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(54) **MULTI-MODE PROVISION OF EMERGENCY ALERTS**

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H04W 76/00	(2009.01)
H04W 4/22	(2009.01)
H04W 4/14	(2009.01)

(52) **U.S. Cl.**

CPC ***H04W 4/22*** (2013.01); ***H04W 76/007*** (2013.01); *H04W 4/14* (2013.01)

USPC **455/466**; 455/406; 455/467; 455/456.1; 455/564; 455/566

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CPC H04W 4/12; H04W 4/14; H04W 4/18; H04W 4/02; H04L 51/38; H04L 12/5895; H04M 1/72552; H04M 1/72547; G06Q 10/107

USPC 455/404.1–404.2, 414.1–414.3, 552.1, 455/466, 456.1, 3.01, 456.3, 411, 414.2, 455/418, 426.1, 432.1, 415, 450, 456.2

See application file for complete search history.

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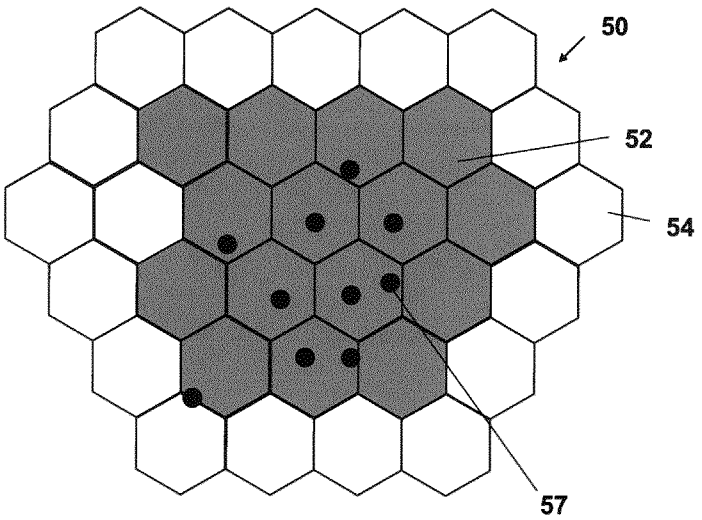
(74) *Attorney, Agent, or Firm* — Baker & Hostetler LLP

(57) **ABSTRACT**

Systems and methods are provided for sending emergency alerts to mobile devices in a geographical region affected by an emergency condition. An emergency alert may be broadcast via cellular network to devices with active cellular communications, while those mobile devices comprising cellular communications components that are temporarily inoperative due to their connection to wireless internet access points can be reached by sending emergency alerts via the internet.

18 Claims, 8 Drawing Sheets



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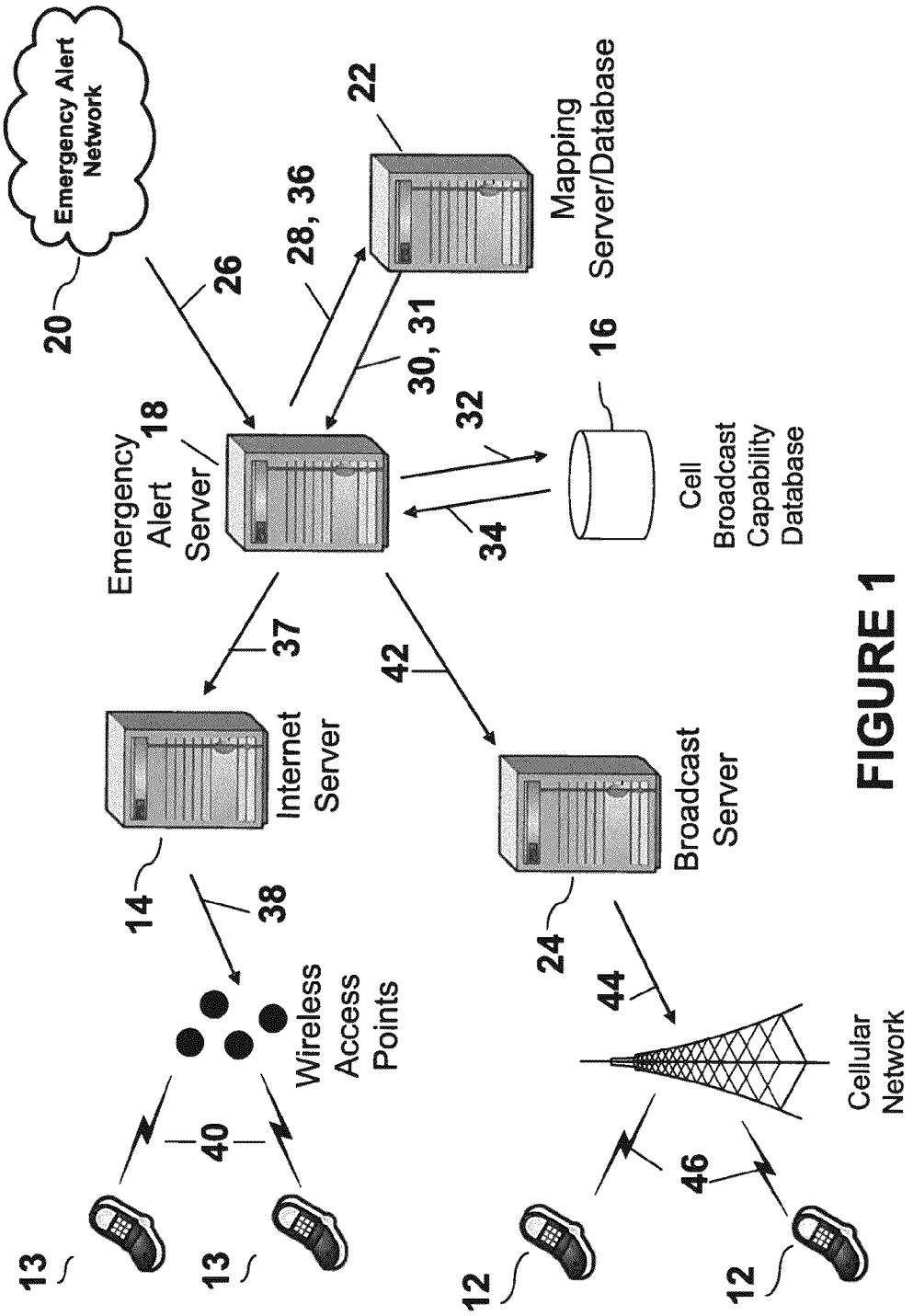
Emergency Alert Network
20
26
28, 36
22
Mapping Server/Database
30, 31
16
32
34
Emergency Alert Server
18
Cell Broadcast Capability Database
37
42
Internet Server
14
38
Broadcast Server
24
44
Wireless Access Points
40
Cellular Network
46
13
13
12
12

FIGURE 1

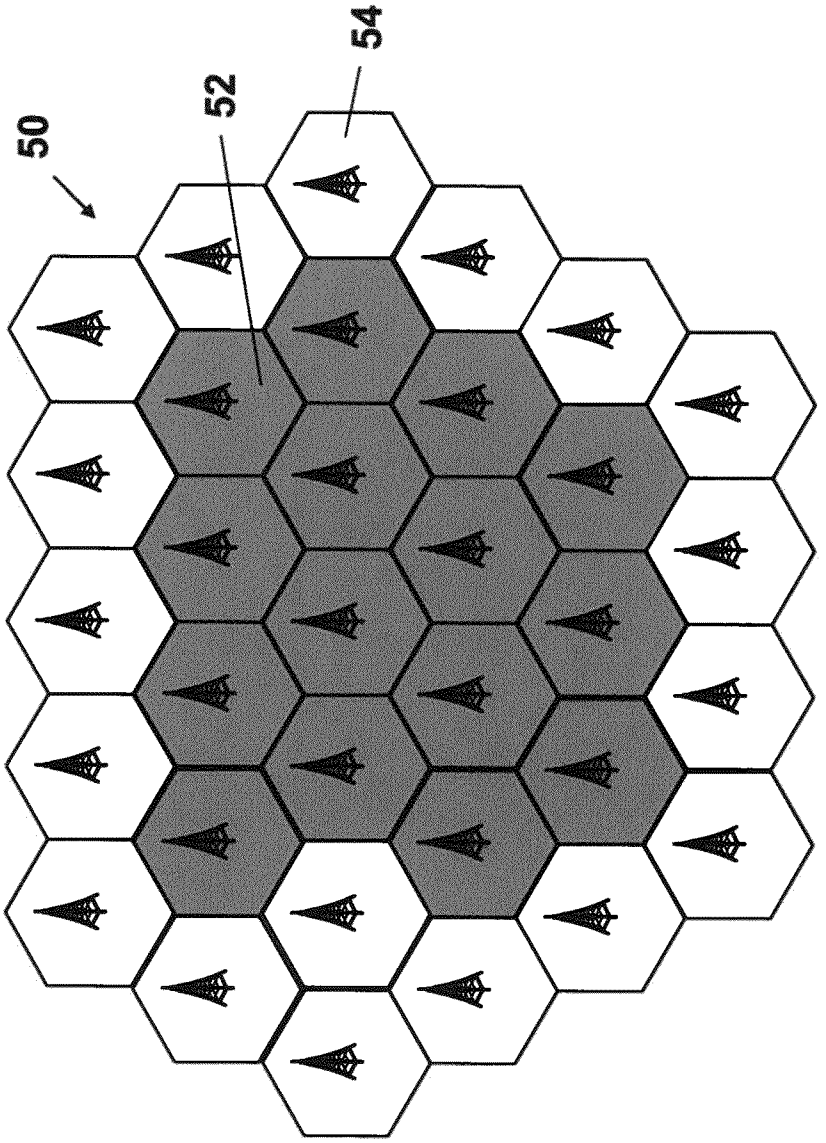

FIGURE 2

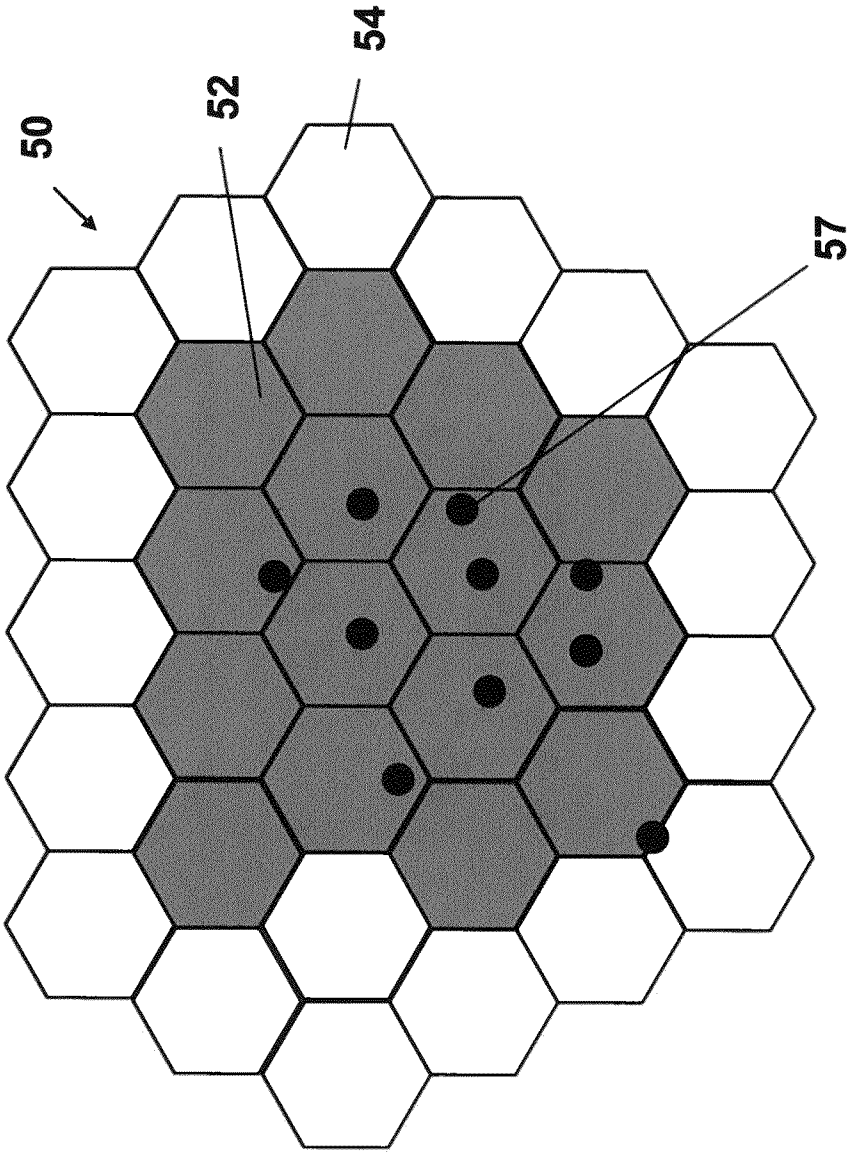

FIGURE 3

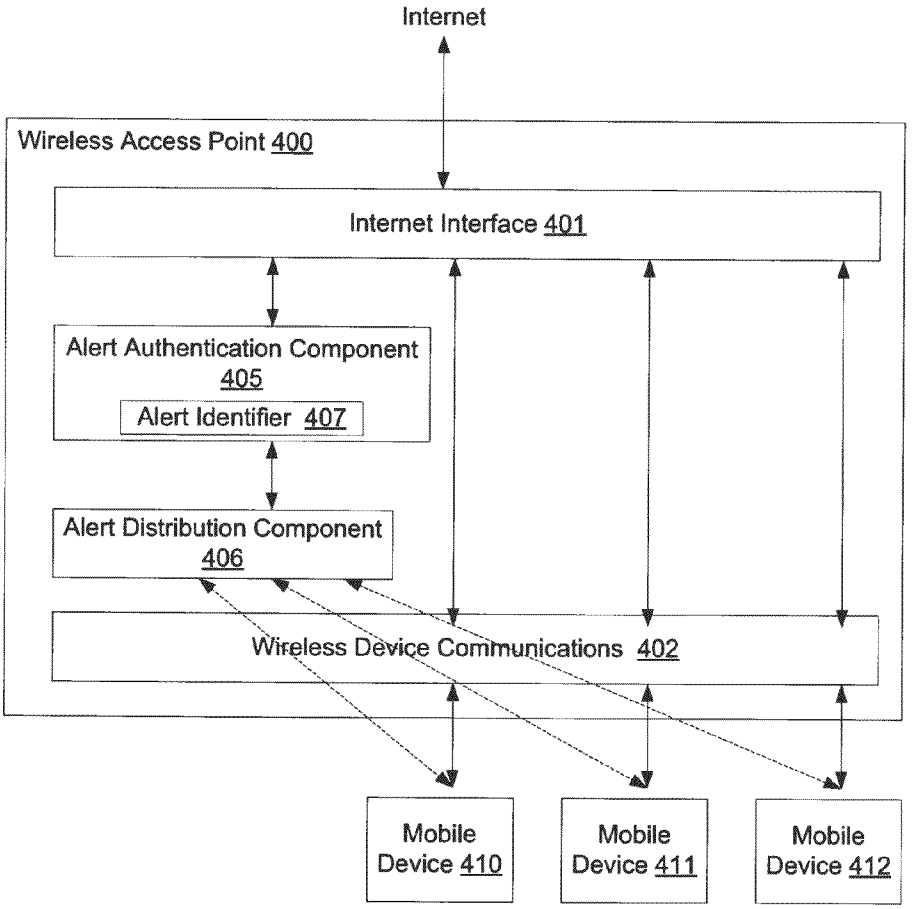
Internet
Wireless Access Point 400
Internet Interface 401
Alert Authentication Component 405
Alert Identifier 407
Alert Distribution Component 406
Wireless Device Communications 402
Mobile Device 410
Mobile Device 411
Mobile Device 412

FIGURE 4

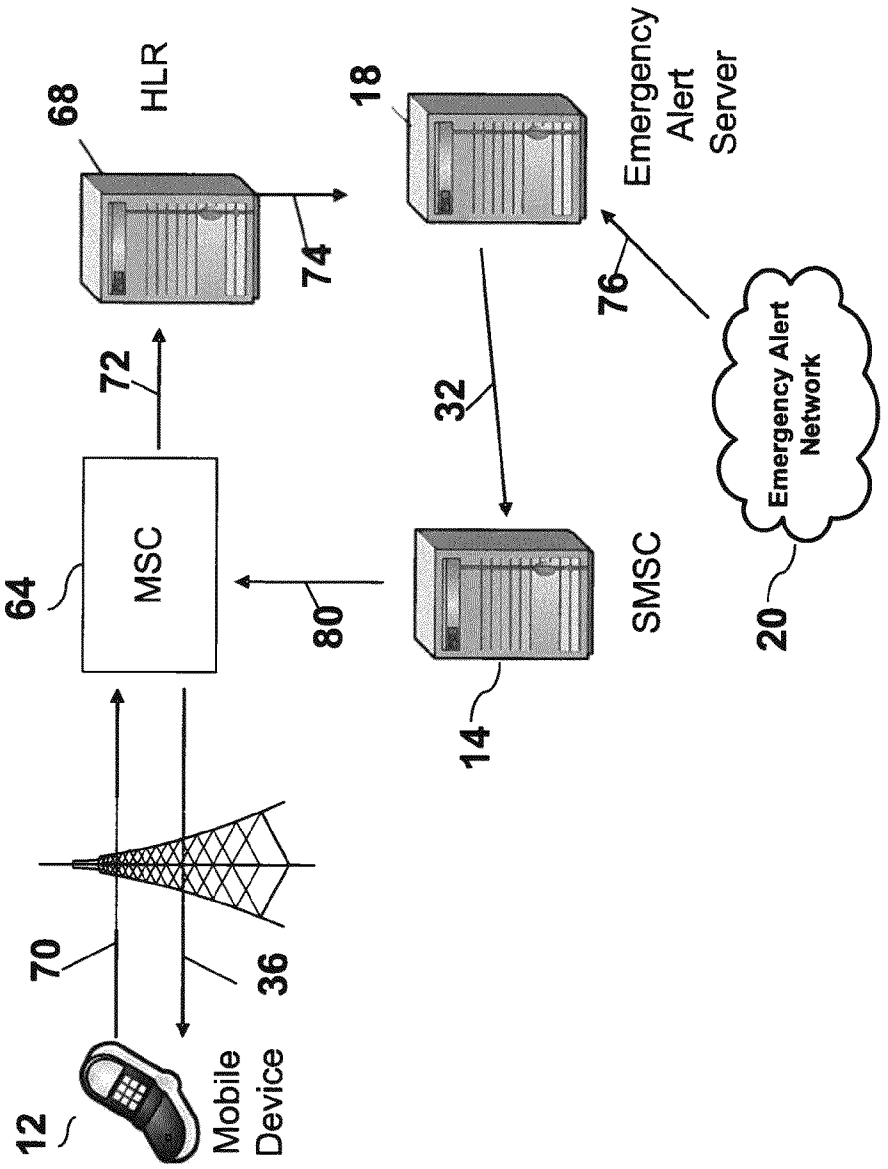
12
Mobile Device
70
36
64
MSC
72
68
HLR
74
80
14
SMSC
32
18
Emergency Alert Server
76
Emergency Alert Network
20

FIGURE 5

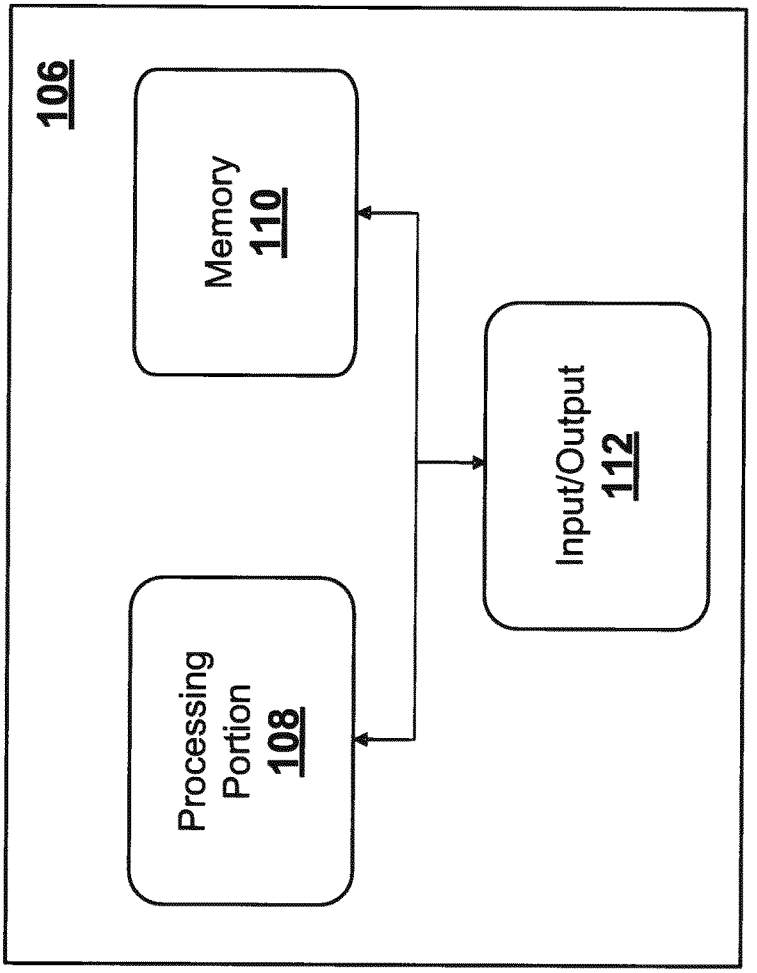

FIGURE 6

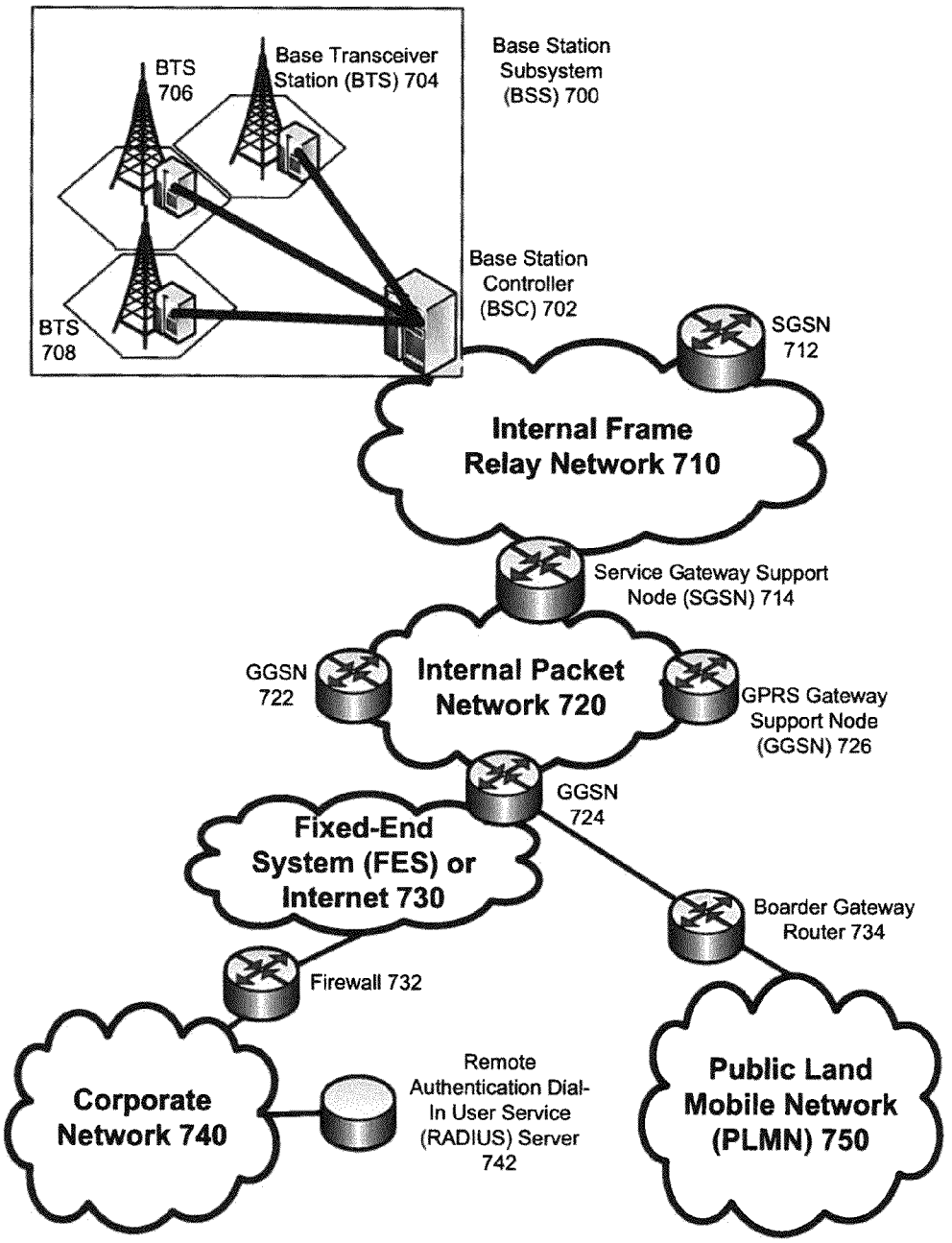
BTS
706
Base Transceiver
Station (BTS) 704
Base Station
Subsystem
(BSS) 700
Base Station
Controller
(BSC) 702
BTS
708
SGSN
712
Internal Frame
Relay Network 710
Service Gateway Support
Node (SGSN) 714
GGSN
722
Internal Packet
Network 720
GPRS Gateway
Support Node
(GGSN) 726
GGSN
724
Fixed-End
System (FES) or
Internet 730
Boarder Gateway
Router 734
Firewall 732
Corporate
Network 740
Remote
Authentication Dial-
In User Service
(RADIUS) Server
742
Public Land
Mobile Network
(PLMN) 750

FIGURE 7

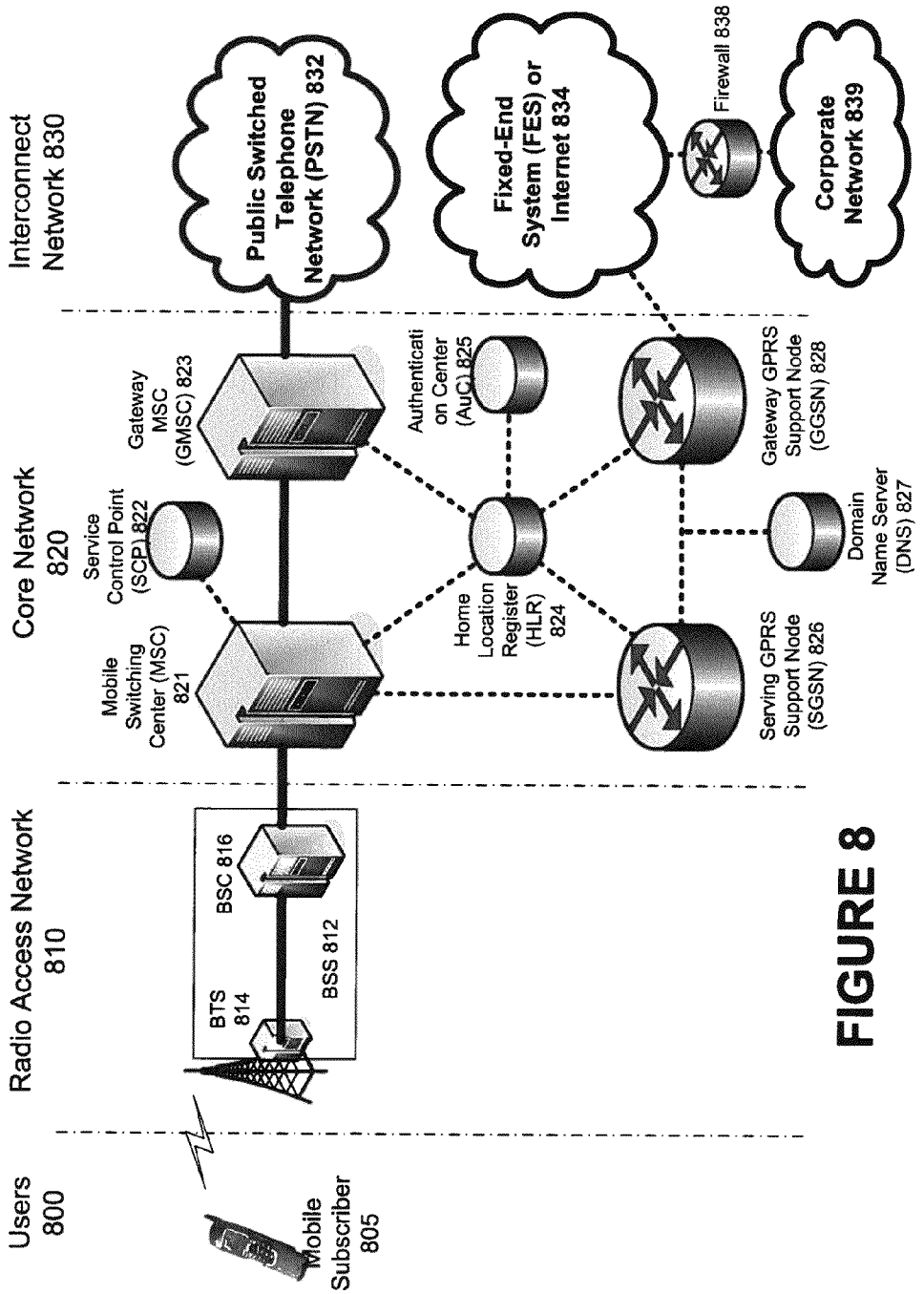
Users
800
Mobile
Subscriber
805
Radio Access Network
810
BTS
814
BSS 812
BSC 816
Core Network
820
Mobile
Switching
Center (MSC)
821
Service
Control Point
(SCP) 822
Gateway
MSC
(GMSC) 823
Interconnect
Network 830
Public Switched
Telephone
Network (PSTN) 832
Home
Location
Register
(HLR)
824
Authenticati
on Center
(AuC) 825
Serving GPRS
Support Node
(SGSN) 826
Domain
Name Server
(DNS) 827
Gateway GPRS
Support Node
(GGSN) 828
Fixed-End
System (FES) or
Internet 834
Firewall 838
Corporate
Network 839

FIGURE 8

MULTI-MODE PROVISION OF EMERGENCY ALERTS

TECHNICAL FIELD

The technical field generally relates to communications systems and more specifically relates to routing emergency alerts, such as those issued by the Emergency Alert System ("EAS").

BACKGROUND

An Emergency Alert System (EAS) communicates emergency alert information to a population of people. One example of such a system is the United States EAS, which is designed to allow the President of the United States to speak directly to the general population of the United States within 10 minutes. Historically, communication channels utilized in connection with the United States EAS have been radio and television.

The prospect of including additional communication channels, especially communication to mobile devices, in an EAS is appealing because a great many people today carry mobile devices such as cellular telephones. Sending emergency alerts to mobile devices allows a great many more people to promptly receive alerts than would otherwise. For this reason, college campuses and other communities have introduced simplistic, opt-in EAS that send Short Message Service (SMS), or so-called text messages to mobile devices of those who subscribe to receive such messages, and may also send emergency alert emails to the relevant population.

In order for an EAS to function on a broader scale, however, it is desirable to broadcast emergency alerts to all mobile devices in a geographical area affected by an emergency condition, rather than simply send emergency alerts to a list of opt-in subscribers as in the example above. Broadcasting emergency alerts potentially eliminates the need to "opt-in" to receive emergency alerts, and also effectively communicates with all mobile devices in the affected area, regardless of whether such devices are in their "home" region or region for which they have opted to receive emergency alert information.

While broadcasting has clear advantages for sophisticated and large-scale EAS, so-called Third Generation (3G) and subsequent generation type mobile devices pose a problem in receiving broadcasted emergency alerts. Most 3G mobile devices can switch between radio communications with a cellular network, and wireless Internet Protocol (IP) or "Wi-Fi" type communications. When such a device enters a Wi-Fi hotspot, it will temporarily disable its cellular communications, and switch to Wi-Fi communications, because the Wi-Fi communications require less power and therefore present less drain on battery life. However, as a result of the switch, the device would no longer receive emergency alerts broadcasted from a cellular communications tower. Therefore, systems and methods are needed to communicate emergency alerts to mobile devices that have a first communications channel disabled while a second communications channel is active.

SUMMARY

In consideration of the above-identified shortcomings of the art, the present invention provides systems and methods for sending emergency alerts to mobile devices. In one embodiment, a method is performed comprising broadcasting via cellular network a Short Message Service (SMS) emergency alert to a first plurality of mobile devices in a geographical region, identifying a second plurality of mobile devices that are wirelessly connected to Wi-Fi access points in said geographical region, wherein said second plurality of mobile devices comprise cellular communications components that are temporarily inoperative due to said second plurality of mobile devices' connection to said Wi-Fi access points, and sending said SMS emergency alert to said second plurality of mobile devices using Internet Protocol (IP) communications.

In another embodiment, a method for sending emergency alerts to mobile devices may comprise identifying a plurality Wi-Fi access points in a geographical region affected by an emergency condition, and sending, using Internet Protocol (IP) communications, a Short Message Service (SMS) emergency alert to a plurality of mobile devices connected to said plurality of Wi-Fi access points, wherein said plurality of mobile devices comprise cellular communications components that are temporarily inoperative due to said plurality of mobile devices' connection to said Wi-Fi access points.

Another exemplary embodiment provides a wireless access point, such as may be used at a Wi-Fi access point, that can distribute emergency alerts to any devices in communication with such access point. Such an access point may comprise, for example, an internet interface for sending and receiving communications via Internet Protocol (IP), a Short Message Service (SMS) emergency alert authentication component that authenticates an emergency alert received via said internet interface, a wireless communications mechanism that sends and receives communications to and from mobile devices, and an emergency alert distribution component that distributes said SMS emergency alert to all mobile devices in communication with said Wi-Fi access point via said wireless communications mechanism.

Other advantages and features of the invention are described below.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description, is better understood when read in conjunction with the appended drawings.

FIG. **1** diagrams an example process and system for broadcasting an emergency alert.

FIG. **2** is an example depiction of cell sites capable of providing cellular coverage to a geographic region.

FIG. **3** is an example depiction wireless access points located within the geographic region.

FIG. **4** illustrates an exemplary wireless access point configured to distribute emergency alerts in accordance with one embodiment.

FIG. **5** is a flow diagram of another example process and system for delivering an alert message.

FIG. **6** is a block diagram of an exemplary electronic device configurable to implement various of the devices contemplated for use with the disclosed embodiments.

FIG. **7** depicts an overall block diagram of an exemplary packet-based mobile cellular network environment, such as a GPRS network.

FIG. **8** depicts an architecture of a typical GPRS network as segmented into four groups.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Certain specific details are set forth in the following description and figures to provide a thorough understanding

of various embodiments of the invention. Certain well-known details often associated with mobile communications, computing, and software technology are not set forth in the following disclosure, however, to avoid unnecessarily obscuring the various embodiments of the invention. Further, those of ordinary skill in the relevant art will understand that they can practice other embodiments of the invention without one or more of the details described below. Finally, while various methods are described with reference to steps and sequences in the following disclosure, the description as such is for providing a clear implementation of embodiments of the invention, and the steps and sequences of steps should not be taken as required to practice this invention.

FIG. **1** diagrams an example process and system for broadcasting via cellular network an emergency alert to a first plurality of mobile devices in a geographical region. An emergency alert comprises information sent to a plurality of people in response to an emergency condition. The people to whom an emergency alert is sent may be the general population, or a subset of people such as emergency first responders, toxic waste cleanup crews, army reservists, and so forth. The information in an emergency alert may comprise the nature of the emergency, instructions for responding to the emergency, where to get more information about the emergency, and/or location of the emergency. One useful form for the emergency alert is that of a Short Message Service (SMS) or "text message." A number of other forms are possible, including for example voicemails, Instant Messages (IMs), and emails.

Utilizing a system such as illustrated in FIG. **1**, an organization, corporation, association, or the like, for example, a mobile communications provider such as Verizon Corporation, Sprint Corporation, AT&T corporation, T-Mobile Corporation, and the like can broadcast emergency alerts to a geographic region covered by applicable cellular communication towers of the cellular radio network. A first plurality of mobile devices **12** can receive the emergency alert by cellular network broadcast, while a second plurality **13** of mobile devices can receive the emergency alert via an internet server and wireless access points as shown. In one embodiment, devices **12** and **13** are subscribers to a same mobile communications service provider, said service provider performs the broadcasting, as well as identifying the second plurality of devices **13**, and sending. said emergency alert to said second plurality of mobile devices **13** using Internet Protocol (IP) communications. 6. It should further be noted that in embodiments where devices **12** and **13** belong to subscribers of a same mobile communications service provider, it would also be possible and advantageous, in many situations, to send emergency alerts additional mobile device in said geographical region using either the broadcast or IP communications capabilities illustrated in FIG. **1**.

Cellular communications networks and corresponding electronics are often owned by a variety of different entities. For example, a first company may own communications equipment that transforms, transmits, or processes information as it is on its way to one or more radio towers, while a second company owns the towers and radio transmission apparatus. The term "broadcast" as used herein refers to any action performed pursuant to ultimately broadcasting information. Thus, any electrical component that transforms, transmits, or processes information in connection with a broadcast, or otherwise facilitates broadcast of information, broadcasts such information.

One exemplary broadcast of an emergency alert begins at step **26**, when an Emergency Alert Network **20**, e.g., a computer affiliated with a government EAS, provides to an emergency alert server **18** an emergency alert, and the information is correspondingly received at emergency alert server **18**. Information regarding an applicable geographic region affected by an emergency condition may also be provided in step **26**. For example, if the emergency is an earthquake in San Francisco, the relevant geographic region may be the greater San Francisco area, or for a large earthquake, perhaps a broader section of the California coast. It may not be necessary or desirable to send an emergency alert to people in New York City when such an emergency occurs, as it may only generate unnecessary panic, confusion, and corresponding load on public services. The relevant geographic region affected by an emergency condition may be supplied by the EAN **20** to the server **18**.

In example embodiments, as described in more detail below, the geographic region can be defined statically and/or dynamically. A statically defined alert area can be specified in the information supplied to server **18**, utilizing for example, geographic code references such as the Federal Information Processing Standard (FIPS), ZIP codes, and/or the National Weather Service Specific Area Message Encoder (SAME) codes. A dynamically defined alert area can be specified, utilizing for example, geometric shapes, such as polygons, formatted in accordance with a World Geodetic System 1984 (WGS-84) format, or the like.

At step **28**, the server **18** determines cellular communications sites that correspond to a geographic region affected by an emergency condition, and that should therefore broadcast emergency alerts to mobile devices in their range. In one arrangement, as illustrated in step **28**, the server **18** can provide a request to a cell site mapping server/database **22** (referred to herein as the "mapping server") for cell IDs (cell sites) associated with the geographic region. As described in more detail below, the mapping server **22** determines (e.g., maps, translates) cell IDs (cell sites) capable of providing cellular coverage to the geographic region. In various example embodiments, as described in more detail below, cell IDs capable of providing coverage to the geographic region are determined in accordance with the statically and/or dynamically defined alert areas.

The mapping server **22** provides, at step **30**, an indication of the cell sites located in a geographic region. That is, the mapping server **22** provides an indication of cell sites capable of providing cellular coverage to the geographic region. FIG. **2** is an example depiction of cell sites capable of providing cellular coverage to a geographical region. Cell sites **50** represent example geographically contiguous cell sites capable of providing cellular coverage to the geographic region and surrounding areas. Shaded cell sites **52** represent cell sites capable of providing cellular coverage to the geographic region. Note, only one shaded cell site is labeled **52** for the sake of simplicity. Un-shaded cell sites **54** represent cell sites outside of the geographic region. That is, cell sites **54** do not provide cellular coverage to the geographic region affected by the emergency. Note, only one un-shaded cell site is labeled **54** for the sake of simplicity.

Referring back to FIG. **1**, upon receiving (at step **30**) the indication (e.g., list) of cell sites capable of providing cellular coverage to the geographic region, the emergency alert server **18**, may determine the broadcast capability of the cell sites received. For example, the Emergency Alert Server **18** determines the broadcast capability of cell sites within the geographic region depicted in FIG. **2**. The emergency alert server **18** can determine the broadcast capability of each cell site in accordance with any appropriate means, such as requesting the broadcast capability of each cell site from an appropriate processor.

At step **42** the emergency alert server **18** provides an indication of cell sites within the alert area and supporting broadcast technology (e.g., cell sites **62**) to a broadcast server **24**. The Emergency Alert Server **18** also provides the alert message to the broadcast server **24**, at step **42**. The broadcast server **24** instructs the wireless broadcast network to transmit the alert message to the identified cell sites providing coverage to the alert area and supporting broadcast technology (e.g., cell sites **62**). At step **46**, the broadcast cell sites broadcast via cellular network an emergency alert to a first plurality of mobile devices **12**.

At step **36**, a second plurality of mobile devices can be identified who are in said geographical region affected by the emergency, and are currently registered as in communication via a connection to the internet, i.e., via Internet Protocol (IP) communications. As explained above, many mobile devices, and in particular 3rd Generation (3G) and subsequent generation type mobile devices temporarily disable their cellular communications components—components for communicating with a cellular radio network—when such devices are communicating via IP, for example, when such devices are communicating via a Wi-Fi access point. This temporarily renders communications via the cellular network inoperative. Once such devices leave communication with a Wi-Fi hotspot, communications via the cellular network are re-activated, in some cases supporting seamless transition between Wi-Fi and cellular communications modes.

The second plurality of devices may be identified by again sending a request **36** to a server such as mapping server **22**. This time, mapping server **22** can supply identifiers, such as IP addresses, or other identifying information for any wireless access points in the geographical region. For example, referring to FIG. **3**, the black dots **57** represent wireless access points within geographical region **52**. Identifiers for these access points **57** can be supplied to the server **18** in step **31**. Mapping server **22** may maintain a list comprising Wi-Fi access points and locations of all Wi-Fi access points for use in identifying all Wi-Fi access points in a given geographical region. A request to mapping server **22** that identifies a geographical region can be responded to with a listing of Wi-Fi access points in the identified region. For the purposes of this disclosure, "all" Wi-Fi access points should be construed to mean all available Wi-Fi access points, as any particular access point may be unavailable due to, for example, the existence of such access point being unknown, or the access point not being interoperable with the emergency alert system.

Having a listing of wireless access points **57** in the geographic region, the system, e.g., server **18**, can perform either of two operations to send emergency alerts to mobile devices in communication with such access points. In one embodiment, mobile devices that are connected to any of said Wi-Fi access points **57** in said geographical region may be determined, and an emergency alert may be individually sent to such devices. In another embodiment, emergency alerts may be sent to wireless access points **57** in the geographic region **52**, and the wireless access points may themselves distribute the emergency alert.

To perform the first embodiment suggested above, a scan may be performed to identify devices in communication with the listed access points **57**. The scan may, for example, identify mobile devices that are communicating via IP addresses corresponding to the listed wireless access points **57**. For example, one or more devices **13** may communicate via wireless access points that route their communications through internet server **14**. Internet server **14** will have an IP address, and will assign devices **13** IP addresses that are identifiably "children" of the address assigned to internet server **14**. A scan for devices connected via access points **57** can thus comprise identifying the IP addresses of servers **14** associated with such access points **57**, and then searching for all devices with IP addresses that currently partially match the IP address of server **14**. Once the IP addresses are identified, sending an emergency alert entails sending an emergency alert to each identified device, for example by addressing an SMS emergency alert to each of said plurality of mobile devices **13**. The emergency alerts can be sent in step **37** to the internet, eventually arriving at internet server **14** which routes the communication **38** to the appropriate wireless access points, which in turn deliver the emergency alerts **40** to the various mobile devices **13**.

To perform the second embodiment suggested above, namely sending emergency alerts to wireless access points **57** in the geographic region **52**, and allowing the wireless access points **57** to subsequently distribute the emergency alerts, wireless access points **57** must be appropriately configured to receive and distribute emergency alerts. FIG. **4** illustrates such an access point. Using such an access point, sending an emergency alert to devices **13** comprises addressing the emergency alert to each of said plurality Wi-Fi access points illustrated in FIG. **1**, wherein said Wi-Fi access points relay emergency alerts to any mobile devices **13** communicating with said Wi-Fi access points.

FIG. **4** illustrates a Wi-Fi access point **400** comprising an internet interface **401** for sending and receiving communications to the internet via Internet Protocol (IP), a Short Message Service (SMS) emergency alert authentication component **405** that authenticates an emergency alert received via said internet interface **401**, a wireless communications mechanism **402** that sends and receives communications to and from mobile devices **410-412**, and an emergency alert distribution **406** component that distributes **406** said SMS emergency alert to all mobile devices in communication with said Wi-Fi access point **400** via said wireless communications mechanism **402**.

In one embodiment, the Wi-Fi access point **400** scans all communications received via said internet interface **401** for an emergency alert identifier. The emergency alert authentication component **405** authenticates said SMS emergency alert by matching a received emergency alert identifier with an identifier **407** stored in said Wi-Fi access point **400**.

Once an alert is authenticated, it must be distributed to mobile devices **410-412**. A number of options are available in terms of how the alert is delivered. In one embodiment, the SMS emergency alert distribution component **406** may cause the access point **400** to send a preformatted alert to devices **410-411**. Such a preformatted alert may be populated with information received in the incoming emergency alert.

In another embodiment, alert distribution component **406** injects said emergency alert into information sent to said mobile devices **410-412**. For example, if mobile device **410** is viewing email, the emergency alert can be injected as an email into the data stream sent to device **410**. Meanwhile, if device **411** is browsing the internet and viewing a web page, the content of a currently viewed webpage can be replaced by distribution component **406** with the emergency alert. Similarly, voice data sent to device **412** pursuant to a telephone call can be replaced with emergency alert voiceover. These are three examples of injecting emergency alert information, others will be appreciated by those of skill with the benefit of this disclosure.

FIG. **5** provides a detailed flow diagram of one example process and system for delivering an SMS based alert message to cell sites in an alert area for broadcast. At step **70**, the

mobile device **12** connects to a cell tower, and then registers with the Mobile Switching Center (MSC) **64**. The MSC **64**, at step **72**, provides registration information to the Home Location Register (HLR) **68**. Upon receiving the registration request, the HLR **68** performs well known registration functions. HLR **68**, at step **74**, provides an indication of the mobile device's geographical location to the emergency alert server **18**.

In an example embodiment, registration information provided (step **74**) by the HLR **68** to the emergency alert server **18** comprises a subscriber ID, such as the subscriber's directory number for example, and an indication of the geographic area in which the subscriber registered, such as the MSC (e.g., cell site). The Emergency Alert Server **18** maintains a list of registered subscribers who want to receive alert messages via SMS. The Emergency Alert Server **18** also maintains a list of the MSCs currently associated with each registered subscriber who wants to receive alerts via SMS.

Each time a mobile device **12** registers with an MSC **64**, steps **70**, **72**, and **74**, are performed, and the lists maintained by the emergency alert server **18** are updated. Thus, if a subscriber registers with a first MSC **64** and later registers with a different MSC **64**, the emergency alert server **18** updates the information stored therein pertaining to the subscriber, including an identification of the different MSC **64**. In this way, the current location of a registered subscriber is maintained. If the HLR **68** determines that a mobile device is no longer registered, the HLR **68** provides an indication thereof to the emergency alert server **18** and the emergency alert server **18** updates accordingly information stored therein pertaining to the subscriber associated with the mobile device.

At step **76**, an Emergency Alert Network **20** provides to the emergency alert server **18** an alert message and an indication of an alert area. At this point, the mobile device **12** is registered with the MSC **64**. The emergency alert server **18**, upon receipt (step **76**) of the alert message from the Emergency Alert Network **20**, determines cell sites within the alert area, as described above with reference to FIG. **1**. The emergency alert server can then send individual emergency alerts to all devices registered with MSC's corresponding to identified cell sites, or can broadcast emergency alerts from the applicable cell sites to reach any and all devices regardless of whether the device is registered.

FIG. **6** is a block diagram of an exemplary system **106** for implementing the various mobile devices, computers, servers, and other electronics discussed herein. The system **106** comprises a processor portion **108**, a memory portion **110**, and an input/output portion **112**. It is emphasized that the block diagram depicted in FIG. **7** is exemplary and not intended to imply a specific implementation. Thus, the system **106** can be implemented in a single processor or multiple processors. Multiple processors can be distributed or centrally located. Multiple processors can communicate wirelessly, via hard wire, or a combination thereof. The processor **108** can comprise any appropriate device for providing communication mode information. Memory **110** may be volatile (such as RAM), non-volatile (such as ROM, flash memory, etc.) or some combination of the two. Additionally, device **106** may also have mass storage (removable and/or non-removable) such as magnetic or optical disks or tape. Input/output may comprise data communication ports as well as devices such as a keyboard, mouse, and display that presents a GUI as a graphical aid accessing the functions of the computing device **106**. Other aspects of device **106** may include communication connections to other devices, computers, networks, servers, etc. using either wired or wireless media. Examples of appropriate devices include mobile communications devices, mobile telephones, personal digital assistants (PDAs), lap top computers, handheld processors, or a combination thereof.

In various example embodiments, the system **106** can comprise, as described above, an MSC, an HLR, an Emergency Alert Server, an SMSC, a cell broadcast capability database, a broadcast server, a mapping server, or a combination thereof. Accordingly, the system **106** can, in various embodiments, perform the functions associated with each of an MSC, an HLR, an Emergency Alert Server, an SMSC, a cell broadcast capability database, a broadcast server, an SMSC, a mapping server, or a combination thereof.

As described above, cell sites providing coverage to the geographic alert area can be determined statically and/or dynamically. Alert notifications are directed to cell sites within an alert area in accordance with a mapping mechanism that identifies cell coverage within the area. Alert area definitions are mapped to associated cell sites such that emergency alerts can be delivered to subscribers within the alert area. In an example embodiment, alert areas are statically defined in accordance with geographic code references such as the Federal Information Processing Standard (FIPS), ZIP codes, and/or the National Weather Service Specific Area Message Encoder (SAME) codes. Radio Frequency (RF) propagation characteristics are determined for the areas, and used to determine if an area is capable of receiving an emergency alert notification. In another example embodiment, alert areas are defined dynamically in accordance with the Geographic Information System (GIS) Alert Mapping Service.

In one example embodiment, the emergency alert information received in step **26** in FIG. **1** comprises an indication of a statically defined alert area. The alert area is statically defined in accordance with an appropriate geographic code reference, such as the Federal Information Processing Standard (FIPS) codes, ZIP codes, and/or the National Weather Service Specific Area Message Encoder (SAME) codes, for example. The emergency alert server **18** requests, from for example a Cell ID Lookup Table in mapping server **22**, the list of all cell sites within the specified geographic code reference. In an example embodiment, the Cell ID Lookup Table comprises information, for each cell site, pertaining to cell ID, cell location, associated ZIP code, associated FIPS code, associated SAME code, any other statically defined geographic code reference, or a combination thereof, for example.

In another example embodiment, the Emergency Alert Network **20** issues an emergency alert for a dynamically defined alert area to the emergency alert server **18**. In an example embodiment, the description of the dynamically defined alert area is formatted in accordance with a World Geodetic System 1984 (WGS-84) format, or the like. The WGS-84 defines a fixed global reference frame for the Earth. In an example configuration, geographic areas are defined by geometric shapes, such as circles, ovals, and/or polygons, or the like. The emergency alert server **18** provides the dynamically defined alert area to the mapping server **22**, which may be, e.g., a GIS based Alert Mapping Server. Mapping server **22** requests from a Cell Site Location Database all cell sites which are contained within the boundaries of the alert area. In an example embodiment, the cell sites within the boundaries of the alert area are determined in accordance with the location, such as latitude and longitude, of respective cell sites.

The Cell Site Location Database can comprise any appropriate database. In an example embodiment, the Cell Site Location Database comprises information pertaining to cell

sites such as a cell ID of each cell site and a cell location (e.g., latitude and longitude) of each cell site, for example. Upon receiving the request from the GIS based Alert Mapping Server, the Cell Site Location Database identifies all cell sites associated with the specified dynamically defined alert area. The Cell Site Location Database provides, to the GIS based Alert Mapping Server **22**, the list of identified cell sites. In an example embodiment, the list comprises a Cell ID for each identified cell site associated with the dynamically defined alert area. In another example embodiment, the list also comprises the cell location of each identified cell site.

GIS based Alert Mapping Server **22** may also request from the Cell Site RF Propagation Database, the RF propagation characteristics for each cell site within the list of Cell IDs for the alert area. The Cell Site RF Propagation Database retrieves, and/or determines, the RF propagation characteristics for each cell site in the list of Cell IDs for the alert area. The RF Propagation Database can comprise a software program that is executed in response to a request for RF propagation characteristics. The software program embodiment of the RF Propagation Database can reside in any appropriate processor, such as the GIS based Alert Mapping Server **22**, for example. In an example embodiment, the GIS based Alert Mapping Server **56** comprises a mapping of Cell ID to input for the RF propagation software, e.g., latitude, longitude, and height of the cell site transmitter antenna, power output of the transmitters, and/or antenna characteristics such as gain, for example. This information can be used to dynamically determine the exact broadcast coverage for sending emergency alerts to a targeted area.

The cellular radio network and/or the wireless broadcast network depicted herein can comprise any appropriate telephony radio network. The Emergency Alert Network depicted herein can comprise any appropriate emergency alert network, such as a telephony radio network, for example. Further, techniques for the delivery of emergency alerts can be implemented with appropriate telephony radio networks. The following description sets forth some exemplary telephony radio networks, such as the global system for mobile communications (GSM), and non-limiting operating environments. The below-described operating environments should be considered non-exhaustive, however, and thus the below-described network architectures merely show how techniques for the delivery of emergency alerts can be incorporated with existing network structures and architectures. It can be appreciated, however, that the techniques for the delivery of emergency alerts can be incorporated with existing and/or future alternative architectures for communication networks as well.

The GSM is one of the most widely utilized wireless access systems in today's fast growing communication environment. The GSM provides circuit-switched data services to subscribers, such as mobile telephone or computer users. The General Packet Radio Service ("GPRS"), which is an extension to GSM technology, introduces packet switching to GSM networks. The GPRS uses a packet-based wireless communication technology to transfer high and low speed data and signaling in an efficient manner. The GPRS attempts to optimize the use of network and radio resources, thus enabling the cost effective and efficient use of GSM network resources for packet mode applications.

As one of ordinary skill in the art can appreciate, the exemplary GSM/GPRS environment and services described herein also can be extended to 3G services, such as Universal Mobile Telephone System ("UMTS"), Frequency Division Duplexing ("FDD") and Time Division Duplexing ("TDD"), High Speed Packet Data Access ("HSPDA"), cdma2000 1x Evolution Data Optimized ("EVDO"), Code Division Multiple Access-2000 ("cdma2000 3x"), Time Division Synchronous Code Division Multiple Access ("TD-SCDMA"), Wideband Code Division Multiple Access ("WCDMA"), Enhanced Data GSM Environment ("EDGE"), International Mobile Telecommunications-2000 ("IMT-2000"), Digital Enhanced Cordless Telecommunications ("DECT"), etc., as well as to other network services that become available in time. In this regard, the techniques of the determination of EAS delivery can be applied independently of the method of data transport, and do not depend on any particular network architecture, or underlying protocols.

FIG. **7** depicts an overall block diagram of an exemplary packet-based mobile cellular network environment, such as a GPRS network, in which the various determination mechanisms for delivery of alert messages can be practiced. In such an environment, there are a plurality of Base Station Subsystems ("BSS") **700** (only one is shown), each of which comprises a Base Station Controller ("BSC") **702** serving a plurality of Base Transceiver Stations ("BTS") such as BTSs **704**, **706**, and **708**. BTSs **704**, **706**, **708**, etc. are the access points where users of packet-based mobile devices (e.g., mobile device **12**) become connected to the wireless network. In exemplary fashion, the packet traffic originating from user devices (e.g., user device **20**) is transported via an over-the-air interface to a BTS **708**, and from the BTS **708** to the BSC **702**. Base station subsystems, such as BSS **700**, are a part of internal frame relay network **710** that can include Service GPRS Support Nodes ("SGSN") such as SGSN **712** and **714**. Each SGSN is connected to an internal packet network **720** through which a SGSN **712**, **714**, etc. can route data packets to and from a plurality of gateway GPRS support nodes (GGSN) **722**, **724**, **726**, etc. As illustrated, SGSN **714** and GGSNs **722**, **724**, and **726** are part of internal packet network **720**. Gateway GPRS serving nodes **722**, **724** and **726** mainly provide an interface to external Internet Protocol ("IP") networks such as Public Land Mobile Network ("PLMN") **750**, corporate intranets **740**, or Fixed-End System ("FES") or the public Internet **730**. As illustrated, subscriber corporate network **740** may be connected to GGSN **724** via firewall **732**; and PLMN **750** is connected to GGSN **724** via boarder gateway router **734**. The Remote Authentication Dial-In User Service ("RADIUS") server **742** may be used for caller authentication when a user of a mobile cellular device calls corporate network **740**.

Generally, there can be four different cell sizes in a GSM network, referred to as macro, micro, pico, and umbrella cells. The coverage area of each cell is different in different environments. Macro cells can be regarded as cells in which the base station antenna is installed in a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level. Micro-cells are typically used in urban areas. Pico cells are small cells having a diameter of a few dozen meters. Pico cells are used mainly indoors. On the other hand, umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

FIG. **8** illustrates an architecture of a typical GPRS network as segmented into four groups: users **850**, radio access network **860**, core network **870**, and interconnect network **880**. Users **850** comprise a plurality of end users (though only mobile subscriber **855** is shown in FIG. **8**). In an example embodiment, the device depicted as mobile subscriber **855** comprises mobile device **12**. Radio access network **860** comprises a plurality of base station subsystems such as BSSs **862**, which include BTSs **864** and BSCs **866**. Core network **870** comprises a host of various network elements. As illus-

trated here, core network **870** may comprise Mobile Switching Center ("MSC") **871**, Service Control Point ("SCP") **872**, gateway MSC **873**, SGSN **876**, Home Location Register ("HLR") **874**, Authentication Center ("AuC") **875**, Domain Name Server ("DNS") **877**, and GGSN **878**. Interconnect network **880** also comprises a host of various networks and other network elements. As illustrated in FIG. **8**, interconnect network **880** comprises Public Switched Telephone Network ("PSTN") **882**, Fixed-End System ("FES") or Internet **884**, firewall **888**, and Corporate Network **889**.

A mobile switching center can be connected to a large number of base station controllers. At MSC **871**, for instance, depending on the type of traffic, the traffic may be separated in that voice may be sent to Public Switched Telephone Network ("PSTN") **882** through Gateway MSC ("GMSC") **873**, and/or data may be sent to SGSN **876**, which then sends the data traffic to GGSN **878** for further forwarding.

When MSC **871** receives call traffic, for example, from BSC **866**, it sends a query to a database hosted by SCP **872**. The SCP **872** processes the request and issues a response to MSC **871** so that it may continue call processing as appropriate.

The HLR **874** is a centralized database for users to register to the GPRS network. HLR **874** stores static information about the subscribers such as the International Mobile Subscriber Identity ("IMSI"), subscribed services, and a key for authenticating the subscriber. HLR **874** also stores dynamic subscriber information such as the current location of the mobile subscriber. Associated with HLR **874** is AuC **875**. AuC **875** is a database that contains the algorithms for authenticating subscribers and includes the associated keys for encryption to safeguard the user input for authentication.

In the following, depending on context, the term "mobile subscriber" sometimes refers to the end user, such as the user having a disability for example, and sometimes to the actual portable device, such as the mobile device **12**, used by an end user of the mobile cellular service. When a mobile subscriber turns on his or her mobile device, the mobile device goes through an attach process by which the mobile device attaches to an SGSN of the GPRS network. In FIG. **8**, when mobile subscriber **855** initiates the attach process by turning on the network capabilities of the mobile device, an attach request is sent by mobile subscriber **855** to SGSN **876**. The SGSN **876** queries another SGSN, to which mobile subscriber **855** was attached before, for the identity of mobile subscriber **855**. Upon receiving the identity of mobile subscriber **855** from the other SGSN, SGSN **876** requests more information from mobile subscriber **855**. This information is used to authenticate mobile subscriber **855** to SGSN **876** by HLR **874**. Once verified, SGSN **876** sends a location update to HLR **874** indicating the change of location to a new SGSN, in this case SGSN **876**. HLR **874** notifies the old SGSN, to which mobile subscriber **855** was attached before, to cancel the location process for mobile subscriber **855**. HLR **874** then notifies SGSN **876** that the location update has been performed. At this time, SGSN **876** sends an Attach Accept message to mobile subscriber **855**, which in turn sends an Attach Complete message to SGSN **876**.

After attaching itself with the network, mobile subscriber **855** then goes through the authentication process. In the authentication process, SGSN **876** sends the authentication information to HLR **874**, which sends information back to SGSN **876** based on the user profile that was part of the user's initial setup. The SGSN **876** then sends a request for authentication and ciphering to mobile subscriber **855**. The mobile subscriber **855** uses an algorithm to send the user identification (ID) and password to SGSN **876**. The SGSN **876** uses the same algorithm and compares the result. If a match occurs, SGSN **876** authenticates mobile subscriber **855**.

Next, the mobile subscriber **855** establishes a user session with the destination network, corporate network **889**, by going through a Packet Data Protocol ("PDP") activation process. Briefly, in the process, mobile subscriber **855** requests access to the Access Point Name ("APN"), for example, UPS.com, and SGSN **876** receives the activation request from mobile subscriber **855**. SGSN **876** then initiates a Domain Name Service ("DNS") query to learn which GGSN node has access to the UPS.com APN. The DNS query is sent to the DNS server within the core network **870**, such as DNS **877**, which is provisioned to map to one or more GGSN nodes in the core network **870**. Based on the APN, the mapped GGSN **878** can access the requested corporate network **889**. The SGSN **876** then sends to GGSN **878** a Create Packet Data Protocol ("PDP") Context Request message that contains necessary information. The GGSN **878** sends a Create PDP Context Response message to SGSN **876**, which then sends an Activate PDP Context Accept message to mobile subscriber **855**.

Once activated, data packets of the call made by mobile subscriber **855** can then go through radio access network **860**, core network **870**, and interconnect network **880**, in a particular fixed-end system or Internet **884** and firewall **888**, to reach corporate network **889**.

Thus, network elements that can invoke the functionality of the emergency alert mapping system can include but are not limited to Gateway GPRS Support Node tables, Fixed End System router tables, firewall systems, VPN tunnels, and any number of other network elements as required by the particular digital network.

While example embodiments of techniques for the delivery of emergency alerts have been described in connection with various computing devices/processor, the underlying concepts can be applied to any computing device, processor, or system capable delivering emergency alerts. The various techniques described herein can be implemented in connection with hardware or software or, where appropriate, with a combination of both. Thus, the methods and apparatuses for the various techniques for the delivery of emergency alerts, or certain aspects or portions thereof, can take the form of program code (i.e., instructions) embodied in tangible media, such as floppy diskettes, CD-ROMs, hard drives, or any other machine-readable storage medium, wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for techniques for the delivery of emergency alerts. In the case of program code execution on programmable computers, the computing device will generally include a processor, a storage medium readable by the processor (including volatile and non-volatile memory and/or storage elements), at least one input device, and at least one output device. The program(s) can be implemented in assembly or machine language, if desired. The language can be a compiled or interpreted language, and combined with hardware implementations.

The methods and apparatuses for techniques for the delivery of emergency alerts also can be practiced via communications embodied in the form of program code that is transmitted over some transmission medium, such as over electrical wiring or cabling, through fiber optics, or via any other form of transmission, wherein, when the program code is received and loaded into and executed by a machine, such as an EPROM, a gate array, a programmable logic device (PLD), a client computer, or the like, the machine becomes an apparatus for implementing techniques for the delivery of emergency alerts. When implemented on a general-purpose

processor, the program code combines with the processor to provide a unique apparatus that operates to invoke the functionality of the various techniques for the delivery of emergency alerts. Additionally, any storage techniques used in connection with the techniques for the delivery of emergency alerts can invariably be a combination of hardware and software.

While techniques for the delivery of emergency alerts have been described in connection with the various embodiments of the various figures, it is to be understood that other similar embodiments can be used or modifications and additions can be made to the described embodiment for performing the same function of the various techniques for the delivery of emergency alerts without deviating therefrom. For example, one skilled in the art will recognize that techniques for the delivery of emergency alerts as described in the present application may apply to any environment, and may be applied to any number of devices connected via a communications network and interacting across the network. Therefore, techniques for the delivery of emergency alerts should not be limited to any single embodiment, but rather should be construed in breadth and scope in accordance with the appended claims.

We claim:

1. A method comprising:

receiving a Short Message Service (SMS) emergency alert addressed for a Wi-Fi access point at said Wi-Fi access point via an internet interface configured to send and receive communications using Internet Protocol (IP);

authenticating said SMS emergency alert received via said internet interface at said Wi-Fi access point;

transmitting said SMS emergency alert from said Wi-Fi access point via a wireless communications mechanism configured to exchange communications with a first mobile device by:

determining a first application currently being used on said first mobile device,

formatting said SMS emergency alert in a format such that said first application is capable of presenting said SMS emergency alert, and

sending said SMS emergency alert as part of a first data stream comprising first data for said first application; and

subsequently transmitting said SMS emergency alert from said Wi-Fi access point via the wireless communications mechanism configured to exchange communications with a second mobile device by:

determining a second application currently being used on said second mobile device, wherein said second application is different than said first application,

formatting said SMS emergency alert in a second format such that the second application is capable of presenting said SMS emergency alert, and

sending said SMS emergency alert as part of a second data stream comprising second data for said second application.

2. The method of claim **1**, wherein said first application is a voice call application, and wherein formatting and sending said SMS emergency alert comprises replacing voice data with audible content derived from the SMS emergency alert.

3. The method of claim **1**, further comprising scanning all communications received via said internet interface for an emergency alert identifier.

4. The method of claim **3**, further comprising authenticating said SMS emergency alert by matching a received emergency alert identifier with an identifier stored at said Wi-Fi access point.

5. The method of claim **1**, wherein said second application is a web browser, and wherein formatting and sending said SMS emergency alert comprises replacing content of a currently viewed web page with the SMS emergency alert.

6. The method of claim **1**, wherein said first application is a web browser, and wherein formatting and sending said SMS emergency alert comprises replacing content of a currently viewed web page with the SMS emergency alert.

7. The method of claim **1**, further comprising receiving said SMS emergency alert from a government Emergency Alert System (EAS).

8. A system comprising:

an internet communications component for sending and receiving communications via Internet Protocol (IP), wherein said internet communications component receives a Short Message Service (SMS) emergency alert addressed for said internet communications component;

an SMS emergency alert authentication component that authenticates said SMS emergency alert received via said internet communications component;

a wireless communications component configured to exchange communications with first mobile devices and second mobile devices;

an emergency alert distribution component that distributes said SMS emergency alert by:

determining a first application currently being used on each of said first mobile devices,

formatting said SMS emergency alert such that said first application is capable of presenting said SMS emergency alert, and

transmitting said SMS emergency alert as part of a first data stream comprising first data for said first application; and

subsequently transmitting said SMS emergency alert from said Wi-Fi access point via the wireless communications mechanism configured to exchange communications with said second mobile devices by:

determining a second application currently being used on each of said second mobile devices, wherein said second application is different than said first application,

formatting said SMS emergency alert in a second format such that the second application is capable of presenting said SMS emergency alert, and

transmitting said SMS emergency alert as part of a second data stream comprising second data for said second application.

9. The system of claim **8**, wherein said second application is a voice call application, and wherein formatting and transmitting said SMS emergency alert comprises replacing voice data with audible content derived from the SMS emergency alert.

10. The system of claim **8**, further comprising sending said SMS emergency alert to each of said first mobile devices using IP communications.

11. The system of claim **8**, wherein said SMS emergency alert is accompanied by an emergency alert identifier.

12. The system of claim **11**, wherein said SMS emergency alert authentication component matches the received emergency alert identifier with a stored identifier.

13. The system of claim **8**, wherein said SMS emergency alert authentication component scans all communications received via said internet communications component for an emergency alert identifier.

14. The system of claim **8**, wherein said first application is a voice call application, and wherein formatting and trans-

mitting said SMS emergency alert comprises replacing voice data with audible content derived from the SMS emergency alert.

15. The system of claim **8**, wherein said first application is a web browser, and wherein formatting and transmitting said SMS emergency alert comprises replacing content of a currently viewed web page with the SMS emergency alert.

16. A Wi-Fi access point, comprising:

an internet interface for sending and receiving communications via Internet Protocol (IP), wherein said internet interface receives a Short Message Service (SMS) emergency alert addressed for said Wi-Fi access point;

an SMS emergency alert authentication component that authenticates said SMS emergency alert received via said internet interface;

a wireless communications mechanism that exchanges communications with mobile devices; and

an emergency alert distribution component that distributes said SMS emergency alert via said wireless communications mechanism by:

determining that a first application currently being used on a first mobile device among the mobile devices is a web browser,

formatting said SMS emergency alert in a format such that said web browser is capable of presenting said SMS emergency alert in a web page,

sending said SMS emergency alert as part of a data stream comprising data for said web browser by replacing content of a currently viewed web page with the SMS emergency alert,

determining that a second application currently being used on a second mobile device among the mobile devices is an email application,

formatting said SMS emergency alert in a format such that said email application is capable of presenting said SMS emergency alert as an email, and

sending said SMS emergency alert as part of a data stream comprising data for said email application.

17. The Wi-Fi access point of claim **16**, wherein said Wi-Fi access point scans all communications received via said internet interface for an emergency alert identifier.

18. The Wi-Fi access point of claim **16**, wherein said emergency alert authentication component authenticates said SMS emergency alert by matching a received emergency alert identifier with an identifier stored in said Wi-Fi access point.

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