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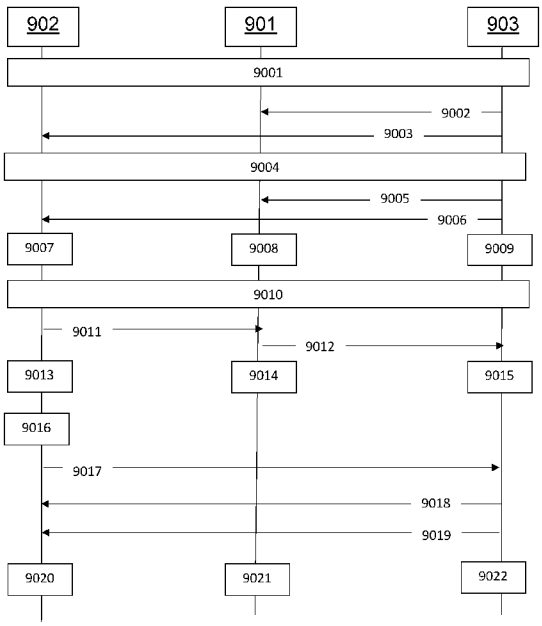

Fig.9

(57) Abstract: There is disclosed a method, computer program and apparatus for a serving network entity that causes the apparatus to: configure at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern and a second reporting pattern with a second discontinuous reception pattern and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity; receive a request from the first user equipment and/or the second user equipment for reporting to the server; determine that the request relates to an event associated with the second reporting pattern; and reconfigure the second user equipment to operate using the second discontinuous reception pattern.

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APPARATUS, METHODS, AND COMPUTER PROGRAMS TO CONFIGURE DISCONTINUOUS RECEPTION PATTERNS ASSOCIATED WITH REPORTING PATTERNS

Field

[0001] The present disclosure relates to apparatus, methods, and computer programs, and in particular but not exclusively to apparatus, methods and computer programs for network apparatuses.

Background

[0002] A communication system can be seen as a facility that enables communication sessions between two or more entities such as user terminals, access nodes and/or other nodes by providing carriers between the various entities involved in the communications path. A communication system can be provided for example by means of a communication network and one or more compatible communication devices. The communication sessions may comprise, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and/or content data and so on. Content may be multicast or unicast to communication devices.

[0003] A user can access the communication system by means of an appropriate communication device or terminal. A communication device of a user is often referred to as user equipment (UE) or user device. The communication device may access a carrier provided by an access node and transmit and/or receive communications on the carrier.

[0004] The communication system and associated devices typically operate in accordance with a required standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. Communication protocols and/or parameters which shall be used for the connection are also typically defined. One example of a communications system is UTRAN (3G radio). Another example of an architecture that is known is the long-term evolution (LTE) or the Universal Mobile Telecommunications System (UMTS) radio-access technology. Another example communication system is so called 5G system that allows user equipment (UE) or user device to contact a 5G core via e.g. new radio (NR) access technology or via other access technology such as Untrusted access to 5GC or wireline access technology.

[0005] There is a need to provide control systems which enable a communications service provider (CSP) to control and optimise a complex network of communications system elements.

[0006] One of current approaches being employed is closed-loop automation and machine learning which can be built into self-organizing networks (SON) enabling an operator to automatically optimize every cell in the radio access network.

Summary

[0007] According to a first aspect there is provided an apparatus for a serving network entity, the apparatus comprising means for: configuring at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity; receiving a request from the first user equipment and/or the second user equipment for reporting to the server; determining that the request relates to an event associated with the second reporting pattern; and reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

[0008] The means for reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise means for: reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment in response to receiving the request from the first user equipment.

[0009] The means for reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment may comprise means for configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

[0010] The means for reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprises means for: reconfiguring the

second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment.

[0011] The apparatus may comprise means for: configuring the first user equipment to act as a relay for the second user equipment; configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern.

[0012] The apparatus may comprise means for: receiving, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment; and determining the configuration information using the received context information.

[0013] According to a second aspect, there is provided an apparatus for a first user equipment, the apparatus comprising means for: receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; sending a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern; determining reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and signalling the reconfiguration information to the second user equipment using sidelink communications.

[0014] The request may originate from the apparatus or the second user equipment, wherein when the request originates from the second user equipment, the apparatus

comprises means for receiving the request from the second user equipment via sidelink communications.

[0015] The means for determining the reconfiguration information may comprise means for: receiving the reconfiguration information from the serving network entity.

[0016] The means for determining the reconfiguration information may comprise means for: detecting that the request relates to an event associated with the second report pattern; and determining the reconfiguration information in response to said detecting.

[0017] The apparatus may comprise means for signalling the reconfiguration information to the serving network entity.

[0018] Said means for signaling the reconfiguration information to the second user equipment using sidelink communications may comprise means for: selecting a wake-up signal that maps to the second discontinuous reception pattern; and signalling the selected wake-up signal to the second user equipment.

[0019] The apparatus may comprise means for sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0020] According to a third aspect, there is provided an apparatus for a second user equipment, the apparatus comprising means for: receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; receiving, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and operating using the second discontinuous reception pattern.

[0021] Said means for receiving reconfiguration information may comprise means for: receiving, from the first user equipment, a wake-up signal that maps to the second discontinuous reception pattern.

[0022] The apparatus may comprise means for sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0023] The means for receiving the configuration information from the serving network entity may comprise means for: receiving configuration information for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern; and performing data transmissions for reporting to the server according to the received configuration information.

[0024] The apparatus may comprise means for signalling, to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

[0025] According to a fourth aspect there is provided an apparatus for a serving network entity, the apparatus comprising: at least one processors; and at least one memory comprising code that, when executed by the at least one processor, causes the apparatus to: configure at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity; receive a request from the first user equipment and/or the second user equipment for reporting to the server; determine

that the request relates to an event associated with the second reporting pattern; and reconfigure the second user equipment to operate using the second discontinuous reception pattern.

[0026] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise: reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment in response to receiving the request from the first user equipment.

[0027] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment may comprise configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

[0028] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprises: reconfiguring the second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment.

[0029] The apparatus may be caused to: configure the first user equipment to act as a relay for the second user equipment; configure the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern.

[0030] The apparatus may be caused to: receive, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment; and determining the configuration information using the received context information.

[0031] According to a fifth aspect, there is provided an apparatus for a first user equipment, the apparatus comprising: at least one processors; and at least one memory comprising code that, when executed by the at least one processor, causes the apparatus to: receive, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; send a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern; determine reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and signal the reconfiguration information to the second user equipment using sidelink communications.

[0032] The request may originate from the apparatus or the second user equipment, wherein when the request originates from the second user equipment, the apparatus may be caused to receive the request from the second user equipment via sidelink communications.

[0033] The determining the reconfiguration information may comprise receiving the reconfiguration information from the serving network entity.

[0034] The determining the reconfiguration information may comprise: detecting that the request relates to an event associated with the second report pattern; and determining the reconfiguration information in response to said detecting.

[0035] The apparatus may be caused to signal the reconfiguration information to the serving network entity.

[0036] Said signaling the reconfiguration information to the second user equipment using sidelink communications may comprise: selecting a wake-up signal that maps to the second discontinuous reception pattern; and signalling the selected wake-up signal to the second user equipment.

[0037] The apparatus may be caused to send, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions;

reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0038] According to a sixth aspect, there is provided an apparatus for a second user equipment, the apparatus comprising: at least one processors; and at least one memory comprising code that, when executed by the at least one processor, causes the apparatus to: receive, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; receive, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and operate using the second discontinuous reception pattern.

[0039] Said receiving reconfiguration information may comprise: receiving, from the first user equipment, a wake-up signal that maps to the second discontinuous reception pattern.

[0040] The apparatus may be caused to send, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0041] The receiving the configuration information from the serving network entity may comprise: receiving configuration information for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is

operating using the second discontinuous reception pattern; and performing data transmissions for reporting to the server according to the received configuration information.

[0042] The apparatus may be caused to signal, to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

[0043] According to a seventh aspect there is provided a method for an apparatus for a serving network entity, the method comprising: configuring at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity; receiving a request from the first user equipment and/or the second user equipment for reporting to the server; determining that the request relates to an event associated with the second reporting pattern; and reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

[0044] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise: reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment in response to receiving the request from the first user equipment.

[0045] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment may comprise configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

[0046] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise: reconfiguring the second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment.

[0047] The method may comprise: configuring the first user equipment to act as a relay for the second user equipment; configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern.

[0048] The method may comprise: receiving, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment; and determining the configuration information using the received context information.

[0049] According to an eighth second aspect, there is provided a method for an apparatus for a first user equipment, the method comprising: receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; sending a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern; determining reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and signalling the reconfiguration information to the second user equipment using sidelink communications.

[0050] The request may originate from the apparatus or the second user equipment, wherein when the request originates from the second user equipment, the method may comprise receiving the request from the second user equipment via sidelink communications.

[0051] The determining the reconfiguration information may comprise: receiving the reconfiguration information from the serving network entity.

[0052] The determining the reconfiguration information may comprise: detecting that the request relates to an event associated with the second report pattern; and determining the reconfiguration information in response to said detecting.

[0053] The method may comprise signalling the reconfiguration information to the serving network entity.

[0054] Said signaling the reconfiguration information to the second user equipment using sidelink communications may comprise: selecting a wake-up signal that maps to the second discontinuous reception pattern; and signalling the selected wake-up signal to the second user equipment.

[0055] The method may comprise sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0056] According to a ninth aspect, there is provided a method for an apparatus for a second user equipment, the method comprising: receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; receiving, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and operating using the second discontinuous reception pattern.

[0057] Said receiving reconfiguration information may comprise: receiving, from the first user equipment, a wake-up signal that maps to the second discontinuous reception pattern.

[0058] The method may comprise sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0059] The receiving the configuration information from the serving network entity may comprise: receiving configuration information for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern; and performing data transmissions for reporting to the server according to the received configuration information.

[0060] The method may comprise signalling, to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

[0061] According to a tenth aspect there is provided an apparatus for a serving network entity, the apparatus comprising: configuring circuitry for configuring at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity; receiving circuitry for receiving a request from the first user equipment and/or the second user equipment for reporting to the server; determining circuitry for determining that the request relates to an event associated with the second reporting pattern; and reconfiguring circuitry for reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

[0062] The reconfiguring circuitry for reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise: reconfiguring circuitry for reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment in response to receiving the request from the first user equipment.

[0063] The reconfiguring circuitry for reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment may comprise configuring circuitry for configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

[0064] The reconfiguring circuitry for reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprises reconfiguring circuitry for: reconfiguring the second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment.

[0065] The apparatus may comprise: configuring circuitry for configuring the first user equipment to act as a relay for the second user equipment; configuring circuitry for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern.

[0066] The apparatus may comprise: receiving circuitry for receiving, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment; and determining the configuration information using the received context information.

[0067] According to an eleventh aspect, there is provided an apparatus for a first user equipment, the apparatus comprising: receiving circuitry for receiving, from a serving

network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; sending circuitry for sending a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern; determining circuitry for determining reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and signalling circuitry for signalling the reconfiguration information to the second user equipment using sidelink communications.

[0068] The request may originate from the apparatus or the second user equipment, wherein when the request originates from the second user equipment, the apparatus comprises receiving circuitry for receiving the request from the second user equipment via sidelink communications.

[0069] The determining circuitry for determining the reconfiguration information may comprise: receiving circuitry for receiving the reconfiguration information from the serving network entity.

[0070] The determining circuitry for determining the reconfiguration information may comprise: detecting circuitry for detecting that the request relates to an event associated with the second report pattern; and determining circuitry for determining the reconfiguration information in response to said detecting.

[0071] The apparatus may comprise signalling circuitry for signalling the reconfiguration information to the serving network entity.

[0072] Said signalling circuitry for signaling the reconfiguration information to the second user equipment using sidelink communications may comprise: selecting circuitry for selecting a wake-up signal that maps to the second discontinuous reception pattern; and signalling circuitry for signalling the selected wake-up signal to the second user equipment.

[0073] The apparatus may comprise sending circuitry for sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal

reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0074] According to a twelfth aspect, there is provided an apparatus for a second user equipment, the apparatus comprising: receiving circuitry for receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; receiving circuitry for receiving, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and operating circuitry for operating using the second discontinuous reception pattern.

[0075] Said receiving circuitry for receiving reconfiguration information may comprise: receiving circuitry for receiving, from the first user equipment, a wake-up signal that maps to the second discontinuous reception pattern.

[0076] The apparatus may comprise sending circuitry for sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0077] The receiving circuitry for receiving the configuration information from the serving network entity may comprise: receiving circuitry for receiving configuration information for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception

pattern; and performing circuitry for performing data transmissions for reporting to the server according to the received configuration information.

[0078] The apparatus may comprise signalling circuitry for signalling, to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

[0079] According to a thirteenth aspect there is provided non-transitory computer readable medium comprising program instructions for causing an apparatus for a serving network entity to perform at least the following: configure at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity; receive a request from the first user equipment and/or the second user equipment for reporting to the server; determine that the request relates to an event associated with the second reporting pattern; and reconfigure the second user equipment to operate using the second discontinuous reception pattern.

[0080] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise: reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment in response to receiving the request from the first user equipment.

[0081] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment may comprise configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

[0082] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprises: reconfiguring the second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment.

[0083] The apparatus may be caused to: configure the first user equipment to act as a relay for the second user equipment; configure the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern.

[0084] The apparatus may be caused to: receive, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment; and determining the configuration information using the received context information.

[0085] According to fourteenth aspect, there is provided non-transitory computer readable medium comprising program instructions for causing an apparatus for a first user equipment to perform at least the following: receive, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; send a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern; determine reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and signal the reconfiguration information to the second user equipment using sidelink communications.

[0086] The request may originate from the apparatus or the second user equipment, wherein when the request originates from the second user equipment, the apparatus

may be caused to receive the request from the second user equipment via sidelink communications.

[0087] The determining the reconfiguration information may comprise receiving the reconfiguration information from the serving network entity.

[0088] The determining the reconfiguration information may comprise: detecting that the request relates to an event associated with the second report pattern; and determining the reconfiguration information in response to said detecting.

[0089] The apparatus may be caused to signal the reconfiguration information to the serving network entity.

[0090] Said signaling the reconfiguration information to the second user equipment using sidelink communications may comprise: selecting a wake-up signal that maps to the second discontinuous reception pattern; and signalling the selected wake-up signal to the second user equipment.

[0091] The apparatus may be caused to send, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0092] According to a fifteenth aspect, there is provided non-transitory computer readable medium comprising program instructions for causing an apparatus for a second user equipment to perform at least the following: receive, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity; receive, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and operate using the second discontinuous reception pattern.

[0093] Said receiving reconfiguration information may comprise: receiving, from the first user equipment, a wake-up signal that maps to the second discontinuous reception pattern.

[0094] The apparatus may be caused to send, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0095] The receiving the configuration information from the serving network entity may comprise: receiving configuration information for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern; and performing data transmissions for reporting to the server according to the received configuration information.

[0096] The apparatus may be caused to signal, to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

[0097] According to a sixteenth aspect, there is provided a computer program product stored on a medium that may cause an apparatus to perform any method as described herein.

[0098] According to a seventeenth aspect, there is provided an electronic device that may comprise apparatus as described herein.

[0099] According to an eighteenth aspect, there is provided a chipset that may comprise an apparatus as described herein.

Brief description of Figures

[0100] Examples will now be described, by way of example only, with reference to the accompanying Figures in which:

[0101] Figures 1A and 1B show a schematic representation of a 5G system;

[0102] Figure 2 shows a schematic representation of a network apparatus;

[0103] Figure 3 shows a schematic representation of a user equipment;

[0104] Figure 4 shows a schematic representation of a non-volatile memory medium storing instructions which when executed by a processor allow a processor to perform one or more of the steps of the methods of some examples;

[0105] Figure 5 shows a schematic representation of a network;

[0106] Figures 6 to 9 show example signalling diagrams; and

[0107] Figures 10 to 12 are flow charts illustrating exampler operations by apparatus described herein.

Detailed description

[0108] In the following, certain aspects are explained with reference to mobile communication devices capable of communication via a wireless cellular system and mobile communication systems serving such mobile communication devices. For brevity and clarity, the following describes such aspects with reference to a 5G wireless communication system. However, it is understood that such aspects are not limited to 5G wireless communication systems, and may, for example, be applied to other wireless communication systems with analogous components (for example, future 6G wireless communication system).

[0109] Before explaining in detail the exemplifying embodiments, certain general principles of a 5G wireless communication system are briefly explained with reference to Figures 1A and 1B.

[0110] Figure 1A shows a schematic representation of a 5G system (5GS) 100. The 5GS may comprise a user equipment (UE) 102 (which may also be referred to as a communication device or a terminal), a 5G access network (AN) (which may be a 5G Radio Access Network (RAN) or any other type of 5G AN such as a Non-3GPP Interworking Function (N3IWF) /a Trusted Non3GPP Gateway Function (TNGF) for Untrusted / Trusted Non-3GPP access or Wireline Access Gateway Function (W-AGF) for Wireline access) 104, a 5G core (5GC) 106, one or more application functions (AF) 108 and one or more data networks (DN) 110.

[0111] The 5G RAN may comprise one or more distributed unit functions connected to one or more centralized unit functions that are part of the gNodeB (gNB). The RAN may comprise one or more access nodes.

[0112] The 5GC 106 may comprise one or more Access and Mobility Management Functions (AMF) 112, one or more Session Management Functions (SMF) 114, one or more authentication server functions (AUSF) 116, one or more unified data management (UDM) functions 118, one or more user plane functions (UPF) 120, one or more unified data repository (UDR) functions 122, one or more network repository functions (NRF) 128, and/or one or more network exposure functions (NEF) 124. The role of an NEF is to provide secure exposure of network services (e.g. voice, data connectivity, charging, subscriber data, etc.) towards a 3rd party. Although NRF 128 is not depicted with its interfaces, it is understood that this is for clarity reasons and that NRF 128 may have a plurality of interfaces with other network functions.

[0113] The 5GC 106 also comprises a network data analytics function (NWDAF) 126. The NWDAF is responsible for providing network analytics information upon request from one or more network functions or apparatus within the network. Network functions can also subscribe to the NWDAF 126 to receive information therefrom. Accordingly, the NWDAF 126 is also configured to receive and store network information from one or more network functions or apparatus within the network. The data collection by the NWDAF 126 may be performed based on at least one subscription to the events provided by the at least one network function.

[0114] The network may further comprise a management data analytics service (MDAS). The MDAS may provide data analytics of different network related parameters including for example load level and/or resource utilization. For example, the MDAS for a network function (NF) can collect the NF's load related performance data, e.g., resource usage status of the NF. The analysis of the collected data may provide forecast of resource usage information in a predefined future time. This analysis may also recommend appropriate actions e.g., scaling of resources, admission control, load balancing of traffic, etc.

[0115] Figure 1B shows a schematic representation of a 5GC 106' represented in current 3GPP specifications.

[0116] Figure 1B shows a UPF 120' connected to an SMF 114' over an N4 interface. The SMF 114' is connected to each of a UDR 122', an NEF 124', an NWDAF 126', an AF 108', a Policy Control Function (PCF) 130', an AMF 112', and a Charging function 132' over an interconnect medium that also connects these network functions to each other.

[0117] 3GPP refers to a group of organizations that develop and release different standardized communication protocols. 3GPP is currently developing and publishing documents related to Release 16, relating to 5G technology, with Release 17 currently being scheduled for 2022.

[0118] Personal Internet of Things (PIoT) will be provided with support in Release 18 and beyond, with some support being provided already in Release 16 and Release 17. The following aims to provide enhancements on UE power-saving for supporting low-power wearable sensor UE devices in PIoT and IIoT.

[0119] Some power saving mechanisms for UEs have already been specified, such as discontinuous reception (DRX) mechanisms for UE power saving over NR interfaces between UEs and access points. These have been described in 3GPP from the start of 5GS. DRX mechanisms have been included over the NR sidelink communications starting from Release 17. Sidelink communications are direct communications between two user equipment, and so do not pass through an access point. Sidelink communications may also be referred to as device-to-device communications in the following.

[0120] For example, current DRX configurations relate to a switching between a long DRX period and a short DRX period. UEs operating using a longer DRX state wake up less frequently relative to UEs operating using a shorter DRX state. This means that UEs operating in a long DRX state save more power relative to UEs operating in a shorter DRX state. Different UE modes (e.g. IDLE, INACTIVE, and CONNECTED) may each be associated with their own respective DRX operations, and so may have different energy savings relative to each other. In other words, different DRX operations may be specified for different UE states.

[0121] DRX states, particularly longer DRX states, may be coupled with a use of wake-up signal from the serving network for supporting narrow-band massive IoT applications, similar to a paging indicator signal. UEs that successfully receive a wake-up signal prepare to monitor for upcoming signal or data from the serving network. A UE waking up from a DRX state in an IDLE or INACTIVE mode does not necessarily enter a CONNECTED mode: instead, the UE may remain in its existing mode (e.g. IDLE or INACTIVE) while monitoring for predetermined signals. The use of wake-up signal enables the UE to remain in DRX state when there is no forthcoming downlink transmission expected. However, the use of wake-up signal from the serving network

may not be flexible, reliable, and efficient enough for the PIoT and IIoT use cases of interest.

[0122] The following relates to the use of a wake-up signalling scheme for synchronization or coordination of a change or activation of a DRX configuration over the air interface between the UE and the serving network, referred to as Uu interface in 3GPP, among UE members of the group, as controlled by the serving network. The main focus of the following is therefore on network configuration and control over the Uu interface.

[0123] One study has considered various methods for switching between different DRX configurations that is initiated at a UE side (or groups of UEs-side). Switching between up to K preconfigured DRX configurations can be done by Radio Resource Control (RRC) signalling, Medium Access Control (MAC) signalling, or Layer 1 (L1) signalling. This switching can also be triggered depending on the nature of active traffic flows.

[0124] It is noted that the current form of DRX in 3GPP is suggested to be extended in the scope of the RedCap Work Item, RP-210918, up to 10.24s, and to add enhanced DRX (eDRX) with DRX cycles up to 10485.76s. The support of these DRX cycles may be added to UE capabilities exchanged between UE and gNB.

[0125] One class of PIoT and IIoT use cases comprise a group of low-power wearable sensor UE devices that are used for, for example, health or environmental-and-operational safety related monitoring of a person, a machine or an automation system, referred to as a system. In this regard, this group of UEs are co-located, forming an inter-related UE group that serve the same system, e.g., sensing and reporting on different objects or parts of a same system (for example, a container with/without content, a robot, a car, a truck, etc.). The group may be configured such that groups members are able to communicate with other group members via sidelink communications.

[0126] It is expected that, under normal operation for this class of devices, individual UE of the group may need to report their sensing results to an application server periodically and infrequently, e.g., once per an hour. The reporting may be polled by the application server or initiated by individual UE periodically, depending on how the UE has been configured to report their results by the application server. This class of devices may also be configured to provide more frequent communications between individual UE and the application server in more abnormal situations/operations, such

as through indicating that an alarm state is occurring or may be likely to occur imminently. These more frequent communications may be initiated by individual UEs and/or the application server for periodical reporting, e.g., once per a minute, as well as event-triggered reporting, e.g., in response to a request from the server and/or from individual UE.

[0127] There may also be different power saving resolutions for the normal situation and/or the abnormal situation, as specific to the system. The power saving mechanism employed in any particular case may be selected to correspond to different frequencies and needs of periodical and/or event-based reporting from individual UE to the application server.

[0128] To this effect, one UE of the group serving the same system may experience a normal situation while another UE of the group may experience an abnormal situation, as different UEs may sense and reporting on different objects or parts of the system, or even the same objects or parts but with different sensitivity levels. However, from the overall system-operation perspective, a report from one UE of the group upon an abnormal situation may likely trigger the application server to request other UEs of the group to report their sensing results more frequently or in real-time per a request from the server.

[0129] For example, consider an in-body sensor system for medical application which comprises, for example, an electrocardiogram (ECG) monitoring device and a photoplethysmography (PPG) monitoring device for measuring a patient's heartrate. The ECG monitoring device may normally operate at low sample rate and low reporting frequency, but higher frequency sampling and real-time reporting may be activated when an anomaly is detected. The anomaly detection may happen in the server side. Thus, the server may have to request the device to move to a more active state with more frequent reporting. This could be triggered based on measurement report from the PPG.

[0130] In another example, an IIoT automation system may require more frequent reports from sensors when operating in a full speed or full capacity than when operating in a half speed or half capacity (e.g. for safety reasons). Then, an abnormal event or situation as reported by one sensor (e.g., a part of the system is heated up above a certain temperature), may trigger the server to request other sensors of the system to provide more frequent reporting of sensing results or to report in real-time in response to a request from the server.

[0131] It would therefore be useful, in such use cases, to provide network support for both periodical and event-triggered reporting of individual UE device of the system, subject to optimal power saving for UE device.

[0132] On the one hand, in a normal situation of the system, individual UE of the system may be kept in a long DRX state of either an IDLE or an INACTIVE state towards the serving network (i.e., deep sleep) and periodically waken up for reporting the sensing results to the server. This allows for maximizing power saving for individual UE.

[0133] On the other hand, individual UE of the system may need to be kept in a short DRX state of either IDLE, INACTIVE or CONNECTED state of the serving network so that individual UE can be requested by the serving network to report to the server without considerable delay whenever needed, e.g., when an abnormal situation of the system happens. This allows for rather limited power saving for individual UE.

[0134] These issues are normally addressed by configuring power saving option that support both periodical and event-triggered traffic.

[0135] However, the following realizes that by exploring and exploiting relationships between UEs of an inter-related UE group (for example, in terms of their collocations and behaviours in the system operation as highlighted above), the above issues may be further resolved for maximizing power saving for each individual UE.

[0136] For example, consider an inter-related UE group comprising at least individual UE members, UE1 and UE2. In a normal situation, UE1 and UE2 may be configured to report to the server once per time period T1.

[0137] When UE1 detects an abnormal situation, UE1 initiates a report to the server without considerable delay. Then upon receiving the report from UE1, the server may need to request UE2 to report to the server either more frequently (e.g. once per time period T2, where T2<T1), and/or on the fly without considerable delay. If the serving network has full knowledge about this inter-related UE group and its operation, the serving network may keep UE's with infrequent events in longer DRX state than devices with frequent events, thereby saving power on keeping the connection between each UE and an access point for the individual UE's configured to report infrequent events.

[0138] That is, the serving network, being aware of the UE group and its operation, may be able to adapt DRX configurations for UE members of the group (i.e., to trigger a DRX reconfiguration to UE1 and UE2 in the present example) upon detecting that

UE1 is reporting to the server out of its periodical reporting pattern in a normal situation or, that is, due to an abnormal situation. In general, so-called “infrequent” reporting events are used for normal situation and so-called “frequent” or “event-based” reporting events are used for abnormal situation.

[0139] In other words, the serving network may be able to detect normal and abnormal situations of the group and (re)configure DRX for UE members of the group accordingly so as to provide optimal power saving for all UE members of the group. The present disclosure provides a method for facilitating such DRX reconfiguration using at least one designated wake-up signal over sidelink via UE1, and further discloses the use of relays within a UE group, as discussed in more detail below.

[0140] However, the UEs may maintain a sidelink option for communication, using one or more UEs as relays for communications from the server. As an example, UE1 will be considered as being configured to function as such a relay. In this case, when the serving network detects a UE-initiated reporting from UE1 that is not on UE1’s regular per-T1 transmission configured, the serving network may proactively reconfigure UE2 to move into a short DRX state via the relay, expecting that the server will request UE2 to report to it. UE2 may therefore receive this request and report to the server without considerable delay. Alternatively, the serving network may route all events through the relay of UE1 until the DRX period expires and then decide whether to re-configure the DRX period of UE2. One of the key issues here is to dynamically control the DRX period on the Uu interface on devices in a known sidelink group in an energy-efficient and reliable manner without excessive delay, including the routing of data for the different configurations.

[0141] The following relates to at least one mechanism for a UE to save power on the Uu interface while being comprised in a group of UEs with good sidelink coverage.

[0142] In such a case, the network may utilize the sidelink relay function to maintain connections to the UEs in the group via one or more UE’s acting as relays, while configuring all other UEs in the group for long DRX durations. At the same time, the network has the option to do infrequent event transfer (i.e. reporting according to infrequent reporting events) to UE’s in long DRX periods via the relay, and/or to decide to wake up at least one UE via a sidelink relay for configuring for shorter DRX periods.

[0143] The serving network may detect that UE1 is reporting a more frequent or event-triggered event (implying abnormal situation) to the server, and may be triggered by this detection in one option, to send a notification to UE2 via UE1 acting as a Relay

UE or, in another option, to request UE1 to send a designated wake-up signal to UE2. The designated wake-up signal may be pre-configured to all UE members of the group and used for moving UE2 from a long DRX state to a shorter DRX state, for example. That is, upon receiving the designated wake-up signal, UE2 stops using DRX configuration corresponding to the long DRX state and starts using DRX configuration corresponding to the shorter DRX state. When UE1 relays the notification from the serving network to UE2, UE2 may be any number of members of the group, including a single UE in the group. The notification may comprise explicit control information. When UE1 sends the designated wake-up signal, UE2 may comprise all members of the group. The designated wake-up signal may comprise implicit control information.

[0144] This mechanism is flexible, reliable, and energy-efficient, not only for maximizing power saving of the UE side but also for minimizing network control overhead.

[0145] Figures 6 to 9 are signalling diagrams that illustrate examples of the mechanism discussed herein. A more general discussion will be provided after these examples.

[0146] Figure 6 is a signalling diagram that illustrates a network-initiated change from DRX1 to DRX2 for UE2 using UE1 as a relay.

[0147] Figure 6 illustrates signalling between UE1 601, UE2 602 and a serving network entity 603. The serving network entity may be, for example, a gNB, an AMF, an SMF, or an AF. It is understood that UE1 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner. Further, UE2 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner.

[0148] At 6001, the interrelated group of UE1 and UE2 is being served by the serving network entity 603. The serving network entity 603 collects context information of the UE group from at least one of UE1 and UE2 and the server (via an application function). This context information may be collected, for example, when a member of the UE group performs a connection setup with the serving network.

[0149] At 6002, the serving network entity 603 configures UE1 601 and UE2 602. This configuration may comprise, for example, a plurality of DRX configurations (e.g. DRX1 and DRX2) for UE1 and UE2 for operation in IDLE and/or INACTIVE states, corresponding sidelink configurations for network synchronization and coordination, and rules for using the DRX configurations. This configuration of 6002 may be performed, for example, before the serving network entity 603 releases UE1 and UE2

into the INACTIVE state with DRX1 activated for a normal situation of the group or system operation at 6003. In other words, during 6003 the serving network entity 603 communicates with UE1 601 and UE2 602 using DRX1.

[0150] At 6004, UE2 602 is in an INACTIVE state and operating using DRX1 for signalling the serving network entity.

[0151] At 6005, UE1 601 is in an INACTIVE state and operating using DRX1 for signalling the serving network entity.

[0152] At 6006, UE1 601 detects an abnormal situation has occurred. The abnormal situation may be of the sensor device and its application, which may be separated from the UE device that provides communication for the sensor device to communicate with the application server via the serving network. In this regard, the reporting of the sensor is actually on the application level and may be kept transparent to the UE and the serving network, meaning that it is considered as user data.

[0153] The UE and the serving network may have certain application awareness in serving the sensor device and its application (PIoT). For instance, UE and the serving network may be informed via the application function that, in normal situations, the sensor device is to report its sensing result to the server once per T1 and the report is initiated by the sensor. The UE and the serving network may also be informed via the application function that, in abnormal situations, the sensor device is to report its sensing result to the server once per T2, as initiated by the sensor, or at any time, as requested by the server.

[0154] Based on this awareness, the UE and/or the serving network may detect whether the reporting is in a normal or an abnormal situation, such as, for example, monitoring the timing and triggers of data (report of sensing results) from the sensor device or application server at the UE and/or the serving network. The definition of what parameter value(s) and/or combination of parameter value(s) constitute an abnormal situation for the reporting of the sensor and/or sensor application may be configured to the UE and/or the serving network during 6001, or at some other time. Definitions of a plurality of abnormal situations may be configured at the UEs in the group.

[0155] In response to detecting the abnormal situation, UE1 601 determines to report the detection of the abnormal situation to the server in accordance with its configuration to reporting such sensing results to the server.

[0156] At 6007, UE1 601 enters a CONNECTED state with the serving network entity 603 for reporting the detection to the server.

[0157] At 6008, UE1 601 signals the serving network entity 603. This signalling may indicate that an abnormal situation has been detected.

[0158] At 6009, the serving network entity 603 signals a reconfiguration of the current DRX periods to UE1 601. In the present example, the reconfiguration may indicate that UE2 is to switch from DRX1 to DRX2. The reconfiguration may be silent with respect to a reconfiguration of the DRX configuration of UE1.

[0159] At 6010, UE1 601 signals UE2 602. This signalling is performed using direct communications between UE1 601 and UE2 602. For example, this signalling is performed using a device-to-device communication mechanism such as sidelink communication. This signalling informs UE2 602 that DRX2 is to be used instead of DRX1 for listening for paging signals/ incoming connections/calls, etc. As discussed above, when UE1 relays the notification from the serving network to UE2, UE2 may be any number of members of the group, including a single UE in the group. The notification may comprise explicit control information. When UE1 sends the designated wake-up signal as part of the signalling of 6010, UE2 may comprise all members of the group. The designated wake-up signal may comprise implicit control information.

[0160] At 6011, UE1 601 signals the serving network entity 603 to confirm that the reconfiguration of UE2 602 has been completed.

[0161] At 6012, UE2 602 is in an INACTIVE state and operating using DRX2 for signalling the serving network entity.

[0162] At 6013, UE1 601 is in an INACTIVE state and operating using DRX1 for signalling the serving network entity.

[0163] At 6014, the serving network entity 603 communicates with UE1 601 using DRX1 and with UE2 602 using DRX2.

[0164] In this example of Figure 6, the serving network determines the change from DRX1 to DRX2 for the group based on one or more “unexpected” UE-initiated reports from one or more UE1 members of the group from DRX1. The unexpected reporting implies that one or more UE1 members of the group experience an abnormal situation and therefore initiate reporting to the server outside the expected periodical reporting in DRX1. It is noted that there can be many different Uu DRX configurations (in addition to DRX1 and DRX2), depending on the resolutions of normal or abnormal situations for the group or system. Thus, for a robust change from one particular DRX

configuration to another particular DRX configuration, the serving network may need to base its decision or the determining, on unexpected reporting from more than one UE. This may take into account unexpected reporting from different UEs in the UE group that is performed simultaneously or in parallel over a monitoring time window. The serving network may subsequently determine the change from DRX1 to DRX2 for the UE(s) based on an update of the context information of the group or system from either one or more UEs or the server via an application function, although only the signalling of UE1 is illustrated in Figure 6.

[0165] The serving network may request one or more UE1 members, among those UE1 members that initiated unexpected reporting, to notify UE2 members over sidelink for the change from DRX1 to DRX2. In the event that more than one UE1 member notifies UE2 members over the sidelink for the change from DRX1 to DRX2, these UE1 members may transmit the same wake-up signal in the same channel resources resulting in a single-frequency-network (SFN) type of transmission. This helps to ensure that all of the relevant UE2 members will receive the notification. However, it is understood that a single UE1 member may be trusted to reconfigure the DRX period using sidelink signalling.

[0166] Figure 7 illustrates an example in which UE1 initiates a change from DRX1 to DRX2. In other words, Figure 7 relates to an example in which a UE initiates a change in DRX configuration.

[0167] Figure 7 illustrates potential signalling that may be performed between UE1 701, UE2 702, and a serving network entity 703. The serving network entity may be as described above in relation to Figure 6. It is understood that UE1 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner. Further, UE2 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner.

[0168] At 7001, the inter-related group of UE1 701 and UE2 702 are served by the serving network, which comprises the serving network entity 703. The serving network may obtain context information of the group from either UE members of the UE group or the server (via an application function). This may be performed, for example, upon connection setup for UE members of the UE group with the serving network.

[0169] At 7002, serving network entity 703 configures UE1 701 and UE2 702. This configuration may comprise, for example, a plurality of DRX configurations (e.g. DRX1

and DRX2) for UE1 and UE2 for operation in IDLE and/or INACTIVE states, corresponding sidelink configurations for network synchronization and coordination, and rules for using the DRX configurations. This configuration of 7002 may be performed, for example, before the serving network entity 703 releases UE1 and UE2 into the INACTIVE state with DRX1 activated for a normal situation of the group or system operation at 7003. In other words, during 7003 the serving network entity 703 communicates with UE1 701 and UE2 702 using DRX1.

[0170] At 7004, UE2 702 is in an INACTIVE state and operating using DRX1 for signalling the serving network entity.

[0171] At 7005, UE1 701 is in an INACTIVE state and operating using DRX1 for signalling the serving network entity.

[0172] At 7006, UE1 701 detects an abnormal situation has occurred.

[0173] In response to detecting the abnormal situation, UE1 701 determines to reconfigure the DRX of UE2 during 7007.

[0174] At 7007, UE1 701 signals UE2 702. This signalling is performed over a device-to-device communication link, such as via sidelink. This signalling instructs UE2 702 to switch from DRX1 to DRX2 when listening for communications from the serving network entity.

[0175] At 7008, UE1 701 enters a CONNECTED communication mode with the serving network entity 703 for reporting to the server.

[0176] At 7009, UE1 701 signals the serving network entity 703 an indication that UE2 has been instructed to operate using DRX2 for communications from the serving network entity 703. Assuming that UE1 also determines to change the DRX configuration that it will be using, this signalling may comprise a further indication that UE1 701 will also be operating using DRX2 for communications from the serving network entity 703. The following assumes that UE1 also changes its operations to use DRX2. However, it is understood that this is not always the case (e.g. UE1 may remain using DRX1 while UE2 is changed to DRX2).

[0177] At 7010, the serving network entity 703 determines from the indication(s) received during 7009 that UE1 and UE2 will both be using DRX2 for communications with the serving network entity 703 during their respective INACTIVE states.

[0178] At 7011, the serving network entity 703 signals UE1 701. This signalling causes UE1 701 to reenter the INACTIVE state, albeit with a DRX frequency defined by DRX2 instead of DRX1 as previously.

[0179] At 7012, UE2 702 is in an INACTIVE state and operating using DRX2 for signalling the serving network entity.

[0180] At 7013, UE1 701 is in an INACTIVE state and operating using DRX2 for signalling the serving network entity.

[0181] At 7014, the serving network entity 703 communicates with UE1 701 and UE2 702 using DRX2.

[0182] In both of these examples of Figures 6 and 7, the group or system may be a large sensor network over an extended service area, with UE1 and UE2 each being able to be comprised of dynamic numbers of UE group members within a device-to-device communication range proximity.

[0183] According to these examples, UE1 may be triggered to notify UE2 members within its device-to-device/sidelink communication proximity of the change from DRX1 to DRX2 either autonomously or in response to a request received from the serving network. To help facilitate the latter, UE1 may indicate its current location information when providing an indication to the network that the unexpected/abnormal event has occurred. This provided information may then be taken into account by the serving network in determining the change from DRX1 to DRX2 for UE2 members in proximity of UE1.

[0184] As the DRX configurations in the above examples correspond to that of IDLE or INACTIVE state towards the serving network, the paging configuration (e.g., paging cycle specifying how often a UE in IDLE or INACTIVE state can be paged by the serving network) may be considered the primary part of the DRX configuration to change when the DRX is changed from DRX1 to DRX2. The following considered paging-related aspects of the changing DRX configuration with reference to the above examples.

[0185] First, the paging-related aspects of Figure 6 are considered, in which UE1 has an event-triggered communication with the serving network.

[0186] When UE1 determines that an abnormal/unexpected situation has occurred, UE1 sends the first message to the serving network for an unexpected reporting. UE1 may comprise, within this first message, an indication or a recommendation of the updated DRX configuration for its associated UEs (i.e., UE2 members of the UE group in the present case). This recommendation may be implicit in the event that UE1 follows the configurations provided by the serving network. The recommendation may be based on, for example, sidelink DRX configurations within the UE group when the

UE group determines its own sidelink communications without input from the serving network. As mentioned above, this first message may comprise location information (either relative or absolute) for UE1.

[0187] In response to receiving the first message from UE1, the serving network may reconfigure the DRX configuration of UE2 member(s). The reconfiguration may be based on the recommendation from UE1 or updated context information of the group from UE1 and/or from the server via the application function. At least some of this updated context information may be obtained from the server via an application function. At least some of this updated context information may be obtained from other UEs in the UE group providing their own respective first messages. The determined reconfiguration may be sent to UE1 using dedicated signalling as UE1 is in CONNECTED state for sending the first message. The reconfiguration may be one of the pre-configured DRX configurations (e.g. DRX1 and DRX2), as determined. Consequently, the determined DRX configuration to be used may be signalled explicitly by signalling an index of the determined DRX configuration to indicate which new DRX configuration among the plural of pre-configured DRX configurations is to be applied (e.g., DRX2). Where there are only two options for DRX configurations DRX1 and DRX2, the value of the new DRX configuration (e.g. DRX2) may be implicitly indicated/signalled to UE1 by only an indication that the serving network is instructing a change in DRX of the UE2 and it automatically switches to DRX2.

[0188] In both of the above examples of Figures 6 and 7, UE1 may send to UE2 the DRX reconfiguration over sidelink using the wake-up signalling scheme, as described above.

[0189] The DRX reconfiguration over sidelink from UE1 to UE2 may be triggered at UE1 by receiving the DRX reconfiguration from the serving network for UE2 via dedicated signalling. In this option, UE1 acts as a relay UE for delivering the DRX reconfiguration to UE2.

[0190] When the DRX reconfiguration over sidelink from UE1 to UE2 is triggered by the event-triggered uplink transmission from UE1 to the serving network upon an unexpected reporting event, the DRX reconfiguration may be based on pre-configuration for UE1 initiated autonomous operation, as described above. UE1 triggers UE2 to reconfigure the DRX configuration and triggers the serving network to make the same reconfiguration or configuration update for UE2 at the network side

upon receiving the first message from UE1. When the DRX is preconfigured, the DRX to be used may be signalled implicitly or explicitly, as described above.

[0191] In another example, the new DRX reconfiguration may be only applied to UE1. UE1 acts as a relay UE for monitoring the paging messages of UE2 according to the reconfigured DRX, and delivers the paging message over sidelink to UE2. This option implies a Layer 2 UE-to-Network relay and this relay is transparent to the core-network functions of the serving network. In this option, the notification between UE1 and UE2 may be implicit and kept between UE1 and UE2. The DRX reconfiguration may also be limited between UE1 and the serving network.

[0192] The DRX reconfiguration may comprise that the paging cycle is reduced by N folds for at least a predefined period of time or until a next reconfiguration of the DRX is explicitly performed by the configuring entity. In other words, the paging cycle may be made more frequent by a multiple of N times for the predetermined time period. This may allow more frequent monitoring of paging by the UE being reconfigured in such a way. N may be configured based on the context information of the group or system (e.g., information related to applications or traffic patterns of the group or system in an abnormal situation). Currently, DRX periods are configured as $(2^N x10)$ms. However, it is understood that the definition of the length of DRX periods may be defined by a communication standard/protocol, and may vary as communication standards/protocols evolve.

[0193] Whether data from UE2 is to be routed via UE1 may be determined as part of the decision process for setting of the DRX configuration. This is illustrated with respect to Figure 8.

[0194] Figure 8 illustrates potential signalling between UE1 801, UE2 802, and a serving network entity 803. The serving network entity 803 may be as discussed above in relation to the serving network entity of Figure 6. It is understood that UE1 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner. Further, UE2 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner.

[0195] At 8001, UE1 801 and UE2 802 are being served by the serving network entity. The serving network entity 803 may obtain context information of the group from at least one of UE1, UE2, and/or the server, via an application function. This context information may be obtained during connection setup for UE members with the serving

network. The context information of the group may comprise UE-to-Network relay-related information that configures UE1 to function as a relay to the network for UE2, and that configures UE2 to use UE1 as a relay to the network (in applicable situations).

[0196] At 8002, the serving network entity 803 signals UE1 801. This signalling may indicate that the UE1 should configure itself to act as a relay for data resulting from infrequent events detected by UE2.

[0197] At 8003, the serving network entity signals UE2 802. This signalling may instruct UE2 802 to route information relating to infrequent events to the serving network entity through UE1 801.

[0198] At 8004, the serving network entity 803 configures UE2 802 with DRX configurations DRX1 and DRX2 for operating in at least one of an IDLE state and an INACTIVE state. The serving network entity 803 may further configure UE2 802 with corresponding sidelink configurations for network-event synchronization events and coordination, and rules for using the configurations. The serving network entity 803 may further release UE2 into the INACTIVE state in which DRX1 is used for normal situations/operating conditions of the UE2 (i.e. an alarm state is not detected).

[0199] As UE1 801 is configured to operate as a relay, UE1 801 is configured to operate in DRX2 (i.e. to make more frequent wakeups). In some examples, UE1 801 may not be configured with DRX1 when configured to operate as a relay.

[0200] At 8005, the serving network entity 803 signals UE2 802 to instruct UE2 802 to enter an IDLE and/or an INACTIVE mode using DRX1 to communicate with the serving network entity 803.

[0201] At 8006, the serving network entity 803 signals UE1 801 to instruct UE1 801 to enter an IDLE and/or an INACTIVE mode using DRX2 to communicate with the serving network entity 803.

[0202] At 8007, UE2 802 is in an INACTIVE state and communicating with the serving network entity 803 using DRX1.

[0203] At 8008, UE1 801 is in an INACTIVE state and communicating with the serving network entity 803 using DRX2, where DRX2 has more frequent wakeup periods for communicating with the serving network entity 803 than DRX1 does.

[0204] At 8009, the serving network entity 803 is configured to communicate with UE2 802 using DRX1, and to communicate with UE1 801 using DRX2.

[0205] During 8010, UE2 802 determines that an infrequent event has occurred. This may be determined, for example, when UE2 802 determines that at least one

parameter associated with a predetermined alarm condition has been met. During this, UE2 802 may determine to relay the information regarding this infrequent event to UE1 801 for relaying to the serving network entity 803.

[0206] Consequently, at 8010', UE2 802 signals information relating to its infrequent event to UE1.

[0207] At 8011, UE1 801 signals the received information relating to UE2's infrequent event to the serving network entity 803.

[0208] At 8012, UE2 802 is in an INACTIVE state and communicating with the serving network entity 803 using DRX1.

[0209] At 8013, UE1 801 is in an INACTIVE state and communicating with the serving network entity 803 using DRX2, where DRX2 has more frequent wakeup periods for communicating with the serving network entity 803 than DRX1 does.

[0210] At 8014, the serving network entity 803 is configured to communicate with UE2 802 using DRX1, and to communicate with UE1 801 using DRX2.

[0211] At 8015, UE1 801 determines that a frequent and/or event-triggered event has occurred. This may be determined, for example, when UE1 801 determines that at least one parameter associated with a predetermined alarm condition has been met.

[0212] At 8016, UE1 801 enters a CONNECTED state for communicating with the serving network entity 803 for reporting the determined event of 8015.

[0213] At 8017, UE1 801 signals its report for the determined event of 8015 to the serving network entity 803.

[0214] At 8018, the serving network entity 803 determines to reconfigure UE1 and UE2 to use DRX2, and to request that UE1 notifies UE2 over the sidelink for this reconfiguration.

[0215] Subsequent to this determination, at 8019 the serving network entity 803 signals reconfiguration information to UE1 801 for UE1 and, optionally, for UE2.

[0216] When the serving information provides reconfiguration information for UE2 802 to UE1 801 during 8019, 8020 to 8021 are performed.

[0217] During 8020, UE1 801 signals reconfiguration information to UE2 802 over their sidelink connection to indicate that DRX2 is to be used.

[0218] At 8021, UE1 801 signals the serving network entity 803 to indicate that the requested reconfiguration has been completed.

[0219] When the serving network does not indirectly reconfigure UE2 802 via UE1 801 during 8019 to 8021, 8022 is performed.

[0220] During 8022, the serving network entity signals UE2. This signalling may indicate that routing of all detected events are to be made directly to the serving network entity 803. This may comprise configuration information for configuring small data transmission for small events on the Uu interface.

[0221] When 8021 and/or 8022 are performed, 8023 to 8029 are performed.

[0222] At 8023, UE2 802 is in an INACTIVE state and communicating with the serving network entity 803 using DRX2.

[0223] At 8024, UE1 801 is in an INACTIVE state and communicating with the serving network entity 803 using DRX2.

[0224] At 8025, the serving network entity 803 is configured to communicate with UE2 802 using DRX2, and to communicate with UE1 801 using DRX2.

[0225] At 8026, UE2 determines that an event has occurred, and should be reported directly to the serving network entity 803 subsequent to the reconfiguration signalling of 8022.

[0226] At 8027, UE2 802 signals information regarding the event to the serving network entity 803.

[0227] At 8028, UE2 802 returns to an INACTIVE state and communicating with the serving network entity 803 using DRX2.

[0228] At 8029, the serving network entity 803 returns to communicating with UE2 802 using DRX2.

[0229] The example of Figure 8 thus provides an example of linking the setting of the DRX configuration with the configuration of data routing. This will allow infrequent events to flow from UE2 to the gNB without entering connected mode on the Uu interface, which will allow UE2 to only maintain the sidelink while maintaining DRX in an IDLE or INACTIVE state towards the serving network.

[0230] Figure 9 provides example signalling that may be performed in another example situation in which each device may be configured to detect a need for change in DRX and routing configuration.

[0231] Figure 9 illustrates example signalling that may be performed between a first UE (UE1) 901, a second UE (UE2) 902, and a serving network entity 903. The serving network entity may be an entity as described above in relation to Figure 6. It is understood that UE1 may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner. Further, UE2

may represent a set of UE (where the set may comprise one UE or more than one UE) that are configured to act in the same manner.

[0232] During 9001, UE1 and UE2 are being served by the serving network entity 903. The serving network entity 903 may obtain context information of the group from at least one of UE1, UE2, and/or the server, via an application function. This context information may be performed during connection setup for UE members with the serving network.

[0233] At 9002, the serving network entity 903 signals UE1 901. Receipt of this signalling may cause UE1 901 to configure itself to function as a relay for UE2 902 for when UE2 detects the occurrence of infrequent events.

[0234] At 9003, the serving network entity 903 signals UE2 902. Receipt of this signalling may cause UE2 902 to configure itself to use sidelink communications via UE1 as a relay for reporting the infrequent events to the serving network entity 903.

[0235] At 9004, the serving network entity 903 configures UE1 and UE2 with: DRX configurations DRX1 and DRX2 for communications over the Uu interface when in the IDLE or INACTIVE state, corresponding sidelink configurations for network-event synchronization and coordination, and rules for using the configurations. After performing this configuration, the serving network entity release UE1 and UE2 into the IDLE and/or INACTIVE states in 9005 and 9006.

[0236] At 9005, the serving network entity 903 signals UE1 901. This signalling may instruct UE1 901 to enter an IDLE and/or INACTIVE state while using DRX1 for communications with the serving network entity 903.

[0237] At 9006, the serving network entity 903 signals UE2 902. This signalling may instruct UE2 902 to enter an IDLE and/or INACTIVE state while using DRX1 for communications with the serving network entity 903.

[0238] At 9007, UE2 902 is in an INACTIVE state and communicating with the serving network entity 903 using DRX1.

[0239] At 9008, UE1 901 is in an INACTIVE state and communicating with the serving network entity 903 using DRX1.

[0240] At 9009, the serving network entity 903 is configured to communicate with UE2 902 using DRX1, and to communicate with UE1 901 using DRX1.

[0241] At 9010, UE2 902 determines that an infrequent event has occurred that is to be reported to the serving network entity 903 via UE1 901.The determination that such an event has occurred may be as described above.

[0242] At 9011, in response to the determination of 9010, UE2 902 signals UE1 901 over the sidelink between UE1 and UE2. This signalling may inform UE1 that an infrequent event has occurred for relaying to the serving network entity. This signalling may comprise a report formed by UE2 that reports the conditions sensed by UE2 relating to the infrequent event.

[0243] At 9012, in response to receipt of the signalling of 9011, UE1 901 forwards to the serving network entity 903 an indication that the infrequent event of 9010 has been detected by UE2. When the signalling comprises a report, this report may be forwarded to the serving network entity 903.

[0244] At 9013, UE2 902 is in an INACTIVE state and communicating with the serving network entity 903 using DRX1.

[0245] At 9014, UE1 901 is in an INACTIVE state and communicating with the serving network entity 903 using DRX1.

[0246] At 9015, the serving network entity 903 is configured to communicate with UE2 902 using DRX1, and to communicate with UE1 901 using DRX1.

[0247] At 9016, UE2 902 determines that a frequent or trigger-event-based event has occurred that would benefit from more frequent two-way communication with the serving network entity.

[0248] In response to this determination of 9016, UE2 902 signals a message to the serving network entity 903 at 9017 for reporting the determined event. Depending on which entity makes a decision regarding how routing is performed (e.g. the serving network entity or a UE such as UE1 or UE2), this signalling may indicate a request by UE2 902 for future routing to be performed directly with the serving network entity 903 or indirectly with the serving network entity 903 (e.g. via UE1 901) and/or an instruction by UE2 902 to perform said future routing directly or indirectly. In the present example, it is assumed that the signalling comprises a request (e.g. the serving network entity makes the decision regarding routing), and that the signalling requests direct routing.

[0249] Consequent to this signalling of 9017, the serving network entity 903 signals UE2 902 at 9018. Receipt of this signalling of 9018 causes UE2 902 to configure itself to report detected events directly to the serving network entity 903, and not via a sidelink relay through UE1 901.

[0250] At 9019, the serving network entity 901 signals UE2 902 for configuring UE2 902 to enter an IDLE/INACTIVE state while using DRX2 for communicating with the serving network entity.

[0251] At 9020, UE2 902 is in an INACTIVE state and communicating with the serving network entity 903 using DRX2.

[0252] At 9021, UE1 901 is in an INACTIVE state and communicating with the serving network entity 903 using DRX1.

[0253] At 9022, the serving network entity 903 is configured to communicate with UE2 902 using DRX2, and to communicate with UE1 901 using DRX1.

[0254] It may therefore be seen from the above examples that any entity in the described system may trigger a change in the DRX configuration and/or a data routing configuration (i.e. direct or indirect).

[0255] The following discusses some general aspects illustrated in the above examples.

[0256] As a first point, it is noted that the serving network may be provided with all necessary context information of the inter-related and collocated UE group, also referred to as the system, and its operation. This may be effected by, e.g., either individual UE members of the group, said UE1 and UE2 (just for a reference example), or from the server via, e.g., an AF. The context information may specify at least one of a plurality of information defining the logical relationships and potential reporting configurations of the group of UEs being considered. For example, reporting patterns of individual UE members of the groups in normal and abnormal situations may be provided, inter-relationships between UE members of the group in terms of their uses of reporting patterns may be provided, present situation or state of the system. It is noted that reporting from individual UE member of the group can be either initiated by individual UE member or polled by the server. This step may be performed during, e.g., the connection setup with the serving network for the service request of the group from the UE members, UE1 and UE2, and updated during the operation of the system.

[0257] After obtaining such context information, the serving network may configure the UE members of the group, UE1 and UE2, based on the context information of the group. This configuration may comprise at least one of:

a. Uu DRX configurations, i.e., DRX configurations for UE over Uu interface between the UE and the serving network, which comprise at least a first DRX configuration for a long DRX state and a second DRX configuration for a short DRX state, denoted as DRX1 and DRX2 respectively. The number of DRX configurations for the group may be determined by the serving network based on the resolutions of normal and/or abnormal situation for the operation of the

group, as provided in the context information of the group to the serving network. DRX1 and DRX2 may correspond to DRX configuration of UE in either IDLE or INACTIVE state towards the serving network for power saving. Each DRX configuration may comprise paging configuration, which includes at least how often and how long UE needs to monitor for paging from the serving network during the DRX state.

b. Sidelink group configurations, which may comprise at least one of a configuration for a use of wake-up signal over sidelink between the UE members of the group, UE1 and UE2, for notification and synchronization on which of the Uu DRX configurations the UE members of the group need to use, as controlled by the serving network. As discussed above, when UE1 relays the notification from the serving network to UE2, UE2 may be any number of members of the group, including a single UE in the group. When UE1 sends the designated wake-up signal, UE2 may comprise all members of the group. The designated wake-up signal may comprise implicit control information. The sidelink configuration information may comprise at least one of, for example, configurations for transmitting and monitoring wake-up signal over sidelink among the UE members of the group, with the sidelink configurations corresponding to Uu DRX configurations, DRX1 and DRX2. These configurations may specify, for example, how resources and/or occasions (e.g., similar to paging occasions) for transmitting and monitoring wake-up signal over sidelink for DRX1 and DRX2 are allocated as well as what kinds of wake-up signal sequences over sidelink may be transmitted or monitored. In one example, the wake-up signal may implicitly indicate a network command to change the Uu DRX configuration according to the wake-up signal, i.e., to activate and use a new Uu DRX configuration. This means that the serving network may configure the UE members of the group with different wake-up signal sequences, with different sequences corresponding to a specific, respective Uu DRX configuration as configured to the group, e.g., DRX1 or DRX2. This implicit control may be preferable for common network control that is targeted to all UE2 members of the group. There may further be configured a general-purpose wake-up signal sequence which may be used, e.g., in case UE1 is triggered to wake UE2 up first and then communicate a network command, request or configuration to UE2

explicitly over sidelink. This explicit control may be useful for either common or selective network control, targeted to all UE2 members or for a specific UE2 member of the group.

c. Rules for applying the above configurations, which may comprise, for example, whether autonomous change of the Uu DRX configuration and UE-initiated notification of the configuration change over sidelink is allowed or not and, if so, to what extent the configuration change is allowed. For example, all or selected UE members of the group, represented by UE1, may be configured to determine a change from DRX1 to DRX2 autonomously upon detecting a need or after getting CONNECTED to the serving network to initiate a report of an abnormal situation or event to the server from DRX1. UE1 may also be configured to notify the group of the change from DRX1 to DRX2, i.e., activation of DRX2, via using wake-up signal over sidelink after the determination. This autonomous operation may not be allowed for a change from DRX2 to DRX1 which needs to be triggered by the serving network for reassuring robustness for the system operation and performance. The trigger from the serving network may be based on, e.g., an update of the context information of the system from the server.

d. Setting the routing of data between a UE member of the sidelink group and an access point to the system (e.g. a gNB). This may be effected, for example, via another device in the sidelink group that is acting as relay for smaller data transfers, or by direct transmission to the access point. The routing may be determined based on at least one of the following factors:

i. Number of data bursts to be exchanged over the next period of time relevant for the DRX configuration above;

ii. Relay capabilities of at least one UE in the group of UEs. These relay capabilities may comprise an indication of how much relating the at least one UE is able to perform (e.g. a maximum number of other UEs to which it is able to route data, and/or a maximum data throughput for relay, etc.); and/or

iii. Amount of data in bytes to be transferred. If the amount is large it could result in an undesired power usage on the device acting as relay. Vice versa, if the amount is small, the change to dedicated mode may result in undesired power usage on the device where the data originates.

[0258] The serving network, upon receiving a request from a UE member of the group, e.g. UE1, for reporting to the server (e.g., as soon as UE1 resumes the active connection, i.e., CONNECTED state, to report to the server), may determine whether UE1 is reporting according to the current DRX configuration, e.g. DRX1, in a normal situation or in an abnormal situation and therefore whether a change to the current DRX configuration to UE1 or to another UE member(s) of the group, e.g., a selected UE2 member or all UE2 members, should be made. This determining can be based on timing of the request from UE1 or trigger thereof as received from the server in case the server is responsible for polling periodical report from UE1 in a normal situation, provided that the serving network is aware of the system and its operation from the context information obtained previously.

[0259] When a change from DRX1 to DRX2 for UE2 is needed and UE1 is allowed to determine and initiate this change to UE2 autonomously via sidelink, the request and/or the reporting message from UE1 may indicate to the serving network a status of this autonomous operation. This signalling may indicate either that the configuration change has already occurred to that it will be performed in an upcoming occasion for sending corresponding wake-up signal over sidelink.

[0260] When a change from DRX1 to DRX2 for UE2 is needed and UE1 is not allowed to determine and initiate this change to UE2 autonomously via sidelink, the serving network may request UE1 to notify UE2 of the change via sidelink using a pre-configured wake-up mechanism.

[0261] The serving network may also update the DRX configuration, e.g., from DRX1 to DRX2, to be used for UE members of the group in the network side according to the change determined. This may comprise, for example, updating paging cycle for UE members of the group, according to the updated DRX configuration, DRX2.

[0262] Figures 10 to 12 illustrate example operations that may be performed by apparatus performing at least one aspect of the above-mentioned examples. It Is therefore understood that elements of the above-mentioned examples that are not explicitly discussed below may be additionally performed by the presently described examples, or otherwise provide additional context for the present examples of Figures 10 to 12.

[0263] Figure 10 illustrates example operations that may be performed by an apparatus for a serving network entity. The serving network entity may be, for example, at least one of: a gNB, an AMF, an SMF, and/or an AF.

[0264] At 1001, the apparatus configures at least a first user equipment and a second user equipment with respective configuration information. The configuration information associates a first reporting pattern with a first discontinuous reception pattern for UE operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for UE operating in the IDLE and/or INACTIVE mode. The first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity.

[0265] The data for reporting may be sensor data (i.e. data obtained from at least one detection made by a sensor). When the data for reporting is sensor data, both of the first and second user equipment may be configured to report sensor data originating from itself, or only one of the first and second user equipment may be configured to report sensor data originating from itself (i.e. one of the first and second user equipment may be configured to act as a relay, but not to obtain it's own sensor data for reporting).

[0266] The first reporting pattern may be associated with reporting of normal events (e.g. the infrequent events referred to above). The second reporting pattern may be associated with reporting of abnormal events (e.g. the frequent events referred to above).

[0267] It is understood that the term "discontinuous reception pattern" may be considered to be a discontinuous reception configuration that generally defines when a UE listens for signals (e.g. paging and/or call signals) from another apparatus and when that UE doesn't listen for such signals from another apparatus.

[0268] At 1002, the apparatus receives a request from the first user equipment and/or the second user equipment for reporting to the server. In other words, the request requests that a report be made to the server. When the reporting relates to sensor data, the request may be a request to report sensor data. The first and/or second user equipment making the request may be in an ACTIVE or CONNECTED mode when making the request. In other words, the first and/or second user equipment may not be in an IDLE and/or an INACTIVE mode when the request is made. The request may be comprised in signalling comprising a report, such as a report of sensor data. The request may be comprised in signalling that does not comprise a report of sensor data.

[0269] At 1003, the apparatus determines that the request relates to an event associated with the second reporting pattern. The apparatus may further determine

that the request relates to a user equipment (e.g. the second user equipment) that is currently configured to operate in the IDLE and/or INACTIVE mode using the first discontinuous reception pattern.

[0270] At 1004, the apparatus reconfigures the second user equipment to operate using the second discontinuous reception pattern.

[0271] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may be performed by reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly (e.g. via the first user equipment). This may be performed in response to receiving the request from the first user equipment. In such a case, reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment may comprise configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

[0272] The reconfiguring the second user equipment to operate using the second discontinuous reception pattern may comprise reconfiguring the second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment. In other words, the reconfiguring of the second discontinuous reception pattern may be performed without relaying the reconfiguration information for this through the first user equipment (or through another user equipment).

[0273] When the apparatus reconfigures the second user equipment directly, this may be performed by signalling the second user equipment during an active reception window of the first discontinuous reception pattern operated by the second user equipment. When the second user equipment is configured with only two discontinuous reception patterns for listening for signalling from the serving network entity (with only one of these discontinuous reception patterns being used at any single time), this signalling may comprise a single indication that the second user equipment is to switch from using the first discontinuous reception pattern to using the second discontinuous pattern. When the second user equipment is configured with more than two discontinuous reception patterns for listening for signalling from the serving network entity (with only one of these discontinuous reception patterns being used at

any single time), this signalling may comprise an explicit identifier of the second discontinuous reception pattern.

[0274] The signalling the reconfiguration information to the second user equipment using sidelink communications may comprise selecting a wake-up signal that maps to the second discontinuous reception pattern, and signalling the selected wake-up signal to the second user equipment.

[0275] The apparatus may configure the first user equipment to act as a relay for the second user equipment. The apparatus may configure the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern. The apparatus may configure the second user equipment to transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern. The first and/or second user equipment may be configured in such a way using at least part of the configuration information referred to in 1001.

[0276] The apparatus may receive, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment. The apparatus may determine the configuration information using the received context information.

[0277] Figure 11 illustrates potential operations that may be performed by an apparatus for a first user equipment. The apparatus of Figure 11 may interact with the apparatus of Figure 10. For example, the first user equipment may be the first user equipment of Figure 10.

[0278] At 1101, the apparatus receives, from a serving network entity (e.g. the serving network apparatus of Figure 10), configuration information. The configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode. The first user equipment is comprised in a group of user equipment

comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity.

[0279] The data for reporting may be sensor data (i.e. data obtained from at least one detection made by a sensor). When the data for reporting is sensor data, both of the first and second user equipment may be configured to report sensor data originating from itself (in other words, the request may originate from the apparatus or the second user equipment), or only one of the first and second user equipment may be configured to report sensor data originating from itself (i.e. one of the first and second user equipment may be configured to act as a relay, but not to obtain its own sensor data for reporting). In both of these cases, when the request originates from the second user equipment, the apparatus may receive the request from the second user equipment via sidelink communications.

[0280] The first reporting pattern may be associated with reporting of normal events (e.g. the infrequent events referred to above). The second reporting pattern may be associated with reporting of abnormal events (e.g. the frequent events referred to above).

[0281] It is understood that the term "discontinuous reception pattern" may be considered to be a discontinuous reception configuration that generally defines when a UE listens for signals (e.g. paging and/or call signals) from another apparatus and when that UE doesn't listen for such signals from another apparatus.

[0282] At 1102, the apparatus sends a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern.

[0283] At 1103, the apparatus determines reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

[0284] At 1104, the apparatus signals the reconfiguration information to the second user equipment using sidelink communications.

[0285] The determining the reconfiguration information may comprise receiving the reconfiguration information from the serving network entity. Alternatively or in addition, the determining the reconfiguration information, may comprise detecting that the request relates to an event associated with the second report pattern, and determining the reconfiguration information in response to said detecting. The determining the reconfiguration information in response to said detecting may be performed without

any input regarding the reconfiguration information being received from the server between the time of said detecting and the time of said determining.

[0286] The apparatus may signal the reconfiguration information to the serving network entity.

[0287] The signalling the reconfiguration information to the second user equipment using sidelink communications may comprise selecting a wake-up signal that maps to the second discontinuous reception pattern, and signalling the selected wake-up signal to the second user equipment.

[0288] When the apparatus reconfigures the second user equipment, this may be performed by signalling the second user equipment during an active reception window of the first discontinuous reception pattern operated by the second user equipment. When the second user equipment is configured with only two discontinuous reception patterns for listening for signalling from the apparatus (with only one of these discontinuous reception patterns being used at any single time), this signalling may comprise a single indication that the second user equipment is to switch from using the first discontinuous reception pattern to using the second discontinuous pattern. When the second user equipment is configured with more than two discontinuous reception patterns for listening for signalling from the apparatus (with only one of these discontinuous reception patterns being used at any single time), this signalling may comprise an explicit identifier of the second discontinuous reception pattern.

[0289] The apparatus may send, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment. When the context information is sent, this may be sent prior to receive any configuration information for configuring the user equipment with the first and second discontinuous reception pattern.

[0290] Figure 12 relates to operations that may be performed by an apparatus for a second user equipment. The apparatus may interact with the serving network entity apparatus of Figure 10. For example, the second user equipment may be the second user equipment discussed in relation to Figure 10. The apparatus may interact with

the first user equipment apparatus of Figure 11. For example, the second user equipment may be the second user equipment discussed in relation to Figure 11.

[0291] At 1201, the apparatus receives, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode. The second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity.

[0292] The receiving the configuration information from the serving network entity may comprise: receiving configuration information for configuring the second user equipment to: transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern; and performing data transmissions for reporting to the server according to the received configuration information.

[0293] The data transmissions for reporting may be sensor data (i.e. data obtained from at least one detection made by a sensor). When the data for reporting is sensor data, both of the first and second user equipment may be configured to report sensor data originating from itself (in other words, the request may originate from the apparatus or the second user equipment), or only one of the first and second user equipment may be configured to report sensor data originating from itself (i.e. one of the first and second user equipment may be configured to act as a relay, but not to obtain its own sensor data for reporting). In both of these cases, when the request originates from the second user equipment, the apparatus may receive the request from the second user equipment via sidelink communications.

[0294] The first reporting pattern may be associated with reporting of normal events (e.g. the infrequent events referred to above). The second reporting pattern may be associated with reporting of abnormal events (e.g. the frequent events referred to above).

[0295] It is understood that the term "discontinuous reception pattern" may be considered to be a discontinuous reception configuration that generally defines when a UE listens for signals (e.g. paging and/or call signals) from another apparatus and when that UE doesn't listen for such signals from another apparatus.

[0296] At 1202, the apparatus receives, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern. The second user equipment may be operating using the first discontinuous reception pattern when the reconfiguration information is received.

[0297] The receipt of this reconfiguration information may be made after the serving network entity has received a request for reporting to the server. In particular, the reconfiguration information may be received in response to a request for reporting to the server. The request may relate to an event associated with the second reporting pattern and originate while the second user equipment is operating using the first discontinuous reception pattern. The request for reporting may originate from the first user equipment. The request for reporting may originate from the apparatus of Figure 12. In this latter case, therefore, the apparatus may signal to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

[0298] At 1203, the apparatus operates using the second discontinuous reception pattern.

[0299] The receiving reconfiguration information may comprise receiving, from the first user equipment and/or the serving network entity, a wake-up signal that maps to the second discontinuous reception pattern. The apparatus may use the wake-up signal to determine the second discontinuous reception pattern. When the second user equipment is configured with only two discontinuous reception patterns for listening for signalling (with only one of these discontinuous reception patterns being used at any single time), this wake-up signalling may comprise a single indication that the second user equipment is to switch from using the first discontinuous reception pattern to using the second discontinuous pattern. When the second user equipment is configured with more than two discontinuous reception patterns for listening for signalling (with only one of these discontinuous reception patterns being used at any single time), this wake-up signalling may comprise an explicit identifier of the second discontinuous reception pattern.

[0300] The apparatus may send, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

[0301] By employing aspects of the above-described mechanisms, the presently described system may allow for maximizing power saving in supporting low-power sensor devices and their applications by allowing devices to maintain only the sidelink and have long DRX periods on the interface between a user equipment and an access point (Uu interface).

[0302] Further, by allowing for efficient group-specific control and reconfiguration of Uu DRX configurations, flexible network reachability without causing excessive delay for application traffic may be obtained, along with flexible routing of data based on the DRX configuration. This is further configured by allowing all devices to initiate a chance of DRX and routing configuration if the situation mandates a change.

[0303] Figure 2 shows an example of a control apparatus for a communication system, for example to be coupled to and/or for controlling a station of an access system, such as a RAN node, e.g. a base station, gNB, a central unit of a cloud architecture or a node of a core network such as an MME or S-GW, a scheduling entity such as a spectrum management entity, or a server or host, for example an apparatus hosting an NRF, NWDAF, AMF, SMF, UDM/UDR etc. The control apparatus may be integrated with or external to a node or module of a core network or RAN. In some embodiments, base stations comprise a separate control apparatus unit or module. In other embodiments, the control apparatus can be another network element such as a radio network controller or a spectrum controller. The control apparatus 200 can be arranged to provide control on communications in the service area of the system. The apparatus 200 comprises at least one memory 201, at least one data processing unit 202, 203 and an input/output interface 204. Via the interface the control apparatus can be coupled to a receiver and a transmitter of the apparatus. The receiver and/or the transmitter may be implemented as a radio front end or a remote radio head. For example, the control apparatus 200 or processor 201 can be configured to execute an appropriate software code to provide the control functions.

[0304] A possible wireless communication device will now be described in more detail with reference to Figure 3 showing a schematic, partially sectioned view of a communication device 300. Such a communication device is often referred to as user equipment (UE) or terminal. An appropriate mobile communication device may be provided by any device capable of sending and receiving radio signals. Non-limiting examples comprise a mobile station (MS) or mobile device such as a mobile phone or what is known as a 'smart phone', a computer provided with a wireless interface card or other wireless interface facility (e.g., USB dongle), personal data assistant (PDA) or a tablet provided with wireless communication capabilities, or any combinations of these or the like. A mobile communication device may provide, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and so on. Users may thus be offered and provided numerous services via their communication devices. Non-limiting examples of these services comprise two-way or multi-way calls, data communication or multimedia services or simply an access to a data communications network system, such as the Internet. Users may also be provided broadcast or multicast data. Non-limiting examples of the content comprise downloads, television and radio programs, videos, advertisements, various alerts and other information.

[0305] A wireless communication device may be for example a mobile device, that is, a device not fixed to a particular location, or it may be a stationary device. The wireless device may need human interaction for communication, or may not need human interaction for communication. In the present teachings the terms UE or "user" are used to refer to any type of wireless communication device.

[0306] The wireless device 300 may receive signals over an air or radio interface 307 via appropriate apparatus for receiving and may transmit signals via appropriate apparatus for transmitting radio signals. In Figure 3 transceiver apparatus is designated schematically by block 306. The transceiver apparatus 306 may be provided for example by means of a radio part and associated antenna arrangement. The antenna arrangement may be arranged internally or externally to the wireless device.

[0307] A wireless device is typically provided with at least one data processing entity 301, at least one memory 302 and other possible components 303 for use in software and hardware aided execution of tasks it is designed to perform, including control of access to and communications with access systems and other communication

devices. The data processing, storage and other relevant control apparatus can be provided on an appropriate circuit board and/or in chipsets. This feature is denoted by reference 704. The user may control the operation of the wireless device by means of a suitable user interface such as keypad 305, voice commands, touch sensitive screen or pad, combinations thereof or the like. A display 308, a speaker and a microphone can be also provided. Furthermore, a wireless communication device may comprise appropriate connectors (either wired or` wireless) to other devices and/or for connecting external accessories, for example hands-free equipment, thereto.

[0308] Figure 4 shows a schematic representation of non-volatile memory media 400a (e.g. computer disc (CD) or digital versatile disc (DVD)) and 400b (e.g. universal serial bus (USB) memory stick) storing instructions and/or parameters 402 which when executed by a processor allow the processor to perform one or more of the steps of the methods of Figure 10 and/or Figure 11 and/or Figure 12.

[0309] The embodiments may thus vary within the scope of the attached claims. In general, some embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. For example, some aspects may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device, although embodiments are not limited thereto. While various embodiments may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

[0310] The embodiments may be implemented by computer software stored in a memory and executable by at least one data processor of the involved entities or by hardware, or by a combination of software and hardware. Further in this regard it should be noted that any procedures, e.g., as in Figure 10 and/or Figure 11 and/or Figure 12, may represent program steps, or interconnected logic circuits, blocks and functions, or a combination of program steps and logic circuits, blocks and functions. The software may be stored on such physical media as memory chips, or memory blocks implemented within the processor, magnetic media such as hard disk or floppy disks, and optical media such as for example DVD and the data variants thereof, CD.

[0311] The memory may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductorbased memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The data processors may be of any type suitable to the local technical environment, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs), application specific integrated circuits (AStudy ItemC), gate level circuits and processors based on multicore processor architecture, as nonlimiting examples.

[0312] Alternatively or additionally, some embodiments may be implemented using circuitry. The circuitry may be configured to perform one or more of the functions and/or method steps previously described. That circuitry may be provided in the base station and/or in the communications device.

[0313] As used in this application, the term “circuitry” may refer to one or more or all of the following:

(a) hardware-only circuit implementations (such as implementations in only analogue and/or digital circuitry);

(b) combinations of hardware circuits and software, such as:

(i) a combination of analogue and/or digital hardware circuit(s) with software/firmware and

(ii) any portions of hardware processor(s) with software (including digital signal processor(s)), software, and memory(ies) that work together to cause an apparatus, such as the communications device or base station to perform the various functions previously described; and

(c) hardware circuit(s) and or processor(s), such as a microprocessor(s) or a portion of a microprocessor(s), that requires software (e.g., firmware) for operation, but the software may not be present when it is not needed for operation.

[0314] This definition of circuitry applies to all uses of this term in this application, including in any claims. As a further example, as used in this application, the term circuitry also covers an implementation of merely a hardware circuit or processor (or multiple processors) or portion of a hardware circuit or processor and its (or their) accompanying software and/or firmware. The term circuitry also covers, for example integrated device.

[0315] The foregoing description has provided by way of exemplary and non-limiting examples a full and informative description of some embodiments. However, various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. However, all such and similar modifications of the teachings will still fall within the scope as defined in the appended claims.

[0316] In the above, different examples are described using, as an example of an access architecture to which the presently described techniques may be applied, a radio access architecture based on long term evolution advanced (LTE Advanced, LTE-A) or new radio (NR, 5G), without restricting the examples to such an architecture, however. The examples may also be applied to other kinds of communications networks having suitable means by adjusting parameters and procedures appropriately. Some examples of other options for suitable systems are the universal mobile telecommunications system (UMTS) radio access network (UTRAN), wireless local area network (WLAN or WiFi), worldwide interoperability for microwave access (WiMAX), Bluetooth®, personal communications services (PCS), ZigBee®, wideband code division multiple access (WCDMA), systems using ultra-wideband (UWB) technology, sensor networks, mobile ad-hoc networks (MANETs) and Internet Protocol multimedia subsystems (IMS) or any combination thereof.

[0317] Figure 5 depicts examples of simplified system architectures only showing some elements and functional entities, all being logical units, whose implementation may differ from what is shown. The connections shown in Figure 5 are logical connections; the actual physical connections may be different. It is apparent to a person skilled in the art that the system typically comprises also other functions and structures than those shown in Figure 5.

[0318] The examples are not, however, restricted to the system given as an example but a person skilled in the art may apply the solution to other communication systems provided with necessary properties.

[0319] The example of Figure 5 shows a part of an exemplifying radio access network. For example, the radio access network may support sidelink communications described below in more detail.

[0320] Figure 5 shows devices 500 and 502. The devices 500 and 502 are configured to be in a wireless connection on one or more communication channels with a node

504. The node 504 is further connected to a core network 506. In one example, the node 504 may be an access node such as (e/g)NodeB serving devices in a cell. In one example, the node 504 may be a non-3GPP access node. The physical link from a device to a (e/g)NodeB is called uplink or reverse link and the physical link from the (e/g)NodeB to the device is called downlink or forward link. It should be appreciated that (e/g)NodeBs or their functionalities may be implemented by using any node, host, server or access point etc. entity suitable for such a usage.

[0321] A communications system typically comprises more than one (e/g)NodeB in which case the (e/g)NodeBs may also be configured to communicate with one another over links, wired or wireless, designed for the purpose. These links may be used for signalling purposes. The (e/g)NodeB is a computing device configured to control the radio resources of communication system it is coupled to. The NodeB may also be referred to as a base station, an access point or any other type of interfacing device including a relay station capable of operating in a wireless environment. The (e/g)NodeB includes or is coupled to transceivers. From the transceivers of the (e/g)NodeB, a connection is provided to an antenna unit that establishes bi-directional radio links to devices. The antenna unit may comprise a plurality of antennas or antenna elements. The (e/g)NodeB is further connected to the core network 506 (CN or next generation core NGC). Depending on the deployed technology, the (e/g)NodeB is connected to a serving and packet data network gateway (S-GW +P-GW) or user plane function (UPF), for routing and forwarding user data packets and for providing connectivity of devices to one or more external packet data networks, and to a mobile management entity (MME) or access mobility management function (AMF), for controlling access and mobility of the devices.

[0322] Examples of a device are a subscriber unit, a user device, a user equipment (UE), a user terminal, a terminal device, a mobile station, a mobile device, etc

[0323] The device typically refers to a mobile or static device (e.g. a portable or non-portable computing device) that includes wireless mobile communication devices operating with or without an universal subscriber identification module (USIM), including, but not limited to, the following types of devices: mobile phone, smartphone, personal digital assistant (PDA), handset, device using a wireless modem (alarm or measurement device, etc.), laptop and/or touch screen computer, tablet, game console, notebook, and multimedia device. It should be appreciated that a device may also be a nearly exclusive uplink only device, of which an example is a camera or

video camera loading images or video clips to a network. A device may also be a device having capability to operate in Internet of Things (IoT) network which is a scenario in which objects are provided with the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction, e.g. to be used in smart power grids and connected vehicles. The device may also utilise cloud. In some applications, a device may comprise a user portable device with radio parts (such as a watch, earphones or eyeglasses) and the computation is carried out in the cloud.

[0324] The device illustrates one type of an apparatus to which resources on the air interface are allocated and assigned, and thus any feature described herein with a device may be implemented with a corresponding apparatus, such as a relay node. An example of such a relay node is a layer 3 relay (self-backhauling relay) towards the base station. The device (or, in some examples, a layer 3 relay node) is configured to perform one or more of user equipment functionalities.

[0325] Various techniques described herein may also be applied to a cyber-physical system (CPS) (a system of collaborating computational elements controlling physical entities). CPS may enable the implementation and exploitation of massive amounts of interconnected information and communications technology, ICT, devices (sensors, actuators, processors microcontrollers, etc.) embedded in physical objects at different locations. Mobile cyber physical systems, in which the physical system in question has inherent mobility, are a subcategory of cyber-physical systems. Examples of mobile physical systems include mobile robotics and electronics transported by humans or animals.

[0326] Additionally, although the apparatuses have been depicted as single entities, different units, processors and/or memory units (not all shown in Figure 5) may be implemented.

[0327] 5G enables using multiple input – multiple output (MIMO) antennas, many more base stations or nodes than the LTE (a so-called small cell concept), including macro sites operating in co-operation with smaller stations and employing a variety of radio technologies depending on service needs, use cases and/or spectrum available. 5G mobile communications supports a wide range of use cases and related applications including video streaming, augmented reality, different ways of data sharing and various forms of machine type applications (such as (massive) machine-type communications (mMTC), including vehicular safety, different sensors and real-time

control). 5G is expected to have multiple radio interfaces, e.g. below 6GHz or above 24 GHz, cmWave and mmWave, and also being integrable with existing legacy radio access technologies, such as the LTE. Integration with the LTE may be implemented, at least in the early phase, as a system, where macro coverage is provided by the LTE and 5G radio interface access comes from small cells by aggregation to the LTE. In other words, 5G is planned to support both inter-RAT operability (such as LTE-5G) and inter-RI operability (inter-radio interface operability, such as below 6GHz – cmWave, 6 or above 24 GHz – cmWave and mmWave). One of the concepts considered to be used in 5G networks is network slicing in which multiple independent and dedicated virtual sub-networks (network instances) may be created within the same infrastructure to run services that have different requirements on latency, reliability, throughput and mobility.

[0328] The current architecture in LTE networks is fully distributed in the radio and fully centralized in the core network. The low latency applications and services in 5G require to bring the content close to the radio which leads to local break out and multi-access edge computing (MEC). 5G enables analytics and knowledge generation to occur at the source of the data. This approach requires leveraging resources that may not be continuously connected to a network such as laptops, smartphones, tablets and sensors. MEC provides a distributed computing environment for application and service hosting. It also has the ability to store and process content in close proximity to cellular subscribers for faster response time. Edge computing covers a wide range of technologies such as wireless sensor networks, mobile data acquisition, mobile signature analysis, cooperative distributed peer-to-peer ad hoc networking and processing also classifiable as local cloud/fog computing and grid/mesh computing, dew computing, mobile edge computing, cloudlet, distributed data storage and retrieval, autonomic self-healing networks, remote cloud services, augmented and virtual reality, data caching, Internet of Things (massive connectivity and/or latency critical), critical communications (autonomous vehicles, traffic safety, real-time analytics, time-critical control, healthcare applications).

[0329] The communication system is also able to communicate with other networks 512, such as a public switched telephone network, or a VoIP network, or the Internet, or a private network, or utilize services provided by them. The communication network may also be able to support the usage of cloud services, for example at least part of core network operations may be carried out as a cloud service (this is depicted in

Figure 5 by "cloud" 514). This may also be referred to as Edge computing when performed away from the core network. The communication system may also comprise a central control entity, or a like, providing facilities for networks of different operators to cooperate for example in spectrum sharing.

[0330] The technology of Edge computing may be brought into a radio access network (RAN) by utilizing network function virtualization (NFV) and software defined networking (SDN). Using the technology of edge cloud may mean access node operations to be carried out, at least partly, in a server, host or node operationally coupled to a remote radio head or base station comprising radio parts. It is also possible that node operations will be distributed among a plurality of servers, nodes or hosts. Application of cloudRAN architecture enables RAN real time functions being carried out at or close to a remote antenna site (in a distributed unit, DU 508) and non-real time functions being carried out in a centralized manner (in a centralized unit, CU 510).

[0331] It should also be understood that the distribution of labour between core network operations and base station operations may differ from that of the LTE or even be non-existent. Some other technology advancements probably to be used are Big Data and all-IP, which may change the way networks are being constructed and managed. 5G (or new radio, NR) networks are being designed to support multiple hierarchies, where Edge computing servers can be placed between the core and the base station or nodeB (gNB). One example of Edge computing is MEC, which is defined by the European Telecommunications Standards Institute. It should be appreciated that MEC (and other Edge computing protocols) can be applied in 4G networks as well.

[0332] 5G may also utilize satellite communication to enhance or complement the coverage of 5G service, for example by providing backhauling. Possible use cases are providing service continuity for machine-to-machine (M2M) or Internet of Things (IoT) devices or for passengers on board of vehicles, Mobile Broadband, (MBB) or ensuring service availability for critical communications, and future railway/maritime/aeronautical communications. Satellite communication may utilise geostationary earth orbit (GEO) satellite systems, but also low earth orbit (LEO) satellite systems, in particular mega-constellations (systems in which hundreds of (nano)satellites are deployed). Each satellite in the mega-constellation may cover several satellite-enabled network entities that create on-ground cells. The on-ground

cells may be created through an on-ground relay node or by a gNB located on-ground or in a satellite.

[0333] It is obvious for a person skilled in the art that the depicted system is only an example of a part of a radio access system and in practice, the system may comprise a plurality of (e/g)NodeBs, the device may have an access to a plurality of radio cells and the system may comprise also other apparatuses, such as physical layer relay nodes or other network elements, etc. At least one of the (e/g)NodeBs or may be a Home(e/g)nodeB. Additionally, in a geographical area of a radio communication system a plurality of different kinds of radio cells as well as a plurality of radio cells may be provided. Radio cells may be macro cells (or umbrella cells) which are large cells, usually having a diameter of up to tens of kilometers, or smaller cells such as micro-, femto- or picocells. The (e/g)NodeBs of Figure 5 may provide any kind of these cells. A cellular radio system may be implemented as a multilayer network including several kinds of cells. Typically, in multilayer networks, one access node provides one kind of a cell or cells, and thus a plurality of (e/g)NodeBs are required to provide such a network structure.

[0334] For fulfilling the need for improving the deployment and performance of communication systems, the concept of “plug-and-play” (e/g)NodeBs has been introduced. Typically, a network which is able to use “plug-and-play” (e/g)Node Bs, includes, in addition to Home (e/g)NodeBs (H(e/g)nodeBs), a home node B gateway, or HNB-GW (not shown in Figure 5). A HNB Gateway (HNB-GW), which is typically installed within an operator’s network may aggregate traffic from a large number of HNBs back to a core network.

Claims

1) An apparatus for a serving network entity, the apparatus comprising means for:

configuring at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity;

receiving a request from the first user equipment and/or the second user equipment for reporting to the server;

determining that the request relates to an event associated with the second reporting pattern; and

reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

2) An apparatus as claimed in any preceding claim, wherein the means for reconfiguring the second user equipment to operate using the second discontinuous reception pattern comprises means for:

reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment in response to receiving the request from the first user equipment.

3) An apparatus as claimed in claim 2, wherein the means for reconfiguring the second user equipment to operate using the second discontinuous reception pattern indirectly via the first user equipment comprises means for configuring the first user equipment to signal reconfiguration information to the second user equipment using sidelink communications while the second user equipment is in said IDLE and/or INACTIVE mode.

4) An apparatus as claimed in claim 1, wherein the means for reconfiguring the second user equipment to operate using the second discontinuous reception pattern comprises means for:

reconfiguring the second user equipment to operate using the second discontinuous reception pattern directly in response to receiving the request from the second user equipment.

5) An apparatus as claimed in any preceding claim, comprising means for:

configuring the first user equipment to act as a relay for the second user equipment;

configuring the second user equipment to:

transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and

transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern.

6) An apparatus as claimed in any preceding claim, comprising means for:

receiving, from at least one of the first and second user equipment and/or the server via an application function context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment; and

determining the configuration information using the received context information.

7) An apparatus for a first user equipment, the apparatus comprising means for:

receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment

is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity;

sending a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern;

determining reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and

signalling the reconfiguration information to the second user equipment using sidelink communications.

8) An apparatus as claimed in claim 7, wherein the request originates from the apparatus or the second user equipment, wherein when the request originates from the second user equipment, the apparatus comprises means for receiving the request from the second user equipment via sidelink communications.

9) An apparatus as claimed in any of claims 7 to 8, wherein the means for determining the reconfiguration information comprises means for: receiving the reconfiguration information from the serving network entity.

10)An apparatus as claimed in any of claims 7 to 8, wherein the means for determining the reconfiguration information, comprising means for:

detecting that the request relates to an event associated with the second report pattern; and

determining the reconfiguration information in response to said detecting.

11) An apparatus as claimed in claim 10, comprising means for signalling the reconfiguration information to the serving network entity.

12) An apparatus as claimed in any of claims 7 to 11, wherein said means for signaling the reconfiguration information to the second user equipment using sidelink communications comprises means for:

selecting a wake-up signal that maps to the second discontinuous reception pattern; and

signalling the selected wake-up signal to the second user equipment.

13) An apparatus as claimed in any of claims 7 to 12, comprising means for sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

14) An apparatus for a second user equipment, the apparatus comprising means for:

receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity;

receiving, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and

operating using the second discontinuous reception pattern.

15) An apparatus as claimed in claim 14, wherein said means for receiving reconfiguration information comprises means for:

receiving, from the first user equipment, a wake-up signal that maps to the second discontinuous reception pattern.

16) An apparatus as claimed in any of claims 14 to 15, comprising means for sending, to the serving network entity, context information, wherein the context information comprises at least one of: reporting patterns of the first and/or second user equipment under normal reporting conditions; reporting patterns of the first and/or second user equipment under abnormal conditions; a present state of the group of

user equipment; and an inter-relationship between the reporting pattern(s) of the first user equipment and the reporting pattern(s) of the second user equipment.

17) An apparatus as claimed in any of claims 14 to 16, wherein the means for receiving the configuration information from the serving network entity comprises means for:

receiving configuration information for configuring the second user equipment to:

transmit data for reporting to the server to the serving network entity indirectly via the first user equipment when the second user equipment is operating using the first discontinuous reception pattern; and

transmit data for reporting to the server to the serving network entity directly when the second user equipment is operating using the second discontinuous reception pattern;

and

performing data transmissions for reporting to the server according to the received configuration information.

18) An apparatus as claimed in any of claims 14 to 17, comprising means for signalling, to the serving network entity via the first user equipment, the request for reporting to the server, wherein the request relates to an event associated with the second reporting pattern.

19) A method for an apparatus for a serving network entity, the method comprising:

configuring at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity;

receiving a request from the first user equipment and/or the second user equipment for reporting to the server;

determining that the request relates to an event associated with the second reporting pattern; and

reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

20) A method for an apparatus for a first user equipment, the method comprising:

receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity;

sending a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern;

determining reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and

signalling the reconfiguration information to the second user equipment using sidelink communications.

21) A method for an apparatus for a second user equipment, the method comprising:

receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity;

receiving, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and

operating using the second discontinuous reception pattern.

22) A computer program product that, when run on an apparatus for a serving network entity, causes the apparatus to perform:

configuring at least a first user equipment and a second user equipment with respective configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment and the second user equipment are comprised in a group of user equipment configured to transmit data for reporting to a server via the serving network entity;

receiving a request from the first user equipment and/or the second user equipment for reporting to the server;

determining that the request relates to an event associated with the second reporting pattern; and

reconfiguring the second user equipment to operate using the second discontinuous reception pattern.

23) A computer program product that, when run on an apparatus for a first user equipment, causes the apparatus to perform:

receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the first user equipment is comprised in a group of user equipment comprising a second user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity;

sending a request for reporting to the server to the serving network entity, wherein the request relates to an event associated with the second reporting pattern;

determining reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and

signalling the reconfiguration information to the second user equipment using sidelink communications.

24) A computer program product that, when run on an apparatus for a second user equipment, causes the apparatus to perform:

receiving, from a serving network entity, configuration information, wherein said configuration information associates a first reporting pattern with a first discontinuous reception pattern for operating in an IDLE and/or INACTIVE mode and a second reporting pattern with a second discontinuous reception pattern for operating in the IDLE and/or INACTIVE mode and wherein the second user equipment is comprised in a group of user equipment comprising a first user equipment, the group of user equipment being configured to transmit data for reporting to a server via the serving network entity;

receiving, from the serving network entity and/or the first user equipment, reconfiguration information for reconfiguring the second user equipment to operate using the second discontinuous reception pattern; and

operating using the second discontinuous reception pattern.

Fig. 1A

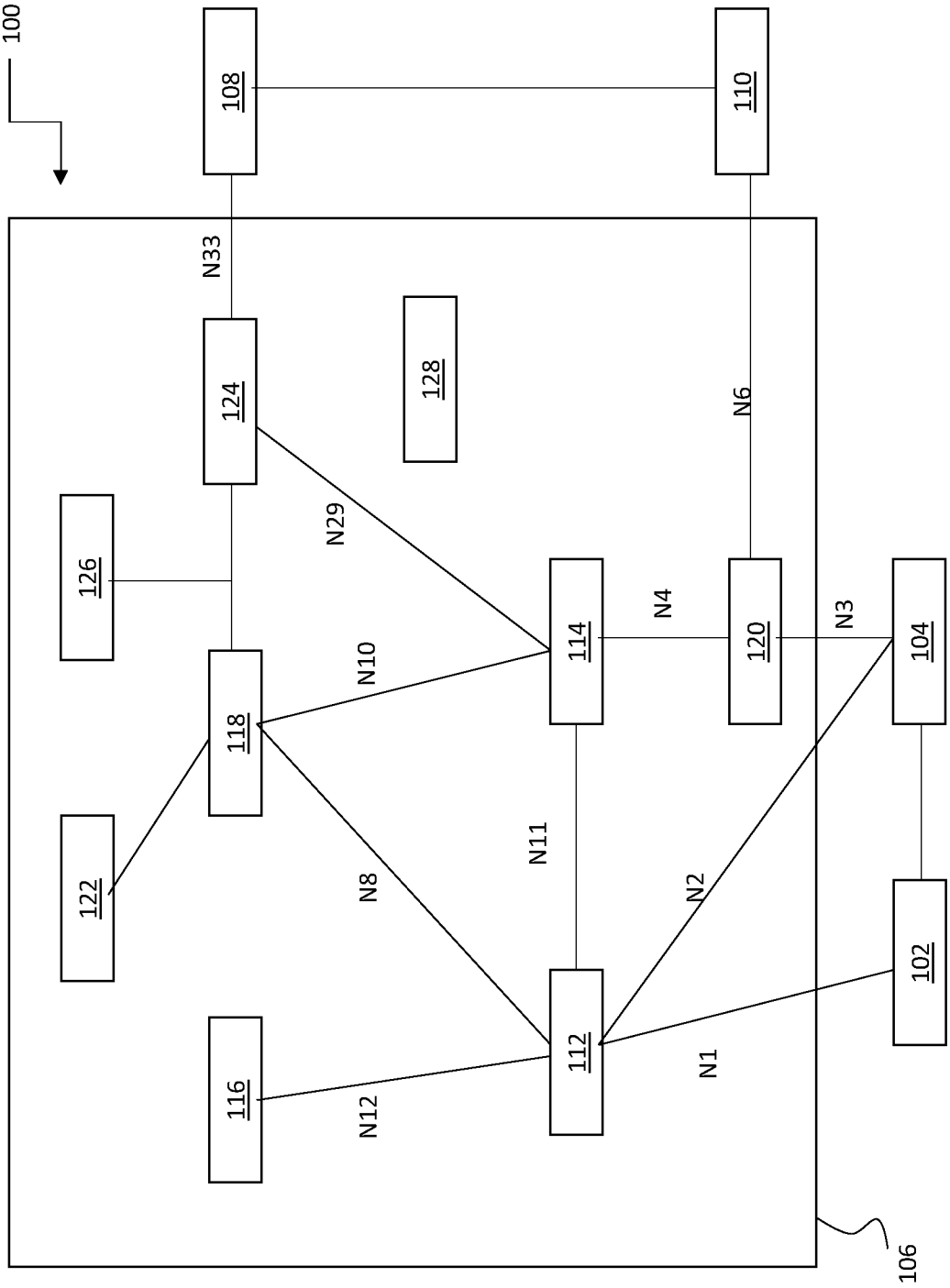
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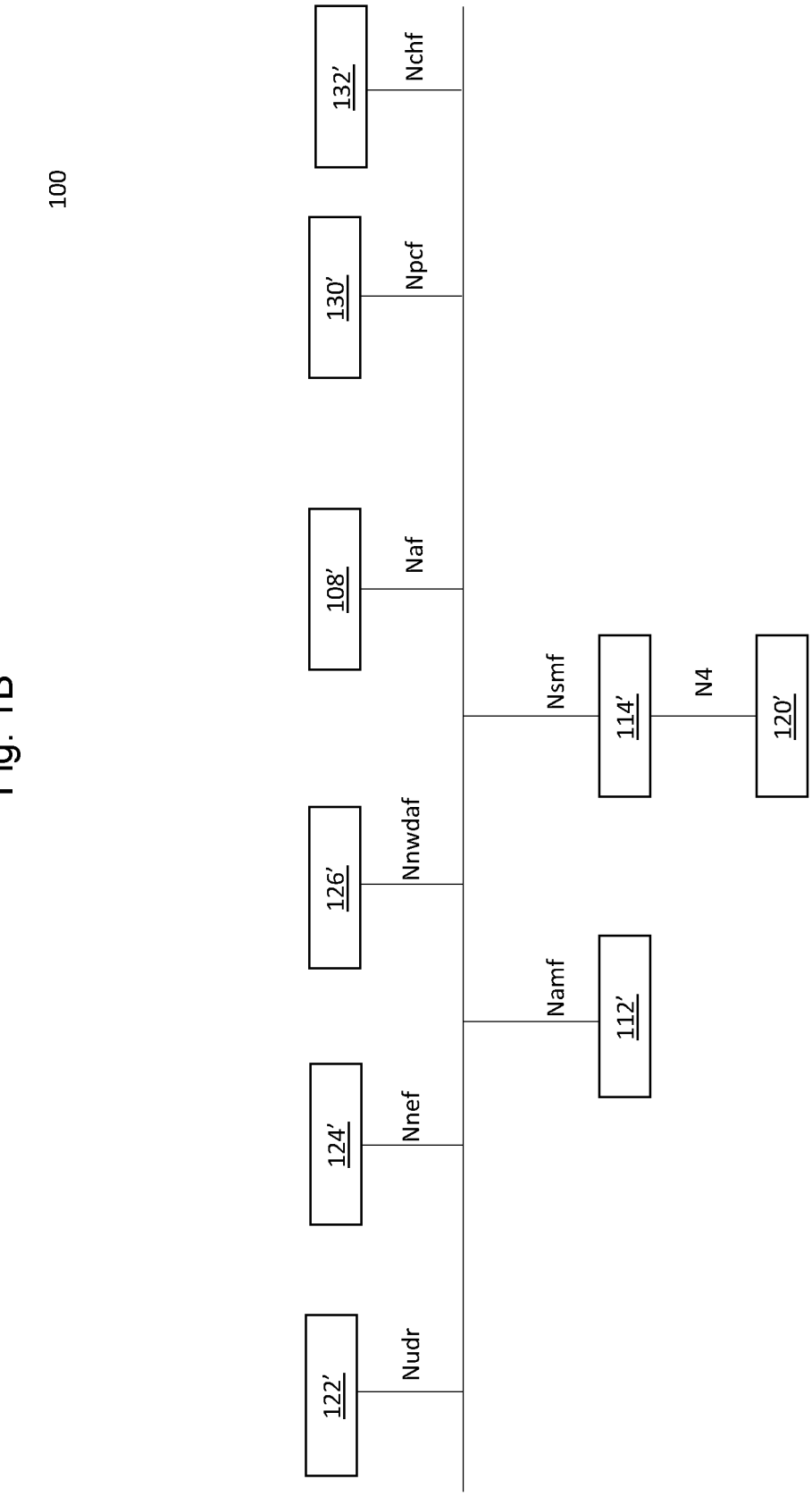
Fig. 1B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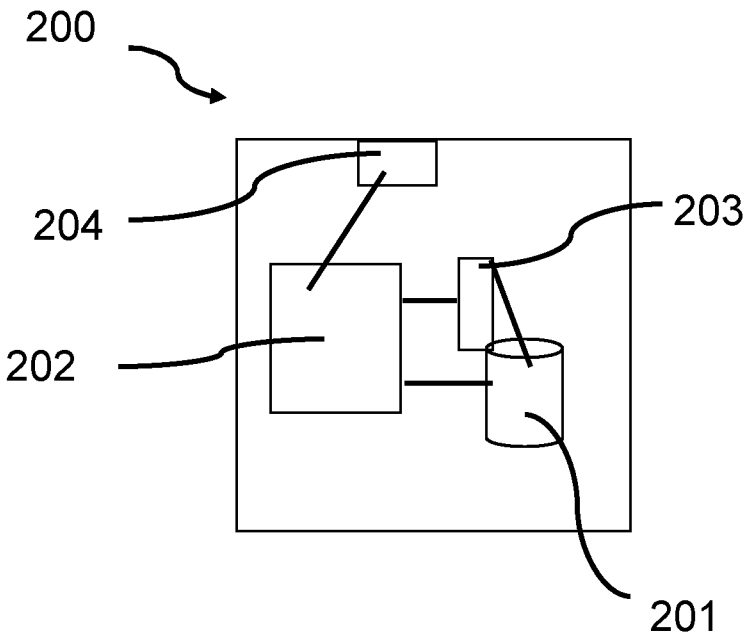


Fig. 2

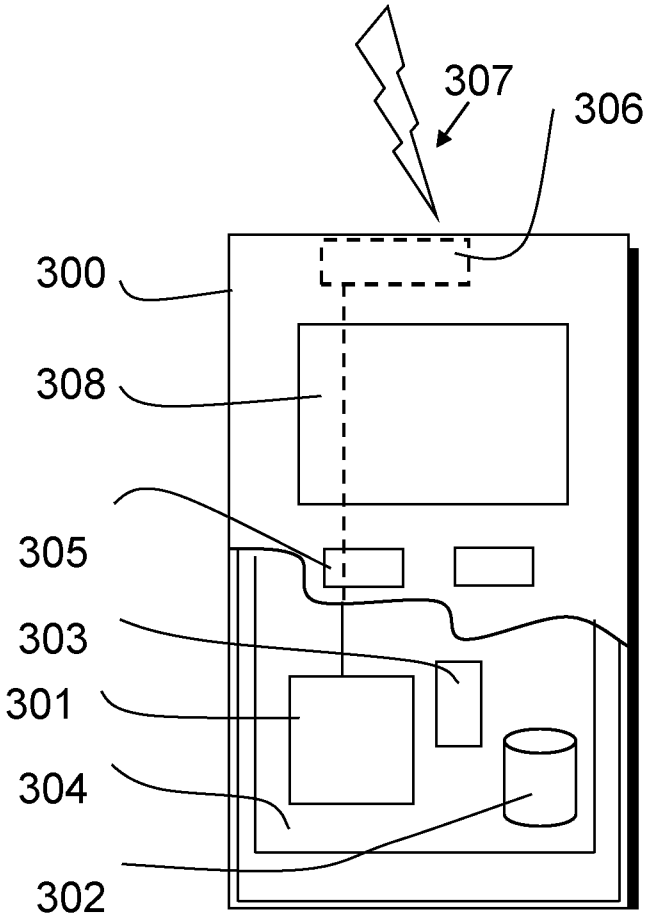


Fig. 3

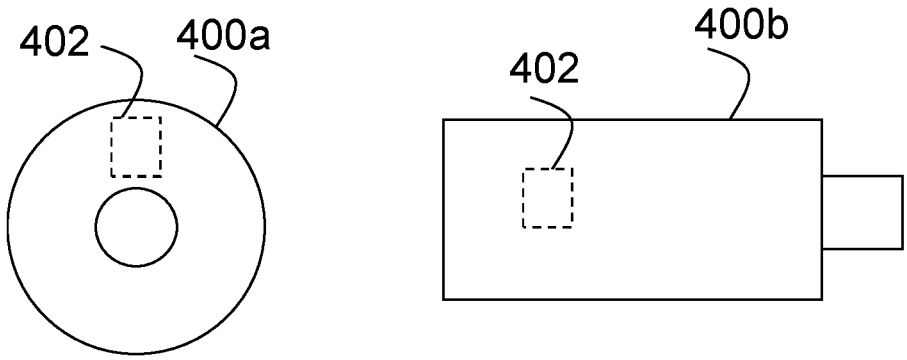
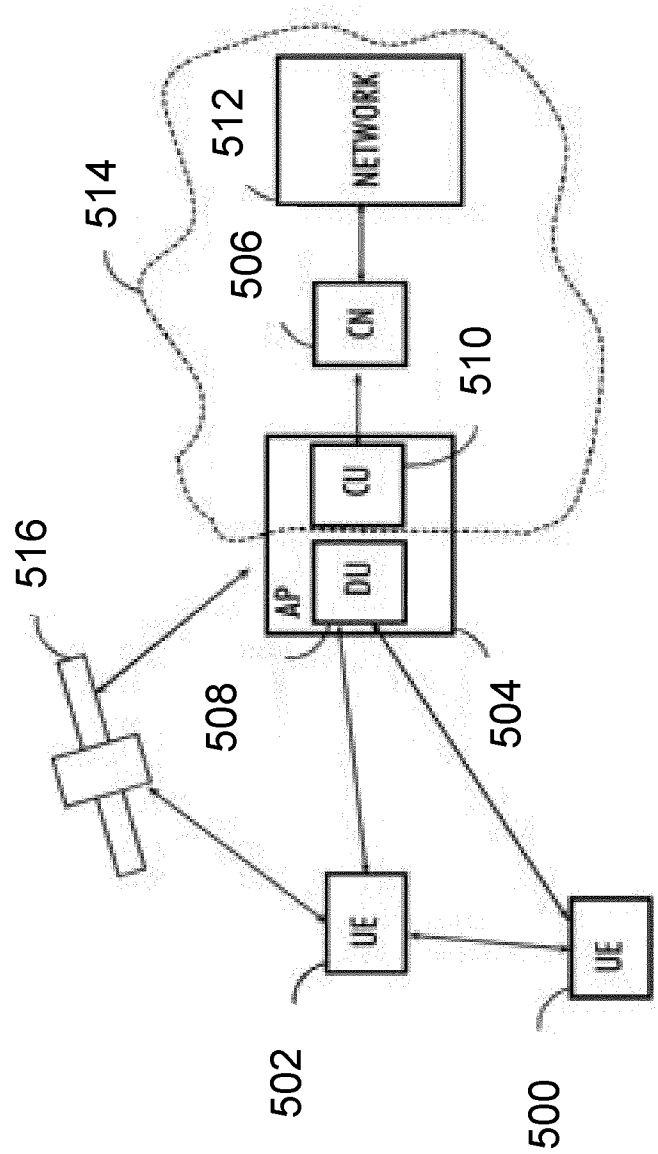


Fig. 4

Fig. 5



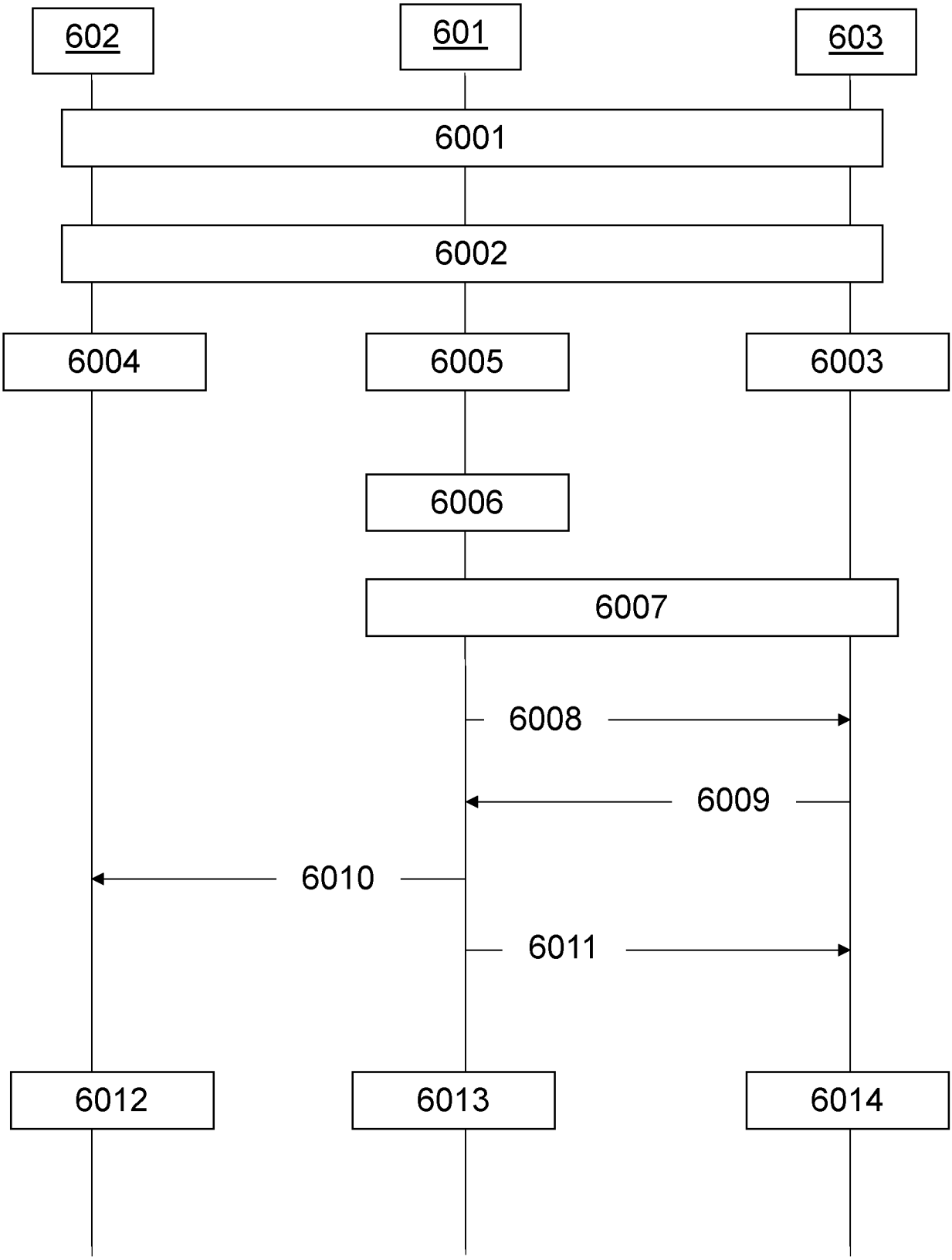

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Fig.6

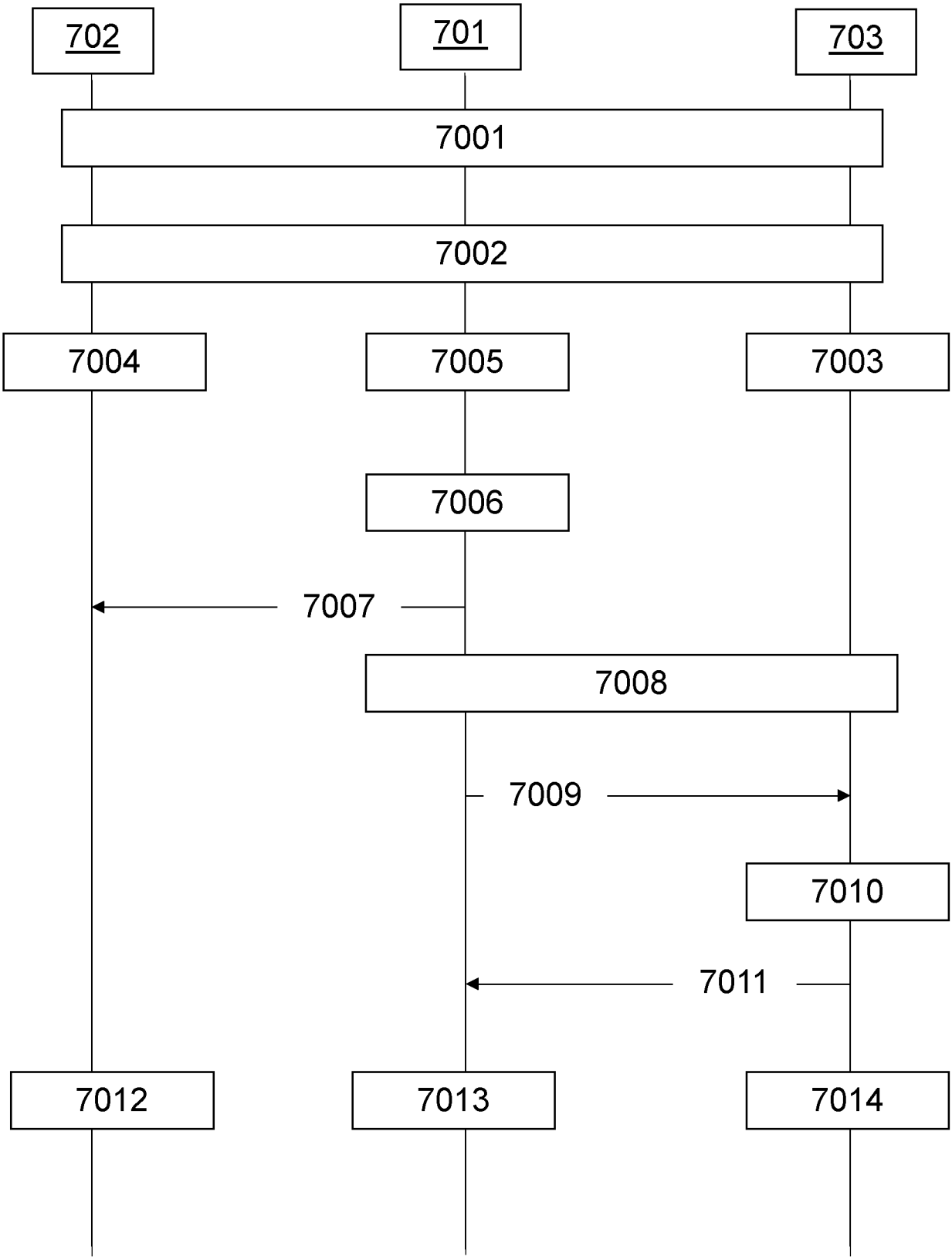
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Fig.7

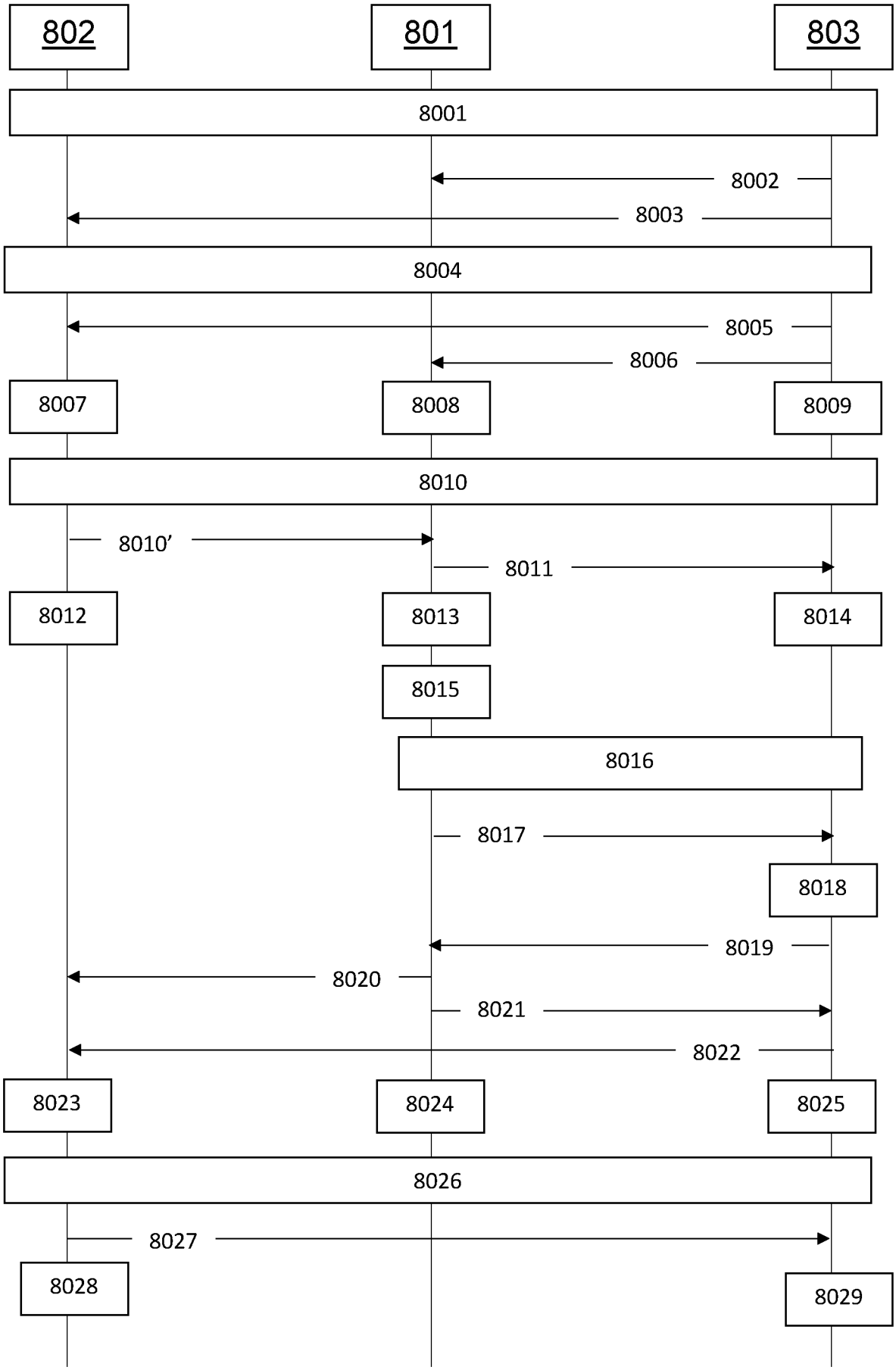
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Fig.8

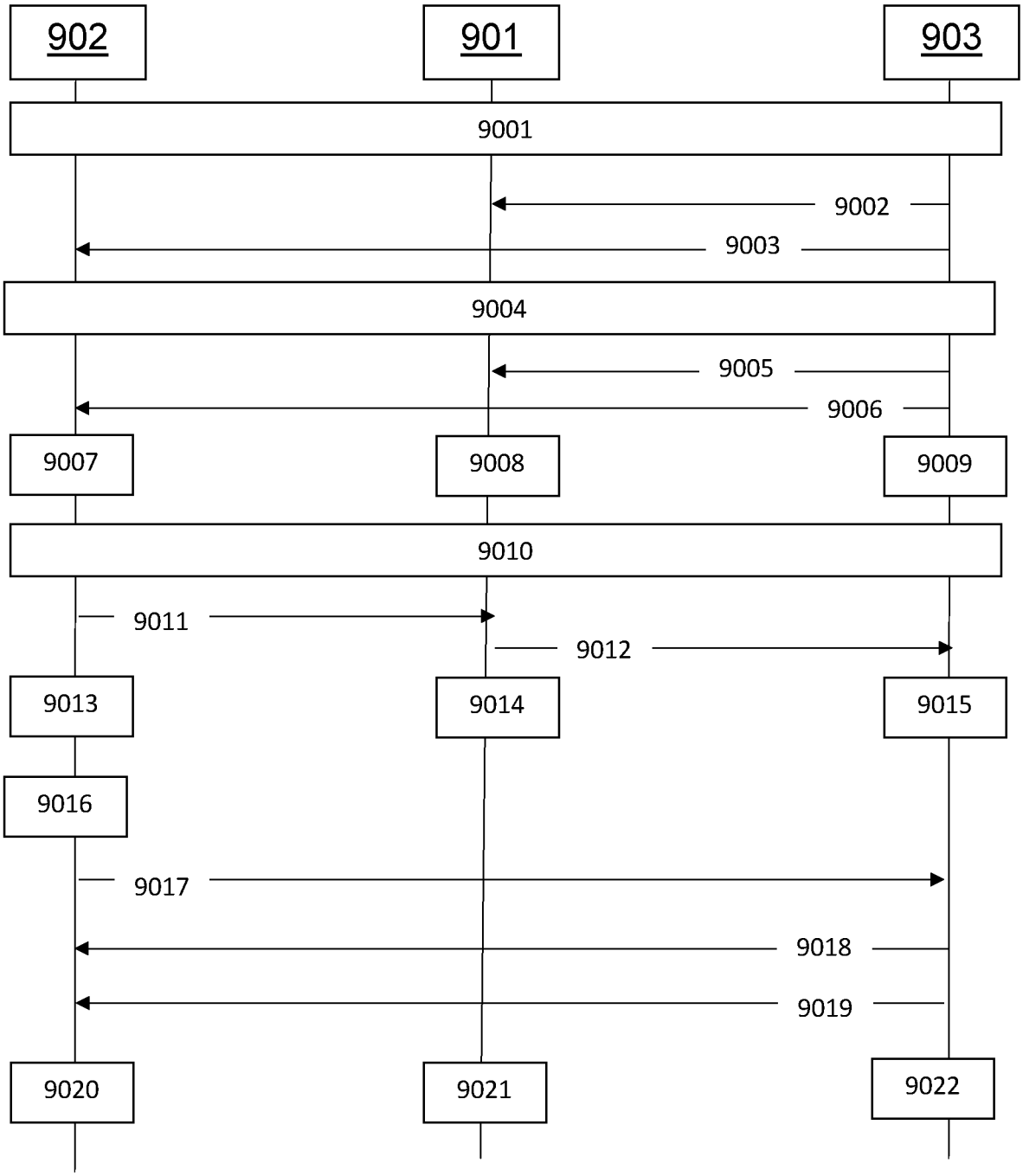
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Fig.9

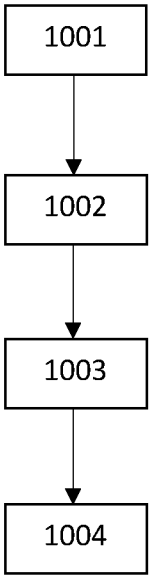

Fig.10

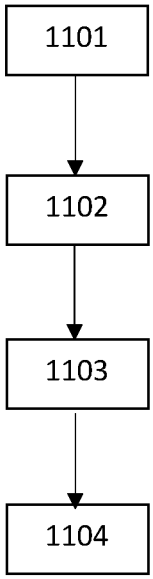

Fig.11

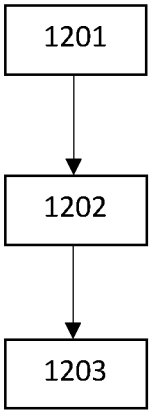

Fig.12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/082987

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/28 H04W24/10 H04W52/02
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

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.
X	WO 2021/147011 A1 (LENOVO BEIJING LTD [CN]) 29 July 2021 (2021-07-29) paragraphs [0044] - [0048]	1-24
A	AU 2021 203 332 A1 (OPTIS WIRELESS TECHNOLOGY LLC [US]) 24 June 2021 (2021-06-24) abstract paragraphs [0016] - [0027], [0031b] - [0036], [0041], [0123], [0135]	1-24
A	WO 2021/048609 A1 (LENOVO SINGAPORE PTE LTD [SG]) 18 March 2021 (2021-03-18) paragraphs [0046], [0059] - [0068]	1-24

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

[x] 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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
14 July 2022	25/07/2022

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Alonso Maleta, J

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/082987

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	HUAWEI: "Motivation for New WID: L2 UE-to-Network Relay for Wearable and IoT Devices", 3GPP DRAFT; RP-171773, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. TSG RAN, no. Sapporo, Japan; 20170911 - 20170914 10 September 2017 (2017-09-10), XP051324342, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN/Docs/ [retrieved on 2017-09-10] pages 6-8 pages 10,12,13 _____	1-24

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2021/082987

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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