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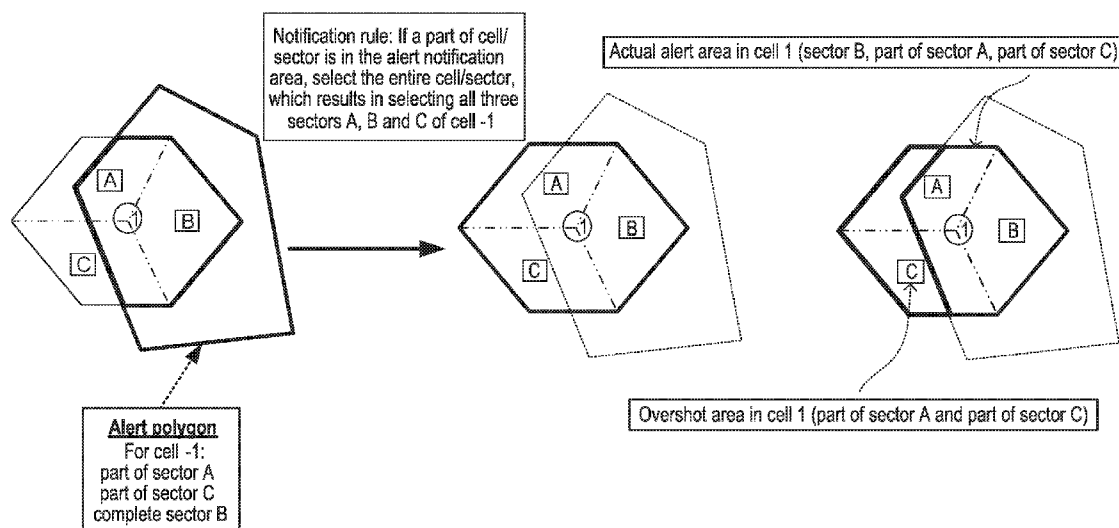


Figure 1

(57) Abstract: Various communication systems may benefit from geo-targeting. For example, certain wireless communication systems may benefit from support for geo-targeting to avoid or minimize overshoot of geo-targeted notifications. A method can include, at an access node, sending a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method can also include, at the access node, sending a second message including the at least one subsequent wireless emergency alert with display text.

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TITLE:

SUPPORT OF LATEST FCC REQUIREMENT OF DEVICE-BASED
GEO-TARGETING

CROSS-REFERENCE TO RELATED APPLICATIONS:

[0001] This application claims priority from U.S. provisional patent application no. 62/630,076 filed on February 13, 2018. The contents of this earlier filed application are hereby incorporated in their entirety.

BACKGROUND:

Field:

[0002] Various communication systems may benefit from geo-targeting. For example, certain wireless communication systems may benefit from support for geo-targeting to avoid or minimize overshoot of geo-targeted notifications.

Description of the Related Art:

[0003] One aspect of wireless technology relates to emergency warning notifications that are sent to mobile devices through the fourth generation (4G) network / long term evolution (LTE) infrastructure of Commercial Mobile Service Providers (CMSPs).

[0004] A part of the network functions involved in the broadcast of wireless emergency alert (WEA) text messages belong to the government in the sense that those network functions are managed by the government. A part of the network functions involved in the broadcast of WEA text messages belong to the CMSP (Commercial Mobile Service Providers).

[0005] A new Federal Communications Commission (FCC) Report and Order (R&O) indicates that the FCC wants the operators to transmit the coordinates of an affected area to the mobile devices and make changes to the mobile devices to make use of its location to see whether the mobile device is inside the affected area before displaying the WEA text on the device screen.

SUMMARY:

[0006] In accordance with some example embodiments, a method may include sending, from an access node, a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method may also include sending, from the access node, a second message including the at least one subsequent wireless emergency alert with display text.

[0007] In accordance with some example embodiments, an apparatus may include means for sending a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The apparatus may also include means for sending a second message including the at least one subsequent wireless emergency alert with display text.

[0008] In accordance with some example embodiments, an apparatus may include at least one processor and at least one memory including computer program code. The at least one memory and the computer program code may be configured to, with the at least one processor, cause the apparatus at least to send a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The at least one memory and the computer program code may also be configured to, with the at least one processor, cause the apparatus at least to send a second message including the at least one subsequent wireless emergency alert with display text.

[0009] In accordance with some example embodiments, a non-transitory computer readable medium can be encoded with instructions that may, when executed in hardware, perform a method. The method may include sending a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method may also include sending a second message including the

at least one subsequent wireless emergency alert with display text.

[0010] In accordance with some example embodiments, a computer program product may perform a method. The method may include sending a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method may also include sending a second message including the at least one subsequent wireless emergency alert with display text.

[0011] In accordance with some example embodiments, an apparatus may include circuitry configured to send a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The apparatus may also include circuitry configured to send a second message including the at least one subsequent wireless emergency alert with display text.

[0012] In accordance with some example embodiments, a method may include receiving, at a user equipment, a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method may also include receiving, at the user equipment, a second message including the at least one subsequent wireless emergency alert with display text.

[0013] In accordance with some example embodiments, an apparatus may include means for receiving a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The apparatus may also include means for receiving a second message including the at least one subsequent wireless emergency alert with display text.

[0014] In accordance with some example embodiments, an apparatus may include at least one processor and at least one memory including computer program code. The at least one memory and the computer program code may

be configured to, with the at least one processor, cause the apparatus at least to receive a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The at least one memory and the computer program code may further be configured to, with the at least one processor, cause the apparatus at least to receive a second message including the at least one subsequent wireless emergency alert with display text.

[0015] In accordance with some example embodiments, a non-transitory computer readable medium can be encoded with instructions that may, when executed in hardware, perform a method. The method may include receiving a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method may also include receiving a second message including the at least one subsequent wireless emergency alert with display text.

[0016] In accordance with some example embodiments, a computer program product may perform a method. The method may include receiving a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The method may also include receiving a second message including the at least one subsequent wireless emergency alert with display text.

[0017] In accordance with some embodiments, an apparatus may include circuitry configured to receive a first message including a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert. The apparatus may also include circuitry configured to receive a second message including the at least one subsequent wireless emergency alert with display text.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0018] For proper understanding of the invention, reference should be made to the accompanying drawings, wherein:

[0019] Figure 1 illustrates the overshooting scenario based on selecting cell-sectors.

[0020] Figure 2 illustrates a flow chart of a method according to certain embodiments.

[0021] Figure 3 illustrates SIB12 Handling in the enhanced mobile devices, according to certain embodiments.

[0022] Figure 4 illustrates enhanced device processing of upper layer handling, according to certain embodiments.

[0023] Figure 5 shows geo-coordinate handling, according to certain embodiments.

[0024] Figure 6 illustrates five different mobile devices in five different circumstances, according to certain embodiments.

[0025] Figure 7 illustrates a scenario where an enhanced mobile device that was outside the affected alert area moves and enters the affected alert area during the alert broadcast, according to certain embodiments.

[0026] Figure 8 illustrates a scenario where an enhanced mobile device that was inside the affected alert area moves out of an affected alert area during the alert broadcast, according to certain embodiments.

[0027] Figure 9 illustrates a scenario where an enhanced mobile device that was inside the affected alert area moves out of an affected alert area during the alert broadcast, according to certain embodiments.

[0028] Figure 10 illustrates a scenario where the WEA message type is turned off, according to certain embodiments.

[0029] Figure 11 illustrates a scenario where the WEA message type is turned off, according to certain embodiments.

[0030] Figure 12 indicates how the Message Identifier/Serial Number combination for two messages can be sent, according to certain embodiments.

[0031] Figure 13 illustrates a possible end-to-end view of two WEA message handling, according to certain embodiments.

[0032] Figure 14 illustrates a system according to certain embodiments.

[0033] Figure 15 illustrates an example flow diagram of a method according to certain embodiments.

[0034] Figure 16 illustrates an example flow diagram of another method according to certain example embodiments.

DETAILED DESCRIPTION:

[0035] With cell broadcast service (CBS), the cell broadcast center (CBC) maps the affected area to a list cell sectors. With the current technology a CBS message is broadcast to either the entire area covered within the cell-sector or none. The method used by the CBC to select a cell-sector can result in an overshooting in the form of devices outside the area receiving the message or in an undershooting in the form of devices within the area not receiving the messages.

[0036] Some CBCs overcome the undershooting cases by selecting the whole cell-sector when a part of that cell-sector is within the affected area. However, there are no conventional ways to avoid the overshooting case. Figure 1 illustrates the overshooting scenario based on selecting cell-sectors.

[0037] As shown in Figure 1, there can be an alert polygon that can overlap with cell-1. In this case, the alert polygon can include part of sector A, part

of sector C, and the complete sector B. There can be a notification rule that if a part of cell/sector is in the alert notification area, the system can select the entire cell/sector, which results in selecting all three sectors A, B and C of cell-1. This can result in coverage of the actual alert area in cell 1 (sector B, part of sector A, and part of sector C) but also an overshoot area in cell 1 (part of sector A and part of sector C).

[0038] The FCC wants the service providers, such as CMSPs, to overcome this overshooting scenario. In other words, the FCC does not want the mobile devices outside the affected area to receive the alert message.

[0039] FCC has recently published a new R&O that requires the CMSPs to deliver the coordinates of the affected area to mobile devices and then make modifications to the mobile devices to display the alert text only when the devices found themselves within the coordinates of the affected area. FCC in the R&O stated that number of display characters sent to the devices should not be affected due to the fact that network utilizes the same channel to broadcast the coordinates of the affected area.

[0040] Nevertheless, there is not currently a way of transferring the co-ordinates of the affected area to the mobile devices. When a new method to broadcast the coordinates of the affected area is implemented, the network may have to broadcast each alert text twice – once without the coordinates and once with the coordinates. The reason for that is the existing devices that cannot handle the coordinates should continue to receive the alerts even if there is an overshooting.

[0041] The industry believes that the only way the coordinates of the affected area can be broadcast is along with the display text. The current mobile devices simply display the contents on the screen with no capability to process the contents and then display only a part of the contents. Even though industry believes that an intelligent application within the device can

do that, the fact is that the broadcasting in the old way and in the new way will still be required.

[0042] In certain embodiments, the affected area co-ordinates can be sent to the mobile devices in a new dedicated WEA message that can carry just the coordinates. A new message identifier can be defined to identify this special new WEA message. The new message identifier may be added only to the new enhanced devices. That way, the existing devices never see this new special WEA message. The method used to broadcast the WEA messages that carry the display text may remain unchanged. This way, the network does not have to broadcast a WEA message that carries the display text twice.

[0043] Within the CBS concepts, a field referred to as Data Coding Scheme (DCM) exists that tells the devices the format of the warning message contents. In the existing WEA scheme, the DCM says GSM 7 bit and the devices simply take the bits from the warning message contents and then display contents on the screen applying the GSM 7-bit format.

[0044] The DCM field for the new special WEA message will use the value to indicate the warning message contents are in binary form. That way, the devices can take the warning contents in the octet form.

[0045] The Message Identifier value tells the devices that this is a new special WEA message that carries the coordinates of the affected area coordinates instead of the display text.

[0046] In addition, the octets included within the warning message contents carry a reference to the WEA message that will carry the display text.

[0047] The devices can first receive the new special WEA message, determine the location based on the coordinates value, and then wait for the referenced WEA message that carry the display text. When the WEA message that carries the display text is received, the devices can display the

text only if it had determined that its own location was within the coordinates of the affected area. For the special case where the device is unable to determine its own location, the device can follow the current logic and go ahead and display the text even if that results in an overshooting.

[0048] Because there is some small real-time delay (value is based on the SI-Periodicity which is set in the eNB), the enhancement made within the devices will define a new field referred in this disclosure as Enable Display Indicator (EDI). When the enhanced device receives the special WEA message, it will set the EDI field to ON when the device location is within the location determined by the affected area coordinates. It will reset the EDI (to OFF) if the device location is outside the location determined by the affected area coordinates. When the referenced WEA message that carries the display text is received, the enhanced device would display the text if and only if the EDI field is set to ON.

[0049] Figure 2 illustrates a flow chart of a method according to certain embodiments. As shown in Figure 2, an eNB can send a new special WEA message with the coordinates of the affected alert area and a pointer to the WEA messages that carry the display text. The mobile device can determine whether the device was within the coordinates of the affected alert area. If not, the device can reset the EDI field, namely to OFF, for the referenced WEA messages that carry the display text. Otherwise, if the device is within the coordinates, the device can set the EDI field, namely to ON, for the referenced WEA messages that carry the display text.

[0050] There can be a real-time delay between the new special WEA message and the WEA message that carries the display text. The real-time delay between the new special WEA message and the WEA message that carries the display text can be on the order of SI-Periodicity values. If the new special WEA message has one segment, if the next SIB12 segment carries the referenced WEA message with the display text, then the real-time

delay can be one SI-Periodicity. The lowest settable value 80 is ms and highest settable value is 5.12 seconds. In the event the device receives the WEA message that carries the display text first, then it will not display the text since the EDI field will not be set to ON. The device can handle the new special WEA message and the WEA message with the display text when the network repeats the same – in order of SI-Periodicity during the Paging period.

[0051] When the device cannot determine its location, the device can set the EDI field to ON when it receives the new special WEA message that carries the coordinates of the affected alert area. That way, the devices that do not know location can continue to exhibit the behavior of the devices that do not have the enhancements, namely that they go ahead and display the text from the WEA message referenced in the special WEA message that carries the coordinates of the affected area.

[0052] Thus, certain embodiments can display the text if inside the coordinates, discard the message if outside the coordinates, and display the text, if the location is not known.

[0053] The alert text within the WEA message can continue to have 360 display characters since the alert coordinates are sent in separate special new WEA message.

[0054] The use of a new message identifier value can allow the approach to be backward compatible. In certain embodiments, because the new message identifier value is only used to broadcast the special WEA message that carries the coordinates of the affected area, the network can broadcast each WEA message that carries the display text only once. The old devices would display the alert text unconditionally and the new enhanced devices would display the alert text only if the device's current location is within the coordinates of the affected area.

[0055] The new special WEA message that carries the coordinates of the affected alert area can be referred to as a geo-coordinate WEA message. The WEA message that carries the display text can be referred to as a display text WEA message. The term geo-coordinate can be used to refer the coordinates of the affected alert area.

[0056] The term alert broadcast area can be used to refer to the area cover by the cell-sectors to which the network broadcasts a WEA message. The term affected alert area can be used to refer to the area within the geo-coordinates. The term Enable Display Indicator (EDI) can be used to refer to the new field.

[0057] The term referenced Display Text WEA message can be used to refer to the Display Text WEA message identified within the warning message content of Geo-coordinate WEA message. Sometimes the term, to-be-displayed WEA message can also be used for the same, depending on the context.

[0058] The term alert text can be used to refer to the display text characters contained within the warning message contents of a Display Text WEA message. A Display Text WEA message can be in multiple languages. As per the current FCC rules, two languages may be used: English and Spanish.

[0059] A Message Identifier/Serial Number combination can be used to uniquely identify or reference a CBS message and hence, the WEA message. There can be more than one referenced Display Text WEA message identified within the Geo-coordinate WEA message if the same rules apply to all referenced Display Text WEA messages. An example to this can be the broadcast of WEA messages in multiple languages.

[0060] The enhancements to be made to mobile devices according to certain embodiments are illustrated using flow-charts, as shown below. The existing mobile devices will not have the Message Identifier value of the

Geo-coordinate WEA message in their search list and consequently will not receive the messages.

[0061] For WEA messages, the mobile devices can discard the messages if the contents were already displayed. The enhanced mobile devices can use a different method to discard the Geo-coordinate WEA messages because the contents are not displayed.

[0062] If all referenced Display Text WEA messages were displayed, then the mobile device would discard the subsequent Geo-coordinate WEA message repeated by the network. A Display Text WEA message is discarded if the contents were already displayed as per the current behavior. However, a few enhancements can be made to the related behaviors.

[0063] When the Geo-coordinate WEA message is received, the enhanced mobile device can determine whether it is within the coordinates of the affected alert area specified within the Geo-coordinate WEA message.

[0064] When the enhanced mobile device finds out that it is within the coordinates of the affected alert area, the device can set the new field Enable Display Indicator (EDI) field to ON within the device.

[0065] When a Display Text WEA message is received, the enhanced mobile device can display the text contained within the warning message contents only if the EDI field is set to ON. If EDI field is OFF, the mobile device can discard the Display Text WEA message.

[0066] Once the alert text contained within the warning message contents of a Display Text WEA message is displayed, a subsequent reception of the same Display Text WEA message can be discarded based on the current logic of discarding a CBS message once the text within the CBS message was displayed.

[0067] Once the alert text of all the referenced Display Text WEA messages are displayed, all the subsequently received Geo-coordinate WEA message

associated with the referenced Display Text WEA messages can be discarded.

[0068] As per the FCC report and order, if the mobile device is unable to determine its location, the mobile device can set the EDI field to ON to enable the alert text within the referenced Display Text WEA message be displayed.

[0069] Three complex flow-charts of enhanced mobile device are given in Figure 3, Figure 4 and Figure 5 to illustrate the handling of WEA messages.

[0070] Figure 3 illustrates SIB12 Handling in the enhanced mobile devices, according to certain embodiments. This SIB12 handling may correspond to the pseudo-code of SIB12 in 3GPP TS 36.331.

[0071] Figure 4 illustrates enhanced device processing of upper layer handling, according to certain embodiments. More particularly, Figure 4 illustrates the upper layer handling of a WEA message. The flow-chart shows that when a displayable WEA message, namely a Display Text WEA message, is received, if the message was not already displayed, a check can be made to see whether the device is capable of handling the location-based display. When the device is not able to handle location-based display, the current handling is presumed which would result in the device displaying the text on the screen.

[0072] When the enhanced mobile device is capable of handling location-based display, the flow-chart shows that the device can check to see whether the EDI field is set to ON. The EDI field set to ON means the Geo-coordinate WEA message has already verified that the mobile device is within the affected area coordinates and the displaying the alert text is fine. If the EDI flag is OFF, then the enhanced mobile device can discard the subsequently received referenced Display Text WEA message, because it is not certain whether the device is within the alert area coordinates.

[0073] The flow-chart also shows the branch when the received message is not a Display Text WEA message. When the received message is a Geo-coordinate WEA message, the flow-chart shows the branch off to handle the geo-coordinate handling, which is shown in Figure 5.

[0074] Figure 5 shows geo-coordinate handling, according to certain embodiments. The flow-chart shows that when the enhanced mobile device is enabled for location-based display, the device can look into the warning message contents to find all the referenced Display Text messages, for example finding the Message Identifier and Serial Number values. When alert from all the referenced Display Text WEA Messages were displayed, the Geo-coordinate WEA message has no role to play and thus can be discarded. The enhanced mobile device can set the EDI field to ON for those referenced Display Text WEA messages that are yet to be displayed on the following cases: mobile device is within the affected area coordinates or mobile device cannot determine its own location. The mobile devices can reset the EDI flag to OFF if the device is found to be outside the affected area coordinates.

[0075] Figure 6 illustrates five different mobile devices in five different circumstances, according to certain embodiments. In Figure 6, device 1 is a mobile device without the enhancement in the broadcast alert area, but outside the affected alert area. Device 2 is a mobile device without the enhancement in the affected alert area. Device 3 is a mobile device with the enhancement in the affected alert area has its own location. Device 4 is a mobile device with the enhancement in the affected alert area, but does not have its own location. Device 5 is a mobile device with the enhancement in the broadcast alert area, but outside the affected alert area.

[0076] As shown in Figure 6, device 1 and device 2 ignore the Geo-coordinate WEA messages and display the alert text present in the Display Text WEA message as they are displayed today.

[0077] Device 3 sets the EDI field to ON upon receiving the Geo-coordinate WEA message since it is within the affected alert area and is able to determine its own location.

[0078] Device 4 also sets the EDI field to ON upon receiving the Geo-coordinate WEA message since it is not able to determine its own location.

[0079] Device 5 resets the EDI field to OFF upon receiving the Geo-coordinate WEA message because the device is outside the affected alert area and is able to determine its own location.

[0080] Among the enhanced devices, device 3 and device 5 display alert text from the Display Text WEA message, whereas device 4 does not. In the flow-diagram of Figure 6, if device 5 moves to the affected alert area while WEA is still valid, since the network would repeat the Geo-coordinate WEA message and the Display Text Message, device 5 will be able to display the alert text when it subsequently receives the two messages.

[0081] Figure 7 illustrates a scenario where an enhanced mobile device that was outside the affected alert area moves and enters the affected alert area during the alert broadcast, according to certain embodiments. As shown in Figure 7, the device did not display the alert text while it was outside the affected alert area. When the device moves into the affected area, the reception of the next Geo-coordinate WEA message may enable the device to set the EDI field to ON which will result in the display of alert text in a subsequently received referenced Display Text WEA message.

[0082] Figure 8 illustrates a scenario where an enhanced mobile device that was inside the affected alert area moves out of an affected alert area during the alert broadcast, according to certain embodiments. As shown in Figure 8, the device has already displayed alert text while it was inside the affected alert area. When the device moves out of the affected alert area, it can

continue to discard the Geo-coordinate WEA message and the referenced Display Text WEA message because the device has already displayed the alert text.

[0083] Figure 9 illustrates a scenario where an enhanced mobile device that was inside the affected alert area moves out of an affected alert area during the alert broadcast, according to certain embodiments. As shown in Figure 9, the device did not display the alert text while it was outside the affected alert area. When the device moves into the affected alert area, the device can discard the Display Text WEA message until it receives the Geo-coordinate WEA message. This is also the expected behavior as the device is expected to display alert text only when it is within the affected alert area.

[0084] Figure 10 illustrates a scenario where the WEA message type is turned off, according to certain embodiments. For example, AMBER alert may be turned off. As shown in Figure 10, the user of the device can change the configuration during the alert broadcast. In Figure 10, the device did not display the alert text while WEA type was turned off even though the device was inside the affected alert area. Later, when the user changes the configuration menu, the device can display the alert text from the WEA message.

[0085] Figure 11 illustrates a scenario where the WEA message type is turned off, according to certain embodiments. For example, an AMBER alert may be off. In Figure 11, the user of the device changes the configuration during the alert broadcast, but the device moves out of affected alert area. In Figure 11, the device did not display the alert text while WEA type was turned off even though the device was inside the affected alert area. Later, when the user changes the configuration menu, the device will not display the alert text from the WEA message when outside of the affected area.

[0086] There may be a possible header configuration within the warning message content of Geo-coordinate WEA message to carry information about the referenced Display Text WEA message.

[0087] With the presumption that the English and Spanish language alerts will have the same geo-targeting requirements, this header can allow the Geo-coordinate WEA message to carry more than one Message Identifier/Serial Number combination. The following can be an example of the format of the Warning Message Contents of a Geo-coordinate WEA message: Display Text WEA Last Message Indicator, Message Identifier of Display Text WEA message, Serial Number of Display Text WEA message, and Geo-coordinates.

[0088] With the Display Text WEA Last Message Indicator, multiple Message Identifier/Serial Number combinations can be sent. For example, the table in Figure 12 indicates how the Message Identifier/Serial Number combination for two messages can be sent, according to certain embodiments.

[0089] Having a new and dedicated WEA message specifically to carry the Geo-coordinates may allow more octets to carry the co-ordinates of the affected area.

[0090] Figure 13 illustrates a possible end-to-end view of two WEA message handling, according to certain embodiments. As shown in Figure 13, a WEA message within the mobile device can be identified uniquely using the Message Identifier and Serial Number combination. Any other methods which perhaps can be implemented may not only impact the other network functions but may also change the CBS concepts.

[0091] To carry the identification of referenced Display Text WEA within, the warning message contents of a Geo-coordinate WEA message may be

able to carry the Message Identifier and Serial Number combination of such referenced messages.

[0092] Since the Message Identifier value is an unknown factor before it is in the flow direction of a WEA message from Alert Originator to mobile devices, the CMSP GW can populate the Message Identifier value of the referenced Display Text WEA message with the contents that will be in the Geo-coordinate WEA message.

[0093] In the same way, since the Serial Number value is an unknown factor before it is in the flow direction of a WEA message from Alert Originator to mobile devices, the CBC can populate the Serial Number value (that it assigns to the referenced Display Text WEA message) within the warning message contents of the Geo-coordinate WEA message.

[0094] In order to place the Serial Number value into the warning message contents of Geo-coordinate WEA message, the CBC can have information about Geo-coordinate WEA message and the Display Text WEA message at the same time. The CBC can send two separate WRITE-REPLACE WARNING REQUESTS toward the eNB and in this respect, the MME and eNB can be immune to this approach.

[0095] Transferring the information together can be realized in more than one way. For example, the CBS_Request from the CMSP GW to CBC can carry the information of both messages in one package. In this approach, as indicated above, the CMSP GW may have to add the Message Identifier value of the Display Text WEA message to warning message contents part of Geo-coordinate WEA message.

[0096] In another approach, the coordinates of affected alert area can be included as an information element within the CBS_Request message sent for Display Text WEA message along with the Message identifier value to be assigned for it. The CBC may then construct the WRWR for the Geo-

coordinate WEA message from that information element and using the provided Message Identifier value. The CBC can then include the Message Identifier and Serial Number of Display Text WEA message to the warning message contents of Geo-coordinate WEA message. In this approach, the CMSP GW does not have a role in constructing the Geo-coordinate WEA message.

[0097] Within the eNB, the Geo-coordinate WEA message can be broadcast first. During the paging period (normal behavior), each segment of SIB12 can be broadcast at the SI-Periodicity rate. For example, if the SI-Periodicity is 320 ms, the time-delay between the two segments will be 160 ms. If Geo-coordinate WEA message has one segment (can carry up to 203 octets of data), and Display Text WEA message has 2 segments (can carry 360 characters), then the segment of Geo-coordinate WEA messages is broadcast first followed by the 2 segments of Display Text WEA message. Together those 3 segments take 480 ms.

[0098] After transmitting the 2 segments of Display Text WEA message, the eNB can repeat the broadcasts of Geo-coordinate WEA message 160 ms later. This indicates that even if there is a timing issue where a device happens to receive the Display Text WEA first (which it would discard as EDI field is not set to ON)), the device would display the alert text correctly when the same messages are repeated. In this example, the delay is about 480 ms.

[0099] In the current system, if the device happens to receive the second segment first, then it has to wait until the entire message is repeated by the network again. The delay would be similar.

[0100] Figure 13 illustrates an example of network process (before the eNB) that can be used to establish an association between the two messages (Geo-coordinate WEA message and Display Text WEA message). In one

approach, as shown in Figure 13, the Message Identifier/Serial Number combination of Displayable Text WEA message can be included in the Geo-coordinate WEA message. Since the Serial Number is an unknown factor before the CBC, the association can be basically made at the CBC.

[0101] Another option to establish the association may also or alternatively be done by including a different association method. For example, the Geo-coordinate message may include the identity of the associated Display Text WEA message in a different form. In this case, different means other than the Message Identifier, Serial Number combination. The identity of the associated Display Text message can be set by the Federal Alert GW or even the alert originator.

[0102] The identity can also be sent in the Display Text WEA message at the beginning as, for example, four characters. The enhanced devices would use the identity to associate the two messages. The current devices would display the 4 characters. In certain embodiments, this alternative may be done without impacting the CMSP GW or the CBC.

[0103] Figure 14 illustrates a system according to certain embodiments of the invention. It should be understood that each block of the flowcharts shown herein may be implemented by various means or their combinations, such as hardware, software, firmware, one or more processors and/or circuitry. In one embodiment, a system may include several devices, such as, for example, network element 1410 and user equipment (UE) or user device 1420. The system may include more than one UE 1420 and more than one network element 1410, although only one of each is shown for the purposes of illustration. A network element can be an access point, a base station, an eNode B (eNB), or any other network element.

[0104] Each of these devices may include at least one processor or control unit or module, respectively indicated as 1414 and 1424. At least one

memory may be provided in each device, and indicated as 1415 and 1425, respectively. The memory may include computer program instructions or computer code contained therein, for example for carrying out the embodiments described above. One or more transceiver 1416 and 1426 may be provided, and each device may also include an antenna, respectively illustrated as 1417 and 1427. Although only one antenna each is shown, many antennas and multiple antenna elements may be provided to each of the devices. Other configurations of these devices, for example, may be provided. For example, network element 1410 and UE 1420 may be additionally configured for wired communication, in addition to wireless communication, and in such a case antennas 1417 and 1427 may illustrate any form of communication hardware, without being limited to merely an antenna.

[0105] Transceivers 1416 and 1426 may each, independently, be a transmitter, a receiver, or both a transmitter and a receiver, or a unit or device that may be configured both for transmission and reception. The transmitter and/or receiver (as far as radio parts are concerned) may also be implemented as a remote radio head which is not located in the device itself, but in a mast, for example. It should also be appreciated that according to the “liquid” or flexible radio concept, the operations and functionalities may be performed in different entities, such as nodes, hosts or servers, in a flexible manner. In other words, division of labor may vary case by case. One possible use is to make a network element to deliver local content. One or more functionalities may also be implemented as a virtual application that is provided as software that can run on a server.

[0106] A user device or user equipment 1420 may be a mobile station (MS) such as a mobile phone or smart phone or multimedia device, a computer, such as a tablet, provided with wireless communication capabilities, personal data or digital assistant (PDA) provided with wireless communication

capabilities, vehicle, portable media player, digital camera, pocket video camera, navigation unit provided with wireless communication capabilities or any combinations thereof. The user device or user equipment 1420 may be a sensor or smart meter, or other device that may usually be configured for a single location.

[0107] In an exemplifying embodiment, an apparatus, such as a node or user device, may include means for carrying out embodiments described above in relation to Figures 1-13.

[0108] Processors 1414 and 1424 may be embodied by any computational or data processing device, such as a central processing unit (CPU), digital signal processor (DSP), application specific integrated circuit (ASIC), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), digitally enhanced circuits, or comparable device or a combination thereof. The processors may be implemented as a single controller, or a plurality of controllers or processors. Additionally, the processors may be implemented as a pool of processors in a local configuration, in a cloud configuration, or in a combination thereof. The term circuitry may refer to one or more electric or electronic circuits. The term processor may refer to circuitry, such as logic circuitry, that responds to and processes instructions that drive a computer.

[0109] For firmware or software, the implementation may include modules or units of at least one chip set (e.g., procedures, functions, and so on). Memories 1415 and 1425 may independently be any suitable storage device, such as a non-transitory computer-readable medium. A hard disk drive (HDD), random access memory (RAM), flash memory, or other suitable memory may be used. The memories may be combined on a single integrated circuit as the processor, or may be separate therefrom. Furthermore, the computer program instructions may be stored in the memory and which may be processed by the processors can be any suitable

form of computer program code, for example, a compiled or interpreted computer program written in any suitable programming language. The memory or data storage entity is typically internal but may also be external or a combination thereof, such as in the case when additional memory capacity is obtained from a service provider. The memory may be fixed or removable.

[0110] The memory and the computer program instructions may be configured, with the processor for the particular device, to cause a hardware apparatus such as network element 1410 and/or UE 1420, to perform any of the processes described above (see, for example, Figures 1, 15, and 16). Therefore, in certain embodiments, a non-transitory computer-readable medium may be encoded with computer instructions or one or more computer program (such as added or updated software routine, applet or macro) that, when executed in hardware, may perform a process such as one of the processes described herein. Computer programs may be coded by a programming language, which may be a high-level programming language, such as objective-C, C, C++, C#, Java, etc., or a low-level programming language, such as a machine language, or assembler. Alternatively, certain embodiments of the invention may be performed entirely in hardware.

[0111] Furthermore, although Figure 14 illustrates a system including a network element 1410 and a UE 1420, embodiments of the invention may be applicable to other configurations, and configurations involving additional elements, as illustrated and discussed herein. For example, multiple user equipment devices and multiple network elements may be present, or other nodes providing similar functionality, such as nodes that combine the functionality of a user equipment and an access point, such as a relay node.

[0112] Figure 15 illustrates an example flow diagram of a method according to certain embodiments. In certain embodiments, the flow diagram of Figure 15 may be performed by a network entity, network node, or access node in a 3GPP system, such as LTE or 5G new radio (NR). For instance, in some

example embodiments, the method of Figure 15 may be performed by a base station or access node, eNB or gNB.

[0113] According to one example embodiment, the method of Figure 15 may initially, at 100, include sending, from an access node, a wireless emergency alert with coordinates for an alert area and a pointer to at least one subsequent wireless emergency alert. The method may also include, at 105, sending, from the access node, the at least one subsequent wireless emergency alert with display text. In an example embodiment, the wireless emergency alert may include a header that indicates that the wireless emergency alert message contains the coordinates. In another example embodiment, the method may include, at 110, sending both the wireless emergency alert and the subsequent wireless emergency alert to each entire sector if an alert area at least partially overlaps a respective sector.

[0114] Figure 16 illustrates an example flow diagram of another method according to certain embodiments. In certain example embodiments, the flow diagram of Figure 16 may be performed by a mobile station and/or UE, for instance. According to one example embodiment, the method of Figure 16 may include initially, at 200, receiving, at a user equipment, a wireless emergency alert with coordinates for an alert area and a pointer to at least one subsequent wireless emergency alert. The method may also include, at 205, receiving, at the user equipment, the at least one subsequent wireless emergency alert with display text. The method may further include, at 210, determining, at the user equipment, whether the user equipment is within the alert area based on the coordinates. In addition, at 215, the method may include conditionally displaying, at the user equipment, the subsequent wireless emergency alert when the user equipment is within the alert area.

[0115] One having ordinary skill in the art will readily understand that the invention as discussed above may be practiced with steps in a different order, and/or with hardware elements in configurations which are different

than those which are disclosed. Therefore, although the invention has been described based upon these preferred embodiments, it would be apparent to those of skill in the art that certain modifications, variations, and alternative constructions would be apparent, while remaining within the spirit and scope of the invention.

[0116] For example, certain embodiments relate to delivering and displaying a text message to a device, such as a user equipment. The same or similar principles can be used for displaying a media file, or transmitting an executable script to the device. In a further example, the user equipment could be configured to run a program, and/or start an application or a process based on the combined Geo-coordinate WEA message and some following WEA message indicating what to do, or possibly even containing the executable. This may be accomplished by indicating that the WEA message is of an executable type or is of a type that encodes actions for the user or user equipment to take. The actions for the user to take may include things like sheltering in place or escaping to high ground. The actions for the user equipment to take may be to provide an audible alert, communicate with other local devices to form a device-to-device cluster, or the like.

[0117] List of Abbreviations

[0118]	3GPP	3rd Generation Partnership Project
[0119]	4G	4th Generation
[0120]	ATIS	Alliance for Telecommunications Industry Solutions
[0121]	CBC	Cell Broadcast Center
[0122]	CBS	Cell Broadcast Service
[0123]	DCI	Downlink Control Information
[0124]	EDI	Enable Display Indicator (introduced in this disclosure)
[0125]	eNB	enhanced Node B
[0126]	ETWS	Earthquake and Tsunami Warning System
[0127]	E-UTRAN	Evolved Universal Terrestrial Radio Access Network

[0128]FCC	Federal Communications Commission
[0129]ID	Identity or Identifier
[0130]Id	Identity or Identifier
[0131]LTE	Long Term Evolution
[0132]MME	Mobility Management Entity
[0133]OMC	Operations Maintenance Center
[0134]PWS	Public Warning System
[0135]SIB	System Information Block
[0136]TA	Tracking Area
[0137]TS	Technical Specification
[0138]WEA	Wireless Emergency Alert
[0139]WRWR	Write Replace Warning Request

WE CLAIM:

1. A method, comprising:
 - sending, from an access node, a first message comprising a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert; and
 - sending, from the access node, a second message comprising the at least one subsequent wireless emergency alert with display text.
2. The method according to claim 1, wherein the wireless emergency alert comprises a header that indicates that the first message contains the coordinates.
3. The method according to claims 1 or 2, further comprising sending both the first message and the second message to each entire sector if the alert area at least partially overlaps a respective sector.
4. The method according to any of claims 1-3, wherein the first message and the second message are sent separately.
5. A method, comprising:
 - receiving, at a user equipment, a first message comprising a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert; and
 - receiving, at the user equipment, a second message comprising the at least one subsequent wireless emergency alert with display text.
6. The method according to claim 5, further comprising determining, at the user equipment, whether the user equipment is within the alert area based on the coordinates.

7. The method according to claims 5 or 6, further comprising conditionally displaying, at the user equipment, the subsequent wireless emergency alert when the user equipment is within the alert area.

8. The method according to claim 7, wherein the conditionally displaying is conditioned on whether the user equipment is configured to suppress wireless emergency alerts of a type corresponding to the subsequent wireless emergency alert.

9. The method according to claims 5 or 6, further comprising:
storing, in the user equipment, the reference and the coordinates received in the first message; and
conditionally displaying, at the user equipment, the subsequent wireless emergency alert with display text in a received third message based on the reference in the third message, and the stored reference and whether the user equipment is within the coordinates given in the first message.

10. The method according to any of claims 5-9, wherein the first message and the second message are received separately.

11. An apparatus, comprising:
at least one processor; and
at least one memory comprising computer program code,
the at least one memory and the computer program code are configured, with the at least one processor to cause the apparatus at least to
send a first message comprising a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert; and
send a second message comprising the at least one subsequent wireless emergency alert with display text.

12. The apparatus according to claim 11, wherein the wireless emergency alert comprises a header that indicates that the first message contains the coordinates.

13. The apparatus according to claims 11 or 12, wherein the at least one memory and the computer program code are further configured, with the at least one processor to cause the apparatus at least send both the first message comprising and the second message to each entire sector if the alert area at least partially overlaps a respective sector.

14. The apparatus according to any of claims 11-13, wherein the first message and the second message are sent separately.

15. An apparatus, comprising:
at least one processor; and
at least one memory comprising computer program code,
the at least one memory and the computer program code are configured, with the at least one processor to cause the apparatus at least to
receive a first message comprising a wireless emergency alert with coordinates for an alert area and a reference to at least one subsequent wireless emergency alert; and
receive a second message comprising the at least one subsequent wireless emergency alert with display text.

16. The apparatus according to claim 15, wherein the at least one memory and the computer program code are further configured, with the at least one processor to cause the apparatus at least to determine whether the user equipment is within the alert area based on the coordinates.

17. The apparatus according to claims 15 or 16, wherein the at least one memory and the computer program code are further configured, with the at least one processor to cause the apparatus at least to conditionally display the subsequent wireless emergency alert when the user equipment is within the alert area.

18. The apparatus according to claim 17, wherein the conditionally displaying is conditioned on whether the user equipment is configured to suppress wireless emergency alerts of a type corresponding to the subsequent wireless emergency alert.

19. The apparatus according to claims 15 or 16, wherein the at least one memory and the computer program code are further configured, with the at least one processor to cause the apparatus at least to:

store, in the user equipment, the reference and the coordinates received in the first message; and

conditionally display, at the user equipment, the subsequent wireless emergency alert with display text in a received third message based on the reference in the third message, and the stored reference and whether the user equipment is within the coordinates given in the first message.

20. The apparatus according to any of claims 15-19, wherein the first message and the second message are received separately.

21. An apparatus comprising means for performing a process according to any of claims 1-10.

22. An apparatus comprising circuitry configured to cause the apparatus to perform a process according to any of claims 1-10.

23. A computer program product encoded with instructions for performing a process according to any of claims 1-10.

24. A non-transitory computer readable medium encoding instructions that, when executed in hardware, performs a process according to any of claims 1-10.

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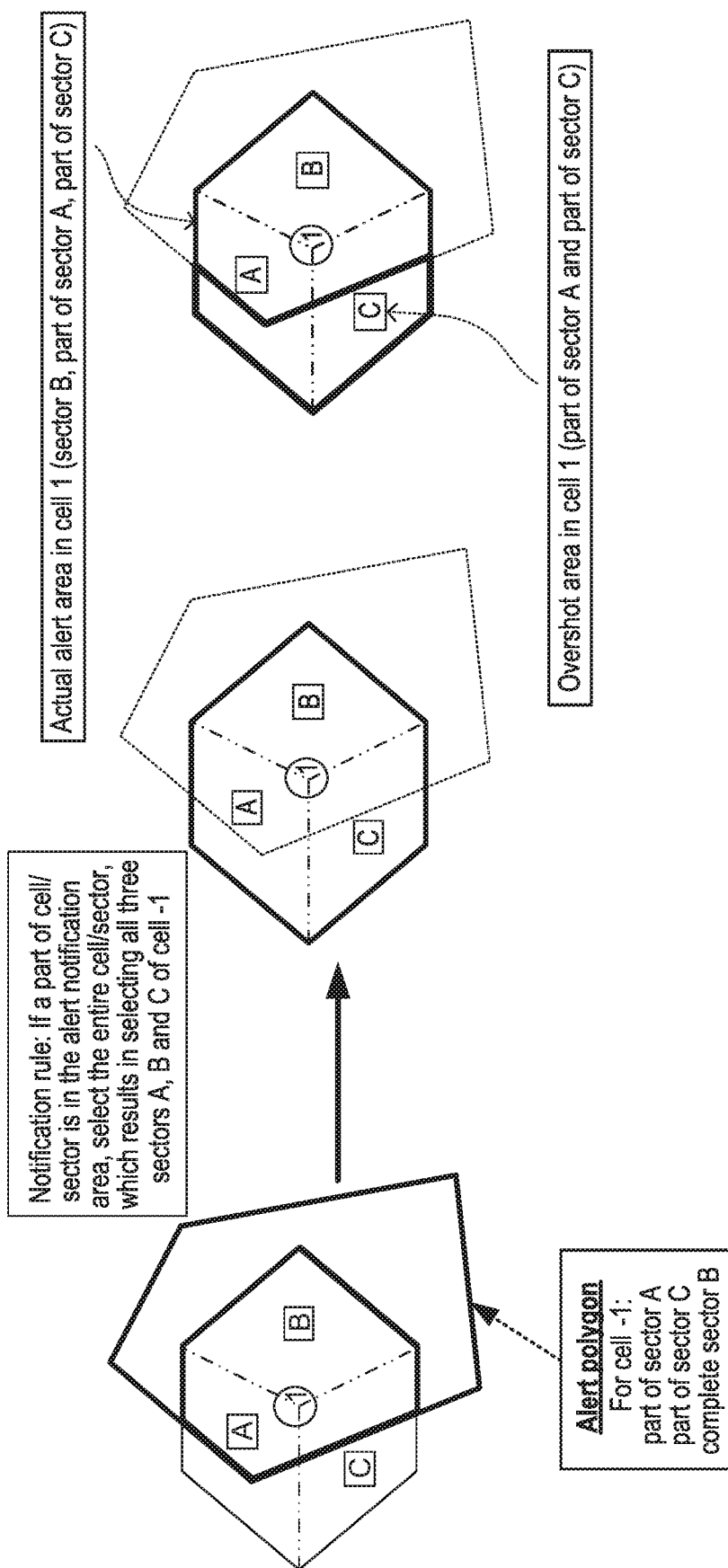


Figure 1

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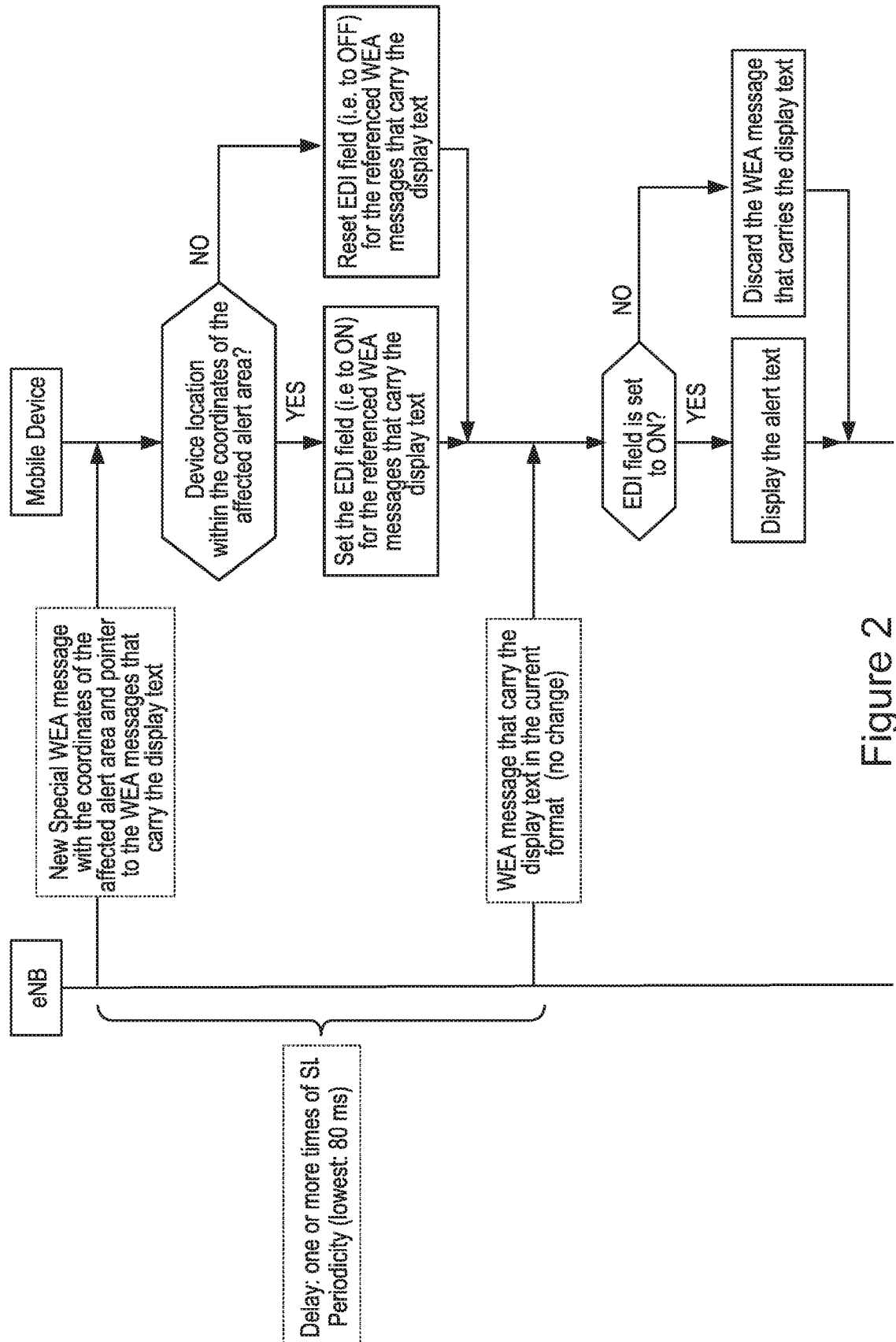


Figure 2

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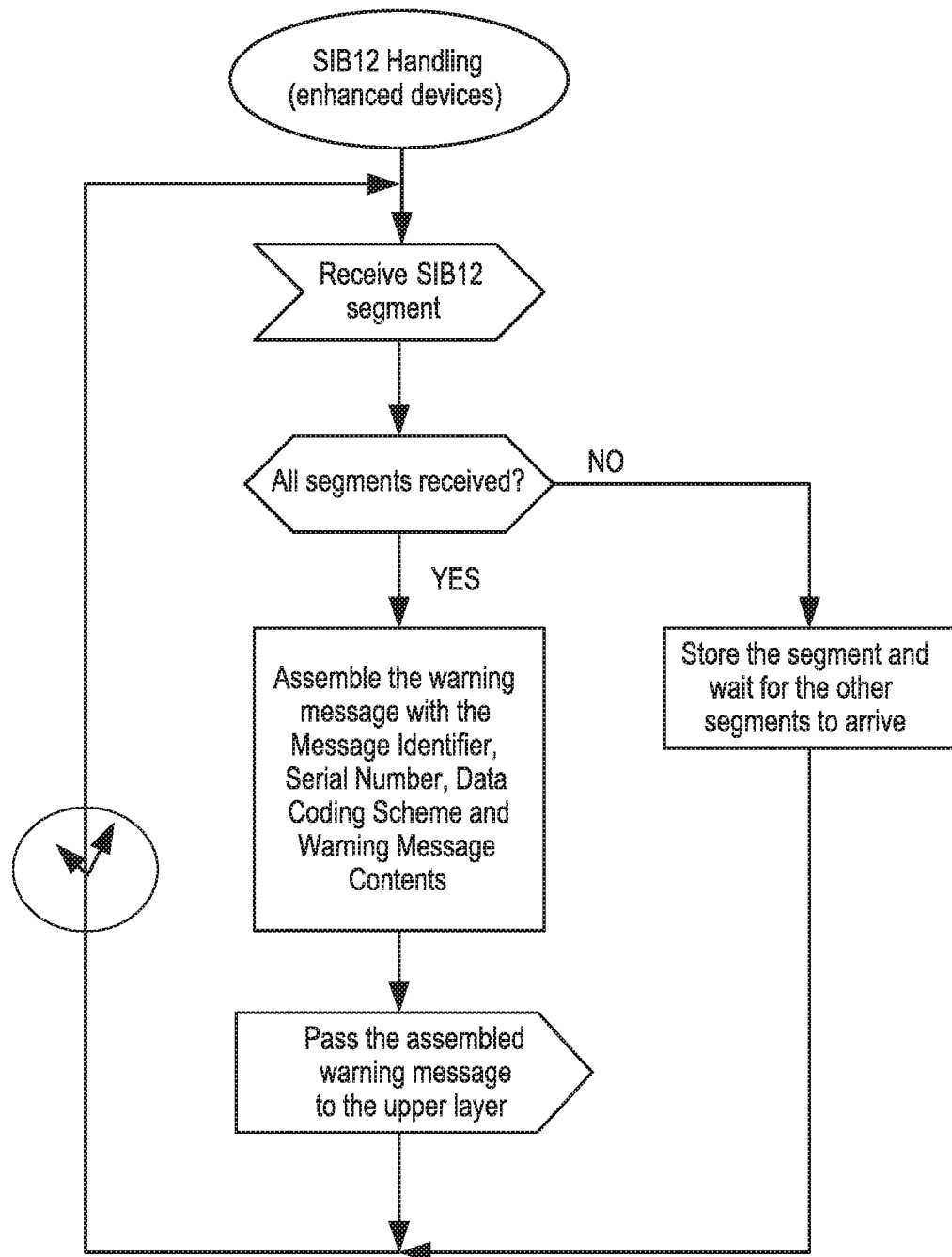


Figure 3

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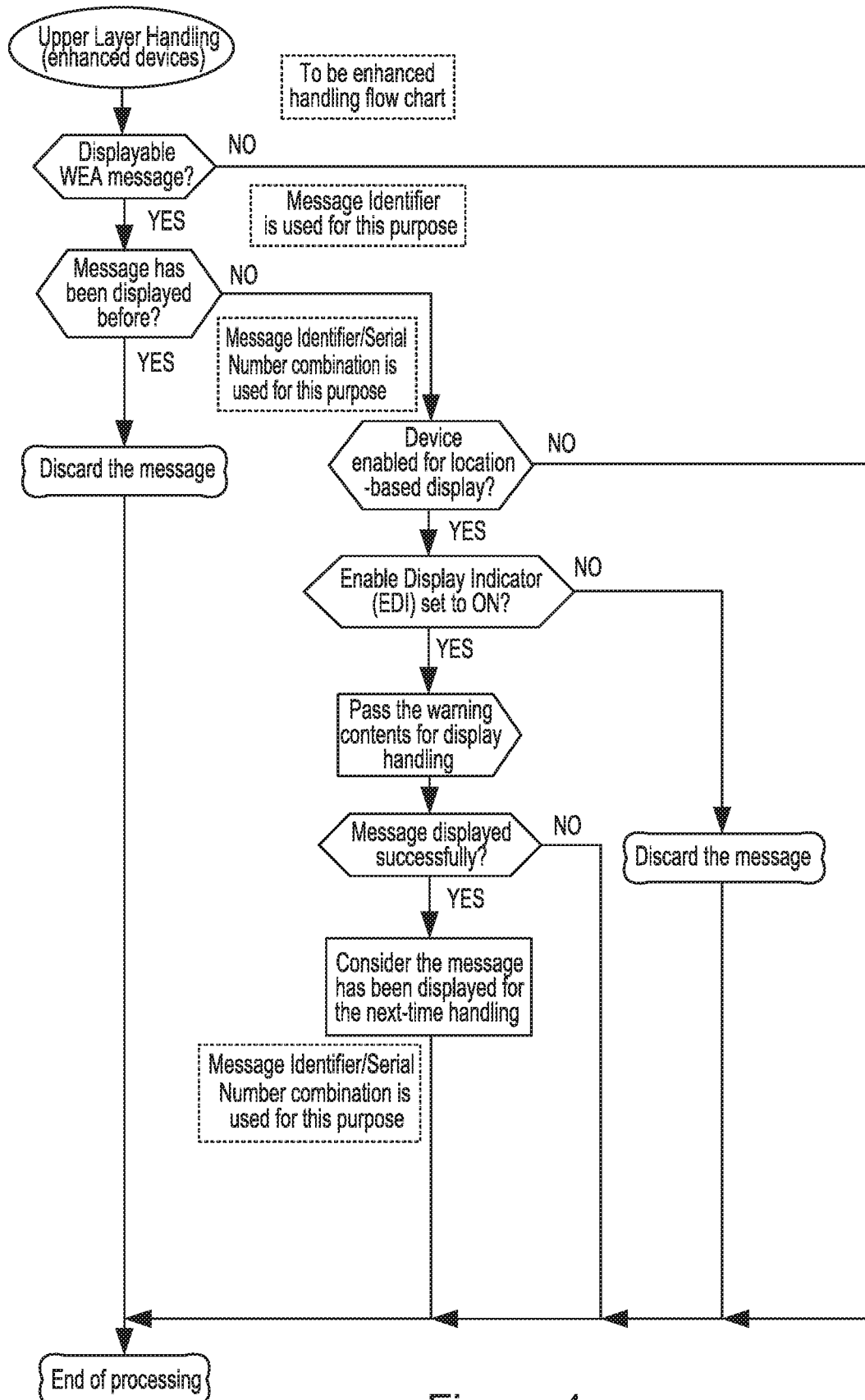


Figure 4
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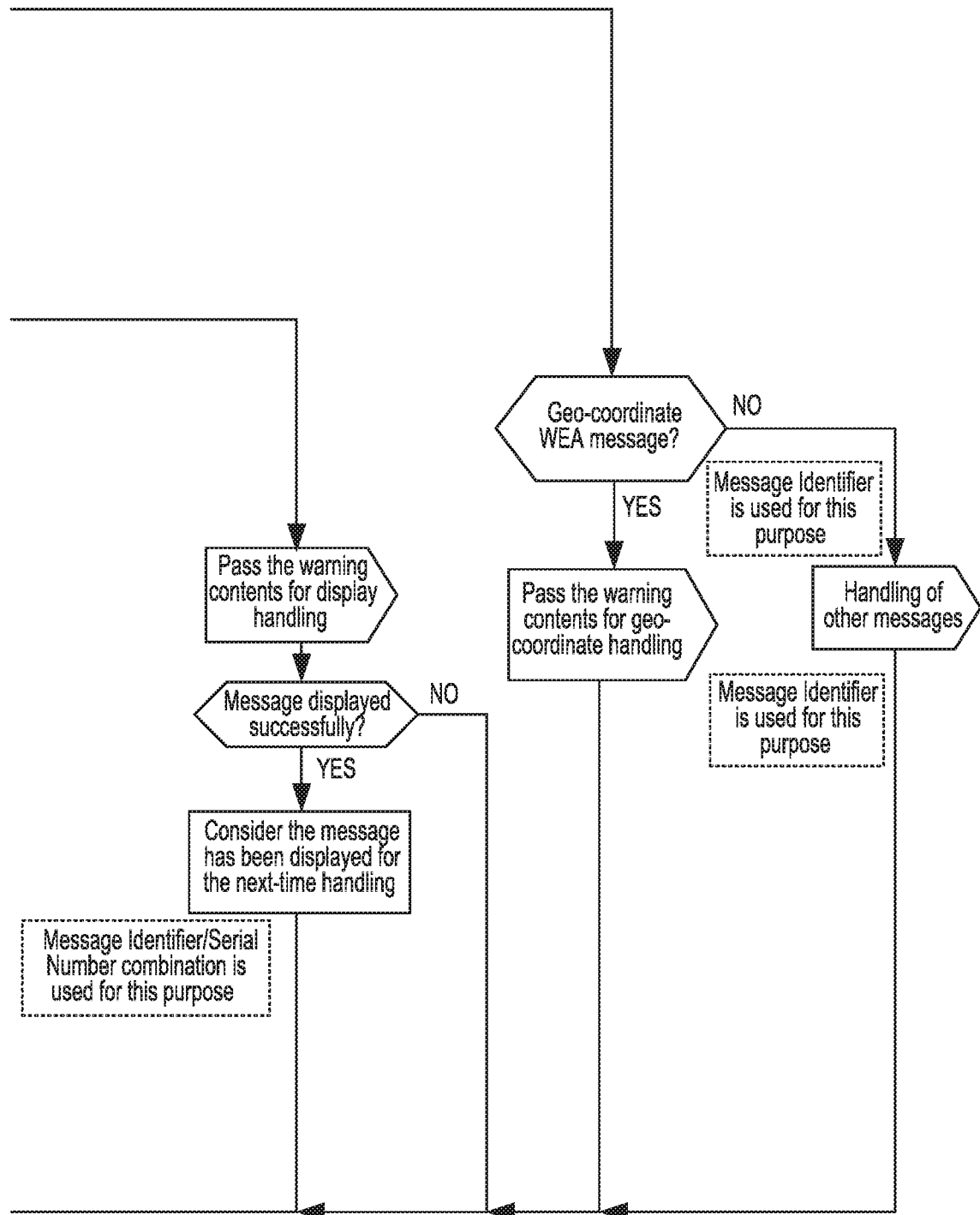


Figure 4 cont.
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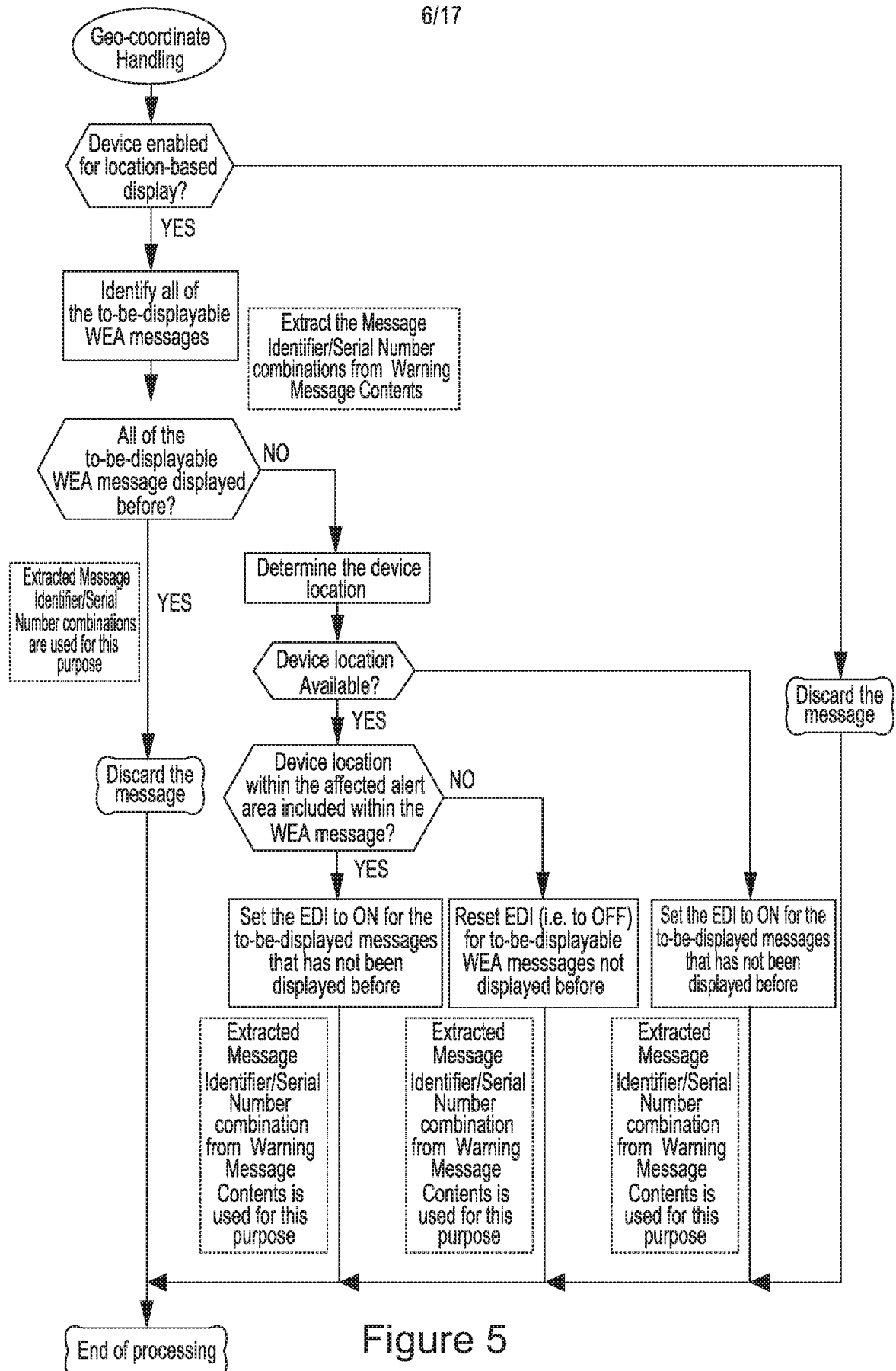
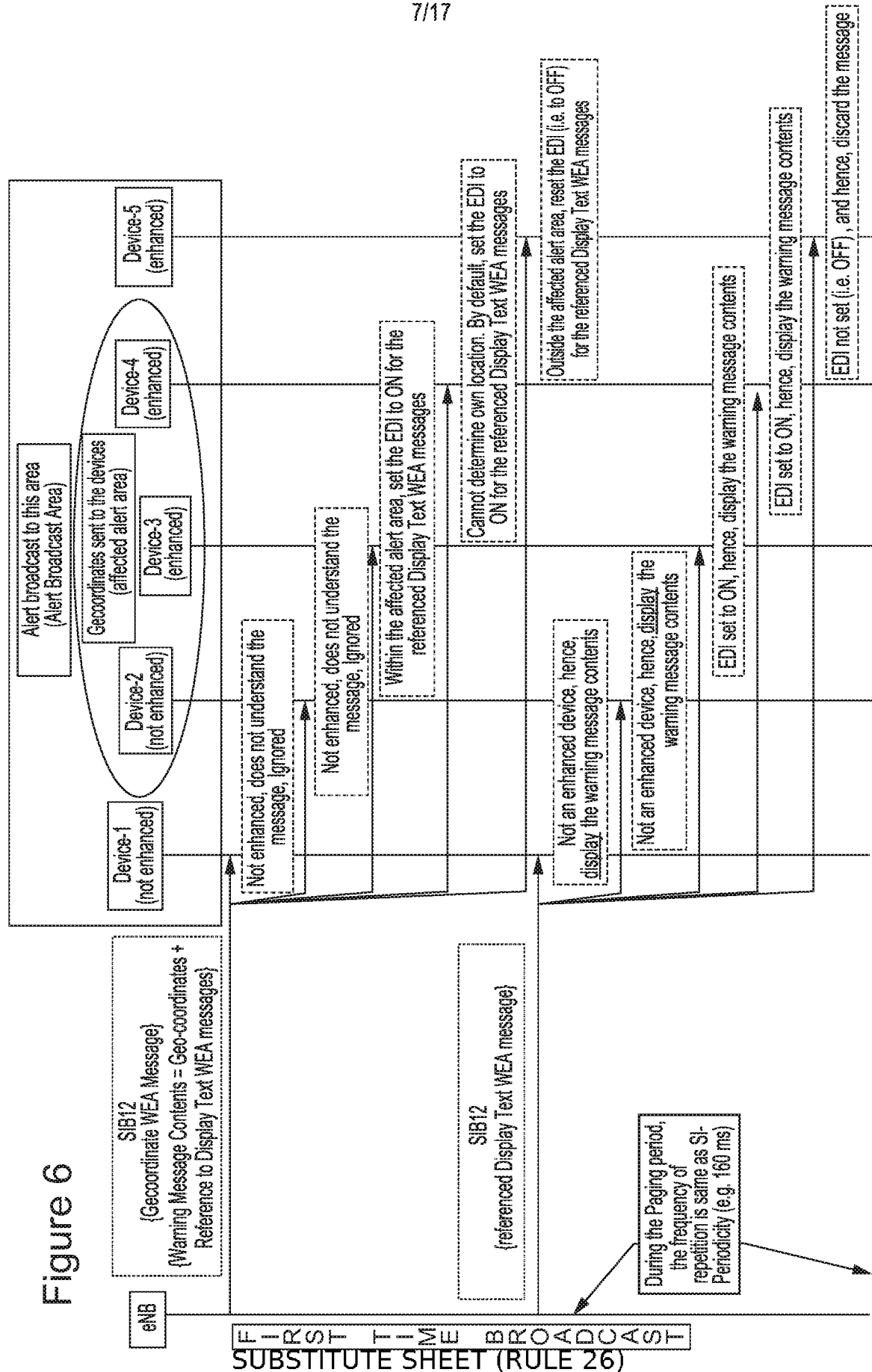
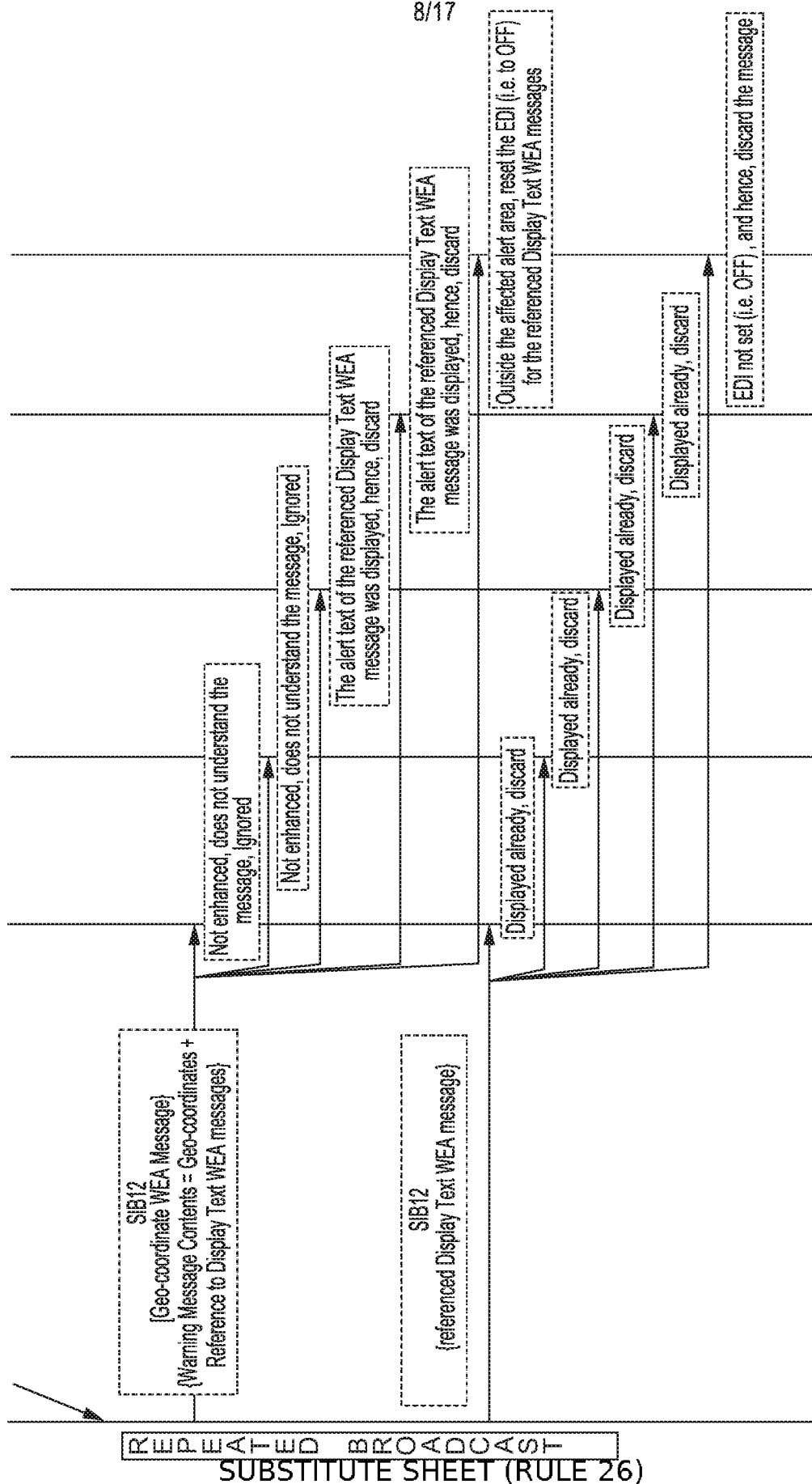


Figure 5
SUBSTITUTE SHEET (RULE 26)

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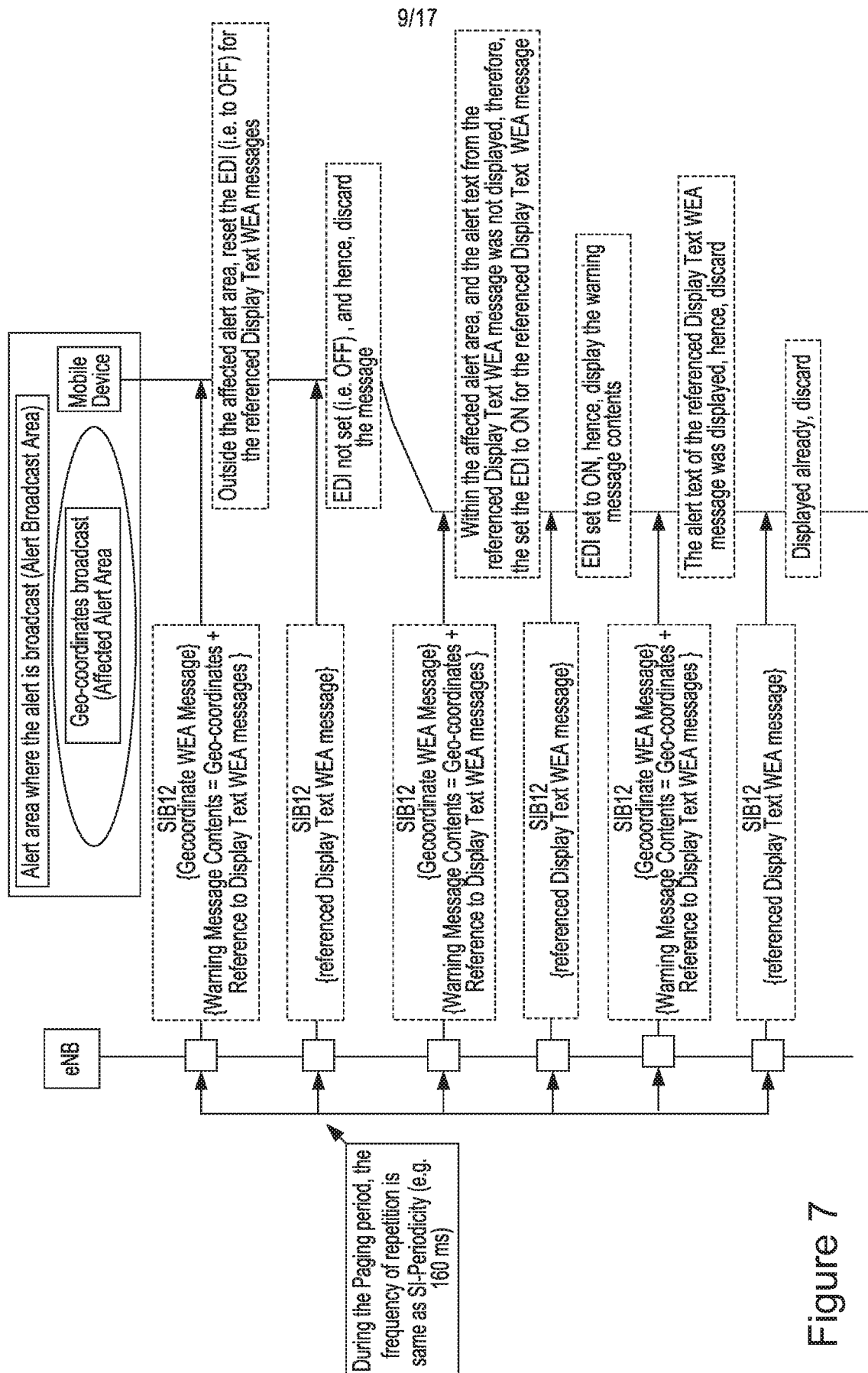


Figure 7

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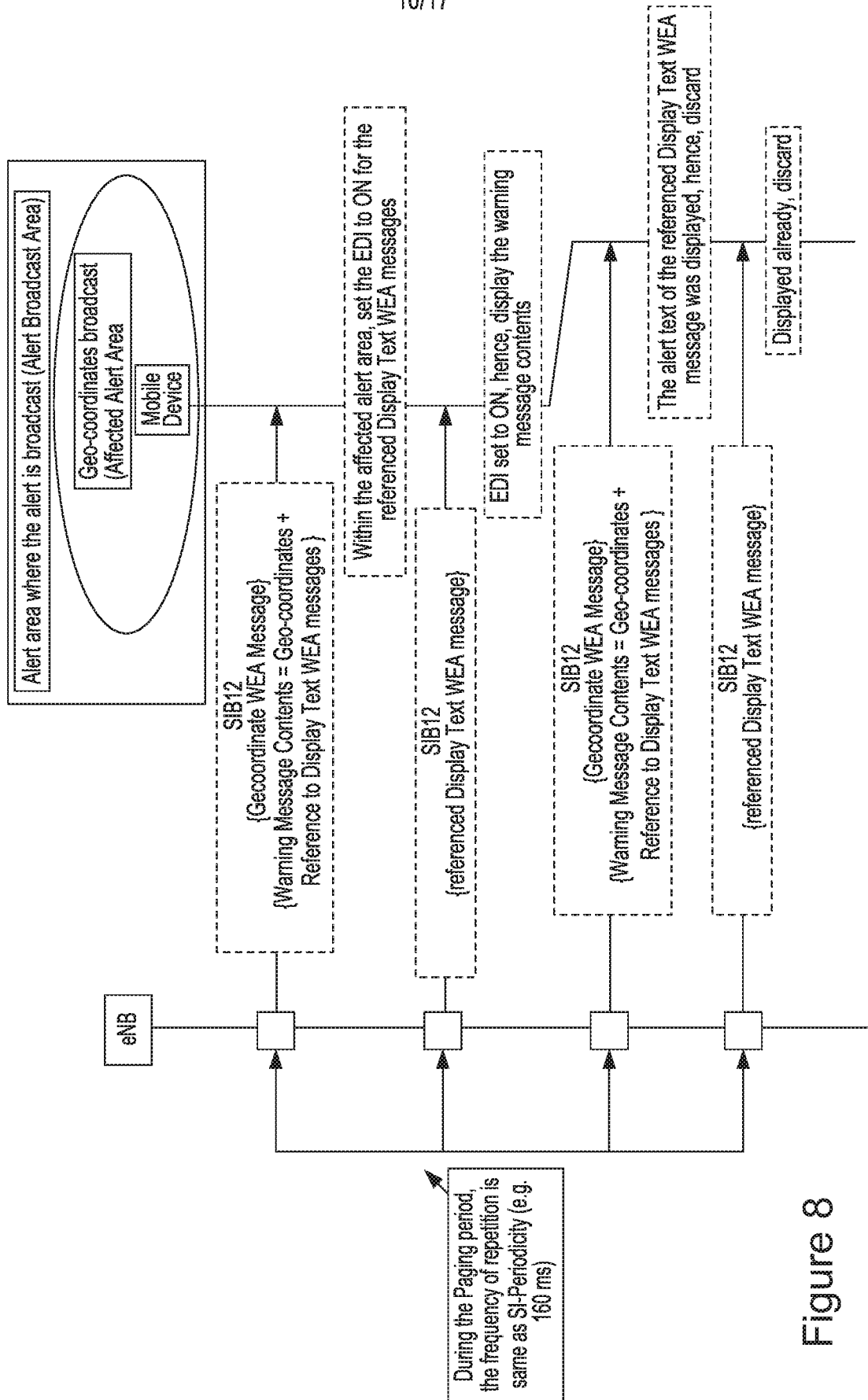


Figure 8

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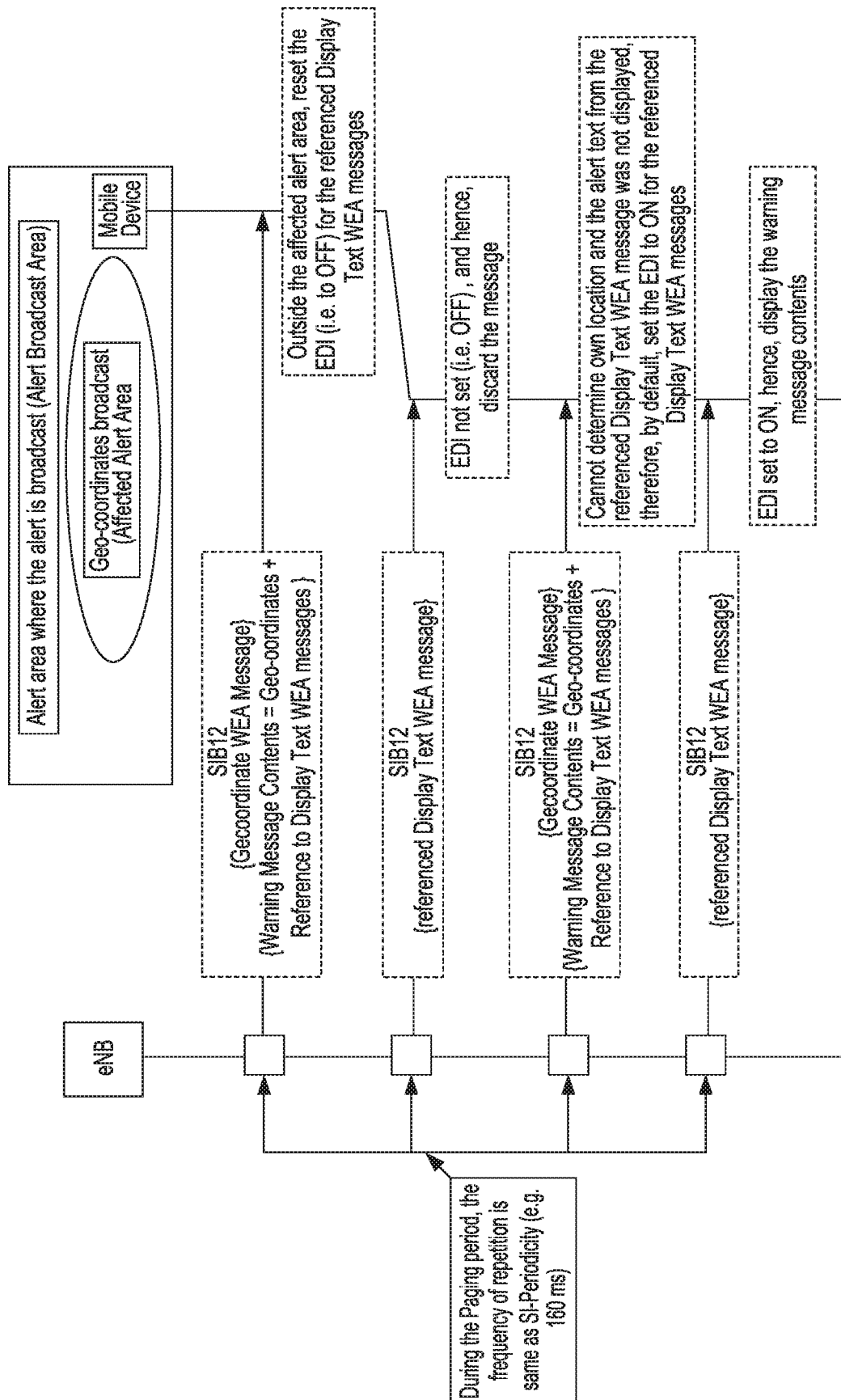


Figure 9

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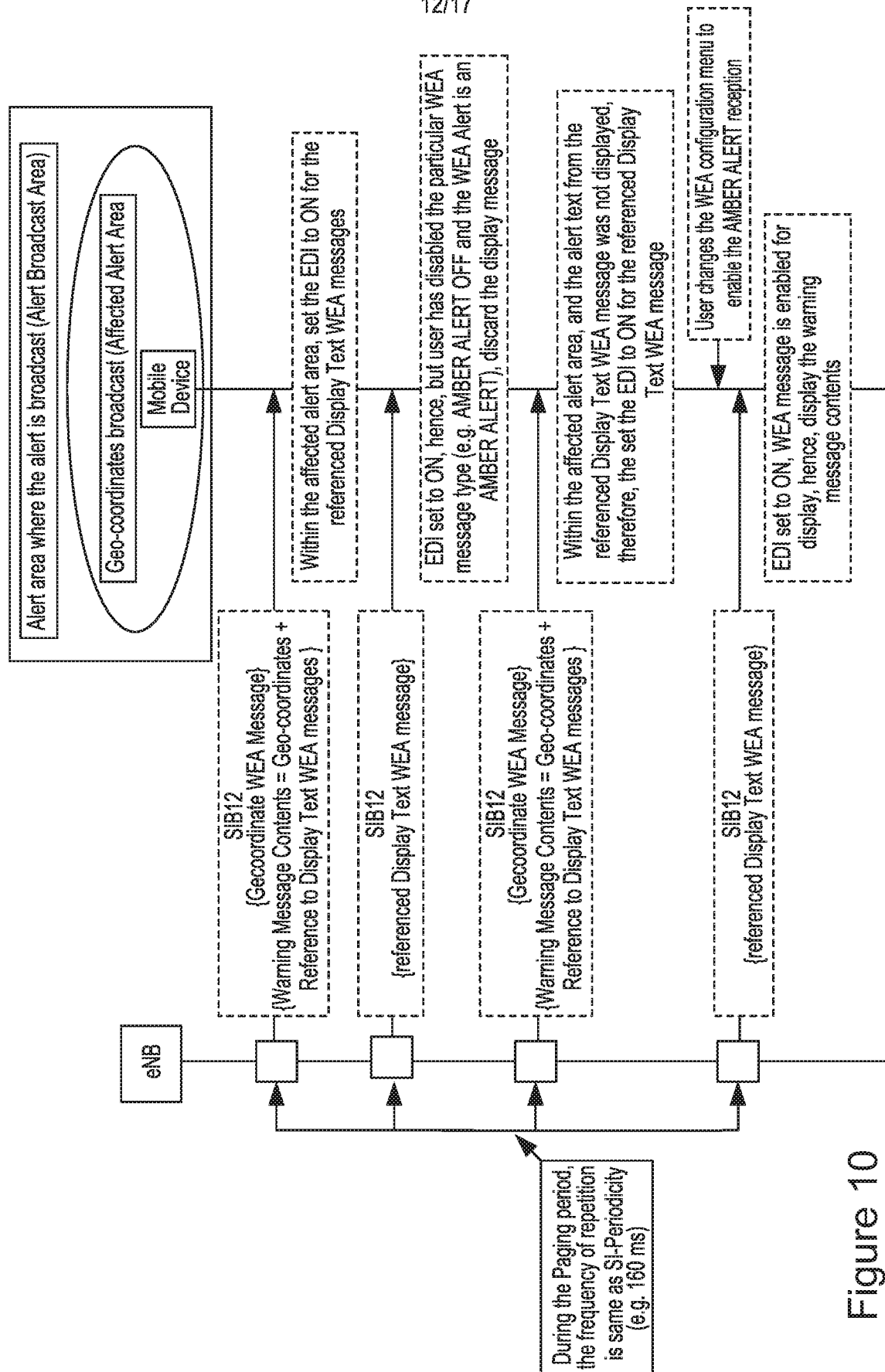


Figure 10

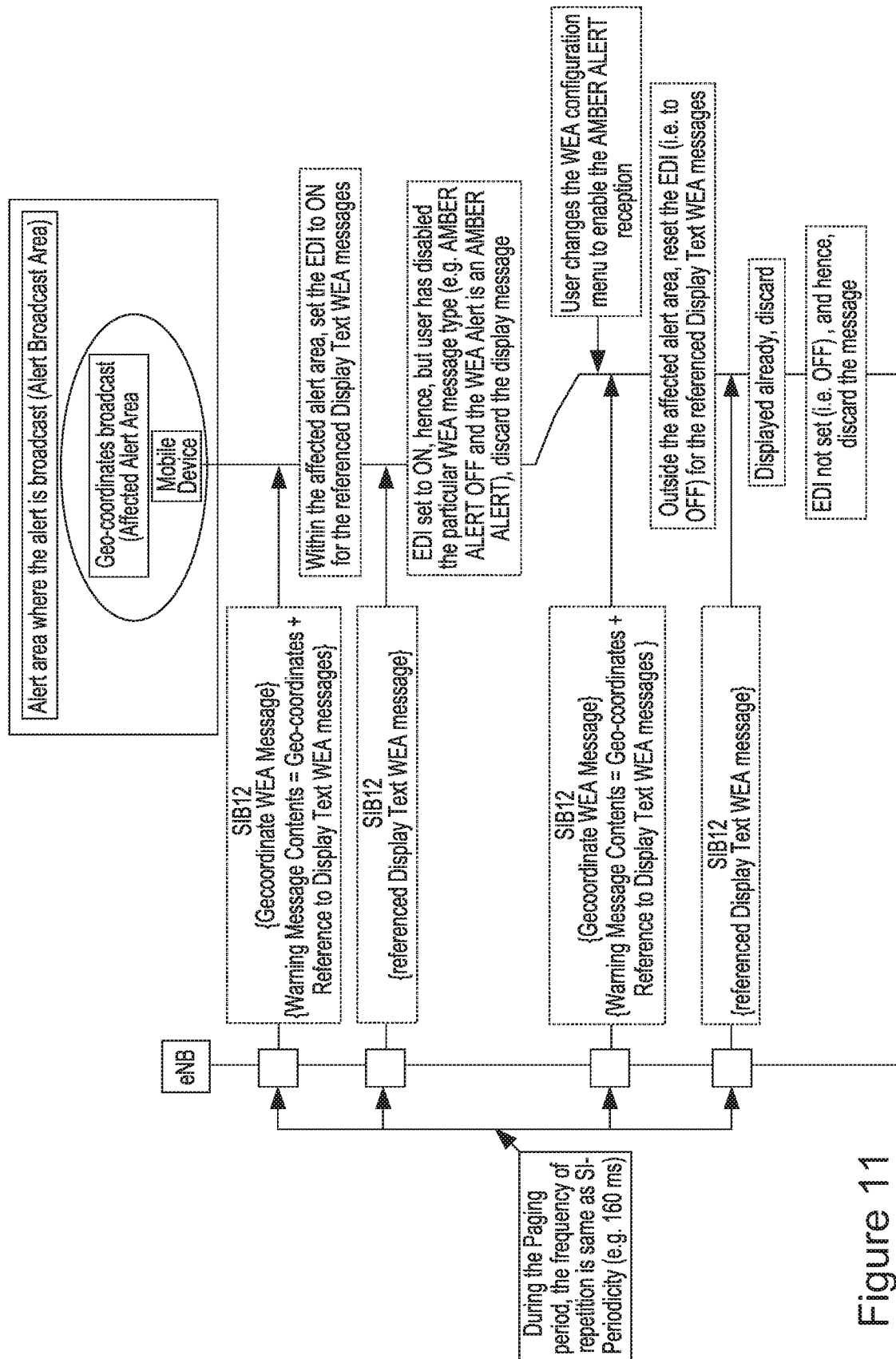


Figure 11

Octet Number (page 1)	Meaning
1	Number of Pages 2
2	Last Display WEA Message Indicator (=No)
3, 4	Message Identifier
5, 6	Serial Number
7	Last Display WEA Message Indicator (=YES)
8, 9	Message Identifier
10, 11	Serial Number
12 to 83	Geo -coordinates
84	Page 1 length (=82)
85 -166	Geo -coordinates
167	Page 2 Length (=82).

Figure 12

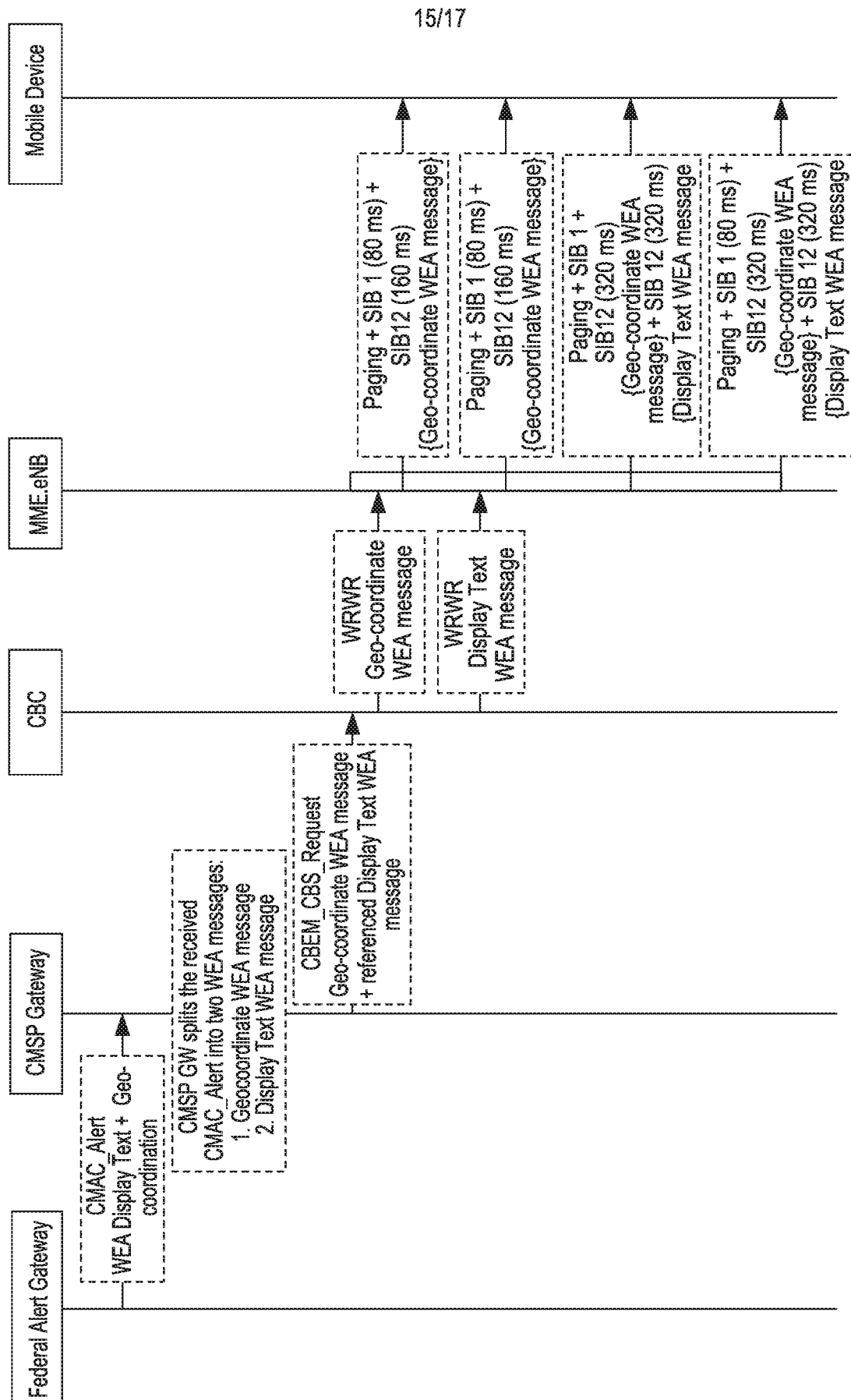


Figure 13

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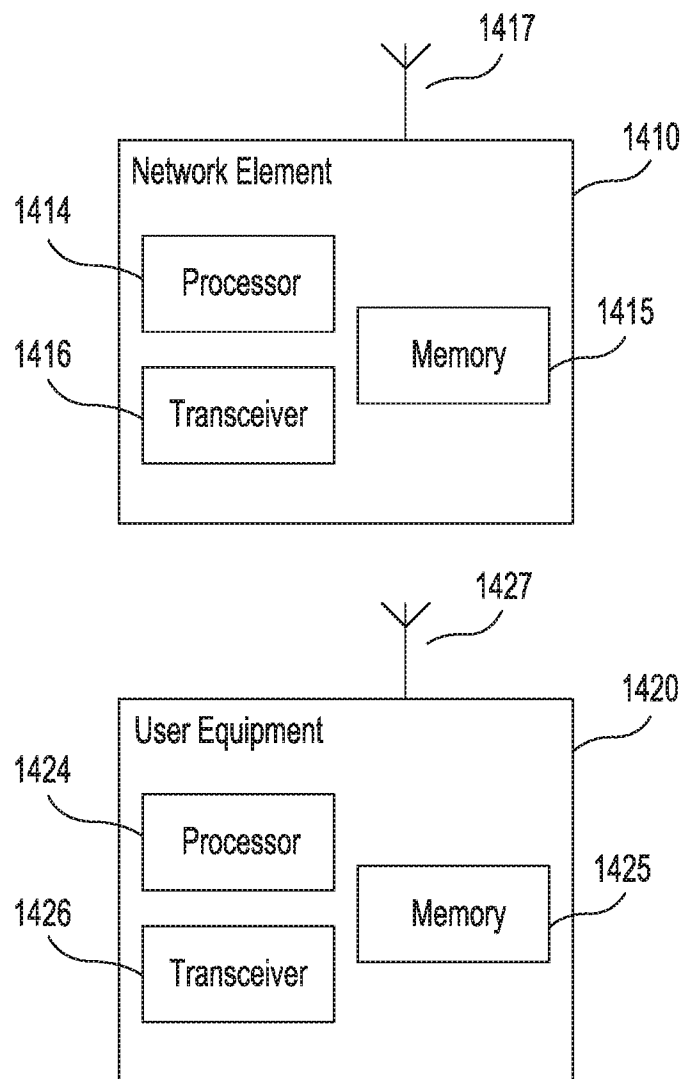


Figure 14

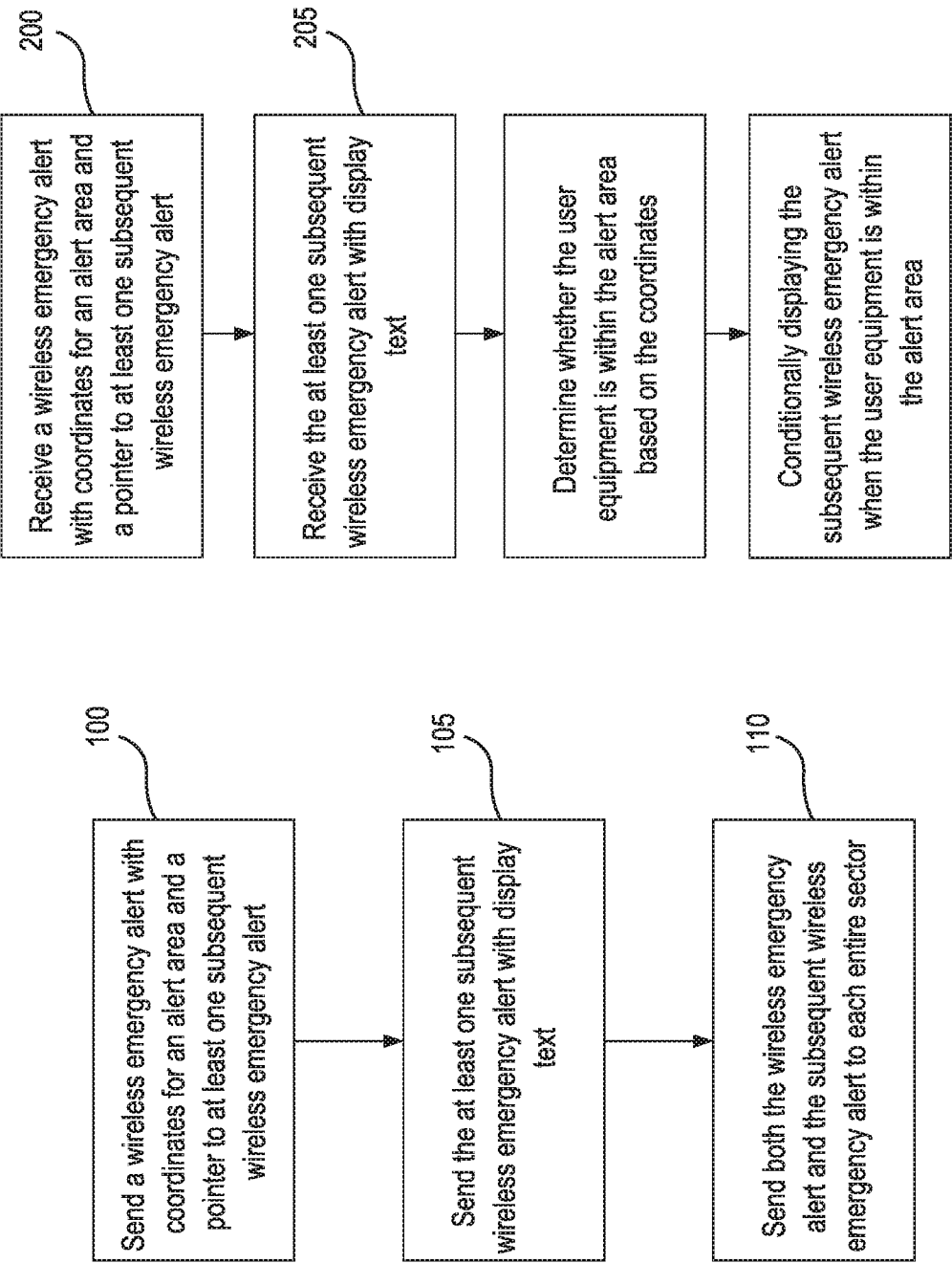


Figure 15

Figure 16

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2019/017868

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W4/021 H04W4/06 H04W4/90
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W H04L

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	Anonymous: "Wireless Emergency Alerts Arbitrary-Size Location-Aware Targeting Final Report", June 2015 (2015-06), pages 1-63, XP055587647, Retrieved from the Internet: URL:https://www.dhs.gov/sites/default/files/publications/WEA%20JHU%20APL%20ASLAT%20Final%20Report.pdf [retrieved on 2019-05-10] section 1 section 2.1 section 4 section 6; figure 24 section 7.5; figure 32 section 9 ----- -/-	1-24

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"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

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Date of the actual completion of the international search

10 May 2019

Date of mailing of the international search report

20/05/2019

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Ruiz Sanchez, J

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/017868

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	W0 2016/210110 A1 (AC&C LLC [US]) 29 December 2016 (2016-12-29) page 3, line 5 - page 4, line 2 page 5, lines 13-21 page 6, lines 20-29 page 13, line 2 - page 17, line 21 page 20, line 29 - page 21, line 6 page 29, lines 8-20 page 33, lines 7-25 -----	1-24
X	W0 2013/173846 A1 (MOBILAPS LLC [US]; KASSAB HISHAM [US]) 21 November 2013 (2013-11-21) paragraph [0013] paragraph [0017] paragraph [0039] paragraphs [0044] - [0048] paragraphs [0062] - [0066] -----	1-24

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/017868

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			BR 112017027979 A2 28-08-2018
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