



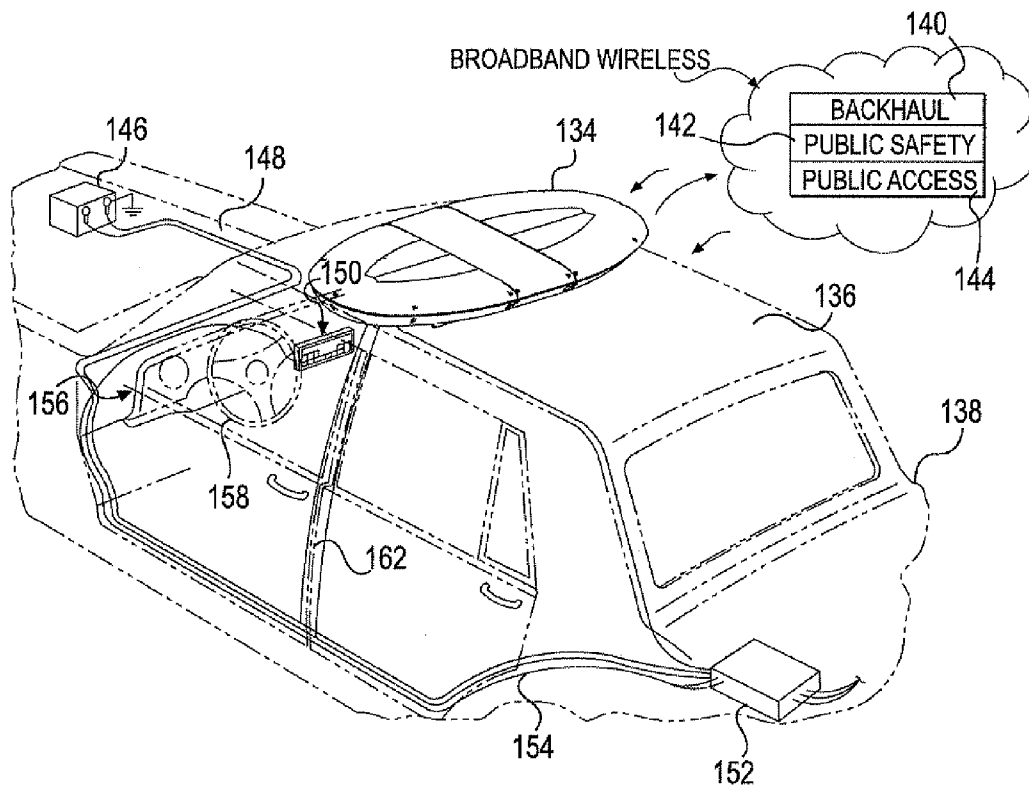
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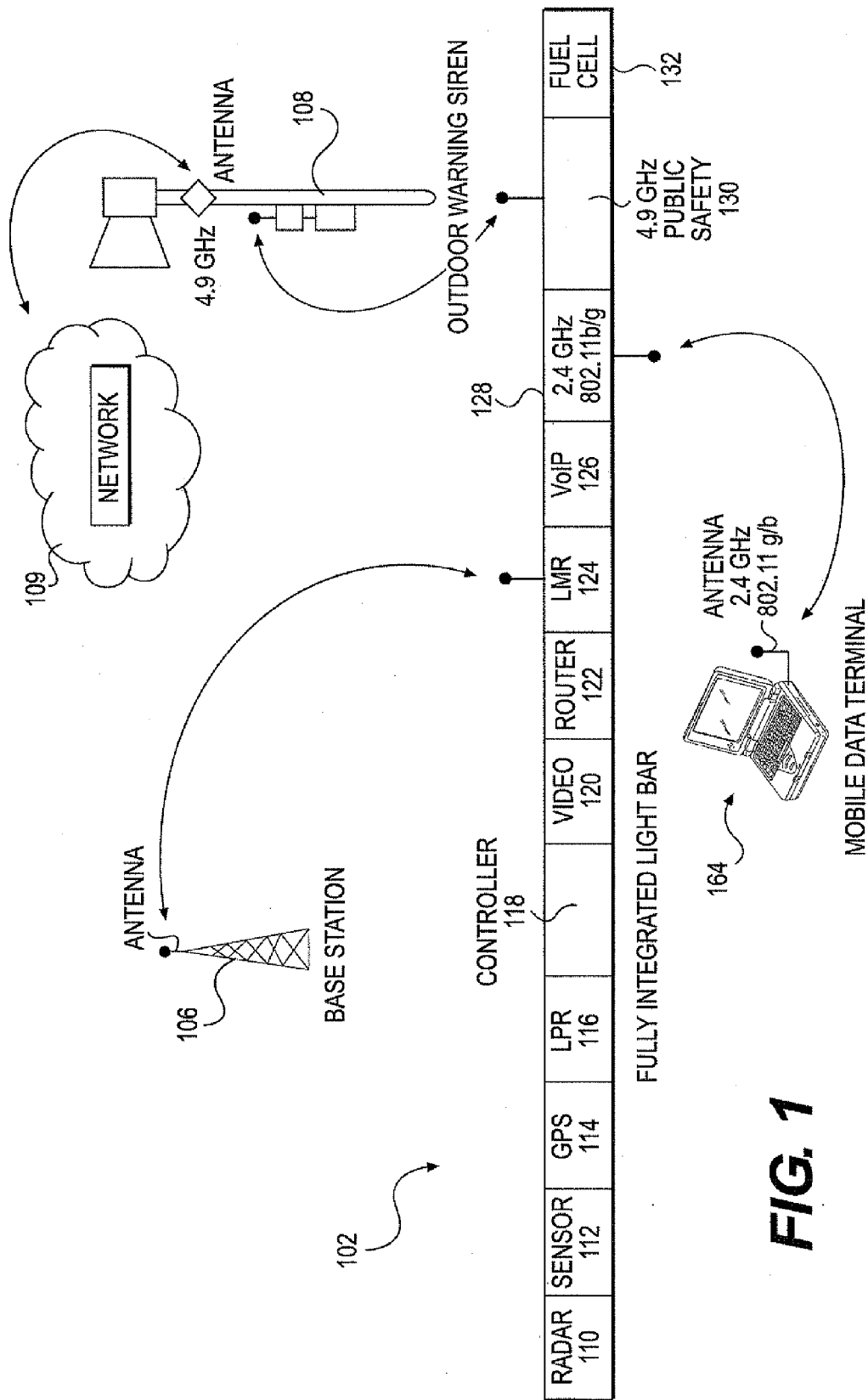
(19) **United States**(12) **Patent Application Publication****Sink et al.**(10) **Pub. No.: US 2007/0195939 A1**(43) **Pub. Date: Aug. 23, 2007**(54) **FULLY INTEGRATED LIGHT BAR**(75) Inventors: **Gregory A. Sink**, Frankfort, IL (US);  
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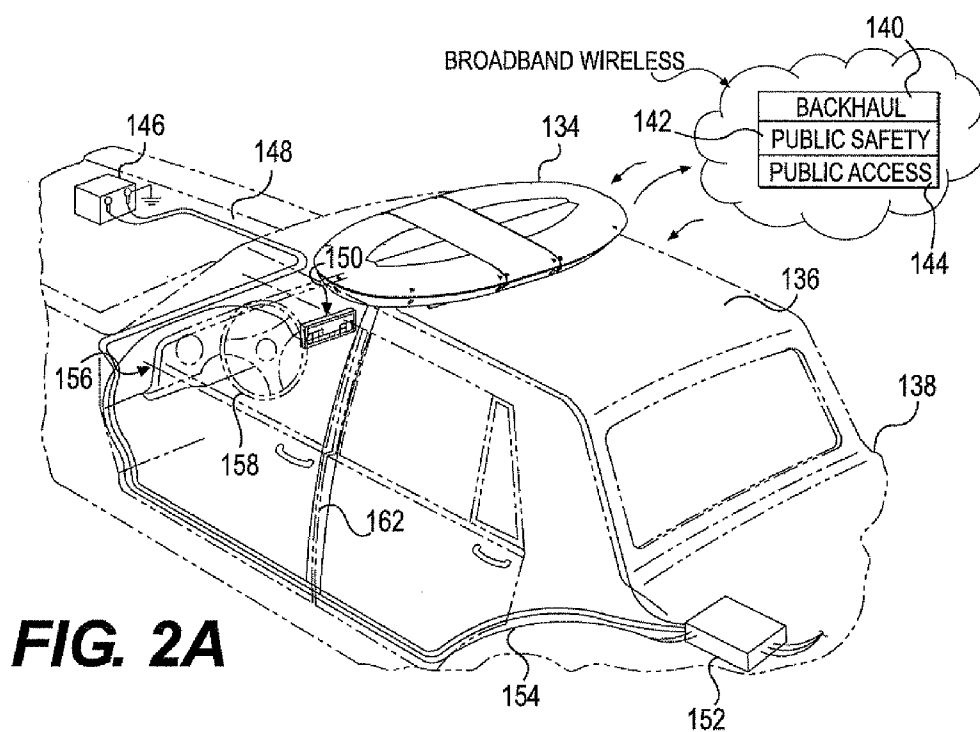
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**TWO PRUDENTIAL PLAZA, SUITE 4900**  
**180 NORTH STETSON AVENUE**  
**CHICAGO, IL 60601-6731 (US)**(73) Assignee: **Federal Signal Corporation**, Oakbrook,  
IL(21) Appl. No.: **11/548,209**(22) Filed: **Oct. 10, 2006****Related U.S. Application Data**(63) Continuation-in-part of application No. 11/394,752,  
filed on Mar. 31, 2006.  
Continuation-in-part of application No. 11/505,642,  
filed on Aug. 17, 2006.(60) Provisional application No. 60/775,634, filed on Feb.  
22, 2006. Provisional application No. 60/775,634,  
filed on Feb. 22, 2006.**Publication Classification**(51) **Int. Cl.**  
**H04M 11/04** (2006.01)(52) **U.S. Cl.** ..... **379/37**(57) **ABSTRACT**

An emergency system for a vehicle integrates many disparate equipment into single housing. In one embodiment of the invention, the emergency system is a light bar. The light bar houses various modules for monitoring and responding to events. Example modules include license plate recognition systems and chemical agent detection sensors. The light bar also houses at least one transceiver for wirelessly connecting the light bar to a wide area network, allowing the modules in the light bar to communicate data to and from a remote site. A data terminal in the vehicle is connected to the light bar and receives and displays data to the vehicle operator generated by the modules in the light bar and also from data received over the network.

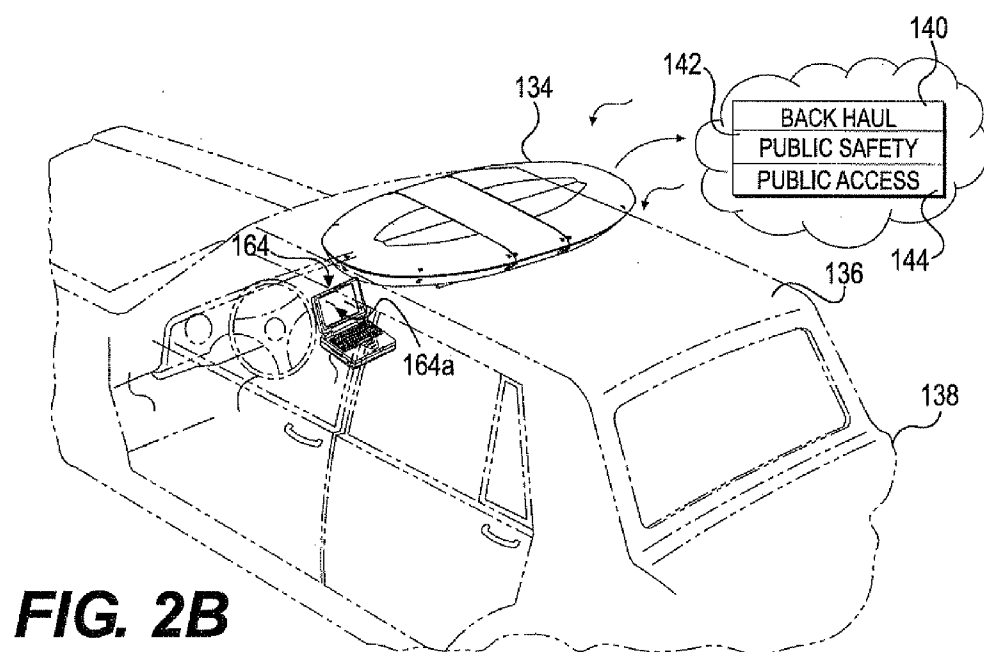




**FIG. 1**



**FIG. 2A**



**FIG. 2B**

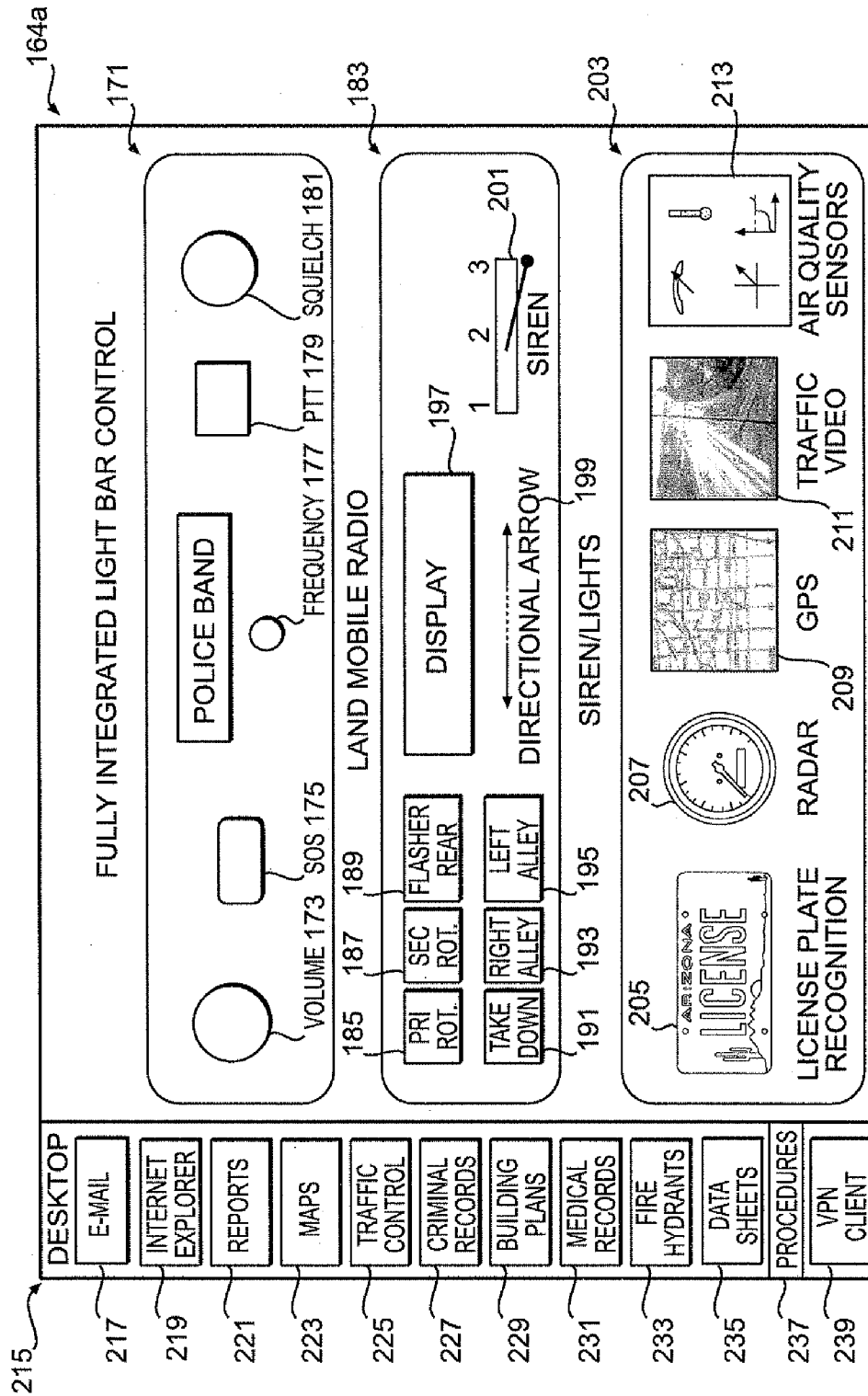
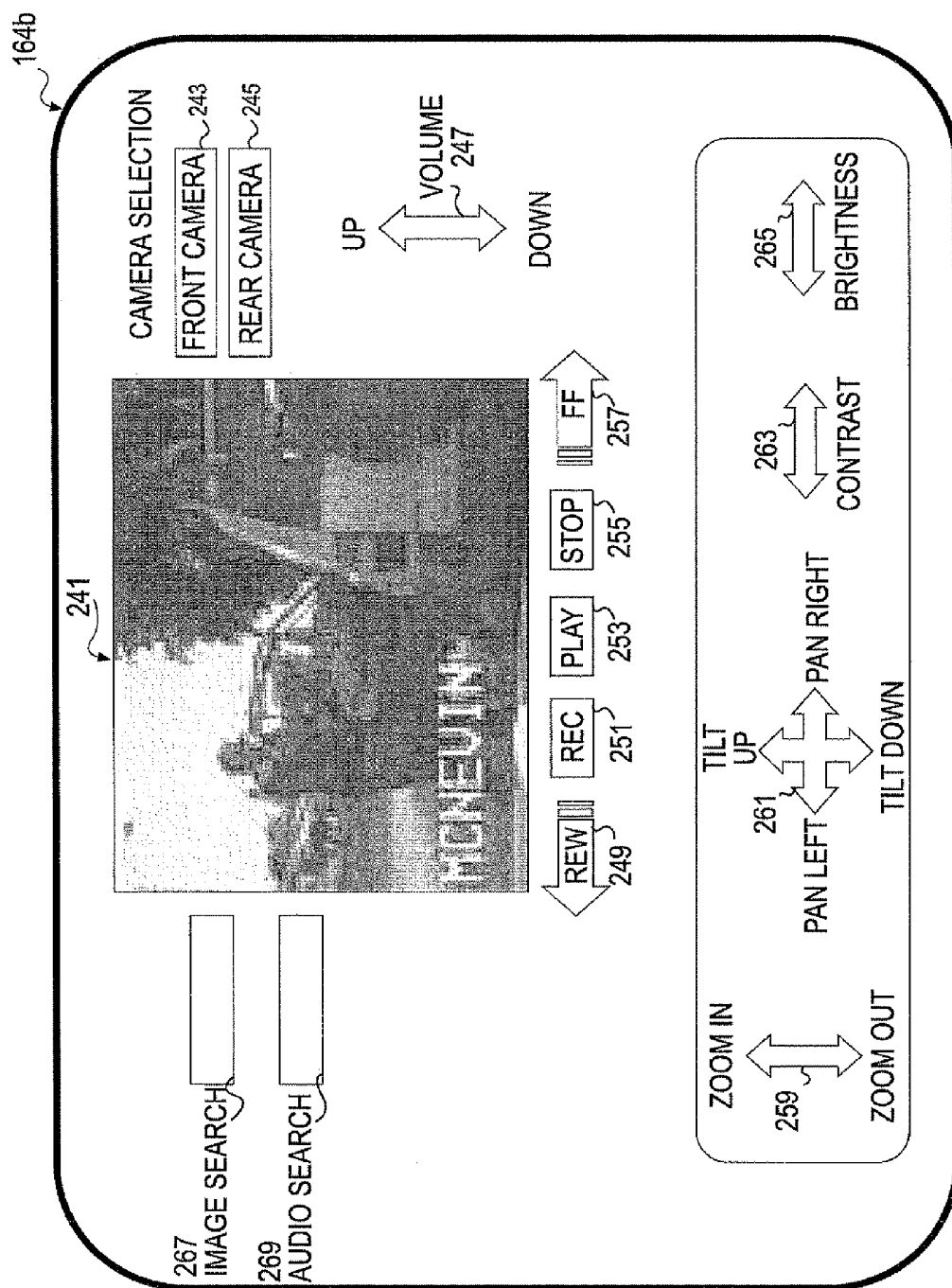
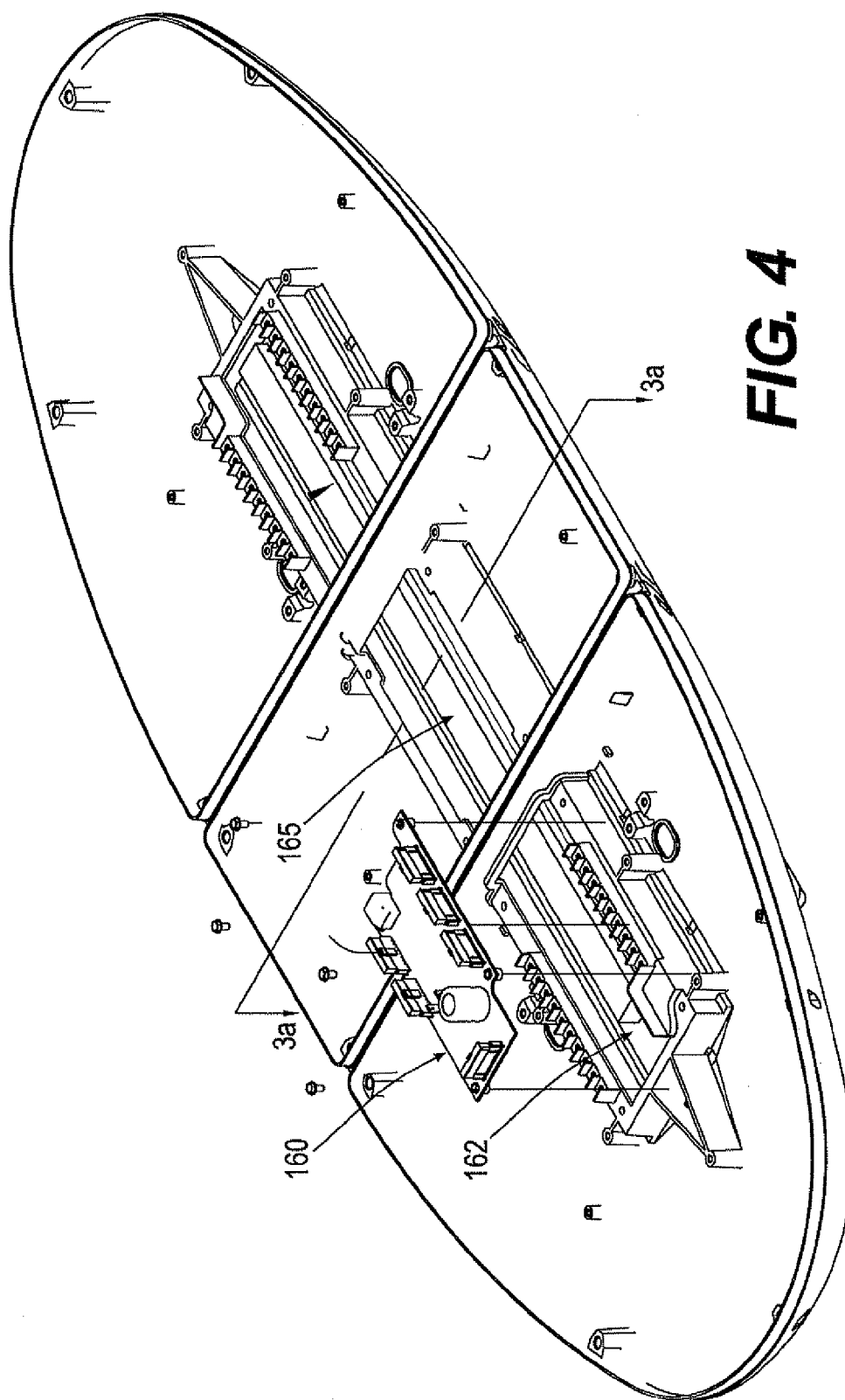
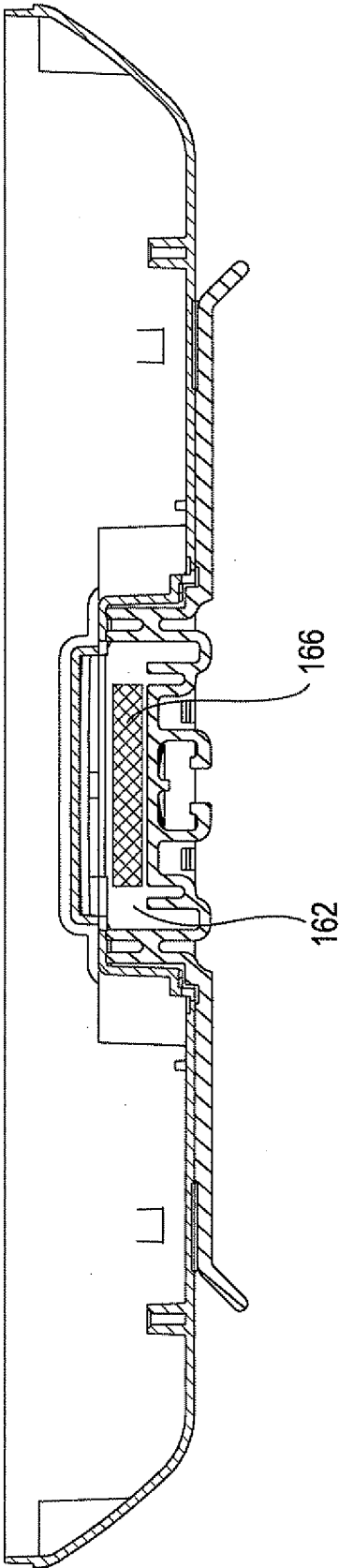


FIG. 3



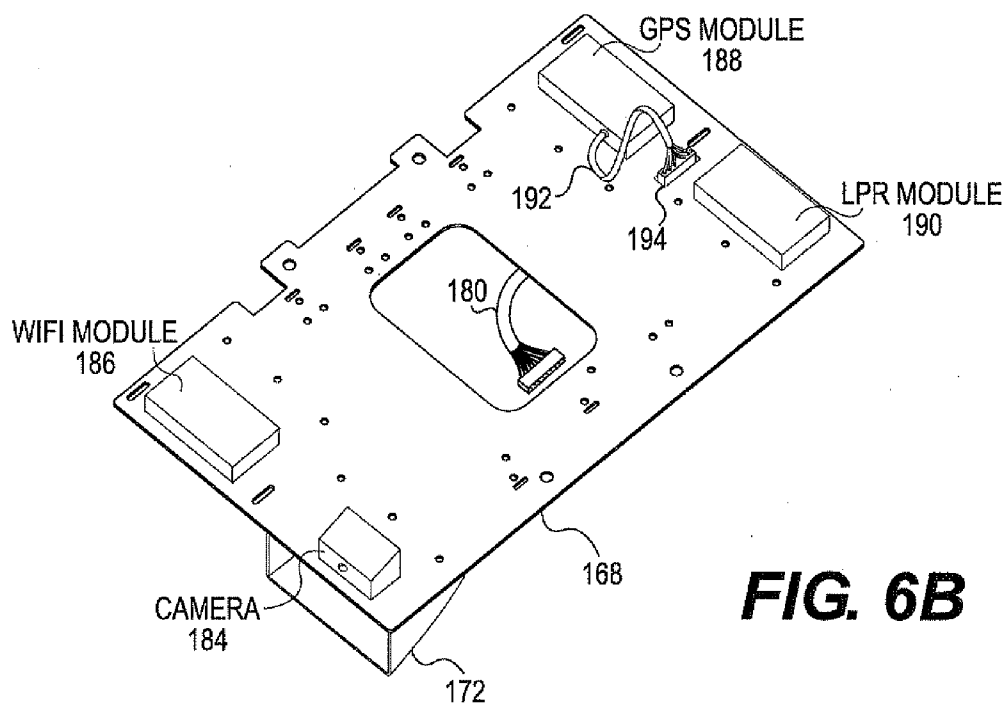
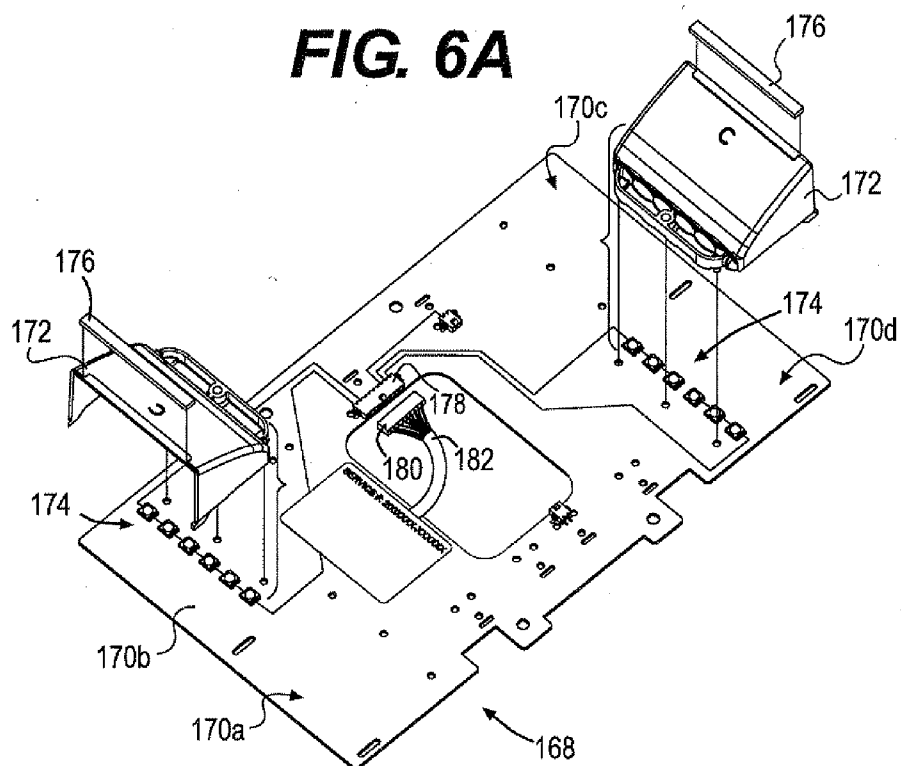
**FIG. 3A**





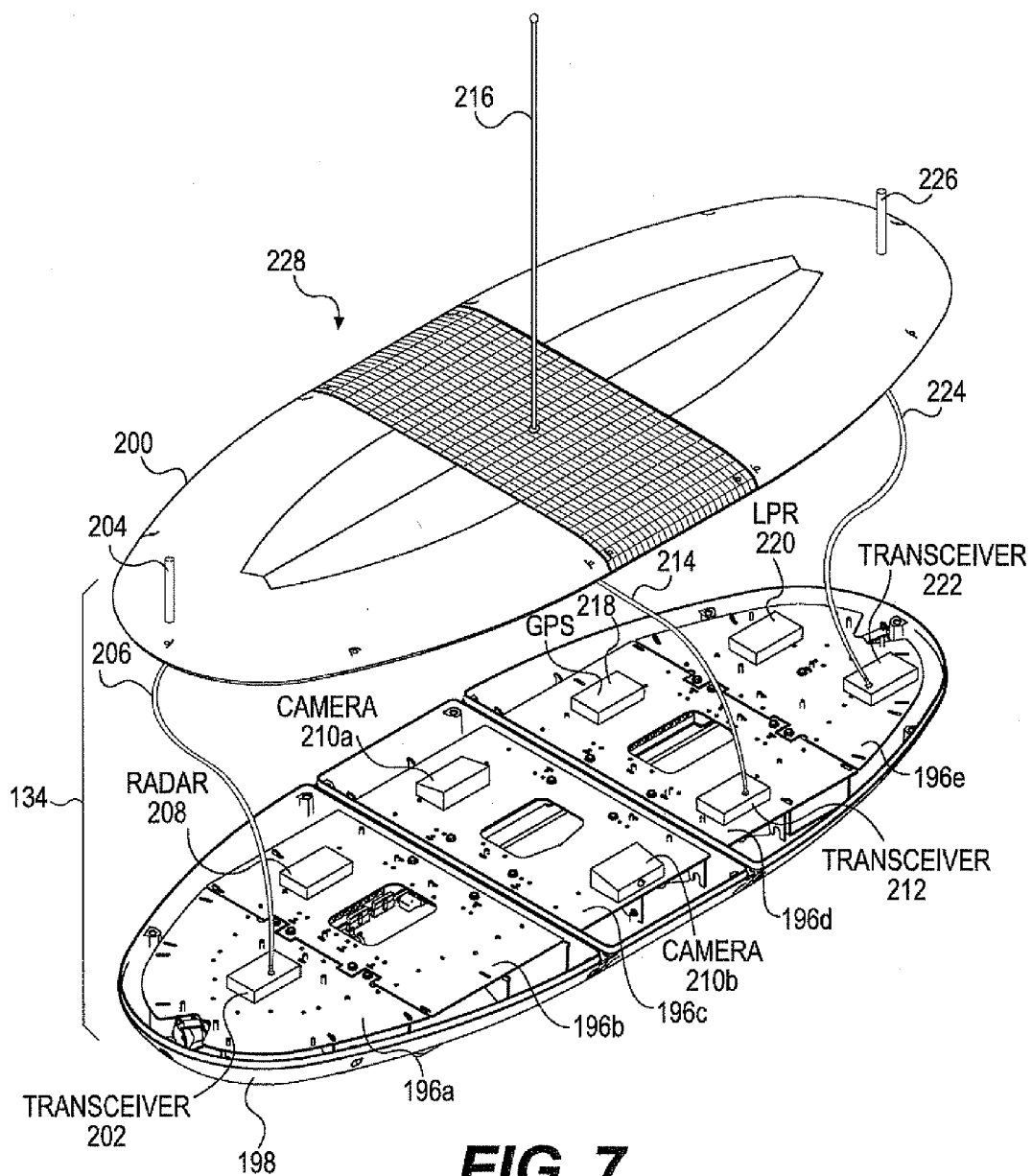
**FIG. 5**

**FIG. 6A**

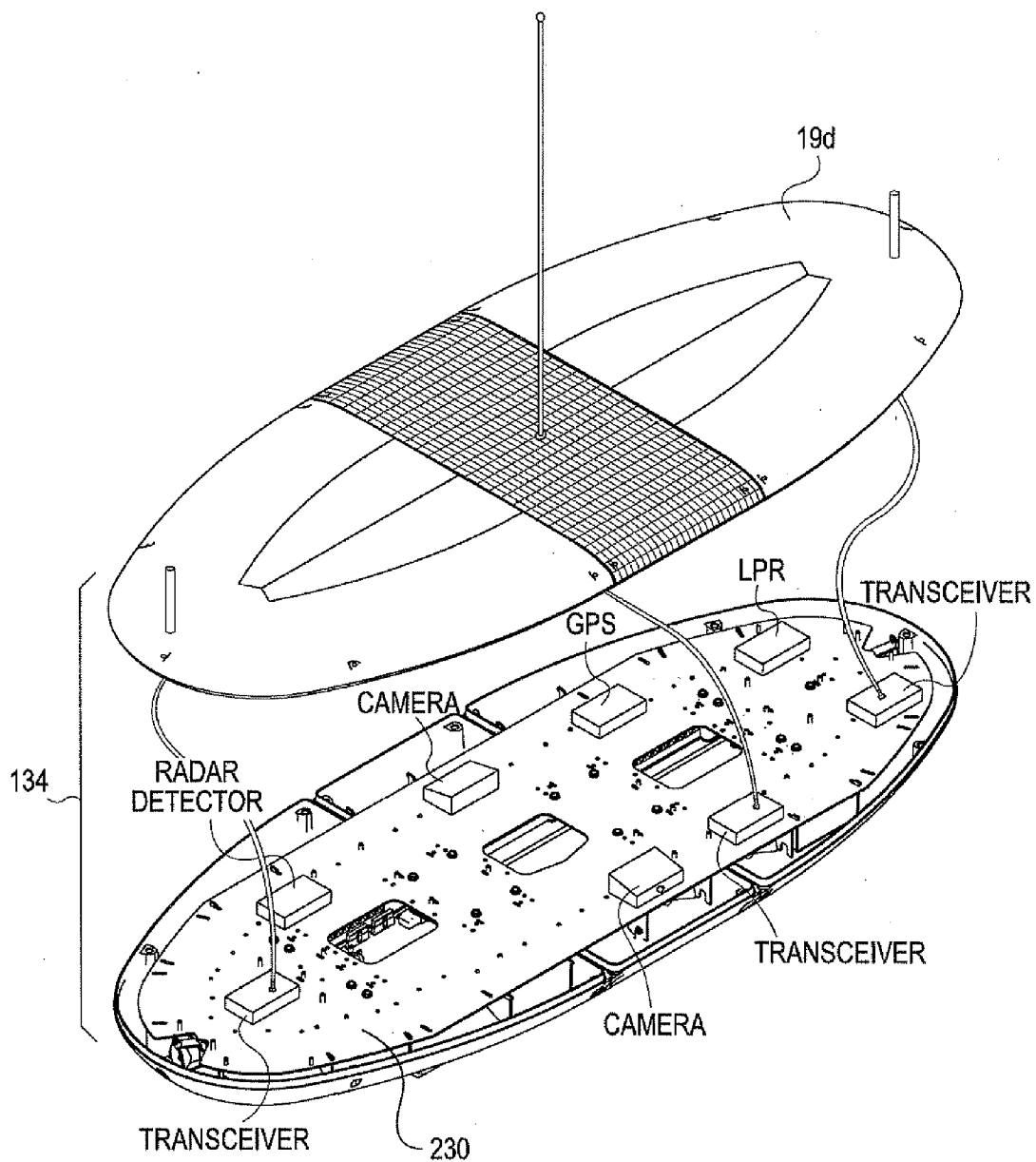


**FIG. 6B**

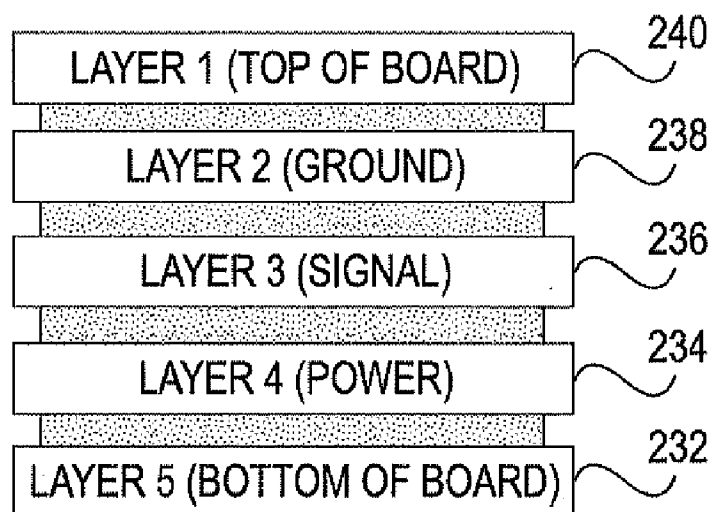




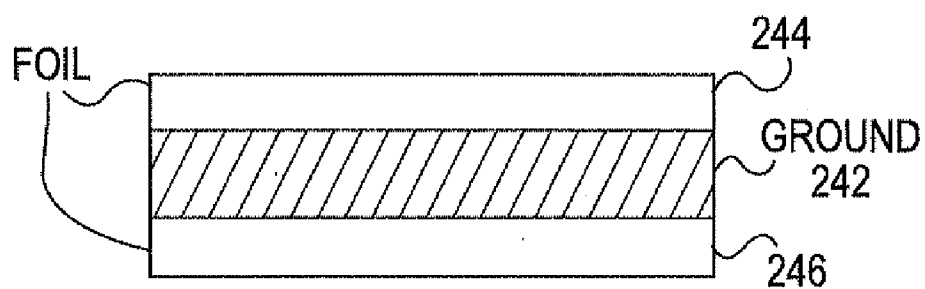
**FIG. 7**



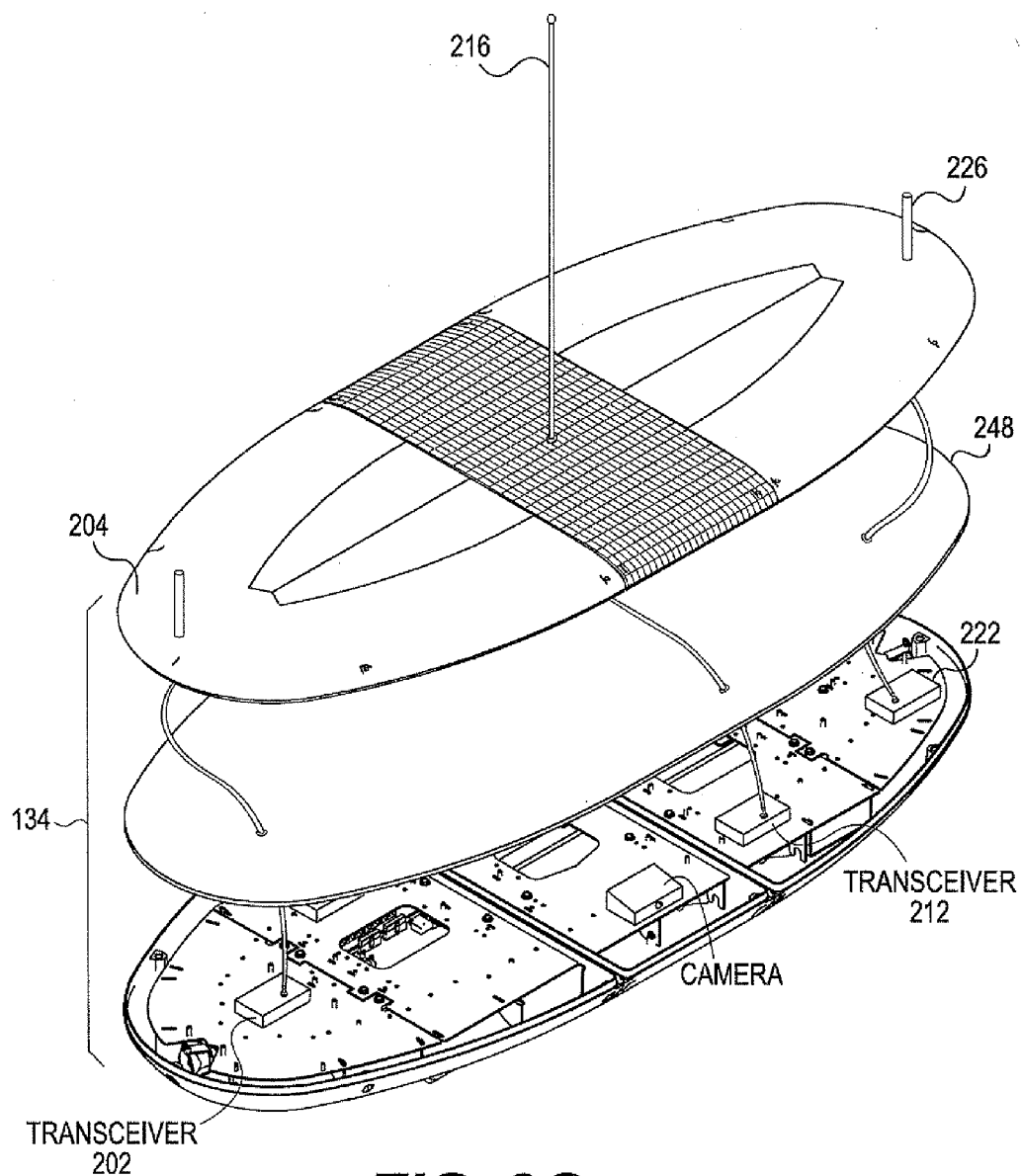
**FIG. 8**



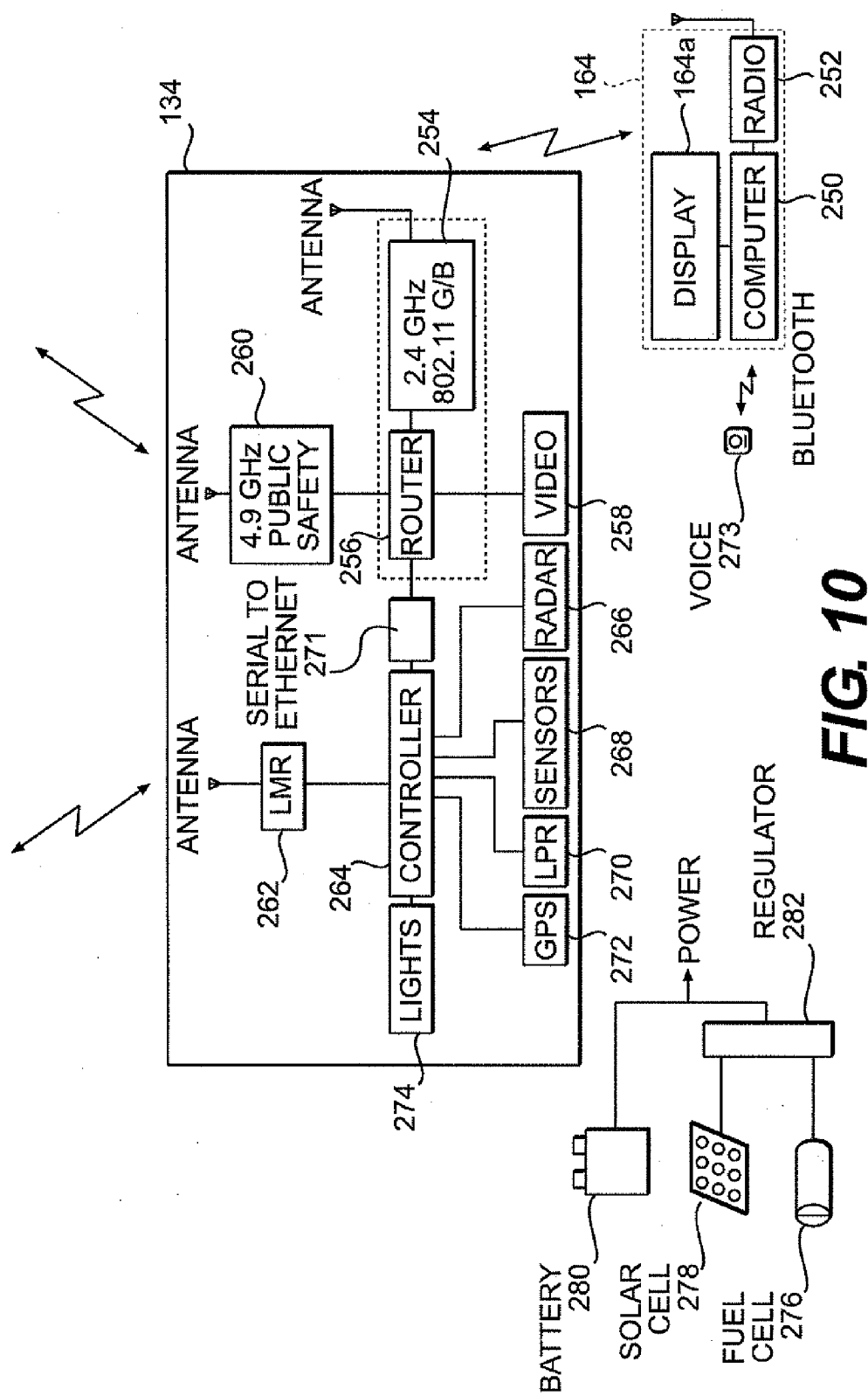
**FIG. 9A**



**FIG. 9B**



**FIG. 9C**



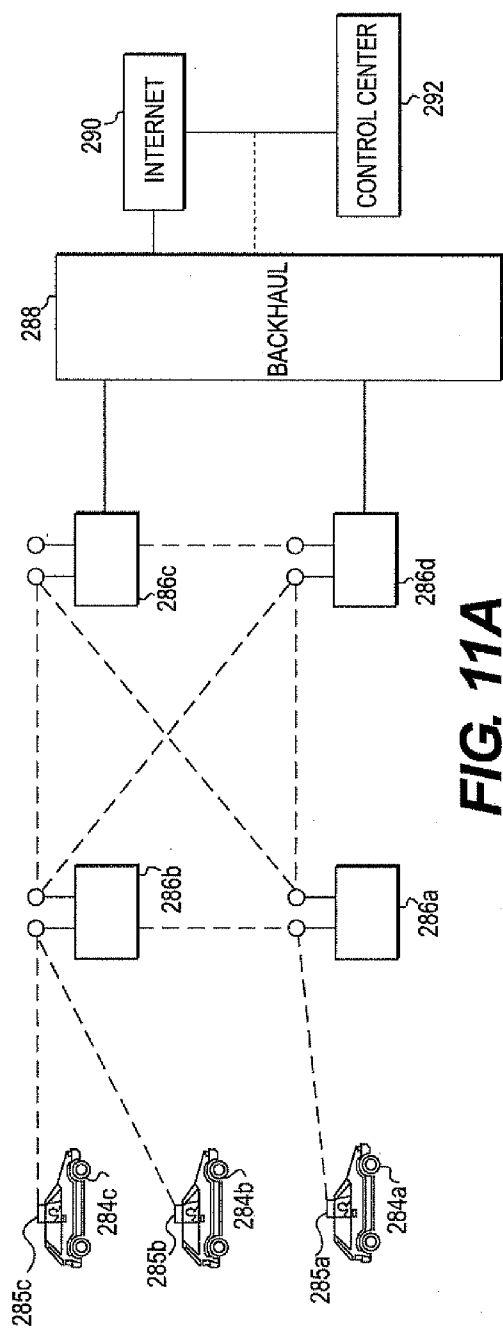


FIG. 11A

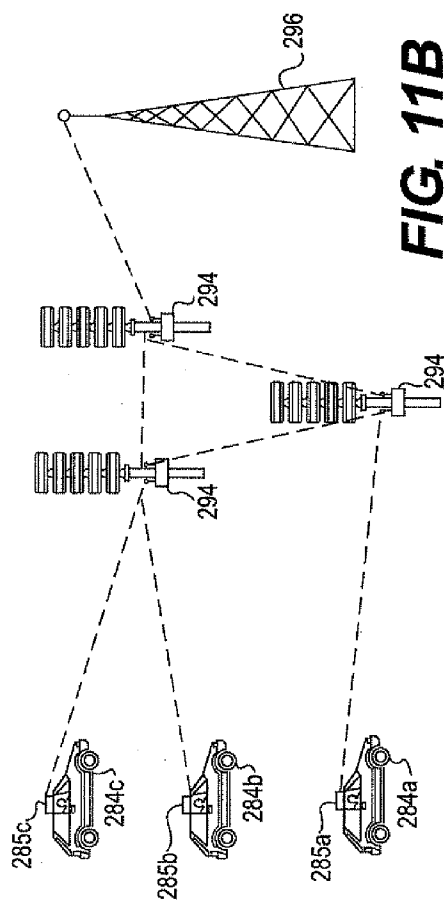
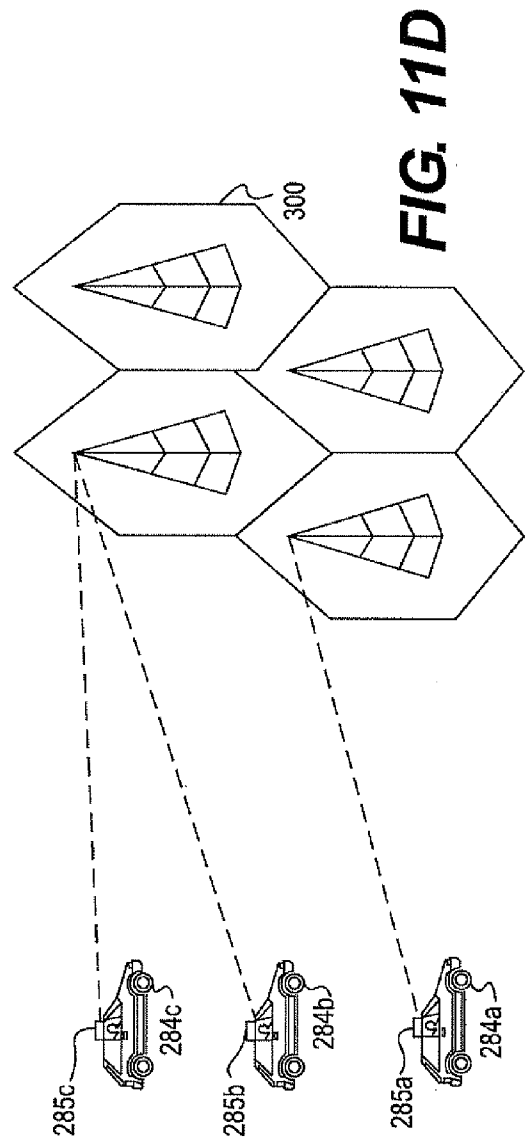
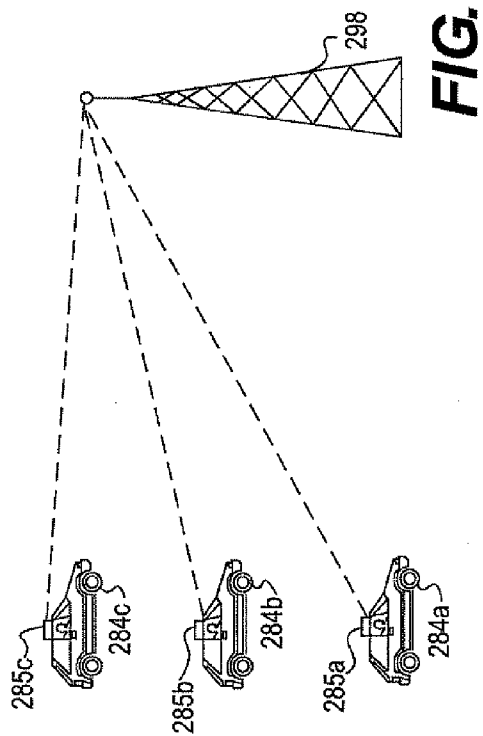


FIG. 11B



**FULLY INTEGRATED LIGHT BAR****CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application is a continuation-in-part of copending U.S. patent application Ser. No. 11/394,752, filed Mar. 31, 2006, and Ser. No. 11/505,642, filed Aug. 17, 2006, which are hereby incorporated by reference in their entirety for everything that they describe. Additionally, this patent application claims the benefit of U.S. Provisional Patent Application No. 60/775,634, filed Feb. 22, 2006.

**BACKGROUND OF THE INVENTION**

[0002] Typical emergency response vehicles have many different systems for monitoring and responding to various situations and emergencies. For example, the vehicles are equipped with communications equipment that includes both voice and data generating devices such as radios and computers. This and other electronic equipment (e.g., controls for devices such as light bars) crowd the interior space of the vehicle, which is not designed for this concentration of electronics.

[0003] It is extremely difficult to equip the vehicles with all of the needed communications, monitoring, and response equipment. Standard commercial vehicles are retrofitted with this equipment through a labor-intensive process. Retrofitting the vehicles is often an iterative process, as new equipment replaces old. Advances in equipment allow first responders to perform their jobs more safely and efficiently. However, each time equipment advances, vehicles must again be retrofitted. Furthermore, when the vehicle is no longer used by emergency services, the equipment must be removed from the vehicle through another costly, labor-intensive process.

[0004] In addition to systems for detecting and responding to emergencies, vehicles must be equipped with various communications systems. For example, in the United States public safety officials including fire departments, police departments and ambulance services primarily use communications systems that work within the VHF and UHF bands. Conventional land mobile radios operate on these and other frequencies. Cellular networks, which operate in the UHF frequency band, are also used for public safety communications systems for both data and voice communications. More recently, the SHF band, such as the 4.9 GHz band reserved by the United States Federal Communications Commission (FCC), have been included in public safety communications systems. Moreover, within these several frequency bands, there are a number of communications standards, such as the IEEE 802.11 protocol, utilized to transmit data. Many other frequency bands and communication protocols are used by emergency service personnel around the country. In order to ensure reliable communications across public safety agencies, vehicles are often now equipped with still further electronics that enable public safety personnel to communicate over several transmissions protocols and/or frequency bands. All of the radios and communications equipment results in a cluttered environment.

[0005] As technology evolves and finds applications in the area of public safety, emergency response vehicles increasingly carry more equipment to detect and respond to count-

less situations and emergencies. Typically, individual systems are installed in the vehicle for each of the tasks aimed at emergency responses. For example, a police vehicle monitors traffic using a radar detector. Cameras mounted in an emergency vehicle gather evidence. Many emergency vehicles have light bars mounted to their roofs. Sirens warn citizens of danger. GPS systems inform a control center of the vehicle's location. Vehicles may contain equipment to detect bio-hazards or chemicals in the event of an industrial spill or terrorist attack. Countless other systems are installed in emergency vehicles based on expected situations. This trend can only be expected to continue.

[0006] Emergency vehicles are often equipped with emergency lighting equipment that draw attention to the vehicles and provide visual warning to citizens. Typically this equipment includes flashing or rotating lights, which generating a considerable amount of electromagnetic noise. Because of the noisy environment and to assist in visibility, the emergency lighting equipment is most often housed in a module commonly called a "light bar" mounted to a roof of the emergency vehicle. Installing the emergency light equipment in a light bar lessens the effect the electromagnetic noise has on the operation of sensitive telecommunications equipment inside the vehicle.

[0007] Installing in emergency vehicles all of this communications, detection and response equipment is costly and labor intensive. All of it is retrofitted into a vehicle manufactured without any accommodation for this special purpose equipment. Some of the equipment, such as radar units and cameras are typically mounted to the front edge of the interior of the roof such that the radar unit and/or the camera extend downwardly to provide views through the front windshield. Power cables are routed from this equipment to the vehicle's power system through the roof lining and down one of the side posts of the car, separating the front and rear car doors, and then to a controller unit, which is located in the trunk, engine compartment or even under a seat in the interior of the vehicle. Many emergency vehicles are equipped with light bars mounted on the roofs of the vehicles. Power and control cables for the light bars are also fished through the side posts and routed to the trunks of the vehicles or to the engine compartments of the vehicles. These cables are fished through the side pillar of the vehicle separating the front and rear doors. Communications antennas are mounted on the roof and on the trunk. Holes are drilled in the car to attach the antennas. Again, cables are routed to a controller in the trunk of the vehicle. Finally, each piece of equipment is wired to controllers in the vehicle's cabin. There are numerous other systems that are regularly installed in emergency vehicles. As technology advances, new devices must be incorporated into emergency vehicles. This requires taking the vehicle out of service for an extended period of time as older devices are removed from the vehicle and newer devices are installed.

[0008] By their nature, emergencies often require deployment of more emergency equipment than normally in use at any given time. Communities must determine how best to provide for emergency situations that may require quick deployment of additional equipment. Typically, communities rely on resources from neighboring communities. This strategy works as long as the neighboring communities are close by and not affected by the same emergency. For



emergencies that affect large areas, however, relying on neighboring communities to loan their resources is not a workable strategy.

[0009] For example, neighboring communities may face a common emergency such as a hurricane, a terrorist attack or an earthquake. In these types of emergencies, the effected communities will need additional emergency vehicles that are not available from nearby neighboring communities. Moreover, because of the labor intensive and costly installation process, non-emergency vehicles cannot be quickly converted for emergency use. Furthermore, existing emergency vehicles may not have the best combination of equipment for dealing with a particular disaster. The time-consuming installation process prevents vehicles from being quickly adapted to respond to an emergency condition that the vehicle is otherwise not equipped to handle.

[0010] After a vehicle is no longer needed by public safety agencies, it is typically sold in the aftermarket. However, all of the communications systems and emergency equipment must be removed from the vehicle before sale. If the vehicle is to be resold at maximum value, the damage to the vehicle done during the process of retrofitting the emergency equipment must be repaired. For example, any holes drilled into the vehicle during installation of the equipment must be patched. The dashboard most likely needs to be repaired because of holes drilled in it to run wiring, mount devices and control units. All of this repairing is expensive and reduces the resale value of the vehicle, which represents a substantial amount of lost revenue to communities.

[0011] Another problem facing first responders is the lack of a unified communications network for transmitting voice and data. For example, different police departments responding to the same emergency affecting several communities may use different radios. Furthermore, live video taken from one vehicle at the scene of an emergency is not available to other vehicles responding to the emergency. Current attempts to solve communications problems result in even more equipment and radios being installed into vehicles.

#### BRIEF SUMMARY OF THE INVENTION

[0012] A fully integrated light bar is provided that not only houses emergency warning lights, but also houses emergency devices such as telecommunications equipment and community monitoring equipment. In one embodiment, all of the emergency equipment that might otherwise be housed in the interior of the vehicle is housed in the light bar so that a vehicle can be easily and quickly retrofitted. In order to avoid fishing wiring from a control head mounted in the interior of the vehicle to the equipment in the light bar, the connection between the control head and the light bar is preferably a wireless connection. All wiring is avoided if the light bar includes its own source of energy such as a fuel cell, solar cell and/or a battery.

[0013] In one embodiment of the invention, the light bar contains a number of modules for sensing real time conditions of the vehicle, its operator and the ambient environment of the vehicle and operator. Example modules include a video camera, a radar unit, a GPS unit, a biological agent sensor and a license plate recognition system. Preferably, the light bar is designed to allow for the custom fitting of modules, thereby enabling a light bar to be equipped with any combination of modules best suited for an application.

[0014] In one embodiment of the invention, the light bar houses at least one transceiver for communicating information gathered from sensors (preferably also in the light bar) over a wireless network. In order to enable real time communication of information demanding high data rates, the transceiver is a broadband device such as a Wi-Fi transceiver. Broadband transceivers allow for real time transmission and reception of information such as video feeds and detailed maps of buildings.

[0015] In one embodiment of the invention, data from the modules are transmitted over a wireless network to a control center where the data is reviewed and analyzed for activating or informing or otherwise marshalling community resources. Further, information may be transmitted from one fully integrated light bar equipped vehicle to other such vehicles to assist in responding to or monitoring emergencies. These and other embodiments of the invention will be more fully explained in the detailed description of the invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a schematic representation of an emergency warning device, such as a light bar, integrated into a broadband community wireless network.

[0017] FIGS. 2A and 2B illustrate a the emergency warning device of FIG. 1 integrated into a light bar with a wireless connection to a broadband network and a wired or wireless connection to a control head within a vehicle (FIGS. 2A and 2B, respectively).

[0018] FIG. 3 illustrates a control interface at a mobile data terminal for controlling modules comprising the emergency warning device.

[0019] FIG. 3A illustrates a user interface at the mobile data terminal for controlling a video camera mobile of the emergency warning device, where the user interface is accessible from the control interface.

[0020] FIG. 4 illustrates a lower portion of a housing for the light bar in FIGS. 2A and 2B including a controller and a fuel cell.

[0021] FIG. 5 is a sectional view of the lower portion of the light bar taken along line 3a-3a in FIG. 4

[0022] FIG. 6A illustrates one of several circuit boards in the light bar fitted with warning light assemblies.

[0023] FIG. 6B illustrates the opposite side of the circuit board in FIG. 6A, showing various modules mounted on the circuit board in keeping with one embodiment of the invention.

[0024] FIG. 7 illustrates an embodiment of the light bar in FIGS. 1-6 with the top half of the light bar's housing exploded away to reveal an interior space of the light bar populated with various electronic modules and antennas supported on circuit boards in keeping with the illustration in FIG. 6B.

[0025] FIG. 8 illustrates an alternative embodiment of the light bar in FIGS. 1-6 with the top half of the light bar's housing exploded away as in FIG. 7 to reveal an interior space of the light bar populated with various electronic modules and antennas supported on a single monolithic circuit board.

[0026] FIG. 9A illustrates a cross sectional view of a circuit board suitable for use as the circuit board in FIGS. 7 and 8 whose ground plane when placed in the light bar creates an area within the light bar that is relatively free of stray electromagnetic radiation from the operation of the warning lights.

[0027] FIG. 9B illustrates a cross sectional view of an alternative circuit board also suitable for use as the circuit board in FIGS. 7 and 8 whose ground plane when placed in the light bar creates an area within the light bar that is relatively free of stray electromagnetic radiation from the operation of the warning lights.

[0028] FIG. 9C illustrates an embodiment of the light bar in FIGS. 1-6 where a grounding plane within a light bar and separate from the circuit board(s) for supporting the warning lights provides isolation from the electromagnetic spray of the warning lights.

[0029] FIG. 10 is a schematic diagram of the electronic modules in one embodiment of the light bar.

[0030] FIG. 11A is a schematic illustration of a wireless wide area network including a wireless mesh network connecting fully integrated light bars such as those illustrated in FIGS. 1-10 to a control center.

[0031] FIG. 11B is a schematic illustration of a wireless wide area network including a wireless mesh network and a wireless point to multipoint network connecting fully integrated light bars such as those illustrated in FIGS. 1-10 to a control center.

[0032] FIG. 11C is a schematic illustration of a wireless wide area network including a point to multipoint network connecting fully integrated light bars such as those illustrated in FIGS. 1-10 to a control center.

[0033] FIG. 11D is a schematic illustration of a wireless wide area network including a cellular network connecting fully integrated light bars such as those illustrated in FIGS. 1-10 to a control center.

[0034] While the following detailed description is made in connection with preferred and alternative embodiments referencing the drawings, the description is not intended to limit the invention to those particular embodiments. On the contrary, the invention is intended to cover all alternatives and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

#### DETAILED DESCRIPTION OF THE INVENTION

[0035] The following description is intended to convey the operation of exemplary embodiments of the invention to those skilled in the art. It will be appreciated that this description is intended to aid the reader, not to limit the invention. As such, references to a feature or aspect of the invention are intended to describe a feature or aspect of an embodiment of the invention, not to imply that every embodiment of the invention must have the described characteristic.

[0036] Turning to the drawings and referring first to FIG. 1, an emergency device 102 is in wireless communication with a mobile data terminal 164, a base station 106 and an outdoor warning siren 108. The emergency device 102

contains a number of monitoring, warning and response systems as needed based on its deployment. For example, in one embodiment of the invention, the emergency device 102 is attached to a police vehicle. When it is attached to a police vehicle, the emergency device 102 likely includes modules otherwise located in the vehicles interior spaces. For example, in the illustrated embodiment of FIG. 1, the device includes (1) a video camera 120 for streaming video signals to displays that may be both in the vehicle and at remote locations, (2) a radar unit 110 for detecting the speed of other vehicles, (3) a sensor 112 for detecting the presence of chemical or biological agents, (4) a global positioning system ("GPS") 114 providing the location of the emergency device, and (5) a license plate recognition system ("LPR") 116 providing the license plate number of vehicles in the vicinity. In the illustrated embodiment, each of the modules 110-116 interfaces with a controller 118. Video camera 120 provides video footage (e.g., streaming video) of an area near the emergency device 102. The video camera or module 120 connects to controller 118 or router 122 for routing the video to either an onboard storage or display at the mobile data terminal 164 or routing the video to a remote terminal by way of the base station 106 or a transceiver associated with the outdoor warning siren 108. The outdoor warning siren 108 connects to a wide area network ("WAN") 109. The WAN may be a public network such as the internet or a private network reserved for emergency use. The outdoor warning siren 108 connects directly to the network 109 or connects through a gateway device.

[0037] The emergency device 102 also includes several wireless network devices. For example, the emergency device 102 also includes a land mobile radio ("LMR") 124 for communicating with other emergency service personnel over a variety of frequencies including the UI-IF and VHF bands. A voice over Internet Protocol ("VoIP") module 126 of the emergency device 102 allows a user of the device to transmit and receive voice messages over standard data networks such as a network based on the IEEE 802.11 standard. A wireless fidelity ("Wi-Fi") module 128 transmits and receives data over an IEEE 802.11 network. A transceiver 130 implements a public safety radio operating at the 4.9 GHz frequency, which the United States Federal Communication Commission (FCC) has dedicated to public safety applications.

[0038] Finally fuel cell 132 the emergency device 102 provides power for the emergency device 102. Preferably, the fuel cell is incorporated in the emergency device 102 as suggested by the illustration in FIG. 1. By providing a power source within the emergency device 102, the device is fully self contained and can be easily and quickly retrofitted onto any vehicle.

[0039] Although FIG. 1 depicts three transceiver modules, the LMR 124, Wi-Fi 128 and the public safety radio 130, one skilled in the art of telecommunications will appreciate that any appropriate wireless standard may be used to enable communication between the emergency device 102 and remote locations. For example, a cellular transceiver for connection to cellular data or voice networks may be included in the emergency device 102. In general, any number of transceiver types may be employed in the emergency device 102. For example, one Wi-Fi transceiver 128 may provide all necessary communication links. Data signals can utilize the Wi-Fi link and voice may pass over the

Wi-Fi link using Vol. On the other hand, a number of specialty transceivers may be employed in the emergency device **102** in order to ensure a more robust communications environment. Embodiments of the emergency device **102** will be more fully described below.

[0040] Emergency signaling systems of the type mounted to the roofs of emergency vehicles are commonly called “light bars” because they are typically shaped as bars traversing the roofs of vehicles. In keeping with this convention, in FIG. 2A and FIG. 2B the illustrated emergency signaling system **134** is hereinafter referred to as a “light bar” since it is primarily intended for mounting to the roofs of emergency vehicles such as the roof **136** of the illustrated vehicle **138**. However, those skilled in the art of emergency warning device will appreciate that the device described hereinafter as a light bar can take on a variety of shapes and placements throughout a community as the need arises. In one embodiment of the invention, emergency device **102** is integrated into light bar **134** for a vehicle. The emergency device could be mounted to other types of mobile units such as boats and aircraft. Furthermore, the emergency device **102** could also be mounted to stationary objects such as a commercial or residential building in order to convert the building to a temporary emergency command center. In any event, details of the emergency device **102** are set forth below in connection with an embodiment in which the device is the light bar **134** for mounting to the vehicle **138**.

[0041] In keeping with one embodiment of the emergency device, the light bar **134** in FIGS. 2A and 2B connects wirelessly to a back haul network **140**, a public safety network **142** and a public access network **144**. In FIG. 2A, the light bar **134** is wired to the vehicle’s power system **146** through cables **148**. A control head **150** in the passenger compartment of the vehicle **138** allows an occupant in the vehicle to control the lights and modules **110-130** in the light bar **134**. The control head **150** connects to control unit **152** through wires **154** in order to communicate control signals to the modules **110-130** in the light bar **134**. The control unit **152** in the illustrated embodiment provides control functions for other emergency signaling apparatus associated with the vehicle **138**. For example, the control unit **152** may also serve a siren. The operator of the vehicle **138** preferably mounts the control head **150** to the dashboard/instrument panel area **156** to the right of the steering wheel **158** for easy access. Although the control unit **152** is depicted mounted in the trunk of the vehicle, it may be mounted elsewhere within the vehicle. For example, control unit **152** may be mounted under the dashboard area **156**.

[0042] Keystrokes to a keypad incorporated into the control head **150** generate control signals and the control head provides the signals to the control unit **152** by way of cables **154**, which in turn communicates signals to the control unit **160** (FIG. 4) within the light bar **134** by way of cable **162**. A control system such as Federal Signal’s Smart Siren™ system is a suitable example of the illustrated control system for certain embodiments of the invention.

[0043] In FIG. 2B, the light bar **134** is in wireless communication with a mobile data terminal (“MDT”) **164**, enabling the light bar to be completely free of external wiring if the power source (e.g., fuel cell and/or solar cell) is contained in the light bar. The MDT **164** replaces the control head **150** in FIG. 2A and controls the lights and

modules **110-130** in the light bar **134**. MDT **164** may be a conventional laptop computer equipped with a wireless network interface card (NIC). Preferable as explained hereinafter, the MDT **164** includes a touch screen **164a** allowing the user to interact with the light bar by simply touching appropriate areas of the screen as prompted by a user interface displayed on the screen.

[0044] Any appropriate wireless standard can be used to connect the MDT **164** and the light bar **134**. Examples of appropriate standards include Wi-Fi a, b, g, or n as defined by the Institute of Electrical and Electronics Engineers (“IEEE”) in the 802.11 specification. Additionally Bluetooth, Wireless USB or Zigbee, which are all based on IEEE 802.15, can be used as the standard between the MDT **164** and the light bar **134**. A user controls the system by entering commands into the MDT **164**. Commands are entered into the MDT through any appropriate means including use of a keyboard, touch screen **164a** or voice recognition software. Commands entered into the MDT are transmitted to the light bar **134** via the wireless network. The MDT **164** can display information gathered by the modules **110-130** located in the light bar **134**. For example, in one embodiment of the invention live video from the video camera **120** is displayed on the screen **164a**. Speeds of passing vehicles detected by the radar unit **110** are displayed by the MDT **164**. Additionally, the MDT **164** displays the license plates of passing vehicles detected by the LPR **116** module.

[0045] FIG. 3 illustrates one embodiment of the interface for a touch screen **164a** integrated into the MDT **164**. The touch screen **164a** includes a LMR interface **171** that either replaces or is in addition to the standard radio controls already located within the vehicle for communicating with the LMR **124**. The interface **171** includes buttons on the touch screen **164a** for operating the land mobile radio (LMR) **124** in much the same manner as is accomplished with a conventional, dedicated control head for the LMR that includes mechanical knobs and switches. For example, the user interface **171** provides a volume control **173**, a SOS button **175**, a frequency control **177**, a push to talk control **179** and a squelch button **181**.

[0046] A light and siren interface **183** controls the light assemblies and siren mounted on a vehicle. The interface **183** includes a primary lights button **185**, a secondary lights button **187** and a flasher rear button **189**. A take down button **191**, right alley button **193** and left alley button **195** operate additional light assemblies. The display **197** indicates the mode that the light assemblies are operating in. Directional control **199** allows the operator to enable flashing directional lighting assemblies. Finally, siren control **201** enables various siren modes.

[0047] Module panel **203** displays the current readings for various modules **110-132** housed in the light bar. For example, the license plate recognition system display **205** indicates the license plate number of nearby vehicles. The radar **207** shows the speed of nearby vehicles. The OPS **209** shows a map with nearby emergency vehicles as well as the location of the occupied vehicle. The traffic video **211** shows live video feeds from traffic monitoring cameras located throughout a community. The air quality sensors **213** display information regarding community air quality. Clicking a sensor expands the sensor to a full screen mode. For example, if a user touches the traffic video display **211**, it will expand to fill the entire screen.

[0048] In another embodiment, the user interface of the touch screen **164a** may be similar to the user interface illustrated and described in co-pending U.S. patent application Ser. No. 11/505,642, filed Jun. 17, 2006 and entitled “Integrated Municipal Management Console,” which is hereby incorporated by reference in its entirety for everything it describes.

[0049] In order to control the devices in the module panel **203** of the user interface **164a**, selection of any of the icons **205**, **207**, **209**, **211** and **213** causes a dialog box or window to appear on the touch screen such as the one illustrated in FIG. 3A for the traffic video icon **211**. In FIG. 3a, the user interface **164b** may be a window or dialog box that appears over the user interface **164a** in FIG. 3. Alternatively, the user interface **164b** may appear in substitution for the user interface **164a**. In either event, the user interface **164b** presents to the user various controls for the video camera **120** in FIG. 1. The touch screen interface **164b** either replaces or is in addition to standard controls for the video camera **120**. The interface **164a** includes buttons on the touch screen **164b** for operating the video camera **120** in much the same manner as is accomplished with a conventional, dedicated control head for the camera, which includes mechanical knobs and switches. The video display **241** displays a live image from the camera **120** mounted in the emergency device **102** or from remote cameras whose signal is received over the network connection. Additionally, the video display **241** displays recorded images taken by the camera **120** or images recorded by another camera and made available for playback on the display **241**.

[0050] The user interface **164b** contemplates more than one camera **120** in the emergency device **102**. In this regard, the user interface **164b** includes touch buttons **243** and **245** for selecting front and rear cameras, respectively. A volume control **247** adjusts the audio volume associated with a video. The “rew” touch button **249** rewinds a recorded video segment. The “rec” touch button **251** toggles the record feature of the video camera **120** and MDT **164**. The play touch button **253** plays back recorded video. The stop touch button **255** stops video play back. The “FF” touch button **257** fast forwards recorded video. The zoom control **259** zooms in and zooms out of a video image. The pan/tilt control **261** rotates the video image up and down and left and right. The contrast touch button **263** and brightness touch button **265** control the contrast and brightness of the image, respectively. The image search interface **267** and audio search interface **269** allow a user to search for images and audio segments in stored video files.

[0051] Returning to the touch screen **164a** in FIG. 3, it includes buttons for accessing various computer programs and resources. For example, e-mail button **217** launches a user’s email program. Similarly, the Internet Explorer® button **219** launches Microsoft’s internet browser. The reports button **221** launches various reports or forms for reports maintained locally or at a remote server. One or more of the broadband wireless connections provides the link to the remote server. Maps button **223** launches mapping software, which presents maps to the user stored either locally or at a remote server. The traffic control button **225** launches a program whose interface enables the user to control traffic intersection lights. Touching the criminal records button **227** launches a program that enables access to criminal records stored either locally or at a remote server.

The building plans button **229** gives the user access to databases of building plans for various buildings stored either locally or at a remote server. Similarly, the medical records button **231** allows a user to search databases of medical records maintained either locally or at a remote server. The fire hydrants button **233** launches a program that displays the location of nearby fire hydrants. The virtual private network (VPN) client **239** provides a secure connection over otherwise public networks to the first responder’s server to access remote databases containing confidential information such as police records. While the VPN client button may allow for browsing of remote databases, the data sheets button **235** allows a user to search remote data sheets, which may contain information such as details of particular types of chemicals involved in a chemical spill. The procedures button displays procedures **237** for handling situations faced by first responders at a scene of an emergency. For example, a data sheet may provide guidance for dealing with a heart attack victim or how best to react to a water rescue.

[0052] Information such as voice and data signals sent over a wide area network (“WAN”) and received by one of the transceivers LMR **124**, Wi-Fi **128** or public safety **130** can be forwarded to the MDT **164** through the wireless connection between it and the light bar **134**. These messages can either be displayed on the MDT’s screen or audibly played over speakers either in the vehicle or in the MDT. Messages originating as voice signals can be play directly. Messages originating as data signals can be converted to voice signals by use of commercially available text-to-speech software and played audibly over speakers in the vehicle.

[0053] In one embodiment of the emergency device **102**, a transceiver sends and receives messages encoded in data packets, an exemplary one of which is illustrated below. The data packet includes a header with information indicating the beginning of a packet. An encryption section contains information related to the encryption of the packet. An address section may contain items such as the emergency device’s IP address and MAC address and the packet’s destination IP address and MAC address. The data section contains the packet’s payload. The payload includes the data to be transmitted. One skilled in the art of communications will recognize that data packets may consist of various fields and are not limited to the specific fields recited. For example, the data format may be TCP/IP based and include IEEE 802.1x compatibility.

Header	Encryption	Address	Payload
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[0054] FIG. 4 depicts a lower portion of the light bar **134** whose top half is best seen in FIGS. 7 and 8. From the controller **160** in FIG. 4, the operation of the light bar modules are directly controlled in accordance with signals generated at the control head **150** or MDT **164**. Installers of the light bar **134** typically strategically place cables **154** and **162** (FIG. 2A) within the interior of the vehicle **138** so they are the least conspicuous and require the least modification of the standard interior features. In this regard, serial connections among the control head **150**, the control unit **152** and the controller **160** in the light bar **134** minimizes the number of wires comprising the cables **154** and **162**. Each of

the two cables **154** and **162** includes two data-carrying wires for bi-directional serial communications. Separate cabling from a battery **146** carries power and reference ground wires to the control units **152** and **160**, which in turn deliver the power to the modules in the light bar **134**. In an alternative embodiment illustrated in FIG. 2B, the control signals are electromagnetic signals that propagate through the air so that the cables are not needed for controlling the light bar **134**. In a further alternative embodiment also illustrated in FIG. 2B, the cables **154** and **162** are entirely eliminated by providing one or more power sources in and/or on the light bar **134**.

[0055] In the illustrated embodiment, the controller **160** is mounted to the lower housing of the light bar **134**. However, the controller **160** can be placed anywhere within or near the light bar **134**. The electrical connection between the controller **160** and the modules is described hereinafter in connection with the illustration of FIG. 10. Looking at the lower portion of the light bar **134** depicted in FIG. 4, a channel **162** receives a fuel cell **165** for providing power to the modules **110-132** and warning lights (e.g., light emitting diodes, strobes and/or halogens) housed within the light bar. With both the fuel cell **165** and a wireless connection between the light bar **134** and the MDT **164**, the light bar is mounted to the vehicle **138** without the need to run any wiring **148**, **162** and **154** through the vehicle. Thus, the light bar **134** is easily installed on the roof **136** and the MDT **164** is easily installed in the interior of the vehicle **138**.

[0056] Various known fastening systems may be used to secure the light bar to the roof **136** of the vehicle **138**. For example, Federal Signal Corporation's U.S. Pat. No. 6,966,682 provides one exemplary means of attaching the light bar **134** to the vehicle **138**. U.S. Pat. No. 6,966,682 is hereby incorporated by reference in its entirety and for everything that it describes. The MDT **164** can be powered by the battery **146** or it can operate from power provided by a fuel cell or solar panels.

[0057] The channel **162** containing the fuel cell **166** can better be seen in FIG. 5, which is a cross sectional view of FIG. 4 taken along the 3a-3a. The fuel cell **166** produces electricity from a fuel supply and oxygen. A typical fuel cell uses hydrogen and oxygen as reactants on the anode side and cathode side, although other fuels may be used. Suitable fuel cells are commercially available from a number of companies such as Adaptive Materials, Inc. of Ann Arbor Mich. and CellTech Power LLC of Westborough Mass. In addition to or as an alternative to fuel cells, channel **162** can house batteries for internally powering the light bar lights and modules **110-132**.

[0058] In one embodiment of the light bar **134**, several, large area circuit boards provide the platform support for the warning lights in the light bar. One of the circuit boards **168** is depicted in FIG. 6A and FIG. 6B. Preferably, the circuit board is composed of a composition that maintains its structural and electrical integrity over the ambient conditions of the light bar **134**. In this regard, the light bar **134** is directly exposed to weather conditions in the area it is placed in service, which can include both hot and cold weather extremes. Also, some of the types of the light beam assemblies and modules **110-132** have attributes that may impose additional requirements on the circuit board. For example, some light beam assemblies produce significant amounts of

heat, making the heat sinking capacity of the circuit board an important characteristic. Specifically, light emitting diodes (LEDs) require adequate heat sinking support in order for the LEDs to operate at their greatest efficiency. In addition, some of the modules contain sensitive electronics, which require environments relatively free of electromagnetic interference such as the electromagnetic spray generated by the light modules, power source and other modules in the light bar **134**. In addition, the printed circuit board is a structural component in the light bar assembly in that it provides a platform for supporting the modules in addition to the warning light assemblies.

[0059] Given the foregoing considerations and requirements, suitable circuit boards for the invention presently available include but are not limited to the following: Fiberglass, phenolic, aluminum (e.g., Berquist boards), steel and ceramic printed circuit board materials. Regardless of the specific composition, the boards need to be structurally robust to environmental conditions that include temperature cycling over an expected wide range that the light bar will be exposed to wherever it is operating. Some specific examples of aluminum products and sources of suitable boards are ELPOR™ by ECA Electronics of Leavenworth, Kans. and Anotherm™ of TT Electronics PLC of Clive House **12-18**, Queens Road, Weybridge Surrey KT13 9XB, England. Moreover, conventional fiberglass-based circuit boards may also provide a basic build block for a suitable board. Multi-layered fiberglass boards by M-Wave™ of Bensenville, Ill. can provide the necessary structural strength and they can be fabricated to have the desired thermal properties by incorporating large ground and power planes into the board and multiple "pass throughs" or "vias."

[0060] Turning to FIG. 6A, an exemplary embodiment of a circuit board **168** in keeping with the invention includes four areas or stations **170a**, **170b**, **170c** and **170d** for fastening light beam assemblies **172** to the board **168**. Each of the areas **170a-170d** includes connections for various light beam assemblies **172** illustrated in FIG. 6A. One skilled in the art of emergency lighting will recognize that many types of warning light assemblies can be installed on the circuit board. Appropriate examples include, but are not limited to light emitting diodes ("LEDs") and halogen warning light assemblies. Further, the assemblies can be in a fixed orientation or may be capable of oscillating. The warning light assemblies in FIG. 6A include six (6) LEDs collectively identified as **174** and a reflector **176**.

[0061] The LEDs **174** are laid down on the circuit board **168** as part of the board's fabrication process. In this regard, the circuit board **168** includes conductive paths leading from a connector **178** mounted along an edge of an opening in the board. As discussed in further detail hereinafter, the connector **178** mates with a connector **180** of a cable **182** that has an opposing end connected to the controller **160**. The cable **182** carries power and control signals to the board **168**. Electrical lead lines in the circuit board **168** carry power and control signals to the electronic components (e.g., drivers) and LEDs **174** and to all other types of light beam assemblies and modules on the circuit board **168**.

[0062] FIG. 6B illustrates the opposite or second side of board **168** shown in FIG. 6A. Light assembly **172** is visible on the bottom of the board **168**. The illustrated embodiment depicts four modules mounted on the board. The video

camera **184** provides video surveillance of an area near the light bar **134**. For example, the video camera may be an Axis **211** network camera by Axis Communications AB, Emdalavägen 14, SE-223 69, Lund, Sweden. The Wi-Fi transceiver **186** provides wireless network connectivity to IEEE 802.11 compatible networks. An example of the Wi-Fi transceiver is a HotPort 3100/PS, which is a multi-spectrum transceiver capable of operating in the IEEE 802.11 2.4 GHz and 5.0 GHz bands and in the 4.9 GHz public safety band. The HotPort 3100/PS is a wireless mesh network node suitable for broadband data, video, and voice (VoIP) communication. The HotPort 3100/PS is available from Firetide, Inc., 16795 Lark Ave., Suite 200, Los Gatos, Calif. 95032. Appropriate network configurations will be discussed hereinafter with reference to FIG. 10. The OPS unit **188** provides the location of the emergency device **102** as currently depicted in a light bar **134**. Appropriate GPS units are available from One Track, Inc. of Phoenix, Ariz. The LPR unit **190** provides the license plate numbers of nearby vehicles. An example of appropriate LPR unit **190** is AutoFind available from Autovu Technologies, Inc. of Montreal, Quebec.

[0063] A wide variety of modules can be mounted on the board **168** in various configurations in order to perform monitoring and response activities. The cable **180** provides control signals, data signals and power from the controller **160** for the modules **184-190**. Each of the modules **184-190** can be soldered directly to the board **168**, or may be fitted with a plug that is received by a socket on the board. By constructing the modules and circuit board **168** with a plug and socket arrangement, the combinations of modules in the light bar **134** are variable and amenable to customization to fit any desired configuration. In fact, for a fully integrated light bar **134** in which the power supply is contained in the light bar, any combination of modules can be easily and quickly placed into the circuit board **168** and the light bar attached to a vehicle so as to provide a light bar that best serves the requirements of a particular emergency condition requiring the vehicle to be retrofitted and put into emergency service.

[0064] The electrical connections from a module to the board **168** may be made through the socket, by direct connection or through use of a cable. For example the Wi-Fi module **186** is depicted with a direct connection to the board **168**. In contrast, the GPS module **188** is depicted connecting to the board **168** via a cable **192** connected to a plug **194** on the circuit board. In general, each of the modules can use any appropriate connection method of connecting to the board. Additionally, modules do not have to be mounted to a board **168** at all, but may be mounted directly to the light bar **134**. Finally, the emergency device **102**, comprising various modules **110-132**, does not have to take the form of a light bar. For example, the emergency device **102** may be built into a body of a vehicle designed for emergency services such as fire trucks and ambulances. The device may be in an undercover police vehicle. Other public service vehicles such as street sweepers may also incorporate the emergency device **102**. Still further, the device can be integrated in to stationary platforms such as emergency sirens mounted to poles distributed through a community. The devices may also be equipped with portable platforms that allow the devices to be deployed as needed for any special circumstances.

[0065] In the fully populated light bar **134** depicted in FIG. 7, the lower housing **198** of the light bar houses five (5) circuit boards **196a**, **196b**, **196c**, **196d** and **196e** of the type illustrated in FIGS. 6A and 6B. The upper housing **200** is exploded away from the lower housing **198** in order to show the circuit boards mounted to the interior of the light bar **134**. The light assemblies **172** are mounted on the underside of the circuit boards **196a-196e** and are thus in the lower housing of the light bar. The transceiver module **202** mounted on circuit board **196a** provides wireless communications with a network such as a Wi-Fi network typically running at 2.4 GHz or 5 GHz. The transceiver **202** connects with antenna **204** thru cable **206** in order to broadcast and receive messages. In the illustrated embodiment, the antenna **204** is mounted to the housing of the light bar. However, the antenna **204** may alternatively be mounted to the circuit board and either fully enclosed within the housing or extending through a hole in the housing that includes a water tight seal. The radar module **208** provides the speed of nearby vehicles. Camera modules **210a** and **210b** provide video surveillance facing the front and rear of the light bar **134**. A second transceiver **212** acts as the land mobile radio (LMR). Cable **214** connects the transceiver **212** with the antenna **216**. GPS module **218** provides location information. LPR **220** provides the license plate number of nearby vehicles. Transceiver **222** connects to the public safety network, typically running at 4.9 GHz. The cable **224** connects the transceiver **222** to its associated antenna **226**. Each of the modules connects to its associated circuit board thru either a direct connection or a cable **192**. The circuit boards may connect directly to one another or may connect to the controller **160** thru use of a cable **180**. Any number or combination of modules may be utilized by embodiments of the light bar **134**, depending on expected uses of the emergency device **102**. Further, the modules depicted in FIG. 7 can be oriented in a variety of ways within the light bar **134** and the particular layout depicted in the figure represents only one embodiment. Referring to FIG. 8, in an alternative embodiment of the light bar **134** the circuit boards **196a-196e** in the embodiment of FIG. 7 are replaced with a single board-**230**. The circuit board **230** in FIG. 8 provides similar functionality to the circuit boards **196a-196e** in FIG. 7. Like the multiple boards of the embodiment in FIG. 7, the ground plane of the board **230** separates the interior space of the light bar into top and bottom sections. The electromagnetically noisy warning lights are contained in the bottom section of the light bar and substantially electromagnetically isolated by the ground plane from the sensitive modules mounted on the top surface of the board facing the top section of the interior space of the light bar.

[0066] In yet another embodiment of the light bar **134**, the upper housing **200** includes a solar panel **228** for providing power to the electrical device in the light bar. The solar panel **228** can be integrated into the upper housing **200** or separately attached to the housing. The solar panel **228** directly provides power to the light bar **134** or alternatively it works in conjunction with the fuel cell **165**. In one embodiment, the solar panel powers electrolyzers for hydrogen production. The hydrogen is then used as a fuel for the fuel cell **165**. Power sources for the light bar **134** will be more fully described with respect to FIG. 10 hereinafter.

[0067] Electromagnetic interference ("EMI") is caused by changes to electrical signals. EMI can induce unwanted electrical signals in other circuits, which are commonly

referred to as noise. Rapidly changing signals produce EMI in frequency regions that potentially are in the same frequency domain as desired communications and data signals. Additionally, higher power signals produce stronger EMI. Physically moving sensitive circuitry away from sources of EMI tends to mitigate the effect of the EMI on the circuitry. However, with the electrical modules integrated into the light bar **134**, these circuits do not benefit from the attenuation of the EMI brought about by the physical distance from the EMI source. Warning lights quickly turning on and off, electric motors and high power requirements all contribute to EMI. Sensitive electronics do not operate efficiently in the presence of EMI. For example, digital clock speeds must be reduced in order to ensure proper operation of circuits. Transceivers lose both data range and data rate because of EMI.

[0068] FIG. 9A, FIG. 9B and FIG. 9C show appropriate methods of minimizing EMI within the light bar **134**. FIGS. 9A-9C illustrate three alternative shielding methods for creating an electromagnetically quiet area in the top section of the light bar, which is hospitable to the electronic modules. FIGS. 9A and 9B illustrate ground planes in circuit boards that function to create an upper section of the light bar **134** that is substantially isolated from the EMI generated from the warning lights in the bottom section. The circuit boards can be made with various materials. One common material is Flame Resistant 4 ("FR-4"). FR-4 is a fiberglass material with a resin epoxy. FIGS. 9A and 9B show the construction of two alternative boards for the light bar **134** illustrated in FIGS. 1-8.

[0069] The board in FIG. 9A is made of FR-4 material, but other board materials may be used. In the illustrated board of FIG. 9A, there are five (5) layers with layer **5** representing the bottom of the board on which the warning light assemblies **172** and LEDs **174** are mounted. Any additional components needed by the light assemblies and LEDs, such as resistors and capacitors and the necessary board traces are on layer **5**. Layer **4** contains the power plane. The power plane can contain both digital and analog islands as needed to minimize noise. Layer **3** is the signal plane. The signal plane is isolated from the warning light assemblies **172** by the power plane **234**. Further, the signal plane is isolated from the modules **110-132** mounted on the top of the board by the ground plane in layer **2**. Thus, inherently sensitive, high-speed signals can be routed on layer **3** and shielded from noisy components on the top and bottom of the board. Layer **1** is the top of the board where the modules **110-132** are mounted. Many of the modules require a relative quiet EMI environment. For example, EMI can result in the radar unit **110** returning incorrect speeds for passing vehicles. The video recorder **120** may not record a clean image if excessive EMI is present. Finally, the transceivers **124**, **128** and **130** need a quiet EMI environment to maximize both their range and data rate. The ground plane in layer **2** provides necessary isolation for the modules **110-132** without the need to additional shielding.

[0070] FIG. 9B represents the cross sectional view of a board made of Anotherm™ by TT Electronics PLC. The board material **242** acts as a natural ground plane. Therefore, the modules **110-132** mounted on the top of the board **244** are isolated from the light assemblies **172** mounted on the bottom of the board **246**.

[0071] FIG. 9C illustrates an additional or alternative grounded shielding plane **248** for the modules, particularly antennas **204**, **216** and **226** connected to the transceivers **202**, **212** and **222**. The grounded shielding plane **248** may be required as additional grounding for the antennas depending on the specific configuration of warning light assemblies **172** and modules **110-132**. The ground plane **248** should be made of a conductive material and for the best isolation, the plane should substantially cover the surface of the circuit boards **196a-196e**. Other methods of minimizing interference due to EMI can be utilized. For example, electrical filtering such as high/low pass filters may be added. The modules most sensitive to EMI may be housed or wrapped in grounded shielding. The most sensitive electronic devices can also be physically located as far apart as possible from the noisiest sources of EMI.

[0072] FIG. 10 is a schematic diagram of the circuitry in the light bar **134**, the MDT **164** and power sources for both. In the illustration, the MDT **164** accepts signals via a Bluetooth IEEE 802.15 network. In one embodiment of the light bar, the signals include voice commands and voice messages broadcast over a network. Data broadcast over the network may be broadcast over the LMR **262** or either of the transceivers **254** and **260**. A variety of companies including Motorola and Nokia make appropriate Bluetooth headsets **273**. A user wears a hands free headset **273** so that commands are issued without distracting from the user's other duties and activities.

[0073] The MDT **164** includes a display **164a**. Preferably, the display is a touch screen as discussed above in connection with FIG. 3 so that the user can enter commands by simply touching the screen. However, other types of displays can be substituted for the touch screen or may complement it. For example, a conventional liquid crystal display can be used as the display **164a**. A computer **250** controls the display **164a**, provides a keyboard for entering commands and receives commands and voice messages from the Bluetooth headset **273**. The computer **250** transmits commands and receives messages from the emergency device **102** in the light bar **134**. In one embodiment of the light bar **134**, the computer **250** uses a transceiver **252** compliant with the IEEE 802.11 specification for transmitting data to the light bar **134** over a Wi-Fi network. In one embodiment of the invention, the display **164a**, computer **250** and radio **252** are integrated into a single laptop computer acting as the MDT **164** as illustrated in FIGS. 1 and 2B.

[0074] The light bar **134** receives commands from the MDT **164** over a Wi-Fi network. The transceiver **254** connects to a router **256**, which forwards data packets from the transceiver **254** across the network. The router **256** is of conventional design and may be any of several commercially available models. For example, the MDT **164** issues a command for the video camera **258** to begin recording. The command is transmitted to the light bar **134** and received by the transceiver **254**. The transceiver sends the data to the router. The video camera **258** has an Ethernet port conforming to the IEEE 802.3 protocol. The camera **258** connects directly to the Ethernet router **256** using a standard Ethernet cable. The router thereby forwards the command issued by the MDT **164** to the camera **258**. In response to the command, the camera **258** begins recording. Additionally, the camera **258** sends the video signal to the MDT **164** via the router **256** and the transceiver **254**. The MDT **164** displays

the live video feed on the display **164a**. Other devices with an Ethernet port, such as the public safety radio **260** connect directly to the router. In one embodiment of the light bar **134**, all modules contain an Ethernet port for direct connection to the router **256**.

[0075] Devices without an Ethernet port connect to a controller **264**. The controller **264** interfaces with each module and a serial to Ethernet converter **271**, which provides an interface between the controller and the router **256**. The converter **271** translates data packets forwarded by the router **256** and then the controller **264** sends commands to each of the connected modules, which include in the illustrated embodiment the radar unit **266**, biological and chemical sensors **268**, the LPR **270** and the GPS **272**. The controller **264** also interfaces with the warning light assemblies **274**. For example, a user turns on the lights by way of commands entered at the MDT **164**. The MDT sends the command over the Wi-Fi network to the transceiver **254**. The transceiver forwards the data to the router **256** and the router forwards the data packet to the converter **271**, which in turn provides serial commands to the controller **264**. The controller **264** interprets the serial commands and turns on the lights **274**. Similarly, a user controls the GPS **272**, LPR **270**, sensors **268** and radar **266** from the MDT **164**. Likewise, modules send data to the MDT **164**. For example, the radar **266** detects the speed of nearby vehicles. The radar sends the speed data to the controller **264**, which outputs a serial data stream to the converter **271**. The converter **271** formats the speed data as an Ethernet data packet and sends the packet to the router **256**. The router forwards the packet the transceiver **254** where it is sent over the Wi-Fi network to the MDT **164**. The MDT formats and displays the speed. A user thereby receives real time information on the speeds of nearby vehicles.

[0076] The controller **264** also interfaces with the land mobile radio (LMR) **262**. Voice and data messages from either the light bar or the MDT are sent over the LMR **262** or the public safety radio **260**. Additional transceivers are added to the system for connecting to additional networks, such as a cellular telephone network or a community Wi-Fi mesh network among others. Additional modules may be housed in the light bar **134** and modules may be removed from the light bar **134** as necessary for a given expected emergency. By way of example, controller **264** may be a Terra3 Intelligent RTU (Remote Terminal Unit) from Federal Signal Corporation, University Park, Ill. The converter **271** may be a TS900 Series serial to Ethernet converter by EtherWAN Systems, Inc., Via Rodeo, Placentia, Calif. 92870.

[0077] In one embodiment of the light bar **134**, a power source is integrated into the bar. The integrated power source may include a fuel cell **276**, a solar panel **278** and a battery **280**. In the schematic diagram of FIG. 10, the fuel cell **276** and solar cell **278** each feed a regulator **282**. The regulator maintains a constant voltage to the light bar **134**. The solar cell **278** charges the battery **280** so that the light bar can keep operating in dim light and at night.

[0078] FIG. 11A depicts a community Wi-Fi mesh network for use by one embodiment of the light bar **134**. Towers **286a**, **286b**, **206c** and **286d** act as nodes within the mesh network, routing data as needed among themselves and to the back haul system **288** for connection to the

Internet **290**. Various devices with Wi-Fi capabilities can connect wirelessly to the mesh network thru the towers **286**. Vehicles **284a**, **284b** and **284c** are each equipped with a light bar **285a**, **285b** and **285c**, respectively, as described above and illustrated in FIGS. 1-10. Each of the light bars connects to the Wi-Fi mesh network using an 802.11 compliant transceiver in the light bar **285**. Using the MDTs in the vehicles **284**, occupants of the vehicles send data to the control center **292**. In one embodiment, vehicle **284a** records live video with a video module in light bar **285a**. The occupant of vehicle **284a** sends the live video feed over the Wi-Fi network using a transceiver in the light bar **285a**. The transceiver connects to tower **286a** and the video feed is forwarded to the back haul system **288**. The back haul delivers the video feed to the control center **292** either directly or via the internet **290** as indicated in FIG. 11A. The co-pending U.S. patent application Ser. No. 11/505,642, filed Aug. 17, 2006 and entitled "Integrated Municipal Management Console" depicts one embodiment of the control center. In keeping with the description in co-pending U.S. patent application Ser. No. 11/505,642, personnel in the control center **292** view the live video feed from vehicle **284a** and alert or marshal resources as needed. Alternatively, the control center can enable the camera in the light bar **285a** remotely. U.S. patent application Ser. No. 11/505,642 is hereby incorporated by reference in its entirety and for everything that it describes.

[0079] In another embodiment of the system supporting the light bar, a video feed from light bar **285a** is sent to the MDT in vehicle **284b**. In a first embodiment the video feed is sent from light bar **285a** to the control center **292**. The control center **292** then forwards the video feed over the internet **290**, back haul **288** and nodes **286** to the light bar **285b**. Light bar **285b** transmits the live video feed from **285a** to the MDT in vehicle **284b**. The occupant of vehicle **284b** can therefore see a live image of the video feed taken by light bar **285a**. In yet another embodiment of the system supporting the light bar, the live video feed is sent directly from light bar **285a** over the Wi-Fi mesh network to light bar **285b**. The video feed is then sent to the MDT in vehicle **284b** where the occupant of the vehicle views it. Any data from a module can be sent over the network to the control center or to other vehicles. Voice messages using Vol. or traditional voice networks can also be sent from a vehicle to the control center and from the control center to a vehicle or from a first vehicle directly to a second vehicle. Further, the control center can send any appropriate data for display on the MDT or for announcement by a vehicle's built in speakers or through a user's Bluetooth headset.

[0080] In one embodiment of the invention depicted in FIG. 11B, outdoor warning sirens **294** act as nodes in a Wi-Fi mesh network allowing vehicles **284a**, **284b** and **284c** to connect to the network. The outdoor warning sirens **294** connect to a tower **296**. The tower **296** provides further access to the back haul, internet or other appropriate network for connecting to a control center. In keeping with one embodiment of the invention, FIG. 101C depicts a point to multipoint network with vehicles **284a**, **284b** and **284c** connecting directly to tower **298** that provides access thru an appropriate network connection to a control center. In another embodiment of the invention, depicted in FIG. 11D, vehicles **284a**, **284b** and **284c** connect to a cellular network **300**. The cellular network **300** provides access to a control center. FIGS. 11A, 11B, 11C and 11D illustrate possible



network protocols and configurations. Embodiments of the invention utilize any appropriate wireless network protocols and network configurations for connecting emergency device 102 to a control center.

[0081] All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0082] The use of the terms “a” and “an” and “the” and similar referents in the context of describing the light bar and its network environment (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms “comprising,” “having,” “including,” and “containing” are to be construed as open-ended terms (i.e., meaning “including, but not limited to,”) unless otherwise noted. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., “such as”) provided herein, is intended merely to better illuminate the various embodiments of the light bar and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in this description should be construed as indicating any non-claimed element as essential to the practice of the invention.

[0083] Preferred embodiments of the light bar and the system supporting it are described herein, including any best mode known to the inventor. Variations of those preferred embodiments may become apparent upon reading the foregoing description. The inventor expects skilled artisans to employ such variations as appropriate, and the inventor intends for the fully integrated light bar and its supporting network system to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

1. A system for use by a vehicle comprising:

an emergency device for mounting to the vehicle and housing at least one transceiver in wireless communication with a network and at least one device connected to the transceiver for transmitting emergency information over the network, where the information includes data other than voice communications that informs a recipient of real time conditions of one or more of the vehicle, its operator and the ambient environment of the vehicle and the operator; and

a control head in an interior of the vehicle in communications with the transceiver for controlling the transmission of the emergency information.

2. The system of claim 1 wherein the emergency device is a light bar.

3. The system of claim 1 wherein the emergency information comprises data packets, each packet comprising address and data fields.

4. The system of claim 1 wherein the network is one of a Wi-Fi network, a WiMax network, a public safety network and a cellular network.

5. The system of claim 1 including a wireless communications link between the at least one transceiver and the control head.

6. The system of claim 5 wherein the wireless communication link is one of a Wi-Fi network, a Bluetooth network, a Zigbee network and a wireless USB network.

7. The system of claim 1 wherein the device connected to the transceiver is one of a camera, a radar detector, a chemical agent detector, a biological agent detector, a license plate recognition system and a global positioning system.

8. The system of claim 1 wherein the emergency device houses a power source for the transceiver and device connected to the transceiver.

9. The system of claim 8 wherein the power source comprises at least one of a battery, a fuel cell, and a solar panel.

10. The system of claim 1 wherein the control head includes an interface for receiving the information from the emergency device.

11. The system of claim 10 wherein the control head includes a display to notify occupants of the vehicle of the information.

12. The system of claim 11 wherein the display comprises a primary display through which another display is accessible for controlling said at least one device.

13. The system of claim 12 wherein the said at least one device is a video camera and said another display includes controls for the video camera.

14. A communications system comprising:

a community wide network;

at least one vehicle with an emergency device housing (1) at least one transceiver in wireless communication with the community wide network and (2) at least one device connected to the transceiver for transmitting information over the network including data other than voice communications informing a recipient of substantially real-time conditions of one or more of the vehicle, its operator and an ambient environment of the vehicle and operator; and

a centralized management console attached to the network for receiving data transmitted from the emergency device;

15. The system of claim 14 wherein the emergency device is a light bar.

16. The system of claim 15 wherein the housing of the light bar contains a power source for the at least one transceiver and the at least one device.

17. The system of claim 16 wherein the emergency device houses a controller in wireless communication with a control head in a passenger compartment of the vehicle.

18. The system of claim 14 wherein the emergency device houses more than one transceiver, with each transceiver in wireless communication with a corresponding community wide network.

19. The system of claim 14 wherein the device connected to the transceiver is one or more of a camera, a radar detector, a chemical agent detector, a biological agent detector, a license plate recognition system and a global positioning system.

20. The system of claim 14 wherein the network is a mesh network.

21. The system of claim 20 wherein the mesh network is one of a Wi-Fi network and a Zigbee network.

22. The system of claim 14 wherein the network is one of a cellular network and a WiMax network.

23. The system of claim 14 wherein the data comprising the information sent to the centralized management console includes data identifying the vehicle.

24. The system of claim 14 wherein the vehicle is a first vehicle and the centralized management console includes a transceiver for transmitting information received from the first vehicle to a second vehicle having an emergency device.

25. The system of claim 14 wherein the information is transmitted to the centralized management console as one or more data packets, each packet comprising address and data fields.

26. The system of claim 14 wherein the at least one vehicle with an emergency device is a first vehicle with a first emergency device whose transceiver transmits the information over the network to a second emergency device of a second vehicle where the information includes data informing a recipient at the second vehicle of the real time conditions at the first vehicle.

27. A method of communicating with a vehicle:

monitoring one or more sensors housed in an emergency module with at least one transceiver, the emergency module mounted to a vehicle;

automatically transmitting from the transceiver and to a network information comprising packets of data and address information, where the data indicates a real time condition detected by the one or more sensors;

receiving the information transmitted over the network at a centralized management console; and

evaluating the received information at the centralized management console against one or more predetermined criteria.

28. The method of claim 27 including transmitting information from the centralized management console to another vehicle in response to the evaluation of the received information.

29. The method of claim 27 wherein the emergency module is a light bar.

30. The method of claim 29 wherein the one or more sensors is one or more of a camera, a radar detector, a chemical agent detector, a biological agent detector, a license plate recognition system and a global positioning system.

31. The method of claim 27 wherein the information is transmitted over one of a Wi-Fi network, a public safety network and a cellular network.

32. The method of claim 27 wherein the information transmitted by the transceiver is received by another vehicle in addition to the centralized management console.

33. A method of retrofitting a vehicle with equipment for responding to an emergency, the method comprising:

providing a module housing (1) emergency equipment for mounting to the vehicle and (2) a source of power for the equipment;

mounting the module to the vehicle;

mounting a control head for the device in the vehicle;

establishing a wireless communication between the control head and the module; and

establishing a connection between a transceiver in the module and a community wide network, thereby enabling a user of the vehicle to communicate to others connected to the network.

34. The method of claim 33 wherein the mounting of the module to the vehicle includes attaching the module to the roof of the vehicle.

35. The method of claim 34 wherein the emergency equipment includes warning lights controlled by the control head.

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