(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

PCT

(43) International Publication Date
21 August 2008 (21.08.2008)

(10) International Publication Number
WO 2008/100283 A2

(51) International Patent Classification:
H04L 29/08 (2006.01)

(21) International Application Number:
PCT/US2007/017459

(22) International Filing Date: 6 August 2007 (06.08.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/500,554 7 August 2006 (07.08.2006) US

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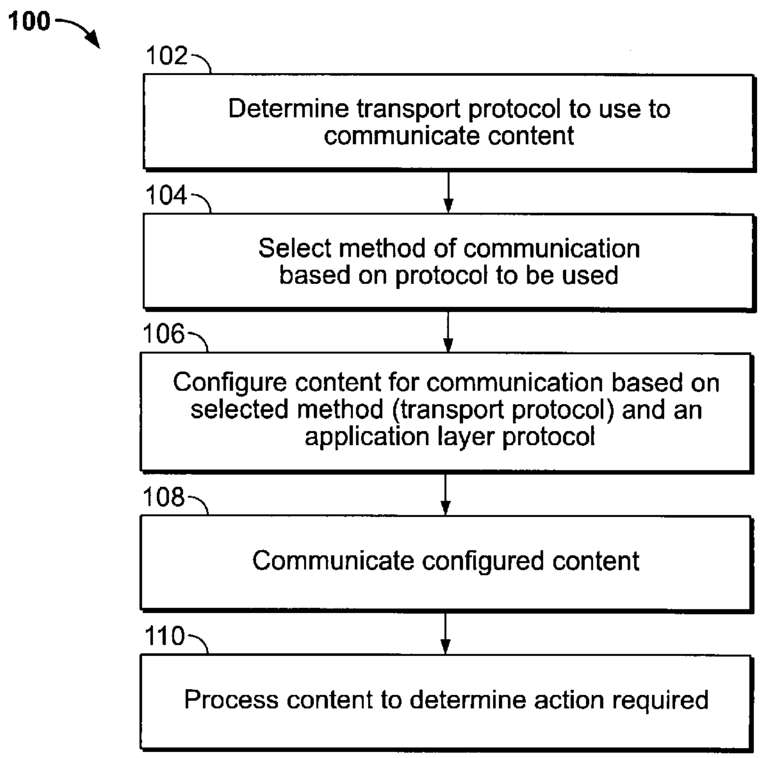
(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

[Continued on next page]

(54) Title: MULTIPLE PROTOCOL LAND MOBILE RADIO SYSTEM

FIG. 6



(57) Abstract: A multiple protocol land mobile radio (LMR) and a method for communicating LMR content are provided. The method includes communicating (108) the LMR content (130) using a plurality of LMR transport protocols within a single LMR network (42). The method further includes configuring (106) the LMR content (130) based on an LMR application layer protocol for a portion of the single LMR network (42) through which the LMR content (130) is to be communicated.

WO 2008/100283 A2

ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

MULTIPLE PROTOCOL LAND MOBILE RADIO SYSTEM

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to land mobile radios, and more particularly, to a system for providing land mobile radio (LMR) services using multiple LMR communication protocols.

[0002] Land mobile radios may be used to provide communication between different mobile units, for example, land mobile radios in different vehicles. Land mobile radio band communication, for example, public safety radio communication (e.g., police, fire department, etc.) is generally available within the VHF, UHF, 700 MHz and 800 MHz frequency bands. Part of each of these frequency bands is allocated by the Federal Communications Commission (FCC) for public safety communication services and are also referred to as Public Safety Frequency Bands. These communications also may be provided using private land mobile radio services (PLMRS).

[0003] Traditionally, LMR networks have been used to provide mission critical applications such as public safety communications. In addition to providing a very high level of system availability, LMR networks are designed to support PTT services, such as a dispatch mode of operation. These LMR systems use specialized LMR airlink protocols to communicate wirelessly between LMR radios and the LMR infrastructure.

[0004] Known LMR systems use a single protocol for the various layers in the communication protocol stack. For example, the same protocol must be used for both a transport layer and an application layer of the protocol stack. Further, when trying to interconnect multiple systems, with each system using a different protocol, transcoding and trascryption of the communicated LMR content is needed. Thus, design of these systems may result in sub-optimal performance and the cost of these systems may be increased.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The solution is provided by a method for communicating land mobile radio (LMR) content. The method includes communicating the LMR content using a plurality of LMR transport protocols within a single LMR network. The method further includes configuring the LMR content based on an LMR application layer protocol for a portion of the single LMR network through which the LMR content is to be communicated.

[0006] The solution is also provided by a wireless communication system that includes a land mobile radio (LMR) infrastructure configured to communicate with a plurality of LMR units within a plurality of coverage areas of an LMR system. At least some of the plurality of coverage areas have different transport protocols. The wireless communication system further includes an interface configured to process received LMR content that is communicated using a first LMR transport protocol and reencapsulate the LMR content for communication using a second LMR transport protocol.

[0007] The solution is also provided by a land mobile radio (LMR) unit that includes at least one voice encode/decoder and a plurality of modems connected to the at least one voice encoder/decoder. The plurality of modems are each configured to communicate using a different LMR transport protocol.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention will now be described by way of example with reference to the accompanying drawings in which:

[0009] Figure 1 is a diagram illustrating a Land Mobile Radio (LMR) communication system constructed in accordance with an exemplary embodiment of the invention.

[0010] Figure 2 is a diagram illustrating coverage areas of a portion of the LMR communication system of Figure 1.

[0011] Figure 3 is a block diagram of a Land Mobile Radio (LMR) unit constructed in accordance with an exemplary embodiment of the invention communicating with an LMR network.

[0012] Figure 4 is a block diagram of Land Mobile Radio (LMR) unit constructed in accordance with another exemplary embodiment of the invention.

[0013] Figure 5 is a block diagram illustrating protocol stacks in accordance with an exemplary embodiment of the invention.

[0014] Figure 6 is a flowchart of a method for controlling communication of LMR content in an LMR communication system in accordance with an exemplary embodiment of the invention.

[0015] Figure 7 is a block diagram of a transport protocol interface constructed in accordance with an exemplary embodiment of the invention.

[0016] Figure 8 is a block diagram showing formatted LMR content in accordance with an exemplary embodiment of the invention.

[0017] Figure 9 is a block diagram of an LMR communication system constructed in accordance with an exemplary embodiment of the invention showing communication coverage areas.

[0018] Figure 10 is block diagram of an LMR communication system constructed in accordance with an exemplary embodiment of the invention showing data flow.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Various embodiments of the invention include a system for providing land mobile radio (LMR) content, for example, LMR services via an LMR network using multiple communication protocols. More particularly, multiple LMR transport layer protocols are used to communicate LMR that can retain a single LMR application layer protocol.

[0020] It should be noted that when reference is made herein to LMR content, this refers generally to any type or kind of LMR voice and/or data content, and may define particular LMR services, operations, controls, etc. For example, the LMR content may include, but is not limited to, voice data, emergency signal data, control data relating to selecting a particular talk group, LMR data for transfer between a radio unit and a server, reprogramming data (e.g., software upgrade data), etc.

[0021] Specifically, as shown in Figure 1, a wireless communication system, and more particularly, an LMR communication system 20 constructed according to various embodiments of the invention provides communication between a plurality of LMR units or LMR terminals (not shown), which may be configured for mobile operation, such as located in various vehicles 22. Communication between the LMR units, for example, located in different vehicles 22 is provided via an LMR network having a communication coverage area defined by a plurality of communication base stations and associated communication towers 24, for example, as part of communication repeater towers. Within the LMR coverage area, Radio Frequency (RF) coverage is provided by each of the base stations 24. The RF coverage may overlap.

[0022] In various embodiments, the communication protocol provided by different base stations and associated communication towers 24 may be different. More particularly, the transmission protocol, and specifically, a transport layer protocol is different for some of the base stations and associated communication towers 24. For example, one base station and associated communication tower 24 may use a Terrestrial Trunked Radio (TETRA) transport protocol (e.g., ETSI TETRA standard) for the RF coverage area of that base station and associated communication tower 24 and another base station may use a P25 transport protocol (e.g., Project 25 (TIA 102) standard) for the RF coverage area of that base station and associated communication tower 24. It should be noted that some of the base stations and associated communication towers 24 may use the same transport protocol. Additionally, it should be noted that other types of LMR communication protocols and standards may be used, including, for example, M/A-COM OpenSky and EDACS protocols.

[0023] In operation, each of the LMR units is configured to communicate LMR content via the LMR communication system 20 using different communication protocols. In particular, and as described in more detail herein, the LMR units select between one of a plurality of transport layer protocols for use in communicating the LMR content (that may be different than an application layer protocol). The LMR content is then configured for communication using the selected communication protocol, and more particularly, encapsulated based on the selected communication protocol. Additionally, different application layer protocols may be used.

[0024] The LMR communication system 20 may include one or more communication areas 30, a portion of one communication area is shown in Figure 2. The communication area 30 is formed from a plurality of RF coverage areas 32 that are serviced by one or more base stations and associated communication towers 24 (shown in Figure 1). Each coverage area 32 may be configured to communicate LMR content using a different transport layer protocol, shown as LMR-1 Transport, LMR-2 Transport and LMR-3 Transport, indicating that three different transport layer protocols are being used. It should be noted that adjacent RF coverage areas 32 may use the same or different transport layer protocols.

[0025] Various embodiments enable end-to-end LMR services to be provided over a plurality of protocols, for example, a plurality of radio and/or airlink protocols. In general, an LMR unit 40 (also referred to as an LMR terminal) as shown in Figure 3 is configured to allow operating end-to-end LMR application layer protocols and services between the LMR units 40 and an LMR network 42 that may include a plurality of LMR base stations 44, each of which may be configured to communicate using a different protocol.

[0026] More particularly, the LMR unit 40 includes a plurality of modules or components configured to provide communication via the LMR network 42. Specifically, the LMR unit 40 includes an LMR application module 46 connected to an LMR transport module 48 together provided for configuring voice and/or data for communication via the LMR network 42 (having one or more LMR base stations 44) using an LMR transmitter/receiver 50, which may be separate units or provided as a single transceiver. The LMR unit 22 further includes an LMR encapsulation module 50 connected between the LMR transport module 48 and the LMR transmitter receiver 50 for encapsulating the voice and/or data for communication using one of a plurality of communication protocols. The LMR transport module 48, the LMR encapsulation module 52 and the LMR transmitter/receiver 50 generally define a multiple protocol communication portion 54.

[0027] The LMR unit 40 may include additional components, for example, an antenna (not shown) for use in transmitting and receiving signals as is known. Additionally, and for example, the LMR unit 40 may include filters (not shown), such as a receive filter and a transmit filter for filtering signals that are received and transmitted, respectively, by the LMR unit 40. The LMR unit 40 also may include components for processing LMR content and for interfacing with a user. For example, a processor 56 connected to a memory 58 may be configured to receive the different LMR content and based on a user input 60 or other information (e.g., configuration or protocol description information in the LMR content signal) determine the manner is which to encapsulate or decapsulate the LMR content as described in more detail below. For example, the processor 56 may be configured to communicate control commands to a selector 62 of the LMR transport module 48 to select a protocol for use in communicating the LMR content. A display 64 also may be provided and configured to display, for example, the current channel, frequency, mode of communication, type of communication, communication protocol, etc, for the LMR unit 40.

[0028] In operation, the LMR communication system 20 with the LMR unit 40 may provide communication via the LMR network 42 using different known protocols, for example, LMR airlink protocols within a single LMR network 42. For example, these LMR airlink protocols include the Project 25 (TIA 102) and ETSI TETRA standards, among others. These LMR airlink protocols specify the format and procedures for information exchange between the LMR unit 40 and the LMR network 42, and in particular, the LMR base stations 44. It should be noted that when the base station(s) 44 are part of a larger system, the base station(s) 44 are interconnected to switching equipment (not shown) that routes voice and data between different parts of the system, such as to other LMR base stations or dispatch consoles. As is known, the LMR base station 44 processes, for example, manipulates, the voice, data and control information received over the airlink into an alternate format suitable for communication within the LMR network 42, for example, for transport to switching equipment.

[0029] For example, based on the current RF coverage area 32 (shown in Figure 2) and associated communication protocol, which may be automatically determined (e.g., using header information in the LMR signal) or manually selected (e.g., selected by a user), LMR content is first generated by the LMR application module 46 based on an application layer and then encapsulated by the LMR encapsulation module 52 based on a transport layer as selected by the LMR transport module 48. It should be noted that when LMR content is communicated through the LMR network 42, the encapsulation of the transport layer may change based on, for example, the protocol used by the current LMR base station 44, but the encapsulation of the application layer remains unchanged. Accordingly, in various embodiments, the LMR unit 40 is configured having at least one voice encoder/decoder 70 connected to a multiple protocol communication portion 72 as shown in Figure 4. In this embodiment, the multiple protocol communication portion 72 includes an interface 74 for communicating with the voice encoder/decoder 70 and a plurality of modems 76 each configured to communicate using a different LMR communication protocol. The number of modems 76 or other communication units may be modified, for example, increased or decreased. Additionally, a single communication unit configured to communicate using a plurality of different communication protocols may be provided. Also, the voice encoder/decoder 70 may be modified or additional voice encoders/decoders 70 added if LMR content is to be communicated using different application layers. In addition, the LMR unit 40 may include a speaker 78 configured to output the decapsulated LMR content.

[0030] In operation, the LMR unit 40 either receives LMR content at the multiple protocol communication portion 72 or a user input (e.g., voice message via a microphone (not shown) or button depression input) at the voice encoder/decoder 70. For LMR content received at the multiple protocol communication portion 72, the LMR content is decapsulated and processed, which may include decoding and decrypting the LMR content, and then output, for example, via the speaker 78. For inputs received at the voice encoder/decoder 70, the input, for example, is encoded (e.g., encapsulated based on an encapsulation layer) and then transmitted from the multiple protocol communication portion 72 using one of the plurality of modems 76 based on the communication protocol for that portion of the LMR network 42 (shown in Figure 3) and as determined by a transport layer.

[0031] Thus, communication of LMR content is communicated over the LMR network 42 and which may include transmitting and receiving using a plurality of different transport protocols and configuring the LMR content accordingly, for example, configuring the LMR content using different airlink protocols. In order to provide communication via the LMR network 42 using the LMR unit 40, the communication protocol stacks for communication using different protocols is partitioned as shown in Figure 5. In particular, and with respect to communication with the LMR unit 40 using the LMR network 42, an LMR protocol stack 80 is partitioned into multiple layers, which in an exemplary embodiment, is a two-layer protocol stack having an LMR application layer 82 and an LMR transport layer 84. The LMR application layer 82 and the LMR transport layer 84 may be provided, for example, by the LMR application module 46 and LMR transport module 48 (both shown in Figure 3), respectively. The LMR application layer 82 is configured to provide interpretation and processing of the voice, data and control information across the entire LMR network 42 and the LMR transport layer 84 is configured to provide delivery of the voice, data and control information over the transmission medium, which may be only over a portion of the LMR network 42 defined by a RF coverage area 32 (shown in Figure 2). As described herein, an LMR airlink protocol defines at least one of the LMR application layer 82 and the LMR transport layer 84 for a particular portion of the LMR network 42, for example, an RF coverage area 32.

[0032] In this two-layer protocol stack model, the LMR base station 44 (shown in Figure 3) and switching equipment in the LMR network 42 (shown in Figure 3) receive content from the LMR unit 40 (shown in Figures 3 and 4) and communicate content of the LMR application layer 82 therebetween with a one or more different transport layers. In particular, and as shown in Figure 5, the content of the application layer 82 is encapsulated at the LMR base station 42 (shown in Figure 3) using LMR content encapsulation 86 as is known. In an exemplary embodiment, discrete transmission units are encapsulated within transport datagrams, and in particular, packet switched transport datagrams 88, that are communicated using one of a plurality of transport protocols. Upon receipt of an encapsulated datagram, the application layer content then may be recovered, and in particular, decapsulated.

[0033] Further, this two-layer protocol stack model enables delivering LMR application layer services over portions of the network using different transport layers defined by different communication protocols or a protocol different from the application layer. Specifically, as shown on the left side of Figure 5, the application layer 82 and transport layer 84 are configured based on the same communication protocol, namely, LMR-1, which may be, for example, a Tetra based communication protocol.

However, as shown on the right hand side of Figure 5, the application layer 82 is the same, namely LMR-1, but the transport layer 84a is different, namely, LMR-2, which may be, for example, a P25 based communication protocol. Accordingly, the application layer content encapsulation is the same, but the transport layer encapsulation is different.

[0034] In particular, the LMR content encapsulation 86 is used with the packet switched transport datagrams 88 such that the LMR network 42 (shown in Figure 3) can communicate with switching equipment using suitable transport protocols, thereby delivering the identical LMR application layer services over the LMR network 42 using LMR base stations 44 (shown in Figure 3) configured to communicate using different LMR communication protocols. Specifically, the LMR infrastructure communicates the LMR application services using an LMR application layer switching 92 in combination with packet switched transport datagrams 68 with different transport layers 84 and 84a.

[0035] It should be noted that the various embodiments are not limited to a two-layer protocol stack and additional layers may be provided to the multi-layer protocol stack as desired or needed. For example, different session layers, such as a bulk encryption layer may be provided. Further, and for example, an RTP layer may be provided. Further, it should be noted that although the example in Figure 5 is shown as providing communication using (i) the same protocol for both the application layer and transport layer and (ii) a different protocol for the transport layer, modifications are contemplated in the various embodiments. For example, the same transport layer may be used with different application layers.

[0036] Various embodiments of the invention provide for controlling communication of LMR content in an LMR communication system using an LMR network having a plurality of LMR base stations or other repeaters or routers that may use different communication protocols. In particular, a method 100 of controlling communication of LMR content is shown in Figure 6 and includes determining at 102 the protocol to use to communicate the LMR content, and more particularly, the transport layer protocol to use. In an exemplary embodiment, a determination is made as to the transport protocol for the current coverage area. The determination may be based on a manual selection, for example, based on a user input selection of which protocol to use or the inputted location of the LMR unit. The selection may be made, for example, using a button or switch on the LMR unit 40 (shown in Figure 3). Alternatively or optionally, the determination of which protocol to use may be automatic. For example, the selection of a protocol for communicating LMR content may be based on the automatic location detection of the LMR unit (e.g., using GPS) or based on information received in the LMR content, for example, in a header portion of the LMR content, or in a setup or configuration message.

[0037] After a determination of the transport protocol to use to communicate the LMR content is made at 102, a method of communication is selected at 104 based on the determined protocol to use. For example, the speed or baud rate of the communication may be selected (manually or automatically) from a range of communication data rates. Additionally, the setup procedures for establishing and connecting to the determined portion of the network may be selected. For example, if a first communication protocol is to be used, an LMR-1 transport layer network communication setup routine may be executed wherein a communication link is established between the LMR unit and that portion of the LMR network via an LMR transmitter/receiver within the LMR unit. If a second communication protocol is to be used, an LMR-2 transport layer network communication setup routine may be executed wherein a communication link is established between the LMR unit and that different portion (different from the first portion) of the LMR network. The setup routine may include any suitable processes as are known for establishing a wireless communication link.

[0038] Thereafter, at 106 the LMR content is configured for communication based on application layer protocol and the selected method of communication. For example, if the LMR content is to be communicated using the LMR-1 transport layer, a selection of a particular LMR standard in which to configure or format the LMR content is selected. In particular, an LMR-1 standard in which to configure the voice and/or data payload defining the LMR content is selected. This may include, for example, selecting one of a Project 25 (TIA 102) or an ETSI TETRA standard for the method of communication and encapsulating the data accordingly, for example, using IP wrapper encapsulation with a particular application layer protocol, for example, an LMR-1 application layer protocol. Further, and for example, a proprietary format may be selected, for example, an OpenSky M/A-COM proprietary format, a NetworkFirst or EDACS system proprietary format. A different communication protocol or format may be used, for example, if the portion of the LMR network requires communication in an LMR-2 standard.

[0039] Additionally, and as described in more detail above in connection with Figure 5, depending on the protocol to be used to communicate the LMR content, a particular protocol stack may be used. Further, an LMR protocol header identifying the transport layer and protocol used to encapsulate the data may be added to the LMR data payload. As described in more detail below, the LMR content is encapsulated, for example, IP encapsulated with an IP wrapper prior to communication. It should be noted that this may include multiple layers of encapsulation.

[0040] Referring again to Figure 6, after the LMR content is configured at 106, the configured LMR content is communicated at 108. For example, if the LMR content is configured for communication using an LMR-1 communication protocol, the modem corresponding to that protocol is used to communicate the LMR content from and with the LMR units. If the LMR content is configured for communication using, for example, another protocol such as an LMR-2 protocol, a different modem corresponding to that protocol is used to communicate the LMR content from and with the LMR units. It should be noted that the LMR unit may be configured to operate in two or more modes of operation, namely, in connection with two or more different communication protocols.

[0041] After the LMR content is communicated and received, for example, by a base station of the network, the LMR content is processed at 110 to determine an action. For example, this may include a determination to communicate voice data or to issue an emergency signal or PTT request to a talk group. Further and for example, if the LMR content is communicated using different transport layers, the IP destination address of an encapsulated datagram may first be determined and then communicated to that location for processing using a router in the network. The LMR content then may be reencapsulated.

[0042] In the various embodiments, as shown in Figure 7, a transport protocol interface 120 may be provided in connection with the base stations 44 (shown in Figure 3). The transport protocol interface 120 may be provided, for example, as a separate unit (e.g., stand alone module), a card for connection to a server within the LMR network 42 (shown in Figure 3) or software for downloading to a server within the LMR network 42. The transport protocol interface 120 includes a processor 122 for processing received encapsulated LMR content for communication within the infrastructure of the LMR network 42. In particular, and as described in more detail in connection with Figures 5 and 6, the processor may receive LMR content formatted as shown in Figure 8. The LMR content generally includes an LMR data portion and a packet switching protocol encapsulation portion. Specifically, the LMR content 130 may include a transport layer protocol header 132, an application layer protocol header 134 and LMR data 136, for example, an LMR data payload.

[0043] This LMR content 130 is essentially encapsulated, for example, encapsulated in one or more IP wrappers such that different communication protocols may be used to communication the LMR content 130. The processor 122 decapsulates the LMR content 130, for example, by removing the transport layer protocol header 132 and may store the decapsulated LMR content 130 in a memory 124. The LMR content 130 then may be further processed by the processor 122 to determine an action to be performed or an address within the packet switched LMR infrastructure to which the LMR content 130 is to be communicated, which may include reencapsulation using a different transport layer identified by a different transport layer protocol header 132.

Essentially, once the LMR content 130 is decapsulated, the LMR content 130 is configured for communication within the LMR infrastructure or within another portion of the LMR network 42. The control of communication of the LMR content 130 is controlled by a controller 126 that may include a router 128 for routing the LMR content 130 to a destination within, for example, the LMR network 42.

[0044] Thus, various embodiments of the invention provide for communicating LMR content using one or more protocols within an LMR network. The content may be encapsulated for communication based on a plurality of different transport layers and communicated accordingly using one of a plurality of modems of an LMR unit. For example, and as shown in Figure 9, an LMR communication system 200 generally includes a plurality of LMR network base stations 202 configured to communicate using a first LMR communication protocol and a plurality of LMR network base stations 204 configured to communicate using a second LMR communication protocol. Each of the plurality of network base stations 202 and 204 have a corresponding coverage area 206 and 208, respectively. The communication coverage areas 206 and 208 may be overlapping at some locations. The various embodiments of the invention as described herein allow an LMR unit 210, for example, an LMR radio in a mobile unit or vehicle, to communicate via different LMR communication protocols (e.g., different transport layer protocols) depending on, for example, the location of the LMR unit 210 and the corresponding available coverage area. More particularly, communication towers (not shown) corresponding to each of the plurality of LMR network base stations 202 and 204 allow wireless communication as described herein.

[0045] Further, as shown in Figure 10, a controller 212 within an infrastructure 211 of an LMR network, for example, the LMR communication system 200 (shown in Figure 9) may be configured to control communications from the plurality of LMR network base stations 202 and 204 as described herein. The controller may process a plurality of data packets received from different portions of the LMR network, for example, different RF coverage areas 214 and 216, having different communication or transport protocol requirements, to determine an appropriate action or routing procedure for the particular data packets as described herein. Accordingly, and for example, the various embodiments may provide for using a Tetra based communication protocol in urban areas for shorter range, higher capacity communications and a VHF based communication protocol in rural areas for longer range, lower capacity communications. Further, the transport layer may be selected based on the type or kind service.

[0046] The various embodiments or components, for example, the LMR communication systems, networks or controllers therein, may be implemented as part of one or more computer systems, which may be separate from or integrated with the LMR communication system. The computer system may include a computer, an input device, a display unit and an interface, for example, for accessing the Internet. The computer may include a microprocessor. The microprocessor may be connected to a communication bus. The computer may also include a memory. The memory may include Random Access Memory (RAM) and Read Only Memory (ROM). The computer system further may include a storage device, which may be a hard disk drive or a removable storage drive such as a floppy disk drive, optical disk drive, and the like. The storage device may also be other similar means for loading computer programs or other instructions into the computer system.

[0047] As used herein, the term "computer" may include any processor-based or microprocessor-based system including systems using microcontrollers, reduced instruction set circuits (RISC), application specific integrated circuits (ASICs), logic circuits, and any other circuit or processor capable of executing the functions described herein. The above examples are exemplary only, and are thus not intended to limit in any way the definition and/or meaning of the term "computer".

[0048] The computer system executes a set of instructions that are stored in one or more storage elements, in order to process input data. The storage elements may also store data or other information as desired or needed. The storage element may be in the form of an information source or a physical memory element within the processing machine.

[0049] The set of instructions may include various commands that instruct the computer as a processing machine to perform specific operations such as the methods and processes of the various embodiments of the invention. The set of instructions may be in the form of a software program. The software may be in various forms such as system software or application software. Further, the software may be in the form of a collection of separate programs, a program module within a larger program or a portion of a program module. The software also may include modular programming in the form of object-oriented programming. The processing of input data by the processing machine may be in response to user commands, or in response to results of previous processing, or in response to a request made by another processing machine.

[0050] As used herein, the terms "software" and "firmware" are interchangeable, and include any computer program stored in memory for execution by a computer, including RAM memory, ROM memory, EPROM memory, EEPROM memory, and non-volatile RAM (NVRAM) memory. The above memory types are exemplary only, and are thus not limiting as to the types of memory usable for storage of a computer program.

[0051] It also should be noted that the various embodiments of the invention also may provide different and/or additional functionality. For example, end-to-end encryption may be performed, thereby eliminating the use of intervening encryption equipment and the security risk encountered by having such intervening equipment with access to encryption keys. Further, various embodiments of the invention may provide end-to-end digital voice coding, thereby eliminating the use of intervening transcoding and transcription equipment and hence the fidelity loss encountered when one format is converted to another format.

WHAT IS CLAIMED IS:

1. A method for communicating land mobile radio (LMR) content (130), said method comprising:

communicating (108) the LMR content (130) using a plurality of LMR transport protocols within a single LMR network (42); and

configuring (106) the LMR content (130) based on an LMR application layer protocol for a portion of the single LMR network (42) through which the LMR content (130) is to be communicated.

2. A method in accordance with claim 1 further comprising using a multi-layer protocol stack (80) for communicating the LMR content (130).

3. A method in accordance with claim 2 wherein the multi-layer protocol stack (80) comprises an LMR application layer (82) and an LMR transport layer (84).

4. A method in accordance with claim 3 wherein the protocol for the LMR application layer (82) is different than the protocol for the LMR transport layer (84).

5. A method in accordance with claim 1 wherein the LMR content (130) comprises content defining at least one of LMR services, operations and controls and including at least one of voice data, emergency signal data, control data relating to selecting a particular talk group, LMR data for transfer between a radio unit and a server and reprogramming data.

6. A method in accordance with claim 1 further comprising performing end-to-end encryption between a plurality of LMR units (40, 210).

7. A method in accordance with claim 1 further comprising performing end-to-end digital voice encoding between a plurality of LMR units (40, 210).

8. A method in accordance with claim 1 further comprising configuring the LMR content (130) for communication using one of a Project 25 (TIA 102) protocol, an ETSI TETRA airlink protocol, an OpenSky proprietary format, an EDACS proprietary format, and a NetworkFirst format.

9. A method in accordance with claim 1 further comprising automatically selecting the transport protocol.

10. A method in accordance with claim 1 further comprising selecting the transport protocol based on a user input.

11. A wireless communication system comprising:

a land mobile radio (LMR) infrastructure (211) configured to communicate with a plurality of LMR units (40, 210) within a plurality of coverage areas (208) of an LMR system (200), at least some of the plurality of coverage areas (208) having different transport protocols; and

an interface (120) configured to process received LMR content (130) that is encapsulated using a first LMR transport protocol and reencapsulate the LMR content (130) for communication using a second LMR transport protocol.

12. A wireless communication system in accordance with claim 11 wherein the LMR infrastructure (211) is configured to communicate the LMR content (130) using a multi-layer protocol stack (80).

13. A wireless communication system in accordance with claim 11 wherein the LMR infrastructure (211) is configured to communicate using one of a Project 25 (TIA 102) protocol, an ETSI TETRA airlink protocol, an OpenSky proprietary format, an EDACS proprietary format, and a NetworkFirst format.

14. A wireless communication system in accordance with claim 11 wherein the LMR infrastructure (211) is configured to communicate LMR content (130) comprising content defining at least one of LMR services, operations and controls and including at least one of voice data, emergency signal data, control data relating to selecting a particular talk group, LMR data (136) for transfer between a radio unit and a server and reprogramming data.

15. A wireless communication system in accordance with claim 11 wherein an application layer (82) and a transport layer (84) of the LMR content (130) are configured based on different LMR protocols.

16. A land mobile radio (LMR) unit comprising:

at least one voice encoder/decoder (70); and

a plurality of modems (76) connected to the at least one voice encoder/decoder (60), the plurality of modems each configured to communicate using a different LMR transport protocol.

17. An LMR unit in accordance with claim 16 further comprising an LMR transport layer module (48) configured to provide the transport layer protocol for communication.

18. An LMR unit in accordance with claim 17 further comprising an LMR encapsulation module (52) configured to encapsulate LMR content (130) to be communicated based on a selected application layer protocol.

19. An LMR unit in accordance with claim 17 further comprising an LMR application layer module (46) configured to provide an application layer protocol for communication.

20. An LMR unit in accordance with claim 19 wherein the transport layer protocol is different than the application layer protocol.

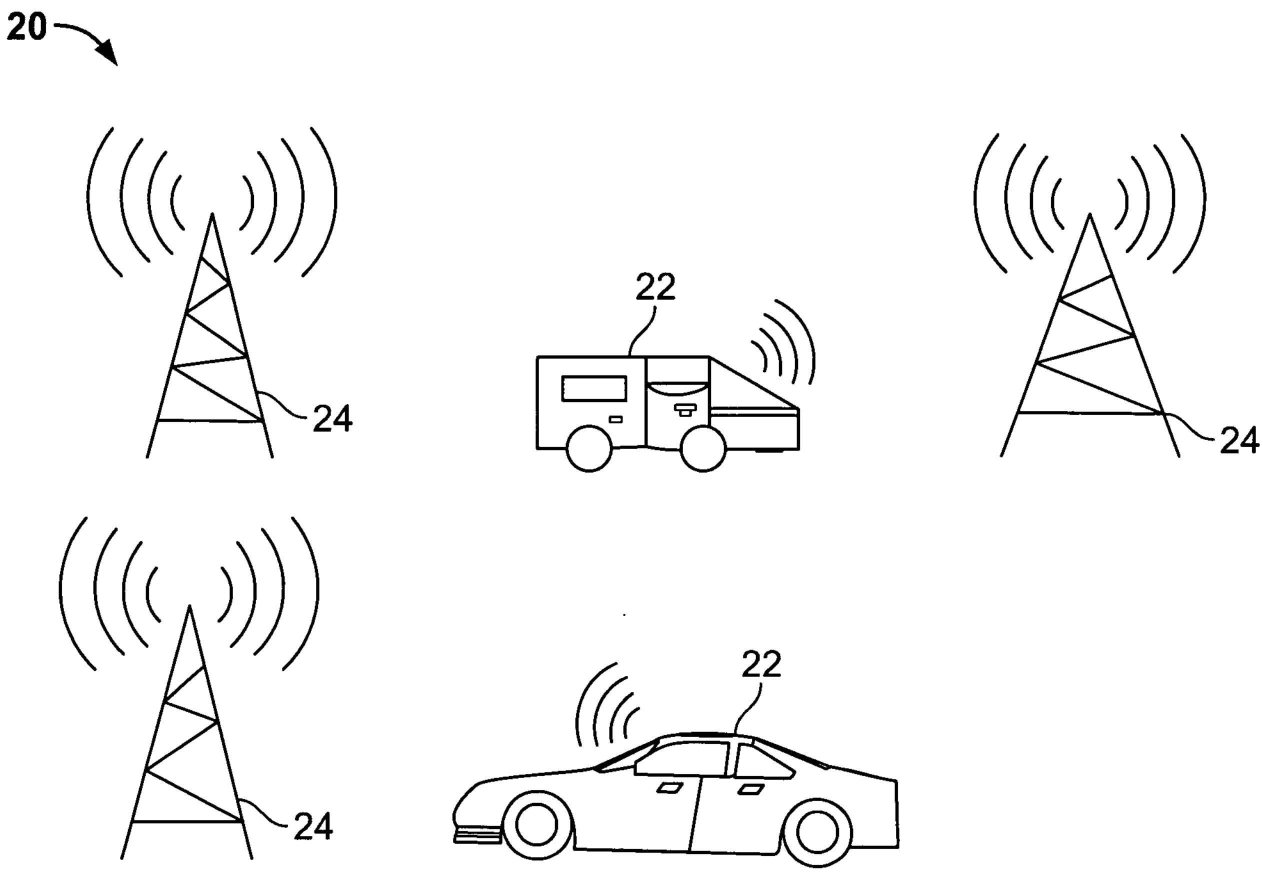

20
22
24
22
24
22
24

FIG. 1

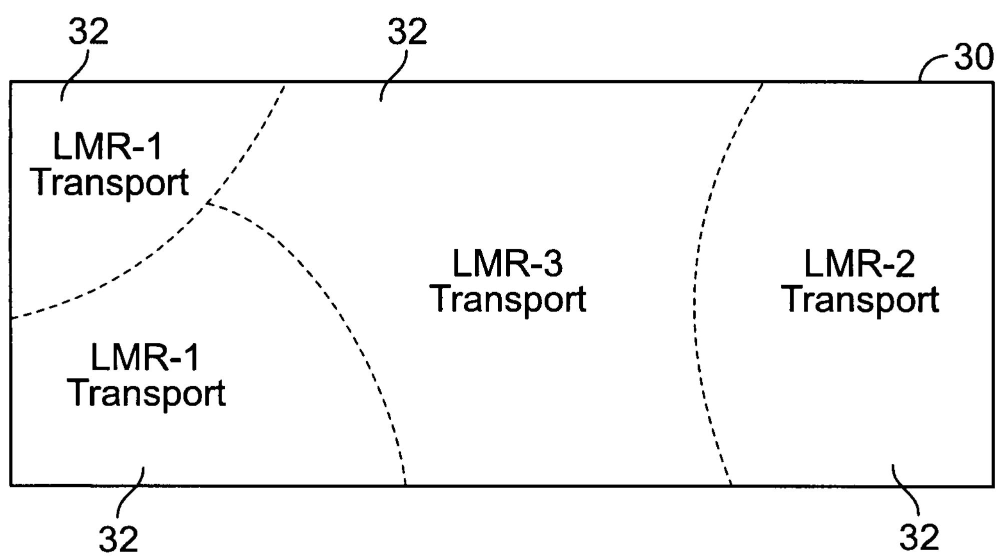

32
32
30
LMR-1
Transport
LMR-3
Transport
LMR-2
Transport
LMR-1
Transport
32
32

FIG. 2

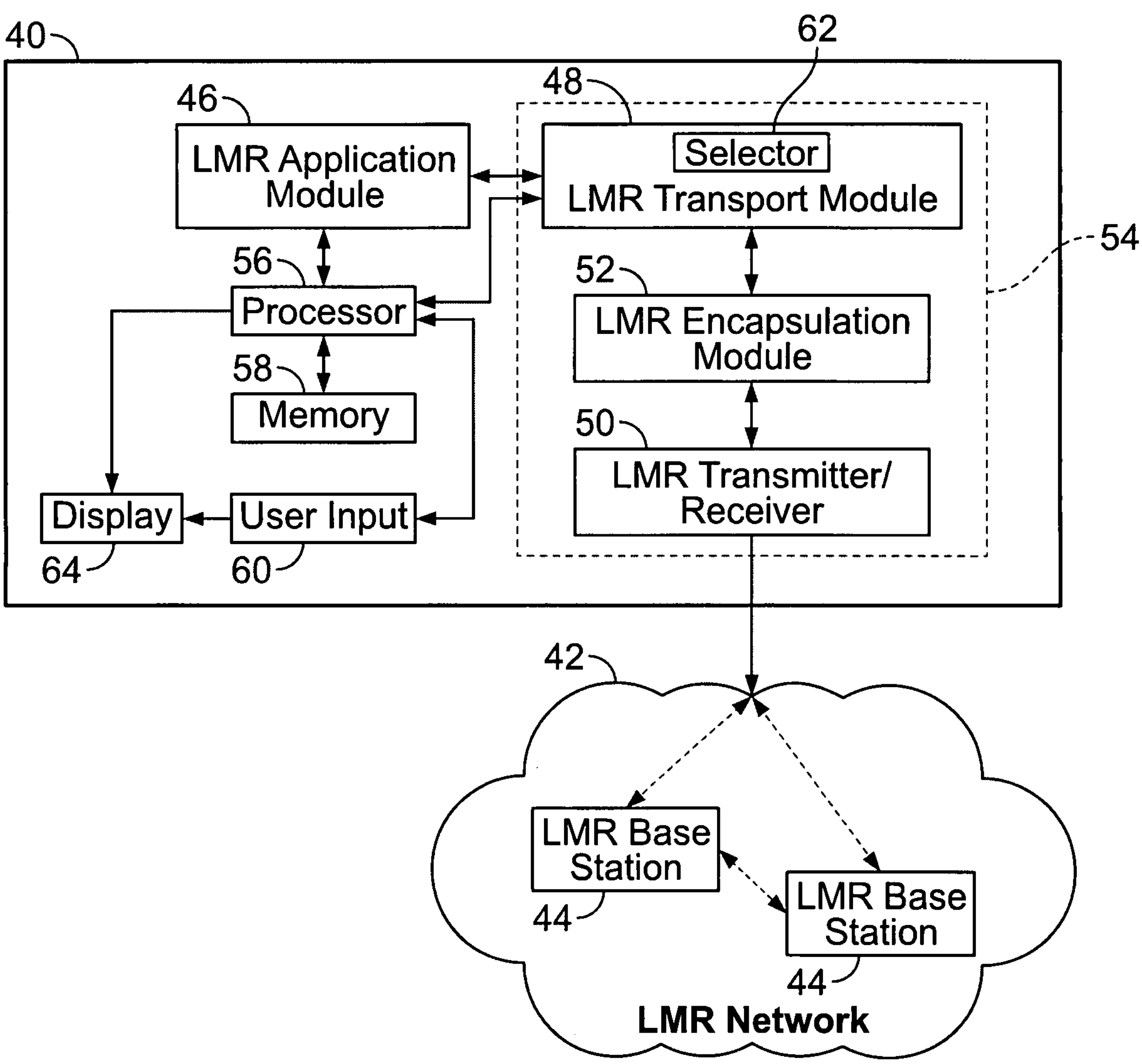

40
62
48
46
LMR Application Module
Selector
LMR Transport Module
54
56
Processor
52
LMR Encapsulation Module
58
Memory
50
LMR Transmitter/ Receiver
Display
User Input
64
60
42
LMR Base Station
44
LMR Base Station
44
LMR Network

FIG. 3

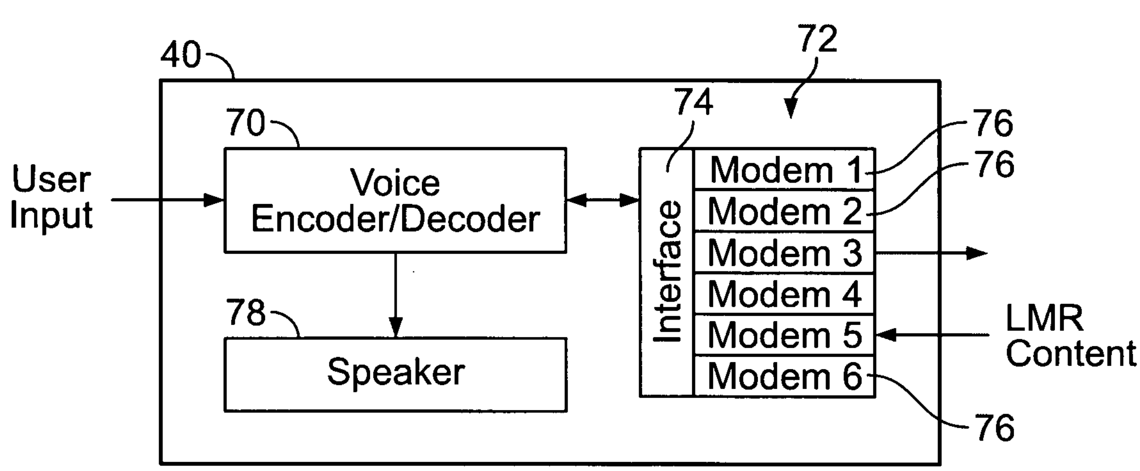

40
72
74
70
76
76
User Input
Voice Encoder/Decoder
Interface
Modem 1
Modem 2
Modem 3
Modem 4
Modem 5
Modem 6
78
Speaker
LMR Content
76

FIG. 4

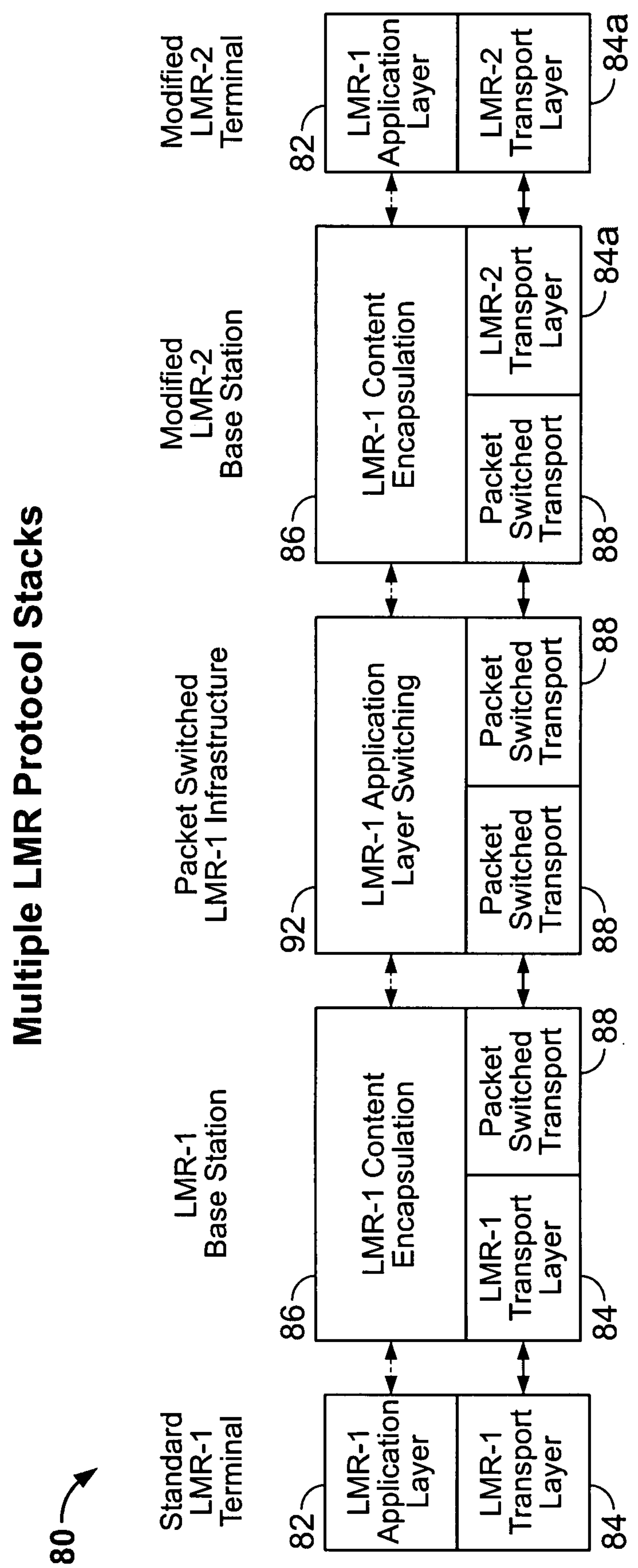

Multiple LMR Protocol Stacks
80
Standard LMR-1 Terminal
LMR-1 Application Layer
LMR-1 Transport Layer
82
84
LMR-1 Base Station
LMR-1 Content Encapsulation
LMR-1 Transport Layer
Packet Switched Transport
86
84
88
Packet Switched LMR-1 Infrastructure
LMR-1 Application Layer Switching
Packet Switched Transport
Packet Switched Transport
92
88
88
Modified LMR-2 Base Station
LMR-1 Content Encapsulation
Packet Switched Transport
LMR-2 Transport Layer
86
88
84a
Modified LMR-2 Terminal
LMR-1 Application Layer
LMR-2 Transport Layer
82
84a

FIG. 5

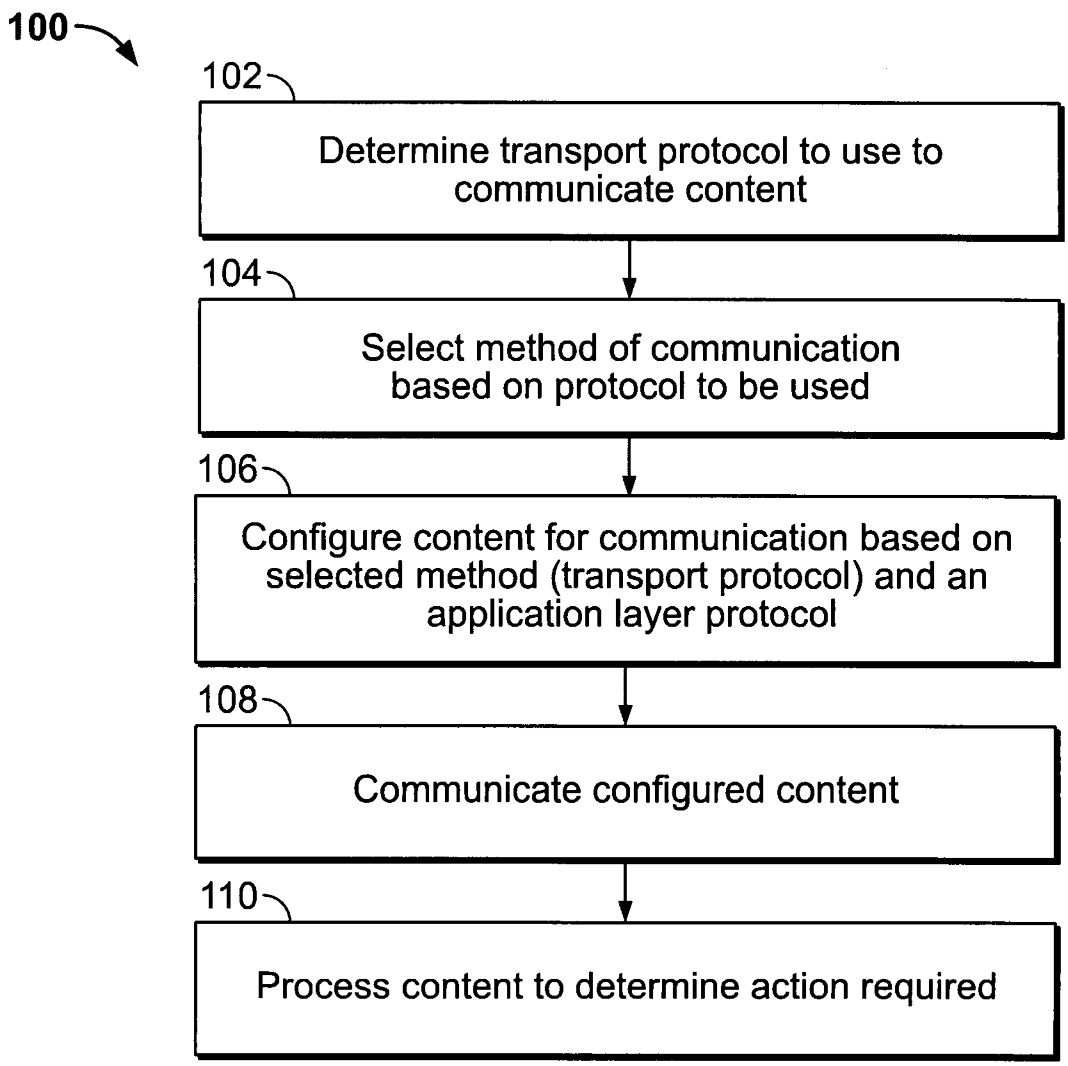

100
102
Determine transport protocol to use to communicate content
104
Select method of communication based on protocol to be used
106
Configure content for communication based on selected method (transport protocol) and an application layer protocol
108
Communicate configured content
110
Process content to determine action required

FIG. 6

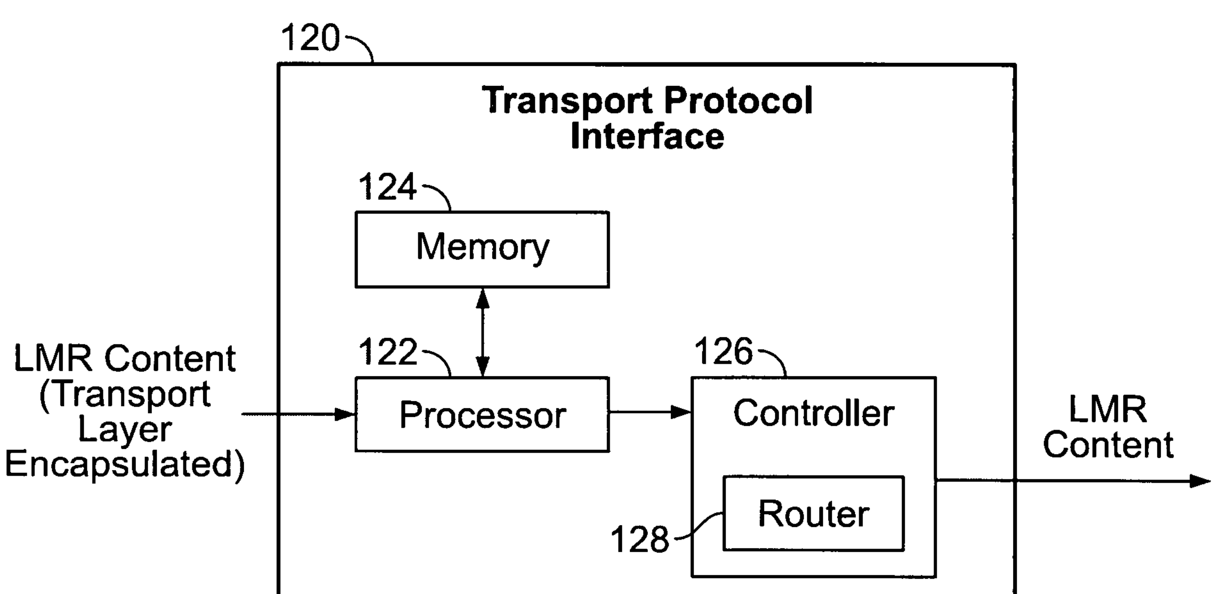

120
Transport Protocol Interface
124
Memory
122
Processor
126
Controller
Router
128
LMR Content (Transport Layer Encapsulated)
LMR Content

FIG. 7

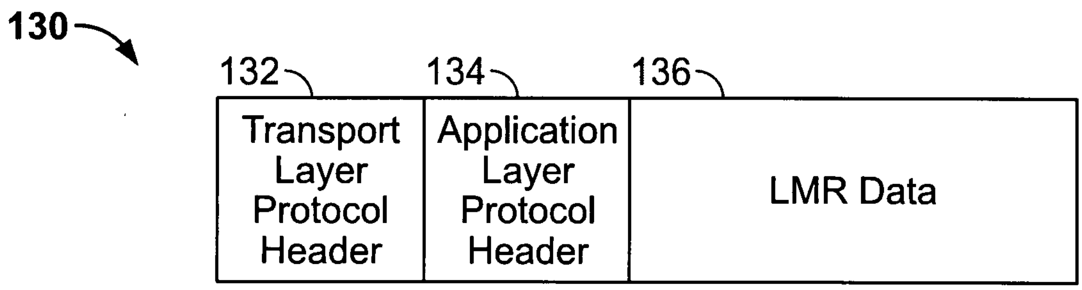


FIG.8

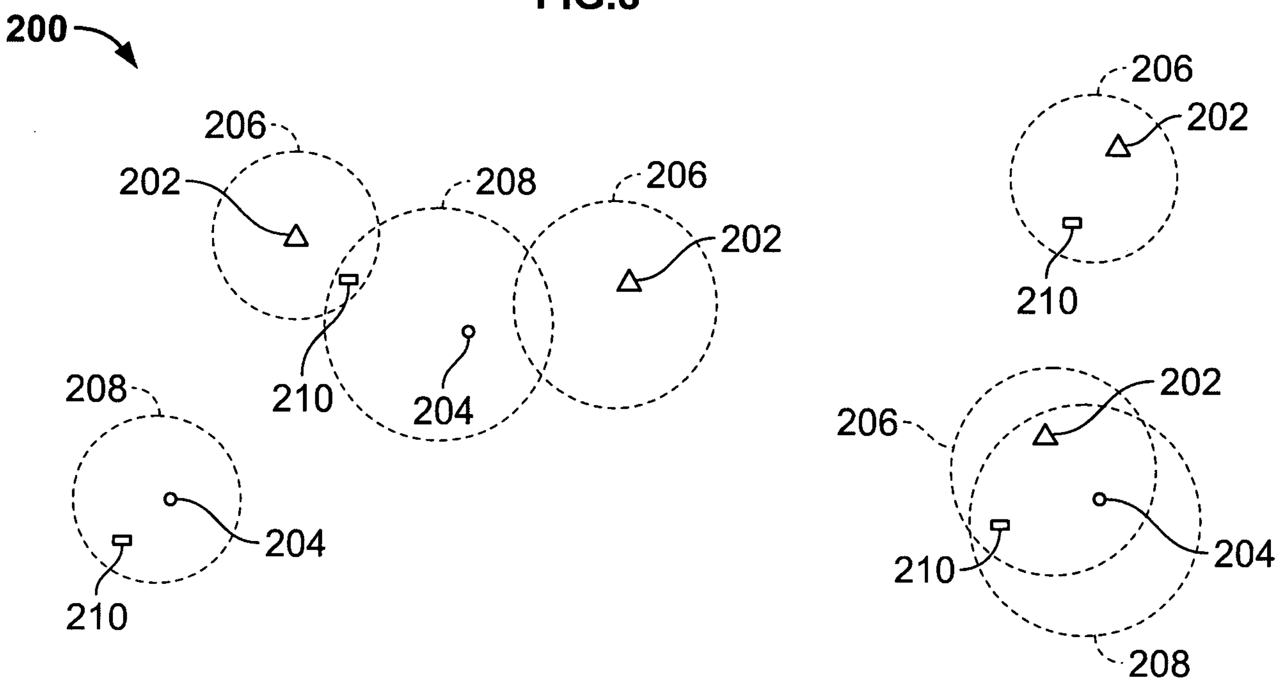


FIG. 9

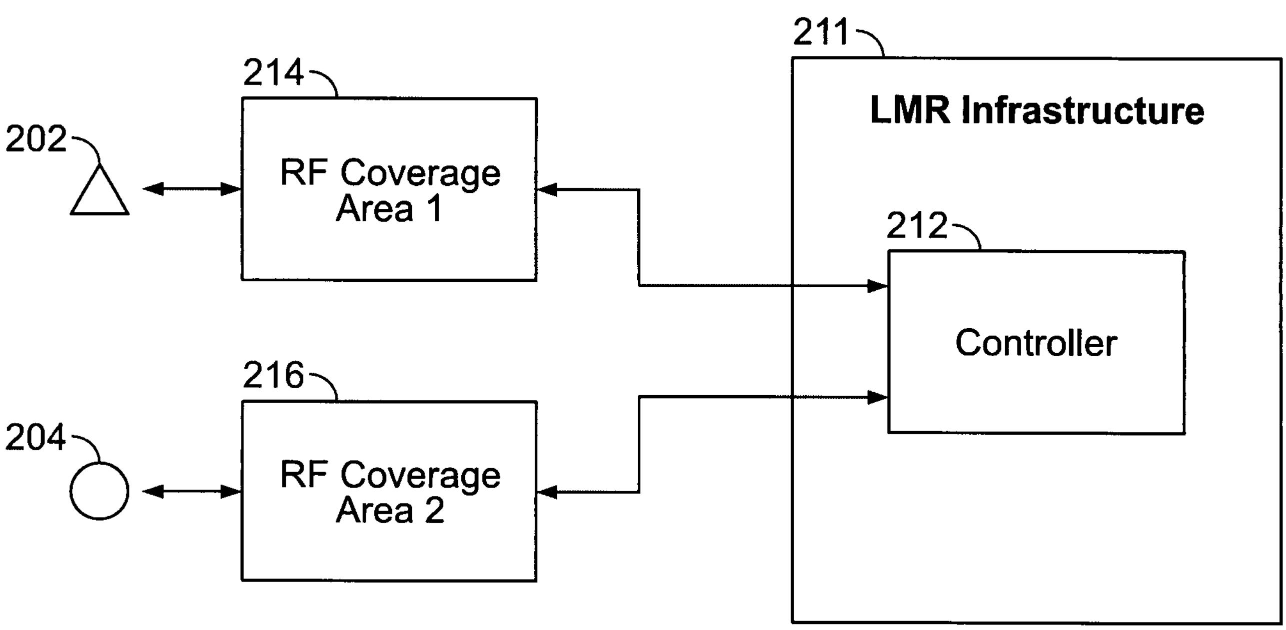


FIG. 10