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[Continued on next page]

(54) **Title**: NETWORK MANAGEMENT

(57) **Abstract**: According to an example aspect of the present invention, there is provided an apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to process a first alarm type message originating in a first geographical area, and subsequent to processing the first alarm type message, cause transmission of at least one suppressing message to a plurality of devices in the first geographical area, the at least one suppressing message instructing to refrain from transmitting further alarm type messages.

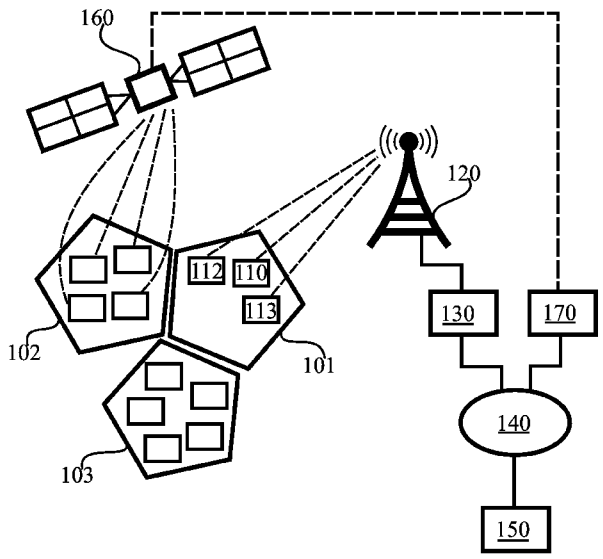

FIGURE 1

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NETWORK MANAGEMENT

FIELD

[0001] The present invention relates to controlling messaging in a communications network, such as, for example, a wireless network.

BACKGROUND

[0002] Communication networks, such as wired or wireless communication networks, may be used to convey messages between communication participants. Wired communication networks may be based on internet protocol, IP, for example. Wireless communication networks may comprise cellular and/or non-cellular networks. Examples of non-cellular wireless network technologies include wireless local area network, WLAN, and worldwide interoperability for microwave access, WiMAX. Examples of cellular wireless network technologies include wideband code division multiple access, WCDMA, and long term evolution, LTE.

[0003] Communication networks may be dimensioned according to a foreseen load. For example, a predicted peak load may be determined, and a network may be designed to be capable of handling the predicted peak load. In some cases, load balancing may be employed to divert increasing load to another network, to prevent overloading and, in some cases, enable a network to be built with lower overall capacity.

[0004] Admitting traffic to a network may be based on priorities, such that higher-priority traffic may displace lower-priority traffic. For example, where a cellular network has no free resources and a subscriber requests an emergency call, one of the occupied resources may be freed and allocated to the emergency call.

[0005] Sensor networks may comprise sensor devices, wherein the sensor devices are furnished with at least one sensor. A sensor, in general, comprises an apparatus configured to measure a physical property, such as temperature, magnetic flux density, electrical current, liquid flow rate, gas composition or particulates suspended in air. One specific example of a sensor is a smoke detector, which may operate based on measuring a density of soot particles in air.

[0006] Sensor networks may be provided with communication networks of their own, for example, sensor devices comprised in a sensor network may be connected with

each other and gateway devices via a wire-line IP network. Alternatively to providing a sensor network with a communication network of its own, the sensor network may be arranged to use a cellular or satellite communication network, for example. In this case, sensor devices comprised in the sensor network may be configured to access the cellular or satellite communications network when they need to communicate information, such as, for example, sensor information.

SUMMARY OF THE INVENTION

[0007] The invention is defined by the features of the independent claims. Some specific embodiments are defined in the dependent claims.

[0008] According to a first aspect of the present invention, there is provided an apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to process a first alarm type message originating in a first geographical area, and subsequent to processing the first alarm type message, cause transmission of at least one suppressing message to a plurality of devices in the first geographical area, the suppressing messages instructing to refrain from transmitting further alarm type messages.

[0009] Various embodiments of the first aspect may comprise at least one feature from the following bulleted list:

- the at least one memory and the computer program code are configured to, with the at least one processing core, cause the apparatus to process the first alarm type message by determining the nature of the alarm based on the first alarm type message, and to cause transmission of the suppressing messages responsive to receiving the first alarm type message
- the at least one memory and the computer program code are configured to, with the at least one processing core, cause the apparatus to process the first alarm type message by compiling the first alarm type message as a response to sensor information, and to cause the transmission of the suppressing messages responsive to receiving an acknowledgement the first alarm type message has been received
- the at least one memory and the computer program code are configured to, with the at least one processing core, cause the apparatus to cause the transmission of the

suppressing messages at least one of as direct device-to-device messages and as multicasted messages via a base station

- the first alarm type message comprises an indication of an environmental alarm condition
- the environmental alarm condition comprises at least one of the following: a forest fire, a house fire, a poisonous gas leak, a vibration state, an earthquake, current, voltage or power fluctuations, air or gas pressure changes, and motion detection.
- the apparatus is further configured to transmit to at least one of the plurality of devices an inquiry message instructing the at least one device to report sensor information
- the apparatus is configured to include in the suppressing messages a timer value indicating a validity time of the suppressing messages
- the acknowledgement comprises a timer value, and the apparatus is configured to include the timer value in the suppressing messages
- direct device-to-device messages are transmitted from a source device to a destination device such that the messages are not re-transmitted along the way by any further device
- the apparatus is further configured to cause transmission of suppressing messages to a second plurality of devices in a second geographical area, the second geographical area being adjacent to the first geographical area
- the apparatus is configured to, responsive to receiving the first alarm-type message via a first communication technology, to cause transmission of suppressing messages to the first geographical area using the first communication technology and to cause transmission of suppressing messages to a second geographical area using a second communication technology, the first and second geographical areas being adjacent to each other.

[0010] According to a second aspect of the present invention, there is provided a method comprising processing a first alarm type message originating in a first geographical area, and subsequent to processing the first alarm type message, causing transmission of at least one suppressing message to a plurality of devices in the first geographical area, the suppressing messages instructing to refrain from transmitting further alarm type messages.

[0011] Various embodiments of the second aspect may comprise at least one feature corresponding to a feature the preceding bulleted list laid out in connection with the first aspect.

[0012] According to a third aspect of the present invention, there is provided an apparatus comprising means for processing a first alarm type message originating in a first geographical area, and means for causing transmission of suppressing messages to a plurality of devices in the first geographical area subsequent to processing the first alarm type message, the suppressing messages instructing to refrain from transmitting further alarm type messages.

[0013] According to a fourth aspect of the present invention, there is provided a non-transitory computer readable medium having stored thereon a set of computer readable instructions that, when executed by at least one processor, cause an apparatus to at least process a first alarm type message originating in a first geographical area, and cause transmission of suppressing messages to a plurality of devices in the first geographical area subsequent to processing the first alarm type message, the suppressing messages instructing to refrain from transmitting further alarm type messages.

[0014] According to a fifth aspect of the present invention, there is provided a computer program configured to cause a method in accordance with the second aspect to be performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIGURE 1 illustrates an example system in accordance with at least some embodiments of the present invention;

[0016] FIGURE 2 illustrates an example system in accordance with at least some embodiments of the present invention;

[0017] FIGURE 3 illustrates an example apparatus capable of supporting at least some embodiments of the present invention;

[0018] FIGURE 4 illustrates signalling in accordance with at least some embodiments of the present invention, and

[0019] FIGURE 5 is a flow graph of a method in accordance with at least some embodiments of the present invention.

EMBODIMENTS

[0020] When a many sensor devices are disposed in an area affected by an environmental condition, such as a forest fire, the sensor devices are configured to report on, a spike in network load may be caused as several sensors are triggered to transmit messages, which may have high priority. Suppressing messages may be transmitted responsive to the sensor-device originated messages that cause other sensors in the area to suppress their own message transmission, so that the other sensors are not triggered to send messages even though they are affected by the environmental condition. This may alleviate or prevent the spike in network load.

[0021] FIGURE 1 illustrates an example system in accordance with at least some embodiments of the present invention. The figure illustrates first geographical area 101, second geographical area 102 and third geographical area 103. Within each of the geographical areas is arranged a plurality of sensor devices, for example within geographical area 101 is disposed a plurality of sensor devices that comprises sensor device 110, sensor device 112 and sensor device 113. Although illustrated in FIGURE 1 as distinct, the geographical areas may overlap, at least partly. The pluralities of sensor devices may each comprise distinct groups, wherein each group may comprise sensor devices of a same type, or application, for example. Although three, four and five sensor devices are illustrated in the geographical areas of FIGURE 1, this is only illustrative and the pluralities may comprise more, in some case significantly more, sensor devices. In FIGURE 1, dashed lines denote wireless links and solid lines denote wire-line connections.

[0022] The sensor devices are arranged to monitor at least one physical property, for example, the geographical areas together may cover a section of a forest, and the sensor devices may comprise forest fire sensors configured to transmit forest fire alarm messages responsive to a determination involving a physical property measurable with a sensor comprised in the sensor devices. In other words, the sensor devices may be triggered by the determination involving the physical property to transmit alarm-type messages. The determination may comprise a determination a threshold value is exceeded. For example, the physical property may comprise temperature or soot concentration, increases in which being indicative of an ongoing forest fire. Alternatively, the sensor devices may be

configured to detect an ongoing tsunami, flood, earthquake or other environmental alarm condition. Sensor devices may be configured to report concerning an environmental alarm condition to a server, for example. Information in the server may be used by rescue services, or by communication network management, for example to anticipate failures and responsively automatically migrate traffic to safer network nodes likely to be unaffected by the environmental alarm condition.

[0023] In the example of FIGURE 1, the sensor devices are furnished with cellular and/or satellite communication capability, although the invention is not limited thereto. For example, the plurality of sensor devices in geographical area 101 is enabled to communicate, using a cellular technology such as, for example, WCDMA or LTE, with a server 150 via base station 120, core network node 130 and network 140. Network 140 may comprise the Internet, for example. In some embodiments, server 150 is comprised in the cellular communication network, for example as a software function in core network node 130 or base station 120. In these embodiments, messaging between sensor device 110 and server 150 need not traverse network 140. To enable cellular communication, the sensor devices in geographical area 101 may be furnished with a subscription to a cellular network in which base station 120 is comprised. Such a subscription may comprise a machine-type communication subscription, for example.

[0024] Machine-type communication subscriptions may be enabled to access the cellular communication network at a set priority. For example, where the information generated is not time-critical and is produced in limited quantity, a low-priority low-bandwidth machine-type subscription may be appropriate, as such a subscription loads the network very lightly and can wait for free capacity. As another example, where the generated information is time-critical and/or is produced in larger quantities, the network load may increase and the communication, if time-critical, should not be re-scheduled to a time when there is spare capacity in the network.

[0025] Sensor devices in geographical area 102 are configured to communicate with server 150 via satellite constellation 160, ground station network 170 and network 140. In general, sensor devices in geographical areas may be enabled to communicate with a server using one or more wired or wireless technologies. In some cases, all sensor devices in all geographical areas are configured to use cellular connectivity, in other cases all sensor devices in all geographical areas are configured to use satellite connectivity and in further

cases, a mix of cellular and satellite communications is used, such that the system comprises cellular-enabled sensor devices, satellite-enabled sensor devices and, optionally, sensor devices configured to communicate using a non-cellular wireless technology, such as WiMAX.

[0026] Communication between the sensor devices and server 150 may be bidirectional. In these cases, wireless links between sensor devices and base station 120 may comprise an uplink arranged to convey information from the sensor device to base station 120, and a downlink arranged to convey information from base station 120 to the sensor device. Likewise satellite links between sensor devices in geographical area 102 may comprise an uplink and downlink. Although some satellite links in FIGURE 1 are drawn as bent lines, this only serves clarity of the illustration.

[0027] Sensor devices may be powered by replaceable or rechargeable batteries, or they may be provided with a stable power source. In some embodiments, the sensors comprise solar panels that charge batteries comprised in the sensor devices.

[0028] Where the sensor devices are configured to report concerning an environmental alarm condition, such as a forest fire, it may well occur that where the environmental alarm condition affects a geographical area, as opposed to a precise location, a large number of sensor devices will determine the environmental alarm condition. Responsive to determining the alarm condition, the large number of sensor devices may then transmit alarm-type messages toward server 150. Furthermore, each sensor device may, as long as the environmental alarm condition lasts, tend to transmit plural alarm messages toward server 150, further increasing the load. These alarm-type messages may be classified as high priority in the network, wherefore a large number of them may cause a loading peak in the network used to convey them. The network may already be loaded owing directly or indirectly to the environmental alarm condition, for example, a fire may have knocked out some base station sites and people may call each other, and emergency services, more frequently as a result of the emergency.

[0029] For server 150 to perform its function, it may be sufficient that server 150 is informed concerning which geographical areas are affected by the environmental alarm condition. At the very least, server 150 need not receive alarm messages from each sensor device that is affected by the environmental alarm condition. The network load may be increased by alarm-type messages, in case of scheduling-based resource management, by

an increase in signalling overhead. In case of contention based access, the network load may increase by a collision rate increase, which causes latency.

[0030] Server 150 may be configured, to ease a loading condition of the network, to transmit suppressing messages to sensor devices responsive to receiving an alarm message from a sensor device. In particular, server 150 may determine a geographical area wherein the sensor device having sent an alarm message, triggered by a preconfigured environmental condition, to server 150 is located, and transmit suppressing messages to at least a subset of sensor devices in that geographical area. The subset may comprise a group of sensor devices comprised in the plurality of sensor devices in the geographical area. The group may be selected, by server 150, as a group of sensor devices sharing a characteristic with the sensor device that sent the alarm message. For example, the group may comprise sensor devices of a same type, or serving a same application, as the sensor device that sent the alarm message. The suppressing messages may be sent to all sensor devices in the geographical area. The suppressing messages may comprise an indication of validity time, the validity time indicating a duration of time the suppressing message is to remain effective. The suppressing message may comprise an indication concerning the kind of alarm message that is to be suppressed. Where a multi-sensor sensor device receives such a suppressing message, it may responsively suppress alarm messages of the indicated type, but not others types of alarm messages. Thus, for example, a forest fire alarm message may cause suppressing messages to be transmitted that suppress alarm messages that relate to the forest fire, but not to other environmental alarm conditions. Sensor devices may be configured to, responsive to receiving a suppressing message, transition to a state in which no alarm messages are transmitted. For example, in this state no alarm messages are transmitted even if a preconfigured environmental condition occurs, which would otherwise trigger transmission of an alarm message. In case the suppressing message comprises an indication concerning the kind of alarm messages to be suppressed, this state may be a state where alarm messages concerning the indicated environmental alarm condition are not sent, while other kind of alarm messages may still be sent.

[0031] Using the suppressing messages, server 150, or another network node, may control the loading level of the network by preventing transmission of the alarm messages, which could have high priority and thus cause significant loading in the network, if they were transmitted. The suppressing messages may be transmitted to sensor devices over the appropriate connectivity, for example, in the example of FIGURE 1, suppressing messages

to sensor nodes in geographical area 101 may be transmitted via base station 120. On the other hand, if an alarm message was received from geographical area 102 via satellite constellation 160, suppressing messages may be transmitted to geographical area 102 via satellite constellation 160. Alternatively to the entire geographical area from where the alarm message was transmitted, server 150 may be configured to transmit suppressing messages to a suitably selected part of thereof.

[0032] Server 150 may be configured to transmit suppressing messages to at least one geographical area adjacent to a geographical area from where it has received an alarm message, for example concerning a preconfigured environmental alarm condition. For example, in terms of FIGURE 1, in case server 150 receives an alarm message from sensor device 110, server 150 may transmit suppressing messages to sensor devices in geographical areas 101 and 103. In some embodiments, server 150 is configured to transmit suppressing messages to each geographical area that is adjacent to the one where an alarm message was received from.

[0033] Server 150 may store a definition of geographical areas, and server 150 may be configured to determine, if a sensor device that has transmitted an alarm message is near an edge of the geographical area where the sensor device is located in. Responsive to a determination the sensor device is near the edge, server 150 may transmit suppressing messages to both the geographical area where the sensor device is located in, and an immediately adjacent geographical area which is on the other side of the edge. This may be useful, since an environmental alarm condition present near the edge of the geographical area is likely to also affect the adjacent geographical area, and transmitting suppressing messages also to the adjacent area may pre-empt a number of alarm messages from being transmitted to server 150 from the adjacent geographical area.

[0034] Alternatively to storing preconfigured definitions of geographical areas, server 150 may store, or have access to, locations of sensor devices comprised in a sensor network. Responsive to receipt of an alarm message from a first sensor device, server 150 may determine a set of sensor devices that are located, for example, within a preconfigured distance from the first sensor device, and transmit suppressing messages to sensor devices comprised in the set. Thus a geographical area is dynamically defined around the first sensor device. Acting thus, server 150 can silence parts of the sensor network more flexibly, in dependence of alarm messages that have been received.

[0035] Having suppressed transmission of alarm messages using suppressing messages, server 150 may query from individual sensor devices their sensor information. For example, in the forest fire example, server 150 may transmit queries to individual sensor devices in an area affected by the forest fire, to find out the locally prevailing temperatures. Sensor devices may be configured to respond to query messages received from server 150 even when in the state where no alarm messages are transmitted. Responding to a query message may leave the sensor device in the state where no alarm messages are automatically sent, in other words, querying by the server need not neutralize the effect of suppression messages. Server 150 may configure selected sensor devices to transmit reports of their surroundings to server 150 at an increased frequency with respect to a frequency at which the sensor devices would transmit alarm messages, were they not suppressed.

[0036] In case sensor devices in adjacent areas are connected toward server 150 via different communication technologies, as in the case of geographical area 101 and geographical area 102 in FIGURE 1, server 150 may be configured to, responsive to receipt of an alarm message via a first communication technology, transmit suppressing messages over the first and a second communication technology to the respective geographical areas, to cause suppression in both adjacent areas. For example, the first communication technology may comprise a cellular technology and the second communication technology may comprise a satellite technology.

[0037] Suppressing messages may have a lower priority than alarm messages, whereby network resources are conserved in case alarm message transmission is avoided by transmission of suppressing messages, since the network can schedule suppressing message delivery more flexibly than it could the conveying of alarm messages.

[0038] FIGURE 2 illustrates an example system in accordance with at least some embodiments of the present invention. The FIGURE 2 example is a distributed solution to transmitting suppressing messages. Like numbering denotes like structure as in FIGURE 1. For the sake of simplicity, only geographical area 101 is illustrated in FIGURE 2. In the embodiments of FIGURE 2, sensor devices in geographical area 101 have, or are capable of forming, device-to-device, D2D, links with each other. By D2D links it is herein meant, that messages conveyed over D2D links are transmitted from a source sensor device and received in a destination sensor device, such that the messages are not conveyed through or

via any further node during passage through the D2D link. The message terminates in the destination sensor device. Thus, for example, D2D messages do not travel from sensor device 110 to sensor device 112 via base station 120.

[0039] In the FIGURE 2 case, sensor device 110 initially, triggered by an environmental condition, transmits an alarm message to server 150, for example via base station 120, core network node 130 and network 140. Server 150 processes the alarm message and transmits an acknowledgement to sensor device 110, thereby informing sensor device 110 the alarm message has been successfully received and processed. As a response to the acknowledgement, sensor node 110 transmits, over D2D links, suppressing messages to nearby sensor nodes, such as sensor node 112 and sensor node 113. In the FIGURE 2 distributed solution, server 150 need not transmit suppressing messages. An advantage is thereby obtained in that a network load is not increased by transmitting suppressing messages.

[0040] The acknowledgement from server 150 may comprise a timer value, which sensor node 110 includes in the suppressing messages it sends, via the D2D links, to further sensor devices in geographical area 101. Thus server 150 is enabled, by selecting the timer value to include in the acknowledgement, to control the length of time alarm message transmission is suppressed in the vicinity of sensor node 110. Sensor node 110 may consider the acknowledgement to be a suppressing message concerning sensor node 110.

[0041] In the distributed solution of FIGURE 2, other communication solutions within the geographical area may be employed alternatively to D2D messaging. For example, where the sensors of geographical area 101 are interconnected in a mesh-style interconnection network, sensor node 110, responsive to the acknowledgement from the server, may transmit suppressing messages in the sensor network interconnection, such that the suppressing messages comprise instructions that they are to be forwarded onward in the interconnection by a set number of hops, for example two. Thus a sensor node receiving the suppressing message may decrement the remaining hop count, and in case it is then still at least one, transmit a copy of the suppressing message to all neighbouring sensor nodes. The sensor node the suppressing message arrived from may be omitted from this onward transmission, since that sensor node already has the suppressing message. A yet further

alternative is one where the sensor node transmits the suppressing messages to other sensor nodes transmits the suppressing messages to the other nodes via base station 120.

[0042] A variant of the distributed solution is one where sensor devices have indirect connectivity to a server, via a gateway device. In this variant, the gateway device may be instructed by the server to transmit suppressing messages to sensor devices it provides connectivity to.

[0043] Whether in the case of the FIGURE 1 or FIGURE 2 solution, suppressing messages may be transmitted periodically. For example, where the suppressing messages comprise the timer value indicating their validity time, the suppressing messages may be re-sent before the timer expires to maintain the suppression. Similarly, in the case of the FIGURE 1 or FIGURE 2 solution, the suppressing messages may be displayed to human users. For example in case of a fire in a high-rise building, without suppressing messages a large number of people may call the emergency dispatcher. By transmitting suppressing messages, which may be displayed as text on users' devices such as smartphones and so on, the users may be informed that emergency services already know about the fire, and they users may, optionally, also be provided with instructions how to evade danger caused by the fire.

[0044] FIGURE 3 illustrates an example apparatus capable of supporting at least some embodiments of the present invention. Illustrated is device 300, which may comprise, for example, sensor device or, where applicable, server of FIGURE 1 or FIGURE 2. Comprised in device 300 is processor 310, which may comprise, for example, a single- or multi-core processor wherein a single-core processor comprises one processing core and a multi-core processor comprises more than one processing core. Processor 310 may comprise more than one processor. A processing core may comprise, for example, a Cortex-A8 processing core manufactured by ARM Holdings or a Steamroller processing core produced by Advanced Micro Devices Corporation. Processor 310 may comprise at least one Qualcomm Snapdragon and/or Intel Xeon processor. Processor 310 may comprise at least one application-specific integrated circuit, ASIC. Processor 310 may comprise at least one field-programmable gate array, FPGA. Processor 310 may be means for performing method steps in device 300. Processor 310 may be configured, at least in part by computer instructions, to perform actions.

[0045] Device 300 may comprise memory 320. Memory 320 may comprise random-access memory and/or permanent memory. Memory 320 may comprise at least one RAM chip. Memory 320 may comprise solid-state, magnetic, optical and/or holographic memory, for example. Memory 320 may be at least in part accessible to processor 310. Memory 320 may be at least in part comprised in processor 310. Memory 320 may be means for storing information. Memory 320 may comprise computer instructions that processor 310 is configured to execute. When computer instructions configured to cause processor 310 to perform certain actions are stored in memory 320, and device 300 overall is configured to run under the direction of processor 310 using computer instructions from memory 320, processor 310 and/or its at least one processing core may be considered to be configured to perform said certain actions. Memory 320 may be at least in part comprised in processor 310. Memory 320 may be at least in part external to device 300 but accessible to device 300.

[0046] Device 300 may comprise a transmitter 330. Device 300 may comprise a receiver 340. Transmitter 330 and receiver 340 may be configured to transmit and receive, respectively, information in accordance with at least one cellular or non-cellular standard. Transmitter 330 may comprise more than one transmitter. Receiver 340 may comprise more than one receiver. Transmitter 330 and/or receiver 340 may be configured to operate in accordance with global system for mobile communication, GSM, wideband code division multiple access, WCDMA, long term evolution, LTE, IS-95, wireless local area network, WLAN, Ethernet and/or worldwide interoperability for microwave access, WiMAX, standards, for example.

[0047] Device 300 may comprise a near-field communication, NFC, transceiver 350. NFC transceiver 350 may support at least one NFC technology, such as NFC, Bluetooth, Wibree or similar technologies.

[0048] Device 300 may comprise user interface, UI, 360. UI 360 may comprise at least one of a display, a keyboard, a touchscreen, a vibrator arranged to signal to a user by causing device 300 to vibrate, a speaker and a microphone. A user may be able to operate device 300 via UI 360, for example to cause transmission of alarm messages or emergency calls.

[0049] Device 300 may comprise or be arranged to accept a user identity module 370. User identity module 370 may comprise, for example, a subscriber identity module,

SIM, card installable in device 300. A user identity module 370 may comprise information identifying a subscription of device 300. A user identity module 370 may comprise cryptographic information usable to verify the identity of device 300 and/or to facilitate encryption of communicated information and billing for communication effected via device 300. Where device 300 comprises a sensor device, it comprises at least one sensor 380 arranged to measure a physical property.

[0050] Processor 310 may be furnished with a transmitter arranged to output information from processor 310, via electrical leads internal to device 300, to other devices comprised in device 300. Such a transmitter may comprise a serial bus transmitter arranged to, for example, output information via at least one electrical lead to memory 320 for storage therein. Alternatively to a serial bus, the transmitter may comprise a parallel bus transmitter. Likewise processor 310 may comprise a receiver arranged to receive information in processor 310, via electrical leads internal to device 300, from other devices comprised in device 300. Such a receiver may comprise a serial bus receiver arranged to, for example, receive information via at least one electrical lead from receiver 340 for processing in processor 310. Alternatively to a serial bus, the receiver may comprise a parallel bus receiver.

[0051] Device 300 may comprise further devices not illustrated in FIGURE 3. For example, where device 300 comprises a smartphone, it may comprise at least one digital camera. Some devices 300 may comprise a back-facing camera and a front-facing camera, wherein the back-facing camera may be intended for digital photography and the front-facing camera for video telephony. Device 300 may comprise a fingerprint sensor arranged to authenticate, at least in part, a user of device 300. In some embodiments, device 300 lacks at least one device described above. For example, some devices 300 may lack a NFC transceiver 350 and/or user identity module 370.

[0052] Processor 310, memory 320, transmitter 330, receiver 340, NFC transceiver 350, UI 360 and/or user identity module 370 may be interconnected by electrical leads internal to device 300 in a multitude of different ways. For example, each of the aforementioned devices may be separately connected to a master bus internal to device 300, to allow for the devices to exchange information. However, as the skilled person will appreciate, this is only one example and depending on the embodiment various ways of

interconnecting at least two of the aforementioned devices may be selected without departing from the scope of the present invention.

[0053] FIGURE 4 illustrates signalling in accordance with at least some embodiments of the present invention. On the vertical axes are disposed, from the left, sensor devices 110, 112 and 113 of FIGURE 1 and FIGURE 2, and on the right, server 150. Time advances from the top toward the bottom. The top part of the figure, labelled "A", relates to FIGURE 1 embodiments, and the lower part, labelled "B", relates to FIGURE 2 embodiments.

[0054] First, the process labelled "A", corresponding to FIGURE 1, is described. In phase 410, an environmental alarm condition, such as a forest fire or flood, affects a geographic area in which sensor nodes 110, 112 and 113 are located. In phase 420, sensor node 110, having compiled an alarm message triggered by the environmental alarm condition, transmits the alarm message to server 150. In phase 430, server 150 processes the alarm message, for example by extracting therefrom information enabling identification of the environmental alarm condition and a geographical area in which sensor node 110 is located. In phases 440 and 450, server 150 transmits suppressing messages to sensor nodes 113 and 112, respectively, responsive to a determination, in server 150, that these sensor nodes are located in the identified geographical area. In some embodiments, server 150 may instruct base station 120 to transmit the suppressing messages to sensor devices disposed within a cell coverage area of a cell controlled by base station 120. Responsive to the suppressing messages, sensor nodes 112 and 113 transition to a state where alarm messages are not sent. Any alarm message that was being compiled when the suppressing message is received may be discarded without being sent. Optionally, a suppressing message or acknowledgement may also be transmitted from server 150 to sensor node 110.

[0055] Turning now to the process labelled "B", corresponding to FIGURE 2, phases 460 and 470 may essentially correspond to phases 410 and 420, respectively, in the process labelled "A". In phase 480, the alarm message is processed in server 150, for example to extracting therefrom information enabling identification of the environmental alarm condition. In phase 490, server 150 transmits an acknowledgement of the alarm message of phase 470 to sensor device 110. This acknowledgement may comprise a timer value. In phases 4100 and 4110, sensor device 110 transmits suppressing messages to

sensor nodes 112 and 113, respectively. In case the acknowledgement of phase 490 comprised the timer value, the timer value may be included in the suppressing messages of phases 4100 and 4110 as well.

[0056] FIGURE 5 is a flow graph of a method in accordance with at least some embodiments of the present invention. The phases of the illustrated method may be performed in sensor device 110, server 150, or in a control device configured to control the functioning thereof, when implanted therein.

[0057] Phase 510 comprises processing a first alarm type message originating in a first geographical area. Finally, phase 520 comprises subsequent to processing the first alarm type message, causing transmission of at least one suppressing message to a plurality of devices in the first geographical area, the suppressing messages instructing to refrain from transmitting further alarm type messages. Processing the first alarm type message may comprise compiling the first alarm type message in a sensor device, or processing may comprise extracting from the first alarm type message information enabling identification of an environmental alarm condition that triggered the first alarm type message, as well as identifying a geographical area from which the first alarm type message was sent.

[0058] It is to be understood that the embodiments of the invention disclosed are not limited to the particular structures, process steps, or materials disclosed herein, but are extended to equivalents thereof as would be recognized by those ordinarily skilled in the relevant arts. It should also be understood that terminology employed herein is used for the purpose of describing particular embodiments only and is not intended to be limiting.

[0059] Reference throughout this specification to one embodiment or an embodiment means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases “in one embodiment” or “in an embodiment” in various places throughout this specification are not necessarily all referring to the same embodiment. Where reference is made to a numerical value using a term such as, for example, about or substantially, the exact numerical value is also disclosed.

[0060] As used herein, a plurality of items, structural elements, compositional elements, and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified

as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary. In addition, various embodiments and example of the present invention may be referred to herein along with alternatives for the various components thereof. It is understood that such embodiments, examples, and alternatives are not to be construed as de facto equivalents of one another, but are to be considered as separate and autonomous representations of the present invention.

[0061] Furthermore, the described features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. In the preceding description, numerous specific details are provided, such as examples of lengths, widths, shapes, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention can be practiced without one or more of the specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

[0062] While the forgoing examples are illustrative of the principles of the present invention in one or more particular applications, it will be apparent to those of ordinary skill in the art that numerous modifications in form, usage and details of implementation can be made without the exercise of inventive faculty, and without departing from the principles and concepts of the invention. Accordingly, it is not intended that the invention be limited, except as by the claims set forth below.

[0063] The verbs “to comprise” and “to include” are used in this document as open limitations that neither exclude nor require the existence of also un-recited features. The features recited in depending claims are mutually freely combinable unless otherwise explicitly stated. Furthermore, it is to be understood that the use of "a" or "an", that is, a singular form, throughout this document does not exclude a plurality.

INDUSTRIAL APPLICABILITY

[0064] At least some embodiments of the present invention find industrial application in managing information flows in communication networks.

ACRONYMS LIST

IP	Internet protocol
D2D	Device-to-device
LTE	Long term evolution
WCDMA	Wideband code division multiple access
WiMAX	Worldwide interoperability for microwave access
WLAN	Wireless local area network

REFERENCE SIGNS LIST

101, 102, 103	Geographical areas
110, 112, 113	Sensor devices
120	Base station
130	Core network node
140	Network
150	Server
160	Satellite constellation
170	Satellite ground stations
310 – 380	Structure of the apparatus of FIGURE 3
410 – 450	Phases of method “A” of FIGURE 4
460 – 4110	Phases of method “B” of FIGURE 4
510 – 520	Phases of the method of FIGURE 5

CITATION LIST

3GPP TR 22.891 “Study on New Services and Markets Technology Enablers”

CLAIMS:

1. An apparatus comprising at least one processing core, at least one memory including computer program code, the at least one memory and the computer program code being configured to, with the at least one processing core, cause the apparatus at least to:

- process a first alarm type message originating in a first geographical area, and
- subsequent to processing the first alarm type message, cause transmission of at least one suppressing message to a plurality of devices in the first geographical area, the at least one suppressing message instructing to refrain from transmitting further alarm type messages.

2. The apparatus according to claim 1, wherein the at least one memory and the computer program code are configured to, with the at least one processing core, cause the apparatus to process the first alarm type message by determining the nature of the alarm based on the first alarm type message, and to cause transmission of the at least one suppressing message responsive to receiving the first alarm type message.

3. The apparatus according to claim 1, wherein the at least one memory and the computer program code are configured to, with the at least one processing core, cause the apparatus to process the first alarm type message by compiling the first alarm type message as a response to sensor information, and to cause the transmission of the at least one suppressing message responsive to receiving an acknowledgement the first alarm type message has been received.

4. The apparatus according to claim 3, wherein the at least one memory and the computer program code are configured to, with the at least one processing core, cause the apparatus to cause the transmission of the at least one suppressing message at least one of as direct device-to-device messages and as multicasted messages via a base station.

5. The apparatus according to any of claims 1 – 4, wherein the first alarm type message comprises an indication of an environmental alarm condition.

6. The apparatus according to claim 5, wherein the environmental alarm condition comprises at least one of the following: a forest fire, a house fire, a poisonous gas leak, a vibration state, an earthquake, current, voltage or power fluctuations, air or gas pressure changes, and motion detection.

7. The apparatus according to claim 3 or any of claims 6 and 5 as dependent on 3, wherein the apparatus is further configured to transmit to at least one of the plurality of devices an inquiry message instructing the at least one device to report sensor information.

8. The apparatus according to any of claims 1 – 7, wherein the apparatus is configured to include in the at least one suppressing message a timer value indicating a validity time of the at least one suppressing message.

9. The apparatus according to claim 4, wherein the acknowledgement comprises a timer value, and the apparatus is configured to include the timer value in the at least one suppressing message.

10. The apparatus according to claim 4 or 9, wherein direct device-to-device messages are transmitted from a source device to a destination device such that the messages are not re-transmitted along the way by any further device.

11. The apparatus according to any of claims 1 – 10, wherein the apparatus is further configured to cause transmission of the at least one suppressing message to a second plurality of devices in a second geographical area, the second geographical area being adjacent to the first geographical area.

12. The apparatus according to claim 3, wherein the apparatus is configured to, responsive to receiving the first alarm-type message via a first communication technology, to cause transmission of the at least one suppressing message to the first geographical area using the first communication technology and to cause transmission of the at least one suppressing message to a second geographical area using a second communication technology, the first and second geographical areas being adjacent to each other.

13. A method comprising:

- processing a first alarm type message originating in a first geographical area, and
- subsequent to processing the first alarm type message, causing transmission of at least one suppressing message to a plurality of devices in the first geographical area, the at least one suppressing message instructing to refrain from transmitting further alarm type messages.

14. The method according to claim 13, wherein processing the first alarm type message comprises determining the nature of the alarm based on the first alarm type message, and causing transmission of the at least one suppressing message occurs responsive to receiving the first alarm type message.

15. The method according to claim 13, wherein processing the first alarm type message comprises compiling the first alarm type message as a response to sensor information, and transmission of the at least one suppressing message occurs responsive to receiving an acknowledgement the first alarm type message has been received.

16. The method according to claim 15, wherein causing transmission of the at least one suppressing message comprises causing the at least one suppressing message to be transmitted at least one of as direct device-to-device messages and as multicasted messages via a base station.

17. The method according to any of claims 13 – 16, wherein the first alarm type message comprises an indication of an environmental alarm condition.

18. The method according to claim 17, wherein the environmental alarm condition comprises at least one of the following: a forest fire, a house fire, a poisonous gas leak, a vibration state, an earthquake, current, voltage or power fluctuations, air or gas pressure changes, and motion detection.

19. The method according to claim 14 or any of claims 18 and 17 as dependent on 14, further comprising transmitting to at least one of the plurality of devices an inquiry message instructing the at least one device to report sensor information.

20. The method according to any of claims 13 – 19, wherein the at least one suppressing message comprises a timer value indicating a validity time of the at least one suppressing message.

21. The method according to claim 15, wherein the acknowledgement comprises a timer value, and the method comprises including the timer value in the at least one suppressing message.

22. The method according to claim 15 or 21, wherein direct device-to-device messages are transmitted from a source device to a destination device such that the messages are not re-transmitted along the way by any further device.

23. The method according to any of claims 13 – 22, further comprising causing transmission of the at least one suppressing message to a second plurality of devices in a second geographical area, the second geographical area being adjacent to the first geographical area.

24. The method according to claim 15, further comprising, responsive to receiving the first alarm-type message via a first communication technology, causing transmission of the at least one suppressing message to the first geographical area using the first communication technology and causing transmission of the at least one suppressing message to a second geographical area using a second communication technology, the first and second geographical areas being adjacent to each other.

25. An apparatus comprising:

- means for processing a first alarm type message originating in a first geographical area, and
- means for causing transmission of at least one suppressing message to a plurality of devices in the first geographical area subsequent to processing the first alarm type message, the at least one suppressing message instructing to refrain from transmitting further alarm type messages.

26. A non-transitory computer readable medium having stored thereon a set of computer readable instructions that, when executed by at least one processor, cause an apparatus to at least:

- process a first alarm type message originating in a first geographical area, and
- cause transmission of at least one suppressing message to a plurality of devices in the first geographical area subsequent to processing the first alarm type message, the at least one suppressing message instructing to refrain from transmitting further alarm type messages.

27. A computer program configured to cause a method in accordance with at least one of claims 13 - 24 to be performed.

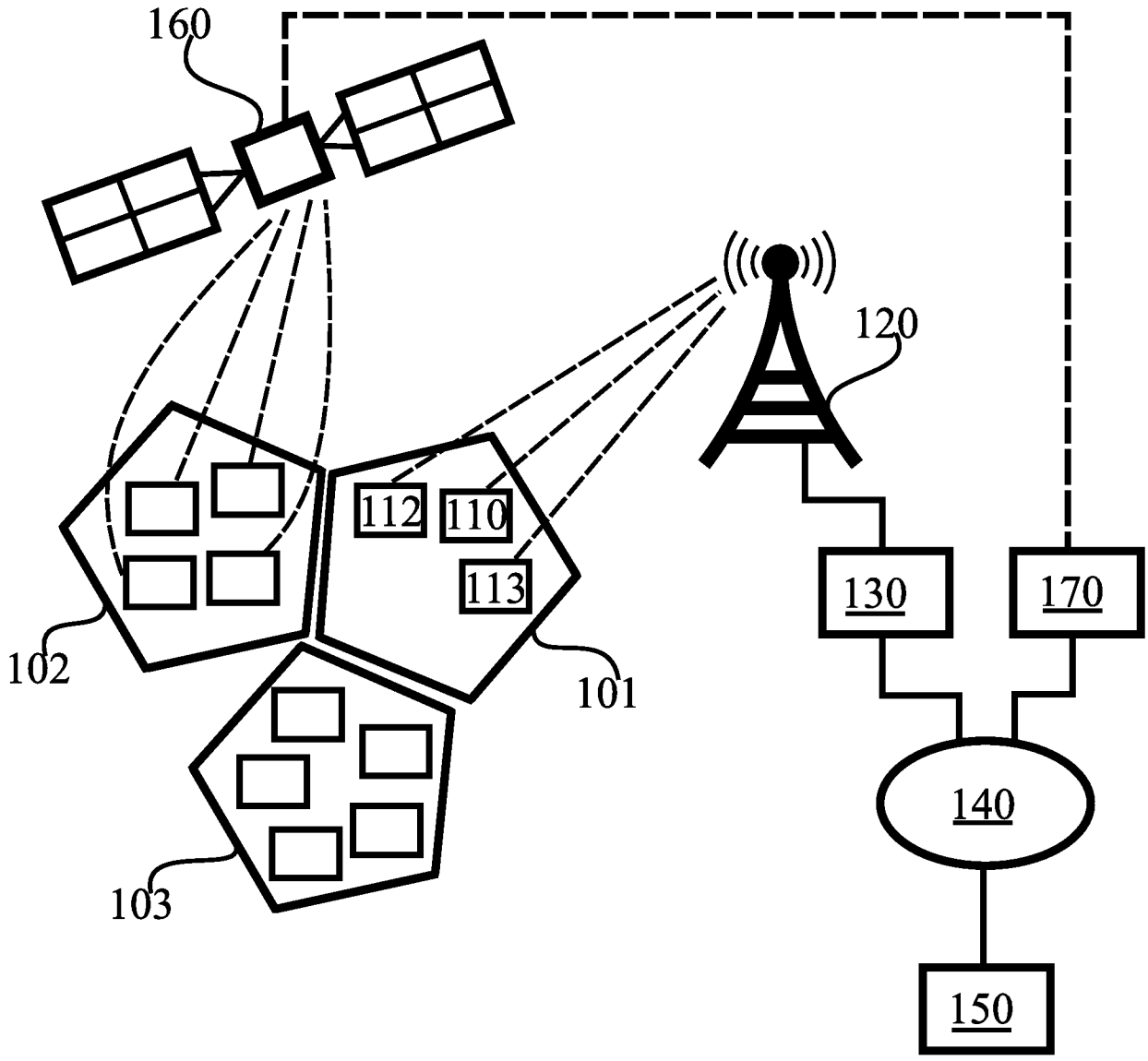

FIGURE 1

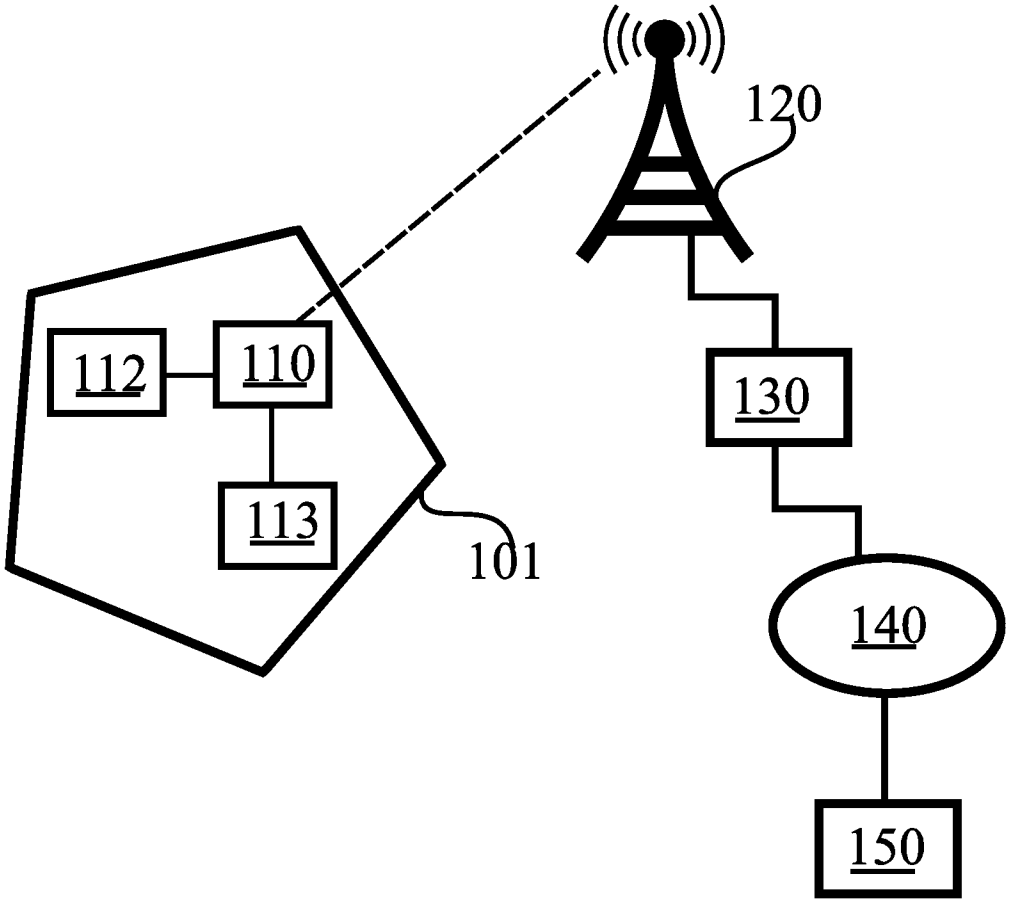

FIGURE 2

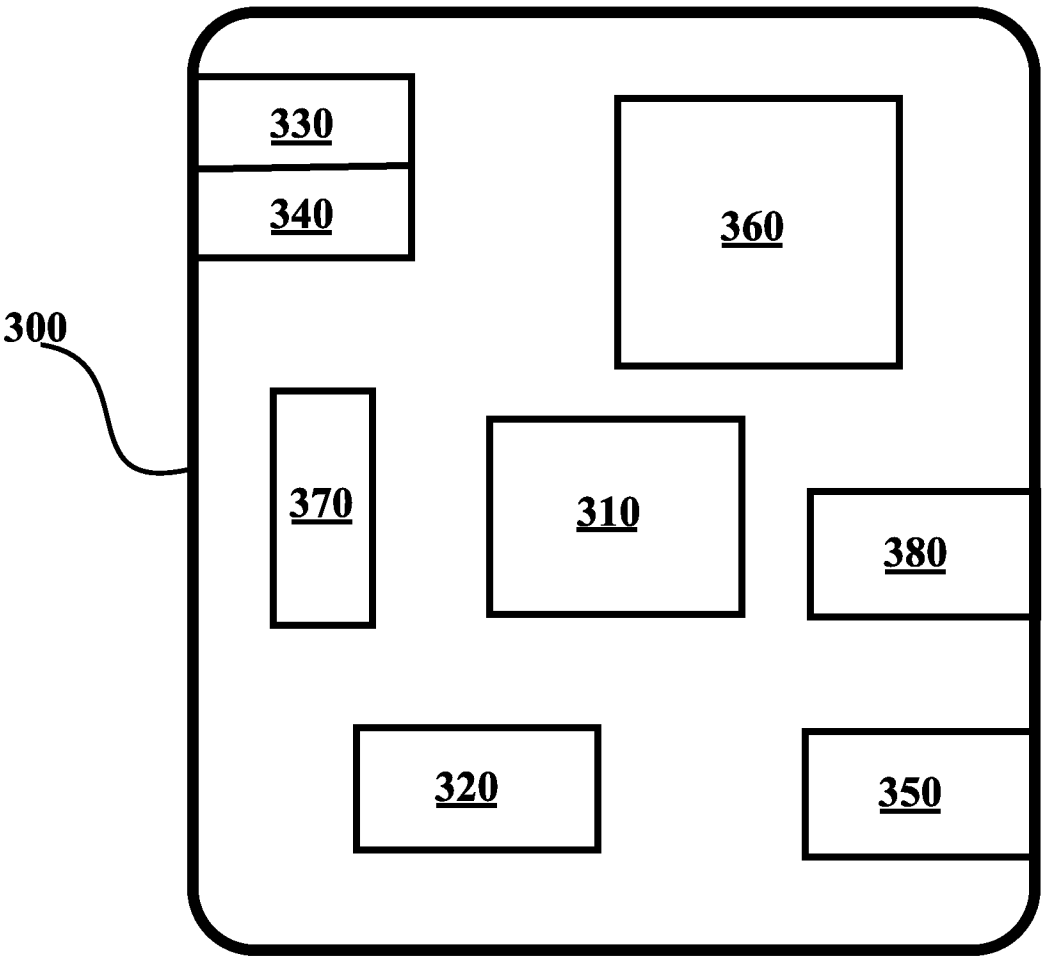

FIGURE 3

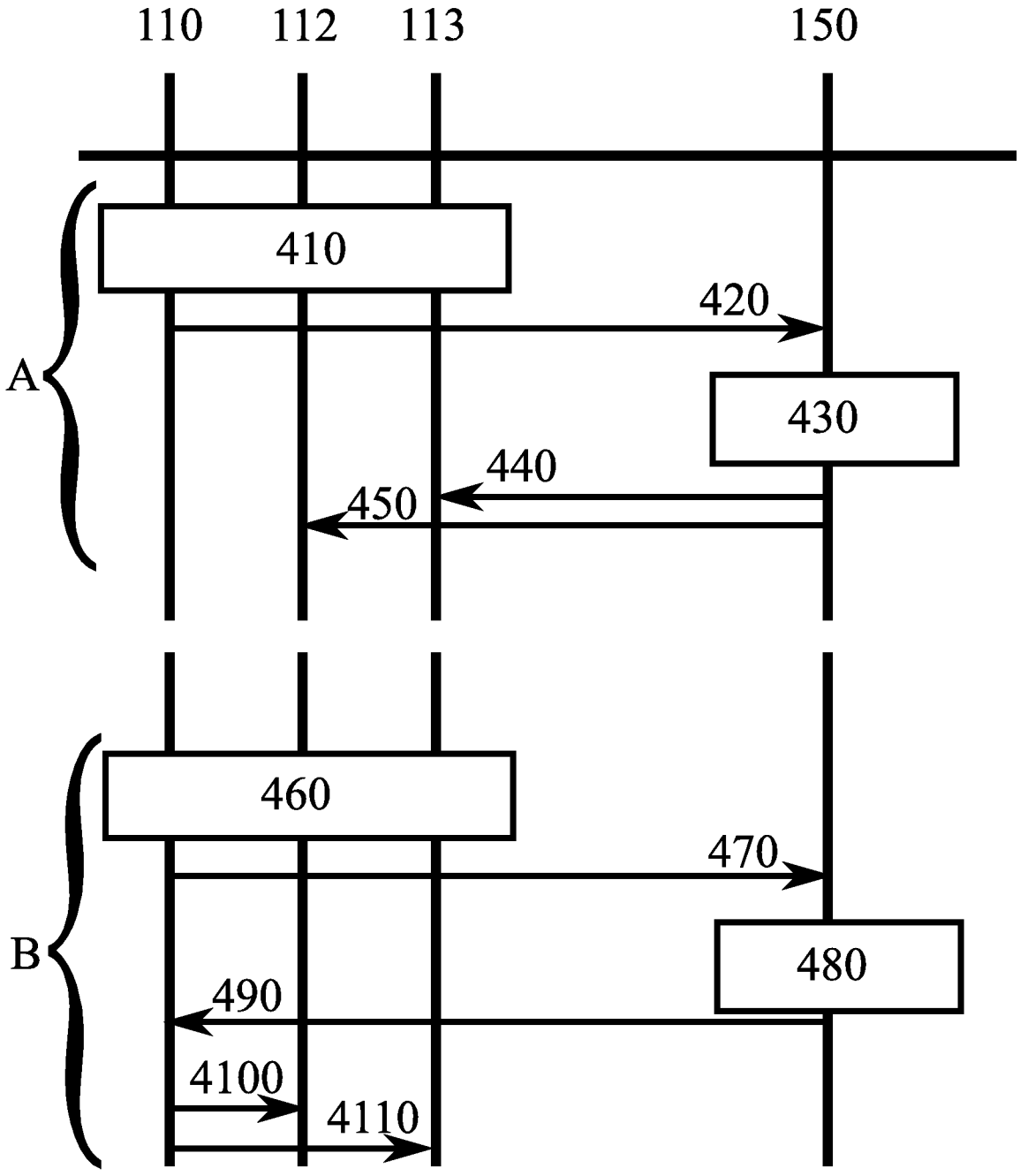

FIGURE 4

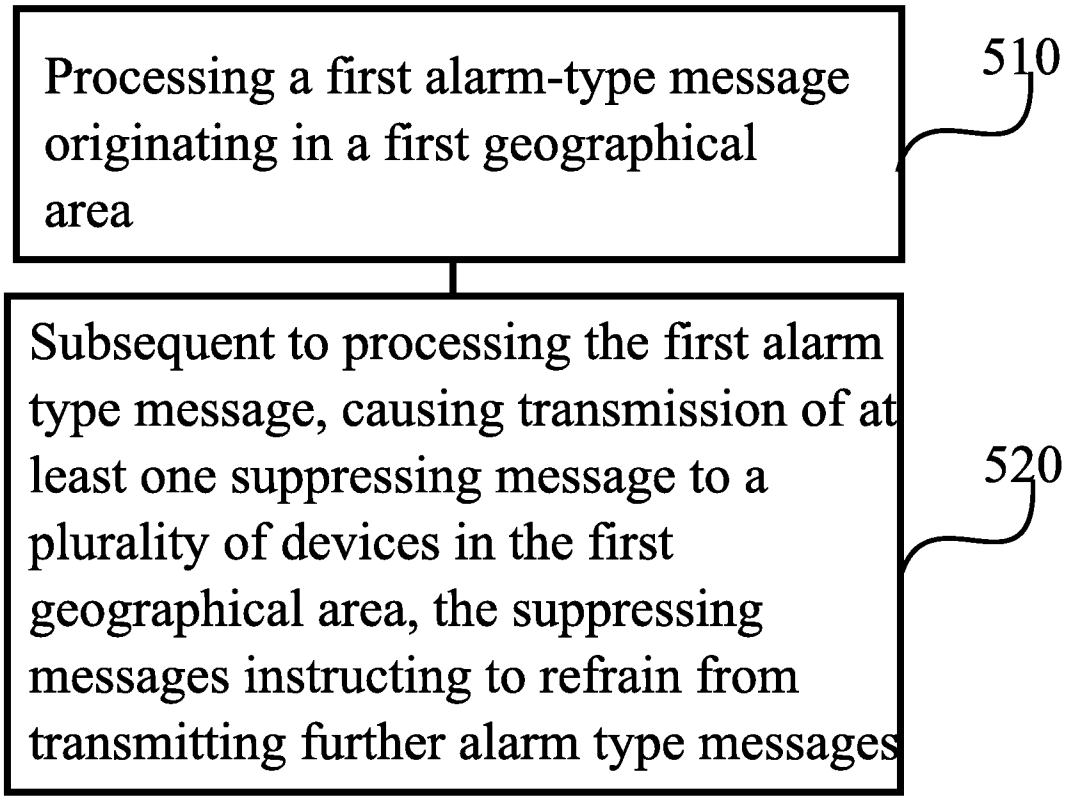
Processing a first alarm-type message originating in a first geographical area
510
Subsequent to processing the first alarm type message, causing transmission of at least one suppressing message to a plurality of devices in the first geographical area, the suppressing messages instructing to refrain from transmitting further alarm type messages
520

FIGURE 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2015/050899

A. **CLASSIFICATION OF SUBJECT MATTER**

See extra sheet

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)

IPC: G05B, G08B, G06F, H04L, H04W.

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

FI, SE, NO, DK

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

EPO-Internal, WPIAP, XP3GPP, XPAIP, XPESP, XPETSI, XPI3E, XPIEE, XPIETF, XPIOP, XPIPCOM, XPJPEG, XPMISC, XPRD, XPTK, COMPDX, INSPEC, NPL, Internet, ESPACENET

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013042011 A1 (SUGIZAKI RYUJI [JP] et al.) 14 February 2013 (14.02.2013) Abstract, paragraphs [0027]-[0029], [0090]-[0092], [0094], [0105]-[0112], [0120], [0122], [0133]-[0135], [0137]-[0142], [0157], [0171]-[0175], [0178]-[0183], [0189]-[0197], [0218], [0221], [0253]-[0255], [0259]-[0270], [0312]-[0317], [0320], [0325], [0389], [0401], figures 3, 4, 10-14, 18, 20, 21, 24, 35.	1-27
A	WO 2012034684 A1 (DEUTSCHE TELEKOM AG [DE]) 22 March 2012 (22.03.2012) The whole document.	1-27
A	WO 2012085744 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]) 28 June 2012 (28.06.2012) The whole document.	1-27

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"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
13 April 2016 (13.04.2016)	15 April 2016 (15.04.2016)

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2015/050899

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2085850 A1 (YOKOGAWA ELECTRIC CORP [JP]) 05 August 2009 (05.08.2009) The whole document.	1-27
A	US 2010123572 A1 (THUBERT PASCAL [FR] et al.) 20 May 2010 (20.05.2010) The whole document.	1-27

INTERNATIONAL SEARCH REPORT
Information on Patent Family Members

International application No.
PCT/FI2015/050899

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
US 2013042011 A1	14/02/2013	JP 5755639 B2	29/07/2015
		WO 2011129098 A1	20/10/2011
WO 2012034684 A1	22/03/2012	EP 2617158 A1	24/07/2013
		US 2013219053 A1	22/08/2013
WO 2012085744 A2	28/06/2012	None	
EP 2085850 A1	05/08/2009	EP 2085850 B1	27/04/2011
		CN 101498935 A	05/08/2009
		CN 101498935 B	31/08/2011
		JP 2009181394 A	13/08/2009
		JP 5024083 B2	12/09/2012
		US 2009201144 A1	13/08/2009
		US 8264339 B2	11/09/2012
US 2010123572 A1	20/05/2010	US 7902973 B2	08/03/2011
		US 2011133924 A1	09/06/2011
		US 8115617 B2	14/02/2012

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2015/050899

CLASSIFICATION OF SUBJECT MATTER

IPC
H04W 4/00 (2009.01)
H04L 12/24 (2006.01)
G06F 15/16 (2006.01)