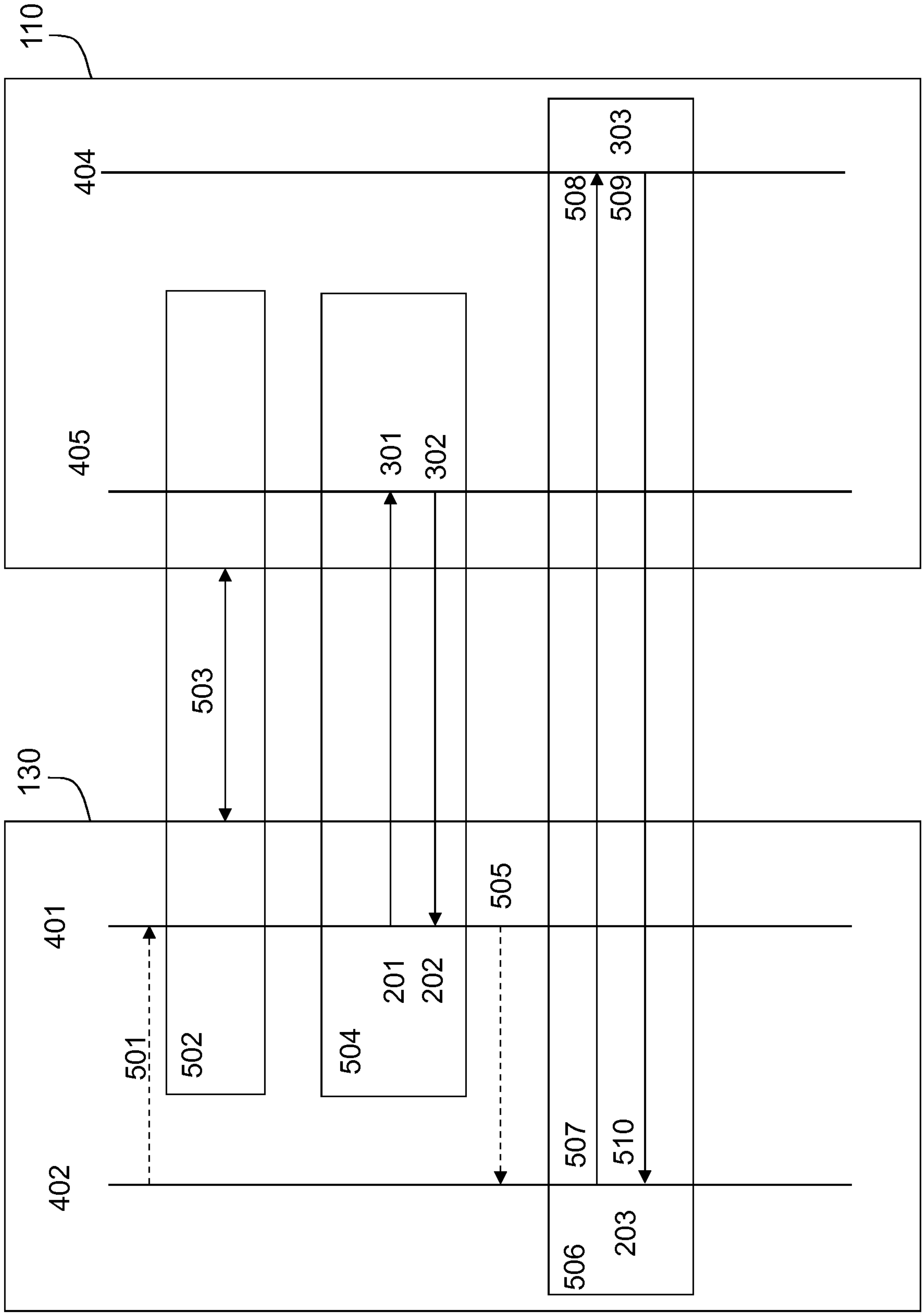

110
130
404
405
303
508
509
301
302
503
401
402
501
502
504
201
202
505
507
510
506
203

Figure 5

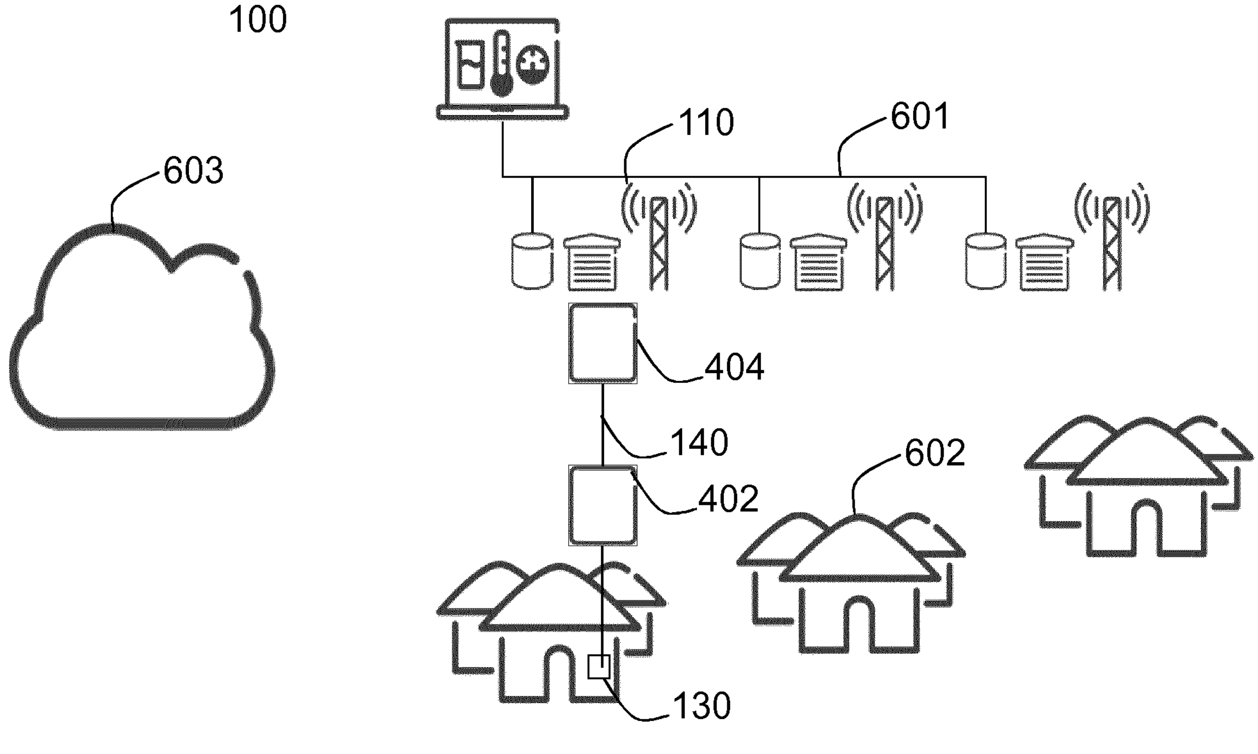
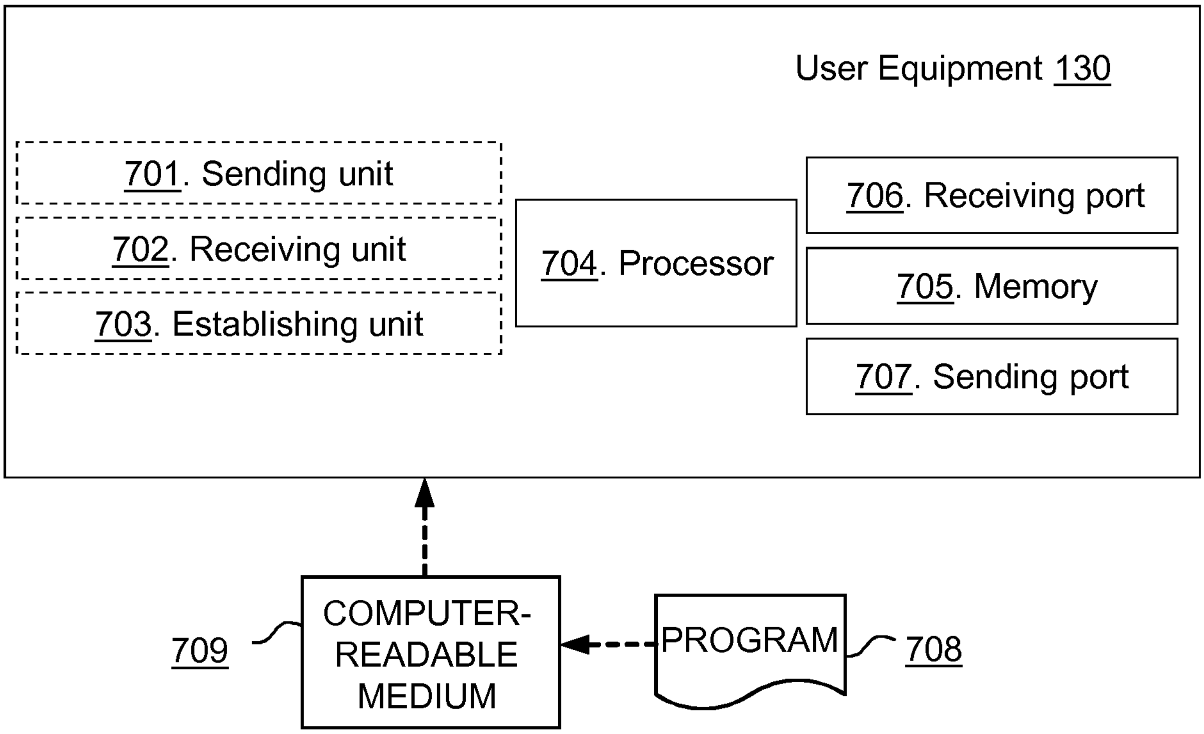



**Figure 6**

a)


User Equipment 130
701. Sending unit
702. Receiving unit
703. Establishing unit
704. Processor
706. Receiving port
705. Memory
707. Sending port
709
COMPUTER-READABLE MEDIUM
PROGRAM
708

b)

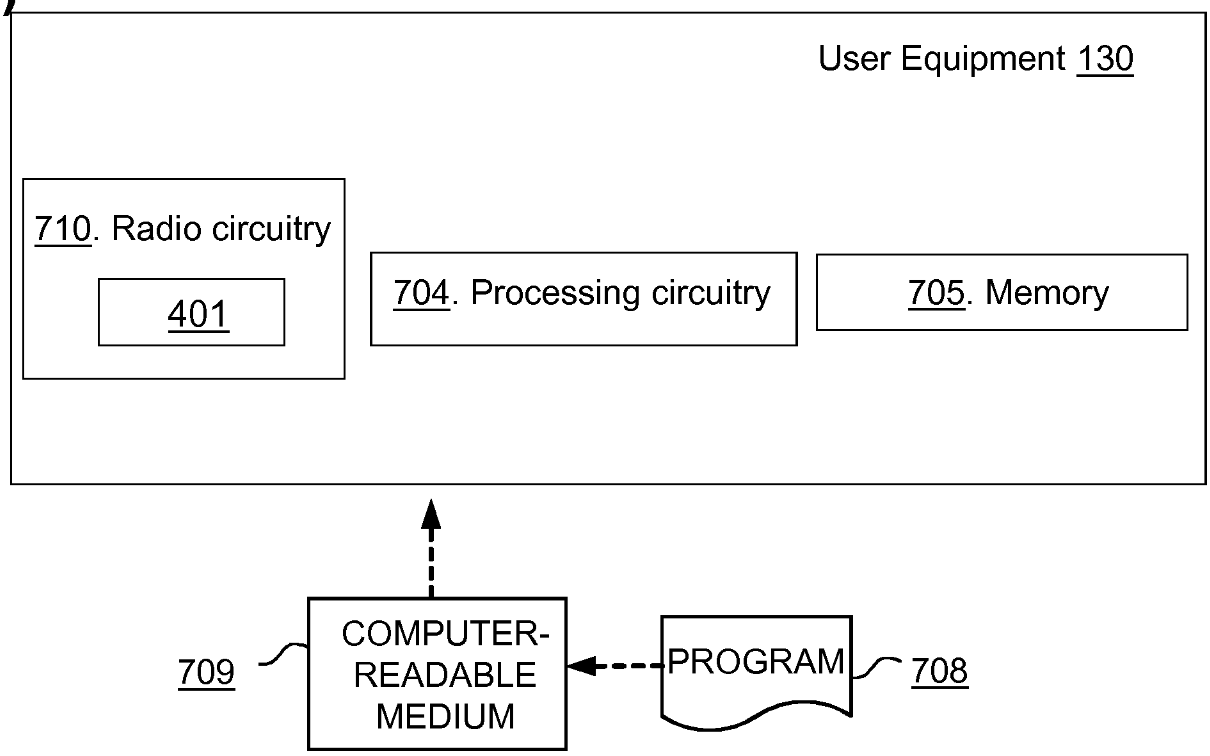
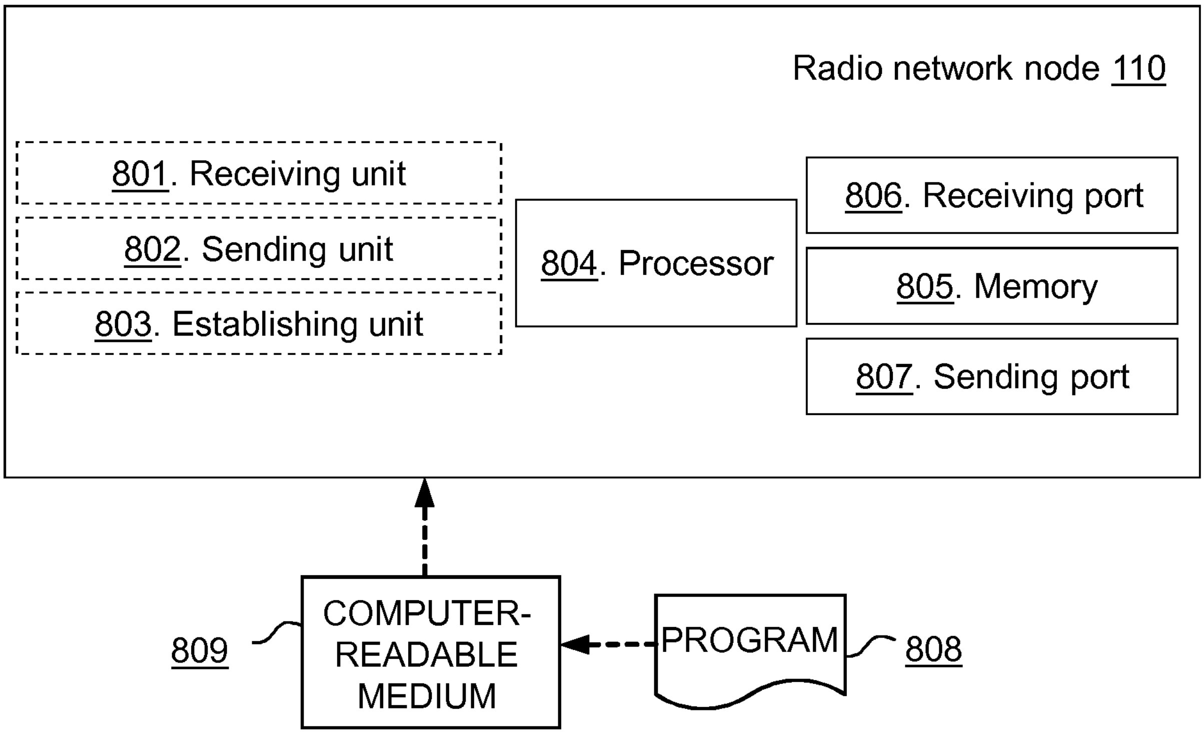

User Equipment 130
710. Radio circuitry
401
704. Processing circuitry
705. Memory
709
COMPUTER-READABLE MEDIUM
PROGRAM
708

**Figure 7**

a)


Radio network node 110
801. Receiving unit
802. Sending unit
803. Establishing unit
804. Processor
806. Receiving port
805. Memory
807. Sending port
809
COMPUTER-READABLE MEDIUM
PROGRAM
808

b)

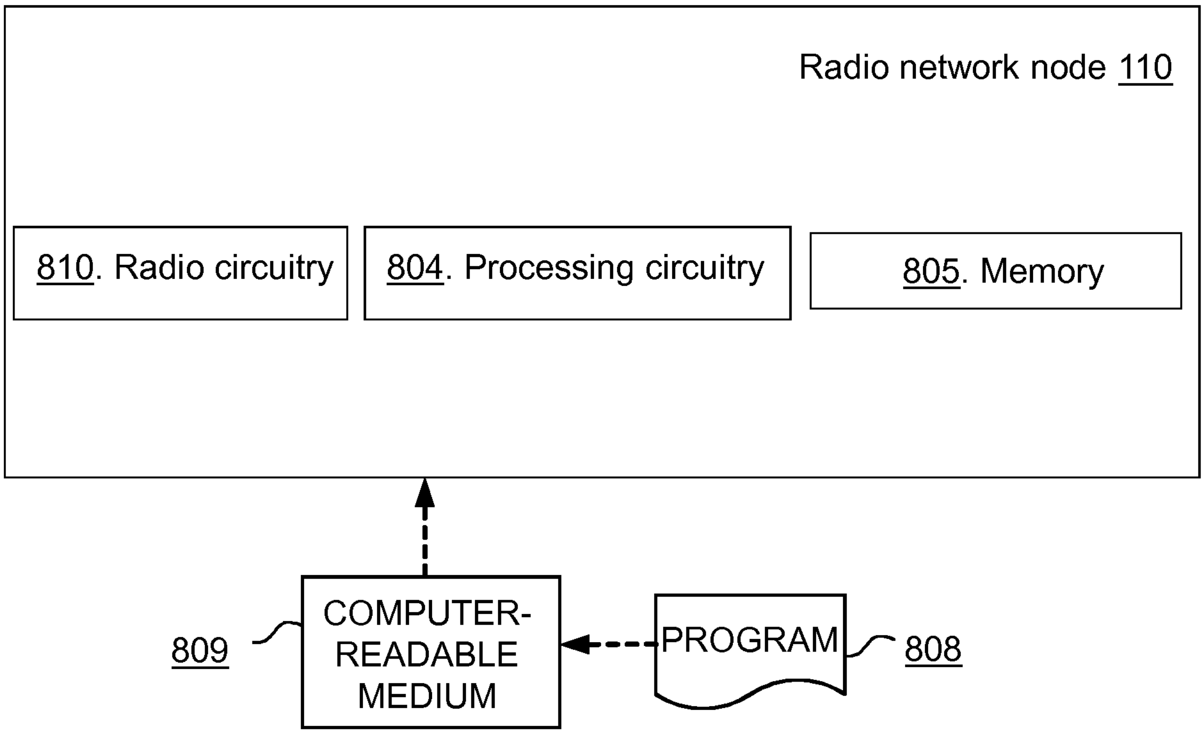

Radio network node 110
810. Radio circuitry
804. Processing circuitry
805. Memory
809
COMPUTER-READABLE MEDIUM
PROGRAM
808

Figure 8

# INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/052101

**A. CLASSIFICATION OF SUBJECT MATTER**
INV. H04L29/08 H04W4/70 H04W76/10
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)
H04W H04L G06F

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

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

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | WO 2018/188759 A1 (ERICSSON TELEFON AB L M [SE]) 18 October 2018 (2018-10-18) | 1-4, 6-13, 15-22, 24-29, 31,32 |
| A | page 1, line 18 - page 2, line 25<br>page 10, line 25 - line 28<br>page 13, line 5 - line 15<br>page 14, line 18 - line 23<br>page 16, line 12 - line 26<br>figure 1<br>----- | 5,14,23, 30 |
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| A | paragraph [0026]<br>-----<br>-/-- | 1-5, 7-14, 16-23, 25-30,32 |

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

[X] See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 9 September 2019 | 23/09/2019 |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Authorized officer<br><br>Walker Pina, J |

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International application No
PCT/EP2019/052101

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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| A | paragraph [0109] - paragraph [0110] | 5,14,23, 30 |
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| A | CN 102 025 851 B (ZTE CORP) 12 March 2014 (2014-03-12) abstract | 1-32 |
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International application No
PCT/EP2019/052101

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